Southern California Range Complex

Draft Environmental Impact Statement/
Overseas Environmental Impact Statement

Volume 1 of 2: Chapters 1-3

April 2008

Commander
United States Navy Pacific Fleet
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Draft
Environmental Impact Statement /
Overseas Environmental Impact Statement

Lead Agency:
Department of the Navy
Action Proponent:
United States Pacific Fleet

Cooperating Agency:
Department of Commerce
National Oceanographic and Atmospheric Administration
National Marine Fisheries Service

Volume 1
Chapters 1-3

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COVER SHEET
DRAFT ENVIRONMENTAL IMPACT STATEMENT/
OVERSEAS ENVIRONMENTAL IMPACT STATEMENT
SOUTHERN CALIFORNIA RANGE COMPLEX

Lead Agency for the EIS:	U.S. Department of the Navy
Title of the Proposed Action:	Southern California (SOCAL) Range Complex
Affected Jurisdiction:	Counties of San Diego, Orange, Los Angeles
Designation:	Draft Environmental Impact Statement/Overseas Environmental Impact Statement (EIS/OEIS)

Abstract

This Environmental Impact Statement (EIS)/Overseas Environmental Impact Statement (OEIS) has been prepared by the Department of the Navy (DoN) in compliance with the National Environmental Policy Act (NEPA) of 1969 (42 United States Code § 4321 et seq.); the Council on Environmental Quality (CEQ) Regulations for Implementing the Procedural Provisions of NEPA (Title 40 Code of Federal Regulations [C.F.R.] §§ 1500-1508); DoN Procedures for Implementing NEPA (32 C.F.R. § 775); and Executive Order 12114 (EO 12114), Environmental Effects Abroad of Major Federal Actions. The Navy has identified the need to support and conduct current, emerging, and future training and research, development, test, and evaluation (RDT&E) operations in the SOCAL Range Complex. Three alternatives are analyzed in this EIS/OEIS. The No Action Alternative will continue training and RDT&E activities of the same types, and at the same levels of training intensity as currently conducted, without change in the nature or scope of military activities. Alternative 1, in addition to accommodating training operations addressed in the No Action Alternative, would support an increase in training operations. Alternative 1 also proposes training and RDT&E required by force structure changes associated with introduction of new weapons systems, new classes of ships, and new types of aircraft into the Fleet. Alternative 2 would include all elements of Alternative 1. In addition, under Alternative 2, training operations would be increased over levels identified in Alternative 1, and certain range enhancements would be implemented, to include establishment of a shallow water minefield and installation and use of a shallow water training range.

This EIS/OEIS addresses the potential environmental impacts that result or could result from activities under the No Action Alternative, Alternative 1, and Alternative 2. Environmental resource topics evaluated include geology and soils, air quality, hazardous waste and materials, water resources, marine plants and invertebrates, sea turtles, marine mammals, sea birds, terrestrial biological resources, cultural resources, traffic, socioeconomics, environmental justice and the protection of children, and public safety.

Prepared by: Department of the Navy

Point of Contact: Naval Facilities Engineering Command Southwest
SOCAL Range Complex EIS Project Manager (Code REVPO)
1220 Pacific Highway
Building 127
San Diego, CA 92132-5190

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Executive Summary

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ES 1 EXECUTIVE SUMMARY

ES 1.1 INTRODUCTION

This Draft Environmental Impact Statement (EIS)/Overseas Environmental Impact Statement (OEIS) analyzes the potential environmental consequences that may result from the United States (U.S.) Navy's proposed action and alternatives, which address ongoing and proposed naval activities within the Navy's existing Southern California (SOCAL) Range Complex.

This Draft EIS/OEIS (hereafter referred to as "EIS/OEIS") has been prepared by the Department of the Navy (DoN) in compliance with the National Environmental Policy Act (NEPA) of 1969 (42 United States Code [U.S.C.] § 4321 et seq.); the Counsel on Environmental Quality [CEQ] Regulations for Implementing the Procedural Provisions of NEPA (Title 40 Code of Federal Regulations [CFR] §§ 1500-1508); Department of the Navy Procedures for Implementing NEPA (32 CFR § 775); and Executive Order 12114 (EO 12114), Environmental Effects Abroad of Major Federal Actions. This EIS/OEIS satisfies the requirements of NEPA and EO 12114, and will be filed with the U.S. Environmental Protection Agency (USEPA) and made available to appropriate Federal, State, local, and private agencies, organizations, and individuals for review and comment.

The Navy is the lead agency for the EIS/OEIS; the National Marine Fisheries Service (NMFS) is a cooperating agency.

The SOCAL Range Complex is situated off the coast of southern California generally between Dana Point and San Diego and encompasses three primary components: ocean operating areas (OPAREAs), special-use airspace (SUA), and San Clemente Island (SCI). Extending more than 600 nm (1,111 km) southwest into the Pacific Ocean, the SOCAL Range Complex encompasses over 120,000 nm2 (411,600 km^2) of sea space, 113,000 nm^2 (387,500 km^2) of Special Use Airspace (SUA), and over 42 nm2 (144 km^2) of land area (i.e., SCI). For range management and scheduling purposes, the SOCAL Range Complex is divided into numerous sub-component ranges or training areas which are described in detail in the Chapter 2 of the EIS/OEIS. Figures ES-1 through ES-5, located at the end of the Executive Summary, depict the SOCAL Range Complex and its components covered in this EIS/OEIS.

The Navy's mission is to organize, train, equip, and maintain combat-ready naval forces capable of winning wars, deterring aggression, and maintaining freedom of the seas. This mission is mandated by Federal law (Title 10 U.S. Code (U.S.C.) § 5062), which charges the Chief of Naval Operations (CNO) with responsibility for ensuring the readiness of the Nation's naval forces.[1] The Navy executes this responsibility by establishing and executing training programs, including at-sea training and exercises, and ensuring naval forces have access to the ranges, OPAREAs, and airspace needed to develop and maintain skills for the conduct of naval operations. Activities involving Research, Development, Test, and Evaluation (RDT&E) for naval systems are an integral part of this readiness mandate.

ES 1.2 PURPOSED AND NEED FOR THE PROPOSED ACTION

The mission of the SOCAL Range Complex is to serve as the principal Navy training venue in the eastern Pacific with the unique capability and capacity to support required current, emerging,

[1] Title 10, Section 5062 of the United States Code provides: "The Navy shall be organized, trained, and equipped primarily for prompt and sustained combat incident to operations at sea. It is responsible for the preparation of Naval forces necessary for the effective prosecution of war except as otherwise assigned and, in accordance with Integrated Joint Mobilization Plans, for the expansion of the peacetime components of the Navy to meet the needs of war."

and future training. The purpose of the Proposed Action is to achieve and maintain fleet readiness using the SOCAL Range Complex, while enhancing training resources through investment on the ranges.

The need for the proposed action is to enable the Navy to meet its statutory responsibility to organize, train, equip, and maintain combat-ready naval forces and to successfully fulfill its current and future global mission of winning wars, deterring aggression and maintaining freedom of the seas.

The existing SOCAL Range Complex plays a vital part in the execution of this naval readiness mandate. The region of San Diego, California is home to the largest concentration of U.S. naval forces in the world, and the SOCAL Range Complex is the most capable and heavily used Navy range complex in the eastern Pacific region. The Navy's Proposed Action is a step toward ensuring the continued vitality of this essential naval training resource.

This EIS/OEIS provides an assessment of environmental effects associated with current and proposed training activities, force structure (to include new weapons systems and platforms), and range investments in the Range Complex.

In summary, the Navy proposes to implement actions within the SOCAL Range Complex to:

- Increase training and RDT&E operations from current levels in order to support Fleet Readiness Training Plan (FRTP);
- Accommodate mission requirements associated with force structure changes and introduction of new weapons and systems to the Fleet; and
- Implement enhanced range complex capabilities.

To support an informed decision, the EIS/OEIS identifies objectives and criteria for naval activities in the SOCAL Range Complex. The core of the EIS/OEIS is the development and analysis of different alternatives for achieving the Navy's objectives. Alternatives development is a complex process, particularly in the dynamic context of military training. The touchstone for this process is a set of criteria that respond to the naval readiness mandate, as it is implemented in the SOCAL Range Complex. The criteria for developing and analyzing alternatives to meet these objectives are set forth in Section 2.2.1. These criteria provide the basis for the statement of the Proposed Action and alternatives and selection of alternatives for further analysis (Chapter 2), as well as analysis of the existing environment and the environmental effects of the Proposed Action and alternatives (Chapter 3).

ES 1.2.1 Why the Navy Trains

The United States military is maintained to ensure the freedom and safety of all Americans both at home and abroad. In order to do so, Title 10 of the United States Code requires the Navy to "maintain, train and equip combat-ready naval forces capable of winning wars, deterring aggression and maintaining freedom of the seas". Modern war and security operations are complex. Modern weaponry has brought both unprecedented opportunity and innumerable challenges to the Navy. Smart weapons, used properly, are very accurate and actually allow us to accomplish our mission with greater precision and far less destruction than in past conflicts. But these modern smart weapons are very complex to use. U.S. military personnel must train regularly with them to understand their capabilities, limitations, and operation. Modern military actions require teamwork between hundreds or thousands of people, and their various equipment, vehicles, ships, and aircraft, all working individually and as a coordinated unit to achieve success. Navy training addresses all aspects of the team, from the individual to joint and coalition teamwork. To do this, the Navy employs a building block approach to training. Training doctrine and procedures are based on operational requirements for deployment of naval forces. Training proceeds on a continuum, from teaching basic and specialized individual military skills, to intermediate skills or small unit training, to advanced, integrated training events, culminating in multi-service (Joint) exercises or pre-deployment certification events.

In order to provide the experience so important to success and survival, training must be as realistic as possible. The navy often employs simulators and synthetic training to provide early skill repetition and to enhance teamwork, but live training in a realistic environment is vital to success. This requires sufficient sea and airspace to maneuver tactically, realistic targets and objectives, simulated opposition that creates a realistic enemy, and instrumentation to objectively monitor the events and learn to correct errors.

Range complexes provide a controlled and safe environment with threat representative targets that enable our forces to conduct realistic combat-like training as they undergo all phases of the graduated buildup needed for combat ready deployment. Navy's ranges and operating areas provide the space necessary to conduct controlled and safe training scenarios representative of those that our men and women would have to face in actual combat. The range complexes are designed to provide the most realistic training in the most relevant environments, replicating to the best extent possible the operational stresses of warfare. The integration of undersea ranges and OPAREAs with land training ranges, safety landing fields, and amphibious landing sites are critical to this realism, allowing execution of multi-dimensional exercises in complex scenarios. They also provide instrumentation that captures the performance of our tactics and equipment in order to provide the feedback and assessment that is essential for constructive criticism of personnel and equipment. The live-fire phase of training facilitates assessment of our ability to place weapons on target with the required level of precision while under a stressful environment. Live training, most of it accomplished in the waters off the nation's East and West Coasts and the Caribbean Sea, will remain the cornerstone of readiness as we transform our military forces for a security environment characterized by uncertainty and surprise.

Navy training activities focus on achieving proficiency in seven functional areas encompassed by Navy operations. These functional areas, known as Primary Mission Areas (PMARs), are: Anti-Air Warfare (AAW), Amphibious Warfare (AMW), Anti-Surface Warfare (ASUW), Anti-submarine Warfare (ASW), Mine Warfare (MIW), Strike Warfare (STW), Electronic Combat (EC), and Naval Special Warfare (NSW). Each training event addressed in the EIS/OEIS is categorized under one of the PMARS.

ES 1.2.2 The Strategic Importance of the SOCAL Range Complex

Navy and Marine Corps training is focused on preparing for worldwide deployment. Naval forces generally deploy in specially organized units called Strike Groups. A Strike Group may be organized around one or more aircraft carriers, together with several surface combatant ships and submarines, collectively known as a Carrier Strike Group (CSG). A naval force known as a Surface Strike Group (SSG) consists of three or more surface combatant ships. A Strike Group may also be organized around a Marine Expeditionary Unit (MEU) embarked on amphibious ships accompanied by surface combatant ships and submarines, known as an Expeditionary Strike Group (ESG). The Navy deploys CSGs, SSGs, and ESGs on a continuous basis. The number and composition of Strike Groups deployed, and the schedule for deployment, is determined based on the worldwide requirements and commitments.

Pre-deployment training is governed by the FRTP. The FRTP sets a deployment cycle for the Strike Groups that includes three phases: (1) basic, intermediate, and advanced pre-deployment training and certification, (2) deployment, and (3) post-deployment sustainment training, and maintenance. While several Strike Groups are always deployed to provide a global naval presence, Strike Groups must also be ready to "surge" on short notice in response to directives from the National Command Authority. One objective of the FRTP is to provide this surge capability. The FRTP calls for the ability to train and deploy six CSGs in a very short time, and two more in stages soon thereafter. Established in 2003, the FRTP calls for changes in the Fleet training cycle, including acceleration of the cycle and near-simultaneous execution of similar training events. Deployment schedules are not fixed, but must remain flexible and responsive to the Nation's security needs. The capability and capacity of ranges such as the SOCAL Range Complex to support the entire training continuum must be available when and as needed.

The SOCAL Range Complex is characterized by a unique combination of attributes that make it a strategically important range complex for the Navy. These attributes include:

Proximity to the Homeport of San Diego. Southern California is home to the Nation's largest concentration of naval forces. One-third of the U.S. Pacific Fleet makes its homeport in San Diego, including two aircraft carriers, over seventy surface combatant ships, amphibious ships, and submarines; several aviation squadrons; and their officers and crews. Major commands in the San Diego area include: Commander, U.S. THIRD Fleet; Commander, Strike Force Training Pacific; CSG-7 and CSG-11 (when not deployed); Amphibious Group 3, which includes four ESGs (at least one of which is always deployed); Commander, Naval Air Forces; Commander, Naval Surface Forces; Commander, Submarine Squadron 11; Naval Special Warfare Command; and Commander, Navy Region Southwest. Several formal Navy training commands also are located in the San Diego region, including the Expeditionary Warfare Training Group Pacific, the Naval Special Warfare Center, and the Afloat Training Group.

Marine Corps Base Camp Pendleton and Marine Corps Air Station Miramar, both in San Diego County, are home to the Marines and Sailors of I Marine Expeditionary Force (I MEF). These forces, from which is drawn the Marine component of the ESGs, require ready access to the SOCAL Range Complex to conduct required training. Camp Pendleton also is home to formal military schools, including the Assault Amphibian Vehicle School.

CSGs and ESGs continuously utilize the SOCAL Range Complex in their pre-deployment certification training. Moreover, the component elements of these war fighting organizations and the formal military schools continuously utilize the Range Complex for their basic, intermediate, or advanced training events. Proximity of these forces and commands to the training resources of the SOCAL Range Complex is vital to efficient execution of each phase of the training continuum.

Proximity of the SOCAL Range Complex to naval facilities in San Diego supports non-training efficiencies as well, such as access to ship and aircraft maintenance functions and access to alternate airfields when circumstances preclude carrier landings of aircraft at sea.

Proximity to Military Families. The region of San Diego is home to thousands of military families. The Navy and Marine Corps strive, and in many cases are required by law, to track and where possible limit "personnel tempo," meaning the amount of time Sailors and Marines spend deployed away from home. Personnel tempo is an important factor in family readiness, morale, and retention. The availability of the SOCAL Range Complex as a "backyard" training range is critical to Navy efforts in these areas.

Proximity to Other Training Ranges in the Southwest. The SOCAL Range Complex is the ocean portion of a unique national military training capability in the southwestern U.S., including the National Training Center, Fort Irwin, California; Nevada Test and Training Range; Marine Corps Air Ground Combat Center, 29 Palms, California; the Bob Stump Training Range Complex in California and Arizona; Camp Pendleton, California; China Lake Range Complex, California; and Fallon Range Complex, Nevada.

Training Terrain. The SOCAL Range Complex includes "terrain" features that present opportunities for realistic training unequaled by any other Navy range complex. Combined, the features provide an ideal naval training environment that is not replicated elsewhere in the U.S. range inventory.

Crucial to Navy deployment preparations is the ability to train in underwater topography that is similar to the "littoral" areas of the world. Figures ES-2 and ES-3 show the underwater topography, known as bathymetry, of the SOCAL Range Complex. This uneven, mountainous bathymetry is essential to Navy training in Anti-submarine Warfare (ASW). Seamounts such as those depicted in Figure ES-3 are used by submarines to hide or mask their presence, requiring the need to train in this complex ocean environment. The SOCAL Range Complex provides precisely the type of area needed by the Navy to train with mid-frequency active sonar (MFAS). This uneven bathymetry also provides shallow-water areas, specifically in the areas of Tanner Bank and Cortes Bank (Figure 1-3). Sound propagates differently in shallower water, which provides an extremely "noisy" and hence complex marine training environment. Modern diesel-electric submarines would be expected, in a real world event, to operate and hide in the noise of shallow[2] waters. Without the critical training near shore that ASW exercises provide, crews will not have the experience needed to successfully operate SONAR in these types of waters, impacting vital military readiness.

The terrain of the SOCAL Range Complex also is critical to Strike Group certification, which involves the multi-dimensional coordination of air, surface, subsurface, and amphibious operations. To be effective, Strike Group training must be integrated; training effectiveness is compromised significantly if exercises are not closely coordinated in a single training area. ESGs conduct vital training between SCI and Camp Pendleton (where landing beaches and ranges to support amphibious training are located). CSG training and certification also demands access to the littoral areas and bathymetry of the SOCAL Range Complex. CSGs transit in the vicinity of SCI to simulate a strait transit which enables training to deal with coastal defense cruise missiles (simulated by emitters on SCI), small boat attacks, adversary submarines, and aircraft defense in restricted waters.

The Navy trains to the greatest threat, which is in the littoral environment at this time. Training in a deep water environment would not provide the unique challenges the Navy faces in the littoral regions, and would not provide realistic training for expected operational environments. Training in deep water areas when the requirement is to conduct training and operations in littorals would be analogous to practicing for a baseball game on a football field. The SOCAL Range Complex provides the terrain that is uniquely suited to the Navy's training requirements.

SCI land areas are an integral component of the SOCAL Range Complex training environment. SCI provides numerous dedicated live-fire range capabilities away from inhabited areas, extensive range instrumentation, landing beaches, and the only location in the continental U.S. that supports live naval gunfire training coordinated with amphibious landings.

The weather of southern California also is an important consideration in assessing the suitability of the training environment. Prevailing weather and ocean surface (sea state) conditions are conducive to year-round flight operations and operational safety.

In sum, the unique attributes and characteristics of the SOCAL Range Complex make it a strategically vital training venue for Navy and Marine Corps forces of the Pacific Fleet.

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[2] In the context of naval operations, specifically submarine operations, the term "shallow water" is a relative term, denoting depths of up to 100 fathoms (or 600 ft), which are considered "shallow" compared to the depth of the ocean.

ES 1.3 SCOPE AND CONTENT OF THE EIS/OEIS

In its analysis under NEPA, the Navy includes areas of the SOCAL Range Complex that lie within 12 nm (22 km), or the territorial seas. Environmental effects in the areas that are outside of U.S. territorial seas are analyzed under EO 12114 and associated implementing regulations.

ES 1.3.1 NEPA

This EIS/OEIS provides an assessment of environmental effects associated with current and proposed training activities, force structure (to include new weapons systems and platforms), and range investments in the Range Complex.

This EIS/OEIS supersedes and significantly expands upon an initiative to assess environmental impacts of military activities on SCI. The SCI environmental analysis, which included within its scope the island and near-shore range areas, was initiated in 1996 but not completed. Rather, the Navy elected to expand the SCI effort to include the surrounding ocean areas and airspace of the SOCAL Range Complex. This expanded EIS/OEIS also gives the Navy an opportunity to review its procedures and ensure the benefits of recent scientific and technological advances are applied toward assessing environmental effects.

In February 2007, the Navy completed an Environmental Assessment (EA)/Overseas Environmental Assessment (OEA) for the Joint Task Force Training Exercises (JTFEX) and Composite Training Unit Exercises (COMPTUEX) conducted in southern California. The scope of the JTFEX/COMPTUEX EA/OEA includes 14 pre-deployment exercises conducted from February 2007 to January 2009. The SOCAL Range Complex EIS/OEIS addresses the continuation of these exercises in the baseline analysis, as well as the Navy and Marine Corp training that currently occurs or is proposed to occur in ocean areas, airspace and SCI land areas of the SOCAL Range Complex.

The first step in the NEPA process is the preparation of a notice of intent (NOI) to develop the EIS. The NOI provides an overview of the Proposed Action and the scope of the EIS. The NOI for this project was published in the *Federal Register* on December 21, 2006, and for five days in three local newspapers: *San Diego Union Tribune*, the *North County Times* (San Diego County); and the *Daily Breeze* (San Pedro, California). The NOI and newspaper notices included information about comment procedures, a list of information repositories (public libraries), the project website address (www.socalrangecomplexeis.com), and the dates and locations of the scoping meetings.

Scoping is an early and open process for developing the “scope” of issues to be addressed in the EIS and for identifying significant issues related to a Proposed Action. The scoping process for this EIS was initiated by the publication of the NOI in the *Federal Register* and local newspapers. During scoping, the public helps define and prioritize issues and convey these issues to the Navy through written comments. Scoping meetings were held in three locations: Coronado Public Library in Coronado, San Diego County, California; Civic Center Public Library in Oceanside, San Diego County, California; and Cabrillo Marine Aquarium in San Pedro, Los Angeles County, California. As a result of the scoping process, the Navy received comments from the public, which have been considered in the preparation of this EIS.

Comments received from the public during the scoping process are categorized and summarized in the following table:

Table ES-1: Public Scoping Comment Summary

Category	Commentator	Comment Summary
Marine Mammal Focus	California Coastal Commission (CCC) Non-Governmental Organization U.S. EPA Channel Islands National Park Private Citizen	Recommend common, Navy-wide approach to addressing potential impacts of sonar use on marine mammals
Coastal Consistency	CCC	Identified need for consistency review in connection with EIS
Airspace Concerns	FAA California Department of Fish and Game (aerial surveys) San Diego County Private citizen	Seeking clarification that the Proposed Action does not contemplate expanding military airspace (Note: The Navy is not proposing expanded airspace.)
Air Quality	U.S. EPA	General comment on regulatory process for air quality matters
Ship traffic	Liquefied Natural Gas (LNG) proponent (commercial entity)	Identifies possibility of conflict between military activities and certain LNG operations in ocean areas
Requests for Information	Los Angeles County Private Citizen	General information requests

Subsequent to the scoping process, this EIS/OEIS was prepared to assess the potential effects of the Proposed Action and alternatives on the environment. A notice of availability was published in the *Federal Register* and notices were placed in the aforementioned newspapers announcing the availability of the EIS/OEIS. The EIS/OEIS is now available for general review and is being circulated for review and comment. Public meetings will be advertised and held to receive public comments on the EIS/OEIS.

A Final EIS/OEIS will be prepared that responds to all public comments received on the EIS/OEIS. Responses to public comments may take various forms as necessary, including correction of data, clarifications of and modifications to analytical approaches, and inclusion of additional data or analyses. The Final EIS will then be made available for public review.

Finally, a Record of Decision (ROD) will be issued, no less than 30 days after the Final EIS is made available to the public. The ROD will summarize the Navy's decision and identify the selected alternative, describe the public involvement and agency decision-making processes, and present commitments to specific mitigation measures.

ES 1.3.2 EO 12114

EO 12114 directs Federal agencies to provide for informed decision-making for major Federal actions outside the U.S. territorial sea, but not including actions within the territory or territorial sea of a foreign nation. For purposes of this EIS/OEIS, areas outside U.S. territorial sea are considered to be areas beyond 12 nautical miles (nm) from shore. This EIS/OEIS satisfies the requirements of EO 12114, as analysis of operations or impacts occurring, or proposed to occur, outside of 12 nm is provided.

For the majority of resource sections addressed in this EIS/OEIS, projected impacts outside of U.S. territory would be similar to those within the territorial sea. In addition, the baseline environment and associated impacts to the various resource areas analyzed in this EIS/OEIS are not substantially different within or outside the 12 nm jurisdictional boundary. Therefore, for these resource sections, the impact analyses contained in the main body of the EIS/OEIS is comprehensive and follow both NEPA and EO 12114 guidelines. The description of the affected environment addresses areas both within and beyond U.S. territorial sea.

ES 1.3.3 Other Environmental Requirements Considered

The Navy must comply with a variety of other Federal environmental laws, regulations, and EOs. These include (among other applicable laws and regulations):

- Marine Mammal Protection Act;
- Endangered Species Act;
- Migratory Bird Treaty Act;
- Coastal Zone Management Act;
- Rivers and Harbors Act;
- Magnuson-Stevens Fishery Conservation and Management Act;
- Clean Air Act;
- Federal Water Pollution Control Act (Clean Water Act);
- National Historic Preservation Act;
- EO 12898, Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations; and
- EO 13045, Environmental Health and Safety Risks to Children.

In addition, laws and regulations of the State of California appropriate to Navy actions are identified and addressed in this eEIS/OEIS. This EIS/OEIS will facilitate compliance with applicable, appropriate state laws and regulations.

ES 1.4 PROPOSED ACTION AND ALTERNATIVES

ES 1.4.1 Alternatives Development

NEPA implementing regulations provide guidance on the consideration of alternatives in an EIS. These regulations require the decision-maker to consider the environmental effects of the Proposed Action and a range of alternatives to the Proposed Action (40 C.F.R. § 1502.14). The range of alternatives includes reasonable alternatives, which must be rigorously and objectively explored, as well as other alternatives that are eliminated from detailed study. To be “reasonable,” an alternative must meet the stated purpose of and need for the Proposed Action.

The purpose of including a No Action Alternative in environmental impact analyses is to ensure that agencies compare the potential impacts of the proposed major Federal action to the known impacts of maintaining the status quo.

With regard to the No Action Alternative, it currently exists in the EIS/OEIS as a baseline, where the action presented represents a regular and historic level of activity on the SOCAL Range Complex to support this type of training and exercises. The No Action Alternative serves as a baseline, or representative "status quo" when studying levels of range use and activity. For this reason, the EIS/OEIS's baseline, or No Action Alternative, stands as no change from current levels of training usage. The potential impacts of the current level of training and RDT&E activity on the SOCAL Range Complex (defined by the No Action Alternative) are compared to the potential impacts of activities proposed under Alternative 1 and Alternative 2.

Alternatives considered in this EIS/OEIS were developed by the Navy after careful assessment by subject -matter experts, including units and commands that utilize the ranges, range management professionals, and Navy environmental managers and scientists. The Navy has developed a set of criteria for use in assessing whether a possible alternative meets the purpose of and need for the Proposed Action. Each of these criteria assumes implementation of mitigation measures for the protection of natural resources as appropriate. Any alternative considered for future analysis should support or employ:

1. All requirements of the FRTP;
2. Achievement of training tempo requirements based on Fleet deployment schedules;
3. Advanced-level training that fully exercises naval capabilities in a training environment that replicates the dynamic nature of modern naval warfare;
4. Large-scale Joint training events;
5. Training requirements of formal military schools located at Navy and Marine Corps installations throughout the greater San Diego region;
6. Navy RDT&E activities;
7. Allied military training and RDT&E activities;
8. State-of-the-art training technologies for live-fire, instrumented, and force-on-force training, including instrumented range facilities in a shallow water environment for ASW and MIW training for ships, aircraft, and submarines;
9. Alignment of the SOCAL Range Complex infrastructure with Naval Force structure, including training with new weapons, systems, and platforms (vessels and aircraft) as they are introduced into the Fleet;
10. Enhancement and development of training resources and capabilities of SCI to provide realistic training opportunities for naval and Joint forces;
11. Use of existing range infrastructure, resources, and facilities to the maximum extent possible;
12. Sustainable range management practices that protect and conserve natural and cultural resources; and
13. Preservation of access to training areas for current and future training requirements, while addressing potential encroachments that threaten to impact range capabilities.

NEPA regulations require that the Federal action proponent study means to mitigate adverse environmental impacts by virtue of going forward with the proposed action or an alternative (40 C.F.R. § 1502.16). Additionally, an EIS is to include study of appropriate mitigation measures not already included in the proposed action or alternatives (40 C.F.R. § 1502.14 [h]). Each of the alternatives, including the Proposed Action considered in this EIS/OEIS, includes mitigation measures intended to reduce the environmental effects of Navy activities. Mitigation measures are discussed throughout this EIS/OEIS in connection with affected resources, and are also addressed in Chapter 5.

The Navy proposes to implement actions within the SOCAL Range Complex to:

- Increase training and RDT&E operations from current levels as necessary to support Fleet Readiness Training Plan (FRTP);
- Accommodate mission requirements associated with force structure changes and introduction of new weapons and systems to the Fleet; and
- Implement enhanced range complex capabilities.

The Proposed Action would result in selectively focused but critical and necessary increases in training, and range enhancements to address test and training resource shortfalls, as required to ensure the SOCAL Range Complex supports Navy and Marine Corps training and readiness objectives.

Actions to support current, emerging, and future training and RDT&E in the SOCAL Range Complex, including implementation of range enhancements, will be evaluated in this EIS/OEIS. These actions include:

- Increase numbers of training operations of the types currently being conducted in the SOCAL Range Complex.
- Expand the size and scope of amphibious landing training operations in the SOCAL Ocean Operating Areas (OPAREAs) and at San Clemente Island (SCI) to include a battalion-sized landing of 1,500+ Marines with weapons and equipment (to be conducted up to two times per year).
- Expand the size and scope of Naval Special Warfare (NSW) training activities in Training Areas and Ranges (TARs), Special Warfare Training Areas (SWATs), and nearshore waters of SCI.
- Install a shallow water training range (SWTR), a proposed extension into shallow water[3] of the existing instrumented deepwater anti-submarine warfare (ASW) range (known as "SOAR").
- Conduct operations on the SWTR.
- Increase Commercial Air Services support for Fleet Opposition Forces (OPFOR) and Electronic Warfare (EW) Threat Training.
- Construct and operate a Shallow Water Mine Field (at depths of 250 to 420 ft) in offshore and near-shore areas in the vicinity of SCI.
- Support training for new systems and platforms, specifically, Littoral Combat Ship (LCS), MV-22 Osprey aircraft, the EA-18G Growler aircraft, the SH-60R/S Seahawk Multi-mission Helicopter, the P-8 Poseidon Multi-mission Maritime Aircraft, the Landing Platform-Dock [LPD] 17 amphibious assault ship, the DDG 1000 [Zumwalt

[3] In the context of naval training activities, the term "shallow water" is a relative term, denoting depths which are considered "shallow" compared to the depth of the ocean.

Class] destroyer, and an additional aircraft carrier (USS CARL VINSON) proposed to be homeported in San Diego.

ES 1.4.2 Alternatives Eliminated From Further Consideration

Having identified criteria for generating alternatives for consideration in this EIS/OEIS (see Section 2.2.1), the Navy eliminated several alternatives from further consideration after initial review. Specifically, the following potential alternatives (described in Sections 2.2.2.1-2.2.2.4) were not carried forward for analysis:

- Alternative range complex locations;
- Reduced levels of training;
- Temporal of geographic constraints on use of the SOCAL Range Complex; and
- Extensive reliance on simulated training in place of live training.

After careful consideration of each of these potential alternatives in light of the identified criteria, the Navy determined that none of them meets the Navy's purpose and need for the Proposed Action.

ES 1.4.3 Alternatives Considered

Three alternatives are analyzed in this EIS/OEIS:

1. The No Action Alternative - Current Operations;
2. Alternative 1-Increase Operational Training and Accommodate Force Structure Changes, and
3. Alternative 2-Increase Operational Training, Accommodate Force Structure Changes, and Implement Range Enhancements. Alternative 2 is the preferred alternative.

As noted in Section 1.4, the purpose of the Proposed Action is to achieve, enhance, and maintain Fleet readiness using the SOCAL Range Complex to support current and future training operations. The Navy proposes to:

- Increase training and RDT&E operations from current levels as necessary to support Fleet Readiness Training Plan (FRTP);
- Accommodate mission requirements associated with force structure changes and introduction of new weapons and systems to the Fleet; and
- Implement enhanced range complex capabilities.

The components that make up the Proposed Action are discussed in the following sections.

1.4.3.1 No Action -- Current Training Operations within the SOCAL Range Complex

The Navy has been operating in the SOCAL Range Complex for over 70 years. Under the No Action Alternative, training operations and major range events would continue at current levels. The SOCAL Range Complex would not accommodate an increase in training operations required to execute the FRTP or implement proposed force structure changes, nor would it implement investments identified as necessary by the Navy. Evaluation of the No Action Alternative in this EIS/OEIS provides a baseline for assessing environmental impacts of Alternative 1 and Alternative 2 (Preferred Alternative), as described in the following subsections.

Operations currently conducted on the SOCAL Range Complex are described in detail in Chapter 2 and Appendix A. Each military training activity described in this EIS/OEIS meets a requirement that can be ultimately traced to requirements from the National Command Authority (NCA). Training activities in the SOCAL Range Complex vary from basic individual or unit level events of relatively short duration involving few participants to integrated major range training events, such as JTFEX, which may involve thousands of participants over several weeks.

Over the years, the tempo and types of operations have fluctuated within the SOCAL Range Complex due to changing requirements, the dynamic nature of international events, the introduction of advances in warfighting doctrine and procedures, and force structure changes. Such developments have influenced the frequency, duration, intensity, and location of required training. The factors influencing tempo and types of operations are fluid in nature, and will continue to cause fluctuations in training activities within the SOCAL Range Complex. Accordingly, operational data used throughout this EIS/OEIS are a representative baseline for evaluating impacts that may result from the proposed training operations under the No Action Alternative.

With reference to criteria identified above and in Section 2.2.1, the No Action Alternative generally satisfies Fleet training requirements; however, because the No Action Alternative does not propose increases in operations it does not accommodate training associated with surge requirements of the FRTP. One goal of the Proposed Action is to implement range enhancements for ASW and MIW training. The No Action Alternative does not satisfy this purpose, because it does not propose establishment of new range facilities.

1.4.3.2 Alternative 1: Increase Operational Training and Accommodate force structure changes

Alternative 1 is a proposal designed to meet Navy and DoD current and near-term operational training requirements. If Alternative 1 were to be selected, in addition to accommodating training operations currently conducted, the SOCAL Range Complex would support an increase in training operations including Major Range Events and force structure changes associated with introduction of new weapons systems, vessels, and aircraft into the Fleet. Under Alternative 1, baseline-training operations would be increased. In addition, training and operations associated with force structure changes would be implemented for the LCS, MV-22 Osprey, the EA-18G Growler, the SH-60R/S Seahawk Multi-Mission Helicopter, the P-8 Poseidon Maritime Multi-mission Aircraft, the Landing Platform-Dock [LPD] 17 amphibious assault ship, and the DDG 1000 [Zumwalt Class] destroyer. Force structure changes associated with new weapons systems would include Organic Airborne Mine Countermeasures (OAMCM) systems. Force Structure changes also would include training and operations associated with the proposed homeporting of the aircraft carrier USS CARL VINSON at Naval Base (NB) Coronado.[4]

While Alternative 1 would meet the Navy’s purpose and need, Alternative 1 does not optimize the training capabilities of the Range Complex to the level needed.. With reference to the criteria identified above and in Section 2.2.1, Alternative 1 only partially satisfies criteria 1, 2, 5, 6, and 7 (relating to support for the full spectrum of training requirements), because it does not fully accommodate surge training needs. Moreover, Alternative 1 does not support criteria 10 (relating to range enhancements for ASW and MIW training) because it does not propose establishment of new range facilities.

[4] This EIS/OEIS addresses only training activities associated with the homeporting of a third aircraft carrier at NB Coronado; separate environmental analysis is being conducted with regard to potential impacts of facilities, personnel, and support activities that might be associated with the homeporting proposal.

1.4.3.3 Alternative 2: Increase Operational Training, Accommodate Force Structure Changes, and Implement Range Enhancements

Implementation of Alternative 2 would include all elements of Alternative 1 (accommodating training operations currently conducted, increasing training operations [including Major Range Events], and accommodating force structure changes). In addition, under Alternative 2:

- In order to optimize training throughput and meet the FRTP, training operations of the types currently conducted would be increased over levels identified in Alternative 1 (see Table 2-8);
- Range enhancements would be implemented, to include an increase in Commercial Air Services, establishment of a shallow water minefield; and installation and use of the Shallow Water Training Range (SWTR), as described in Section 2.5.2. Figure ES-6 depicts the proposed location of the SWTR.

Alternative 2 is the preferred alternative, because it would optimize the training capability of the SOCAL Range Complex. Alternative 2 fully meets the criteria identified above and in Section 2.2.1 of the EIS/OEIS.

ES 1.5 TRAINING AND RDT&E ACTIVITIES IN THE SOCAL RANGE COMPLEX

For purposes of analysis, operations data for use in the EIS/OEIS are organized according to the seven Primary Mission Areas, or PMARs (described in Section 1.2.2 and 2.3.1.1 through 2.3.1.12). In addition, operations data include RDT&E events. Summary descriptions of current training activities conducted in the SOCAL Range Complex are provided in the following subsections.

ES 1.5.1 Descriptions of Primary Mission Areas

Anti-Air Warfare (AAW) Training

AAW is the PMAR that addresses combat operations by air and surface forces against hostile aircraft. Navy ships contain an array of modern anti-aircraft weapon systems, including naval guns linked to radar-directed fire-control systems, surface-to-air missile systems, and radar-controlled cannon for close-in point defense. Strike/fighter aircraft carry anti-aircraft weapons, including air-to-air missiles and aircraft cannon. AAW training encompasses events and exercises to train ship and aircraft crews in employment of these weapons systems against simulated threat aircraft or targets. AAW training includes surface-to-air gunnery surface-to-air and air-to-air missile exercises and aircraft force-on-force combat maneuvers

Anti-Submarine Warfare (ASW) Training

ASW involves helicopter and sea control aircraft, ships, and submarines, operating alone or in combination, in operations to locate, track, and neutralize submarines. Controlling the undersea battlespace is a unique naval capability and a vital aspect of sea control. Undersea battlespace dominance requires proficiency in ASW. Every deploying strike group and individual surface combatant must possess this capability.

Various types of active and passive sonars are used by the Navy to determine water depth, locate mines, and identify, track, and target submarines. Passive sonar “listens” for sound waves by using underwater microphones, called hydrophones, which receive, amplify and process underwater sounds. No sound is introduced into the water when using passive sonar. Passive sonar can indicate the presence, character and movement of submarines. However, passive sonar provides only a bearing (direction) to a sound-emitting source; it does not provide an accurate range (distance) to the source. Active sonar is needed to locate objects because active sonar provides both bearing and range to the detected contact (such as an enemy submarine).

Active sonar transmits pulses of sound that travel through the water, reflect off objects and return to a receiver. By knowing the speed of sound in water and the time taken for the sound wave to travel to the object and back, active sonar systems can quickly calculate direction and distance from the sonar platform to the underwater object. There are three types of active sonar: low frequency, mid-frequency, and high-frequency.

Low-frequency sonar operates below 1 kHz and is designed to detect extremely quiet diesel-electric submarines at ranges far beyond the capabilities of mid-frequency active sonars. There are only two ships in use by the U.S. Navy that are equipped with low frequency sonar; both are ocean surveillance vessels operated by Military Sealift Command. Low-frequency active sonar is not presently utilized in the SOCAL Range Complex, and use of low-frequency active sonar is not contemplated in the Proposed Action of the EIS/OEIS.

High-frequency active sonar, operates at frequencies greater than 10 kilohertz (kHz). At higher acoustic frequencies, sound rapidly dissipates in the ocean environment, resulting in short detection ranges, typically less than five nm. High-frequency sonar is used primarily for determining water depth, hunting mines and guiding torpedoes.

Mid-frequency active sonar (MFAS) operates between 1 and 10 kHz, with detection ranges up to 10 nautical miles (nm). Because of this detection ranging capability, MFAS is the Navy’s primary tool for conducting ASW. Many ASW experiments and exercises have demonstrated that this improved capability for long range detection of adversary submarines before they are able to conduct an attack is essential to U.S. ship survivability. Today, ASW is the Navy’s #1 war-fighting priority. Navies across the world utilize modern, quiet, diesel-electric submarines which pose the primary threat to the U.S. Navy’s ability to perform a number of critically necessary missions. Extensive training is necessary of if Sailors, ships, and strike groups are to gain proficiency in using MFAS sonar. If a strike group does not demonstrate MFAS proficiency, it cannot be certified as combat ready.

The Navy’s ASW training plan, including the use of active sonar in at-sea training scenarios, includes multiple levels of training. Individual-level ASW training addresses basic skills such as detection and classification of contacts, distinguishing discrete acoustic signatures including those of ships, submarines, and marine life, and identifying the characteristics, functions, and effects of controlled jamming and evasion devices. More advanced, integrated ASW training exercises involving active sonar is conducted in coordinated, at-sea operations during multi-dimensional training events involving submarines, ships, aircraft, and helicopters. This training integrates the full anti-submarine warfare continuum from detecting and tracking a submarine to attacking a target using either exercise torpedoes or simulated weapons. Training events include detection and tracking exercises (TRACKEX) against “enemy” submarine contacts; torpedo employment exercises (TORPEX) against the target; and exercising command and control tasks in a multi-dimensional battlespace.

ASW sonar systems are deployed from certain classes of surface ships, submarines, helicopters, and fixed-wing maritime patrol aircraft (Table 2-4). The surface ships used are typically equipped with hull-mounted sonars (passive and active) for the detection of submarines. Helicopters equipped with dipping sonar or sonobuoys are utilized to locate suspect submarines or submarine targets within the training area. In addition, fixed-wing MPA are used to deploy both active and passive sonobuoys to assist in locating and tracking submarines during the duration of the exercise. Submarines are equipped with hull-mounted sonars sometimes used to locate and prosecute other submarines and/or surface ships during the exercise.

Anti-Surface Warfare (ASUW) Training

ASUW is a type of naval warfare in which aircraft, surface ships, and submarines employ weapons, sensors, and operations directed against enemy surface ships or boats. Aircraft-to-surface ASUW is conducted by long-range attacks using air-launched cruise missiles or other precision guided munitions, or using aircraft cannon. ASUW also is conducted by warships employing torpedoes, naval guns, and surface-to-surface missiles. Submarines attack surface ships using torpedoes or submarine-launched, anti-ship cruise missiles. Training in ASUW includes surface-to-surface gunnery and missile exercises, air-to-surface gunnery and missile exercises, and submarine missile or torpedo launch events. Training generally involves expenditure of ordnance against a towed target. A sinking exercise (SINKEX) is a specialized training event that provides an opportunity for ship, submarine, and aircraft crews to deliver live ordnance on a deactivated vessel, which is deliberately sunk using multiple weapons systems.

ASUW also encompasses maritime interdiction, that is, the interception of a suspect surface ship by a Navy ship for the purpose of boarding-party inspection or the seizure of the suspect ship. Training in these tasks is conducted in Visit, Board, Search and Seizure exercises.

Amphibious Warfare (AMW) Training

AMW is a type of naval warfare involving the utilization of naval firepower and logistics, and Marine Corps landing forces to project military power ashore. AMW encompasses a broad spectrum of operations involving maneuver from the sea to objectives ashore, ranging from reconnaissance or raid missions involving a small unit, to large-scale amphibious operations involving over one thousand Marines and Sailors, and multiple ships and aircraft embarked in a Strike Group.

AMW training includes tasks at increasing levels of complexity, from individual, crew, and small unit events to large task force exercises. Individual and crew training include the operation of amphibious vehicles and naval gunfire support training. Small-unit training operations include events leading to the certification of a Marine Expeditionary Unit (MEU) as “Special Operations Capable” (SOC). Such training includes shore assaults, boat raids, airfield or port seizures, and reconnaissance. Larger-scale amphibious exercises involve ship-to-shore maneuver, shore bombardment and other naval fire support, and air strike and close air support training.

Electronic Combat (EC) Training

EC is the mission area of naval warfare that aims to control use of the electromagnetic spectrum and to deny its use by an adversary. Typical EC activities include threat avoidance training, signals analysis for intelligence purposes, and use of airborne and surface electronic jamming devices to defeat tracking systems.

Mine Warfare (MIW) Training

MIW is the naval warfare area involving the detection, avoidance, and neutralization of mines to protect Navy ships and submarines, and offensive mine laying in naval operations. A naval mine is a self-contained explosive device placed in water to destroy ships or submarines. Naval mines are deposited and left in place until triggered by the approach of or a contact with an enemy ship, or are destroyed or removed. Naval mines can be laid by purpose-built minelayers, other ships, submarines, or airplanes. MIW training includes Mine Countermeasures (MCM) Exercises and Mine Laying Exercises (MINEX).

Naval Special Warfare (NSW) Training

NSW forces (SEALs and Special Boat Units [SBUs]) train to conduct military operations in five Special Operations mission areas: unconventional warfare, direct action, special reconnaissance, foreign internal defense, and counterterrorism. NSW training involves specialized tactics, techniques, and procedures, employed in training events that include: insertion/extraction operations using parachutes rubber boats, or helicopters; boat-to-shore and boat-to-boat gunnery; demolition training on land or underwater; reconnaissance; and small arms training.

Strike Warfare (STW) Training

STW operations include training of fixed-wing fighter/attack aircraft in delivery of precision guided munitions, non-guided munitions, rockets, and other ordnance against land targets in all weather and light conditions. Training events typically involve a simulated strike mission with a flight of four or more aircraft. The strike mission may simulate attacks on “deep targets” (i.e., those geographically distant from friendly ground forces), or may simulate close air support of targets within close range of friendly ground forces. Laser designators from aircraft or ground personnel may be employed for delivery of precision guided munitions. Some strike missions involve no-drop events in which prosecution of targets is simulated, but video footage is often obtained by onboard sensors.

Combat Search and Rescue (CSAR) is a strike warfare operation with the purpose of training aircrews to locate, protect, and evacuate downed aviation crew members from hostile territory. The operation can include reconnaissance aircraft to find the downed aircrew, helicopters to conduct the rescue, and fighter aircraft to perform close air support to protect both the downed aircrews and the rescue helicopters.

Explosive Ordnance Disposal (EOD) Activities

The EOD mission area involves employment of skills, tactics, and equipment designed to safely render unexploded ordnance (UXO). EOD personnel are highly trained and operate in both tactical and administrative capacities. Tactical missions include safe disposal of improvised explosive devices. Administrative missions include range clearance and ordnance safety in support of operational forces.

U.S. Coast Guard Training

Coast Guard Sector San Diego, a shore command within the Coast Guard 11th District, carries out its mission to serve, protect and defend the American public, maritime infrastructure and the environment. The Sector San Diego Area of Responsibility (AOR) extends southward from the Dana Point harbor to the border with Mexico. Equipment utilized by the Coast Guard includes 25-ft response boats, 41-ft utility boats and 87-ft patrol boats, as well as HH-60 helicopters. Training events include: search and rescue, maritime patrol training, boat handling, and helicopter and surface vessel live-fire training with small arms.

Naval Auxiliary Landing Field (NALF) SCI Airfield Activities

NALF SCI provides opportunities for aviation training and aircraft access to the island. The airfield is restricted to military aircraft and authorized contract flights. There are no permanently assigned aircraft, and aviation support is limited essentially to refueling. NALF SCI has the primary mission of training Naval Air Force Pacific aircrews in Field Carrier Landing Practice

(FCLP). FCLP involves landing on a simulated aircraft carrier deck painted on the surface of the runway near its eastern end. Other military activities include visual and instrument approaches and departures, aircraft equipment calibration, survey and photo missions, range support, exercise training, RDT&E test support, medical evacuation, and supply and personnel flights.

RDT&E Events

Space and Naval Warfare Systems Center (SPAWARSYSCEN) conducts RDT&E, engineering, and fleet support for command, control, and communications systems and ocean surveillance. Space and Naval Warfare System's (SPAWAR's) tests on SCI include a wide variety of ocean engineering, missile firings, torpedo testing, manned and unmanned submersibles, Unmanned aerial vehicles (UAVs), EC, and other Navy weapons systems. Specific events include:

- Ship Tracking and Torpedo Tests;
- Unmanned Underwater Vehicle (UUV) Tests;
- Sonobuoy Quality Assurance (QA)/Quality Control (QC) Tests;
- Ocean Engineering Tests;
- Marine Mammal Mine Shape Location and Research; and
- Missile Flight Tests;

The San Diego Division of the Naval Undersea Warfare Center is a Naval Sea Systems Command (NAVSEA) organization supporting the Pacific Fleet. NUWC operates and maintains the SCI Underwater Range (SCIUR). NUWC conducts tests, analysis, and evaluation of submarine USW exercises and test programs. NUWC also provides engineering and technical support for Undersea Warfare (USW) programs and exercises, design cognizance of underwater weapons acoustic and tracking ranges and associated range equipment, and provides proof testing and evaluation for underwater weapons, weapons systems, and components.

ES 1.5.2 Integrated, Multi-Dimensional Training

The Navy must execute training involving ships, aircraft, submarines, and Marine Corps forces operating in multiple dimensions (at sea, undersea, in the air, and on land) in order to ensure the readiness of naval forces. Unit training proceeds on a continuum, ranging from events involving a small number of ships, submarines, or aircraft engaged in training tailored to specific tasks, to large-scale pre-deployment or readiness exercises involving Strike Groups.

To facilitate analysis, this EIS/OEIS examines the individual activities of each integrated unit-level training event or major range event, rather than examining the exercise as a whole. Given the complexity of these exercises, particularly major range events, analyzing potential impacts over numerous resource areas requires the exercises to be broken down into temporally and spatially manageable components. Moreover, exercise design may differ from event to event, depending on factors such as the composition of the force to be trained and the expected mission of that force. For these reasons, and to ensure consistency, the tables of operations that follow throughout this EIS/OEIS include the individual activities that are conducted as part of a larger event. It is useful to view individual training events as a menu from which a larger, integrated unit training exercise or major range event can be constructed.

1.5.2.1 Major Range Events

The Navy conducts large-scale exercises, or major ranges events, in the SOCAL Range Complex. These exercises are required for pre-deployment certification of naval formations. The composition of the force to be trained, and the nature of its mission upon deployment, determines the scope of the exercise. The Navy currently conducts up to fourteen major range events per year.

Major range events bring together the component elements of a Strike Group or Strike Force (that is, all of the various ships, submarines, aircraft, and Marine Corps forces) to train in complex command, control, operational coordination, and logistics functions.

Major range events require vast areas of sea space and airspace for the exercise of realistic training, as well as land areas for conducting land attack training events. The training space required for these events is a function of naval warfighting doctrine, which favors widely dispersed units capable of projecting forces and firepower at high speeds across distances of up to several hundred miles in a coordinated fashion, to concentrate on an objective. The three-dimensional space required to conduct a major range event involving a CSG or ESG is a complicated polygon covering an area as large as 50,000 nm^2. The space required to exercise an ESF is correspondingly larger.

A major range event is comprised of several "unit level" range operations conducted by several units operating together while commanded and controlled by a single commander. These exercises typically employ an exercise scenario developed to train and evaluate the Strike Group/Force in required naval tactical tasks. In a major range event, most of the operations and activities being directed and coordinated by the Strike Group commander are identical in nature to the operations conducted in the course in individual, crew, and smaller-unit training events. In a major range event, however, these disparate training tasks are conducted in concert, rather than in isolation.

For example, within a single exercise scenario a CSG could conduct a coordinated ASW operation in which several ships and aircraft work together to find and "destroy" an "enemy" submarine, while Marine forces, surface combatant ships, and / or aircraft conduct a coordinated air and amphibious strike operation against objectives ashore. While exercise scenarios for different major range events would be similar in some or many operational respects, they would not be identical. Operations are chosen to be included in a given major range event based on the anticipated operational missions that would be performed during the Strike Group's deployment, and other factors such as the commander’s assessment of the participating units’ state of readiness.

Major range events include:

- Composite Training Unit Exercise (COMPTUEX). The COMPTUEX is an Integration Phase, at-sea, major range event. For the CSG, this exercise integrates the aircraft carrier and carrier air wing with surface and submarine units in a challenging operational environment. For the ESG, this exercise integrates amphibious ships with their associated air wing, surface ships, submarines, and MEU. Live-fire operations that may take place during COMPTUEX include long-range air strikes, Naval Surface Fire Support (NSFS), and surface-to-air, surface-to-surface, and air-to-surface missile exercises. The MEU also conducts realistic training based on anticipated operational requirements and to further develop the required coordination between Navy and Marine Corps forces. Special Operations training may also be integrated with the exercise scenario. The COMPTUEX is typically 21 days in length. The exercise is conducted in accordance with a schedule of events, which may include two 1-day, scenario-driven, “mini” battle problems, culminating with a scenario-driven 3-day Final Battle Problem. COMPTUEX occurs three to four times per year.

- JTFEX. The JTFEX is a dynamic and complex major range event that is the culminating exercise in the Sustainment Phase training for the CSGs and ESGs. For an ESG, the exercise incorporates an Amphibious Ready Group (ARG) Certification Exercise (ARG CERT) for the amphibious ships and a Special Operations Capable Certification (SOCCERT) for the MEU. When schedules align, the JTFEX may be conducted concurrently for an ESG and CSG. JTFEX emphasizes mission planning and effective execution by all primary and support warfare commanders, including command and control, surveillance, intelligence, logistics support, and the integration of tactical fires. JTFEXs are complex scenario-driven exercises that evaluate a strike group in all warfare areas. JTFEX is normally 10 days long, not including a 3-day in-port Force Protection Exercise, and is the final at-sea exercise for the CSG or ESG prior to deployment. JTFEX occurs three to four times per year.

Major range events would utilize the SOCAL Range Complex and may also utilize other military range areas in California, Arizona, and Nevada, including the Point Mugu Sea Range, Marine Corps Base Camp Pendleton, Fallon Range Complex, and China Lake Range Complex in California; Bob Stump Training Range Complex in California and Arizona, and Nevada Test and Training Range (Nellis AFB). Utilization of these other range complexes in the course of a major range event is and would be limited and relatively infrequent. Table 2-5 identifies Navy range complexes in addition to the SOCAL Range Complex at which portions of a Major Range Event can occur, depending on the exercise scenario.

1.5.2.2 Integrated Unit-Level Training Events

Integrated unit-level training events, which pursue tailored training objectives for components of a Strike Group, include:

- Ship ASW Readiness and Evaluation Measuring (SHAREM). SHAREM is a Chief of Naval Operations (CNO) chartered program with the overall objective to collect and analyze high-quality data to quantitatively "assess" surface ship ASW readiness and effectiveness. The SHAREM will typically involve multiple ships, submarines, and aircraft in several coordinated events over a period of a week or less. A SHAREM may take place once per year in SOCAL.
- Sustainment Exercise. Included in the FRTP is a requirement to conduct post-deployment sustainment, training, and maintenance. This ensures that the components of a Strike Group maintain an acceptable level of readiness after returning from deployment. A sustainment exercise is an exercise designed to challenge the strike group in all warfare areas. This exercise is similar to a COMPTUEX but of shorter duration. One to two sustainment exercises may occur each year in SOCAL.
- Integrated ASW Course (IAC) Phase II. IAC exercises are combined aircraft and surface ship events. The IAC Phase II consists of two 12-hour events conducted primarily on SOAR over a 2-day period. The typical participants include four helicopters, two P-3 aircraft, two adversary submarines, and two Mk 30 or Mk 39 targets. Frequently, IACs include the introduction of an off-range Mk 30 target. Four IAC Phase II exercises may occur per year.

ES 1.6 ALTERNATIVES ANALYSIS

Chapter 3 of the EIS/OEIS describes existing environmental conditions for resources potentially affected by the Proposed Action and alternatives described in Chapter 2. This chapter also identifies and assesses the environmental consequences of the Proposed Action and alternatives. The affected environment and environmental consequences are described and analyzed according to categories of resources. The categories of resources addressed in this EIS/OEIS and the location of the respective analyses are identified in the following table:

Table ES-2: Categories of Resources Addressed, and EIS/OEIS Chapter 3 Analysis Guide

Geology and Soils (3.1)	Air Quality (3.2)
Hazardous Materials and Wastes (3.3)	Water Quality (3.4)
Acoustic Environment (3.5)	Marine Plants and Invertebrates (3.6)
Fish (3.7)	Sea Turtles (3.8)
Marine Mammals (3.9)	Sea Birds (3.10)
Terrestrial Biological Resources (3.11)	Cultural Resources (3.12)
Traffic (3.13)	Socioeconomics (3.14)
Environmental Justice & Protection of Children (3.15)	Public Safety (3.16)

In the environmental impact analysis process, the resources analyzed are identified and the expected geographic scope of potential impacts for each resource, known as the resource's region of influence (ROI), is defined. The discussion and analysis, organized by resource area, covers the SOCAL OPAREAs, Special Use Airspace (SUA), and the land area of SCI to the extent affected resources or potential impacts are present.

In describing and analyzing affected resources and environmental consequences, this chapter identifies current mitigation measures that are integral to the activities covered by the Proposed Action and alternatives.

Analysis of potential impacts of Navy activities on marine mammals is particularly complex. Therefore, the Navy has prepared a detailed appendix (Appendix F) to this EIS/OEIS that provides a comprehensive discussion of the approach to and results of the impacts analysis relating to marine mammals. Section 3.9 summarizes Appendix F.

ES 1.7 CUMULATIVE IMPACTS

The approach taken to analysis of cumulative impacts (or cumulative effects)[5] addresses the objectives of NEPA and CEQ regulations and CEQ guidance. CEQ regulations define "cumulative effects" as:

> ". . . the impact on the environment which results from the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions regardless of what agency (Federal or non-Federal) or person undertakes such other actions Cumulative impacts can result from individually minor but collectively significant actions taking place over a period of time." (40 CFR 1508.7).

CEQ provides guidance on cumulative impacts analysis in *Considering Cumulative Effects Under the National Environmental Policy Act* (CEQ 1997). This guidance further identifies cumulative effects as those environmental effects resulting "from spatial and temporal crowding of environmental perturbations. The effects of human activities will accumulate when a second perturbation occurs at a site before the ecosystem can fully rebound from the effects of the first perturbation." Noting that environmental impacts result from a diversity of sources and processes,

[5] CEQ Regulations provide that the terms "cumulative impacts" and "cumulative effects" are synonymous (40 CFR § 1508.8(b)); the terms are use interchangeably.

this CEQ guidance observes that "no universally accepted framework for cumulative effects analysis exists," while noting that certain general principles have gained acceptance. One such principal provides that "cumulative effects analysis should be conducted within the context of resource, ecosystem, and community thresholds—levels of stress beyond which the desired condition degrades." Thus, "each resource, ecosystem, and human community must be analyzed in terms of its ability to accommodate additional effects, based on its own time and space parameters." Therefore, cumulative effects analysis normally will encompass geographic boundaries beyond the immediate area of the Proposed Action, and a time frame including past actions and foreseeable future actions, in order to capture these additional effects. Bounding the cumulative effects analysis is a complex undertaking, appropriately limited by practical considerations. Thus, CEQ guidelines observe, "[i]t is not practical to analyze cumulative effects of an action on the universe; the list of environmental effects must focus on those that are truly meaningful."

ES 1.7.1 Identifying Geographical Boundaries for Cumulative Impacts Analysis

Geographic boundaries for analyses of cumulative impacts in this EIS/OEIS vary for different resources and environmental media. For air quality, the potentially affected air quality regions are the appropriate boundaries for assessment of cumulative impacts from releases of pollutants into the atmosphere. For wide-ranging or migratory wildlife, specifically marine mammals and sea turtles, any impacts from the Proposed Action or alternatives might combine with impacts from other sources within the range of the population. Therefore, identification of impacts elsewhere in the range of a potentially affected population is appropriate. For terrestrial biological resources, San Clemente Island (SCI) is the appropriate geographical area for assessing cumulative impacts. For all other ocean resources, the ocean ecosystem of the Southern California Bight (SCB) is the appropriate geographic area for analysis of cumulative impacts. The following table identifies the geographic scope of this cumulative impacts analysis, by resource area.

Table ES-3: Geographic Areas for Cumulative Impacts Analysis

Resource	Area for Impacts Analysis
Geology and Soils	SCI
Air Quality	South Coast Air Basin San Diego Air Basin South Central Coast Air Basin
Hazardous Materials and Hazardous Wastes	SCI and SCB
Water Resources	SCI and SCB
Marine Plants and Invertebrates	SCB
Fish	SCB
Sea Turtles	Pacific Range
Marine Mammals	Pacific Range
Sea Birds	SCB

Resource	Area for Impacts Analysis
Terrestrial Biological Resources	SCI
Cultural Resources	SCI and SCB
Traffic	SCB
Socioeconomics	SCB
Environmental Justice	SCB
Public Safety	SCB

Identifiable present effects of past actions are analyzed, to the extent they may be additive to impacts of the Proposed Action. Cumulative impacts are addressed on a resource-by-resource basis in Chapter 4, as follows:

Table ES-4: Guide to Cumulative Impacts Analysis

Geology and Soils (Section 4.3.1)	Air Quality (Section 4.3.2)
Hazardous Materials and Wastes (Section 4.3.3)	Water Resources (Section 4.3.4)
Acoustic Environment-Airborne Sound (Section 4.3.5)	Marine Plants and Invertebrates (Section 4.3.6)
Fish (Section 4.3.7)	Sea Turtles (Section 4.3.8)
Marine Mammals (Section 4.3.9)	Sea Birds (Section 4.3.10)
Terrestrial Biological Resources (Section 4.3.11)	Cultural Resources (Section 4.3.12)
Traffic (Section 4.3.13)	Socioeconomics (Section 4.3.14)
Environmental Justice (Section 4.3.15)	Public Safety (Section 4.3.16)

ES 1.8 MITIGATION MEASURES

NEPA regulations require an EIS to include appropriate mitigation measures not already included in the Proposed Action or alternatives (40 C.F.R. § 1502.12(f)). Each of the alternatives, including the Proposed Action considered in this EIS/OEIS, already includes protective or mitigation measures intended to reduce environmental effects of Navy activities. Mitigation measures, are discussed in the resource by resource analysis, and also are addressed in detail in Chapter 5, Mitigation and Protective Measures.

Effective training in the SOCAL Range Complex dictates that ship, submarine, and aircraft participants utilize their sensors and exercise weapons to their optimum capabilities as required by the mission. As part of its commitment to sustainable use of resources and environmental stewardship, the Navy incorporates measures that are protective of the environment into all of its activities. Some of these measures are generally applicable and others are designed to apply to certain geographic areas during certain times of year, for specific types of Navy training. Conservation measures covering habitats and species occurring in the SOCAL Range Complex have been developed through various environmental analyses conducted by the Navy for land and sea ranges and adjacent coastal waters. In addition, the Navy also has a Protective Measures Assessment Protocol (PMAP) initiative in place which is intended to ensure the latest protected species/habitats mitigation data and guidance are available to the operators conducting training exercises. These mitigation measures are promulgated through the use of Navy messages issued to all units and commands participating in an exercise as well as to non-Navy participants (e.g., Department of Defense agencies). The discussion in Chapter 5 describes mitigation measures applicable to Navy activities in the SOCAL Range Complex.

ES 1.9 OTHER REQUIRED CONSIDERATIONS

ES 1.9.1 Possible Conflicts with Objectives of Federal, State, and Local Plans Policies and Controls

Based on an evaluation with respect to consistency with statutory obligations, the Navy's alternatives including the Proposed Action ("Proposed Action") for the SOCAL Range Complex EIS/OEIS does not conflict with the objectives or requirements of Federal, State, regional, or local plans, policies, or legal requirements. Chapter 6, Table 6-1 provides a summary of environmental compliance requirements that may apply.

ES 1.9.2 Relationship Between Short-term Uses and Long-term Productivity

The Proposed Action would result in both short- and long-term environmental effects. However, the Proposed Action would not be expected to result in any impacts that would reduce environmental productivity, permanently narrow the range of beneficial uses of the environment, or pose long-term risks to health, safety or the general welfare of the public. The Navy is committed to sustainable range management, including co-use of the SOCAL Range Complex with the general public and commercial interests to the extent practicable consistent with accomplishment of the Navy mission and in compliance with applicable law. This commitment to co-use enhances the long-term productivity of the range areas surrounding SOCAL Range Complex.

ES 1.9.3 Irreversible or Irretrievable Commitment of Resources

For the alternatives including the Proposed Action, most resource commitments are neither irreversible nor irretrievable. Most impacts are short-term and temporary. Implementation of the Proposed Action would require fuels used by aircraft, ships, and ground-based vehicles. Total fuel consumption would increase and this nonrenewable resource would be considered irreversibly lost.

ES 1.9.4 Energy Requirements and Conservation Potential

Increased training and testing operations on the SOCAL Range Complex would result in an increase in energy demand over the No Action Alternative. Energy requirements would be subject to established energy conservation practices. The use of energy sources has been minimized wherever possible without compromising safety, training, or testing operations. No additional conservation measures related to direct energy consumption by the proposed operations are identified.

ES 1.9.5 Natural or Depletable Resource Requirements and Conservation Potential

Resources that will be permanently and continually consumed by project implementation include water, electricity, natural gas, and fossil fuels. Pollution prevention is an important component of mitigation of the alternative’s adverse impacts. To the extent practicable, pollution prevention considerations are included. Sustainable range management practices are in place that protect and conserve natural and cultural resources; and preservation of access to training areas for current and future training requirements, while addressing potential encroachments that threaten to impact range capabilities.

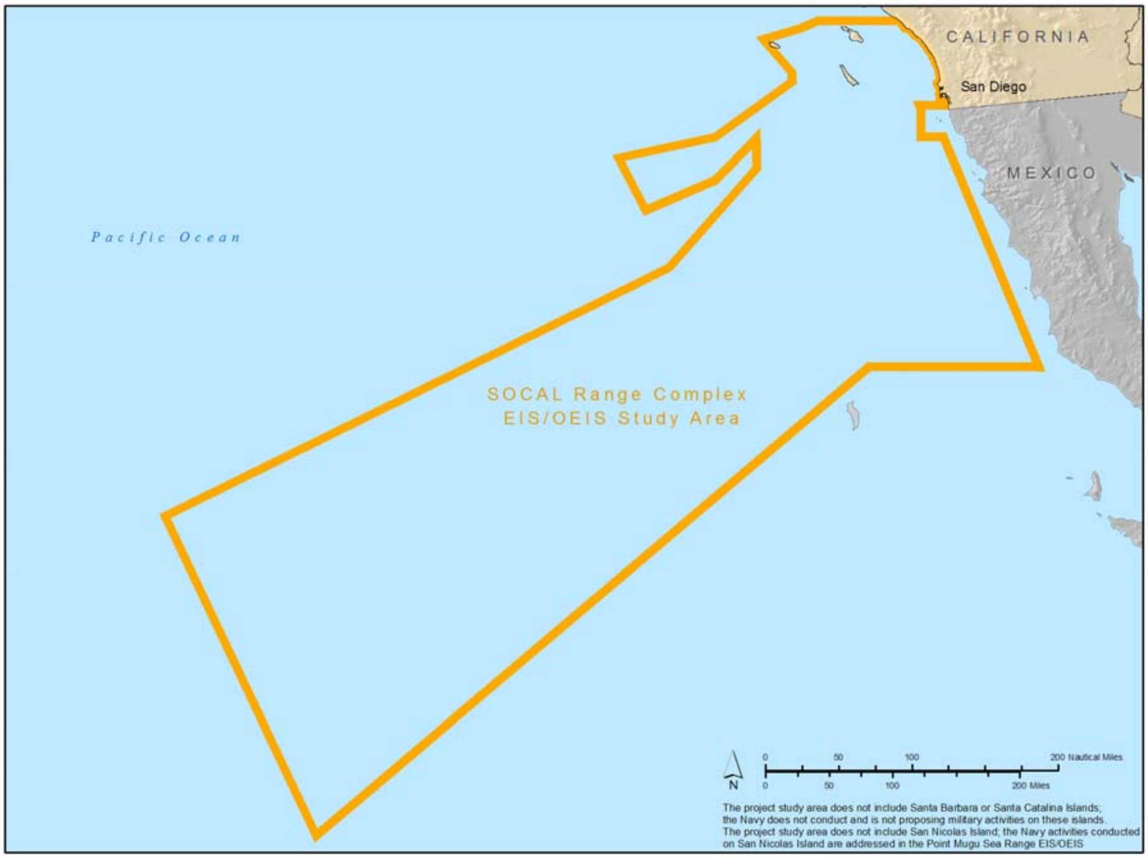

Figure ES-1: SOCAL Range Complex (EIS/OEIS Study Area)

The project study area does not include Santa Barbara or Santa Catalina Islands; the Navy does not conduct and is not proposing military activities on these islands.
The project study area does not include San Nicolas Island; the Navy activities conducted on San Nicolas Island are addressed in the Point Mugu Sea Range EIS/OEIS.

Figure ES-2: Detail of SOCAL Range Complex

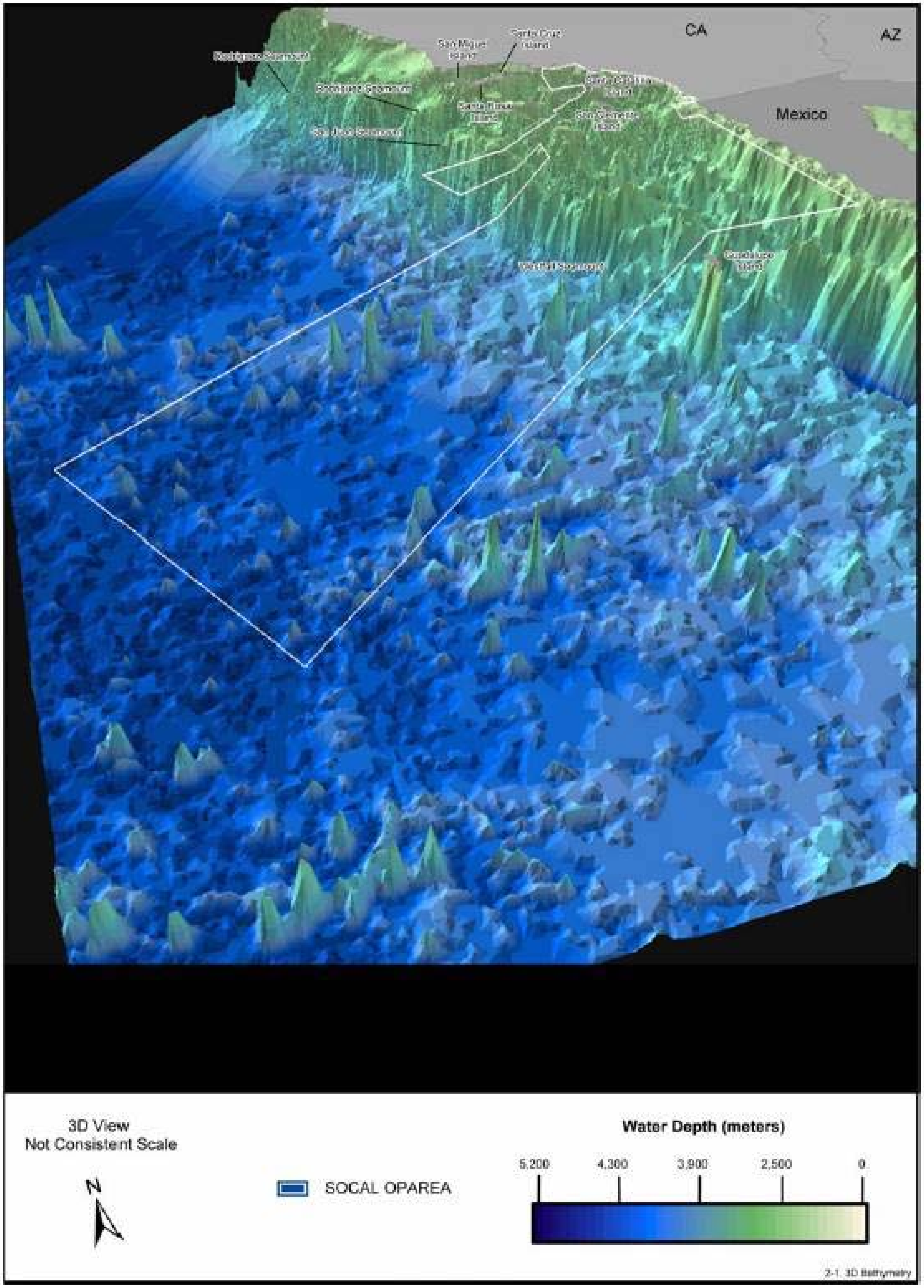

Figure ES-3: Detailed Bathymetry and Topography of the SOCAL Range Complex

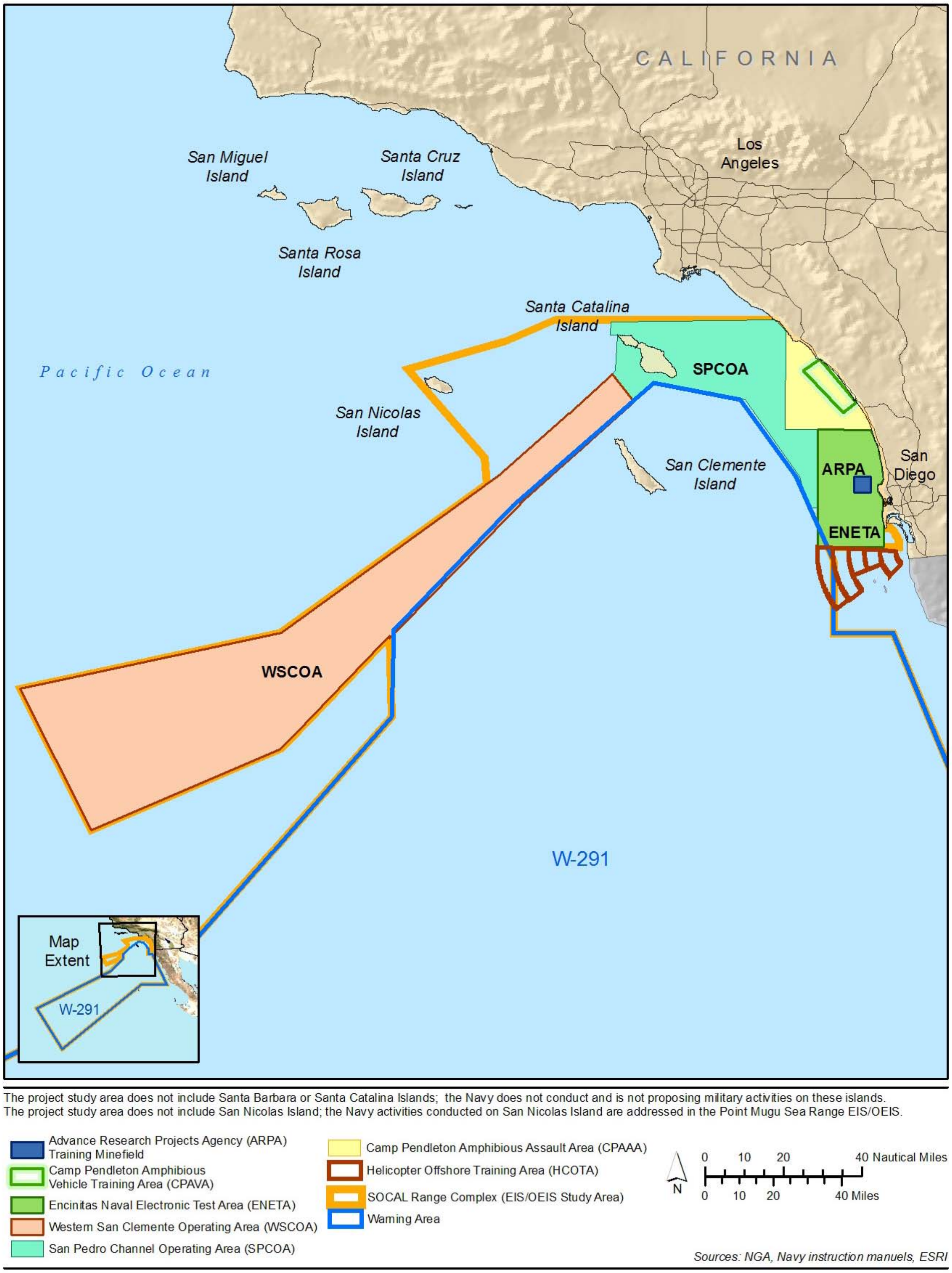

Figure ES-4: Ocean OPAREAs Outside W-291

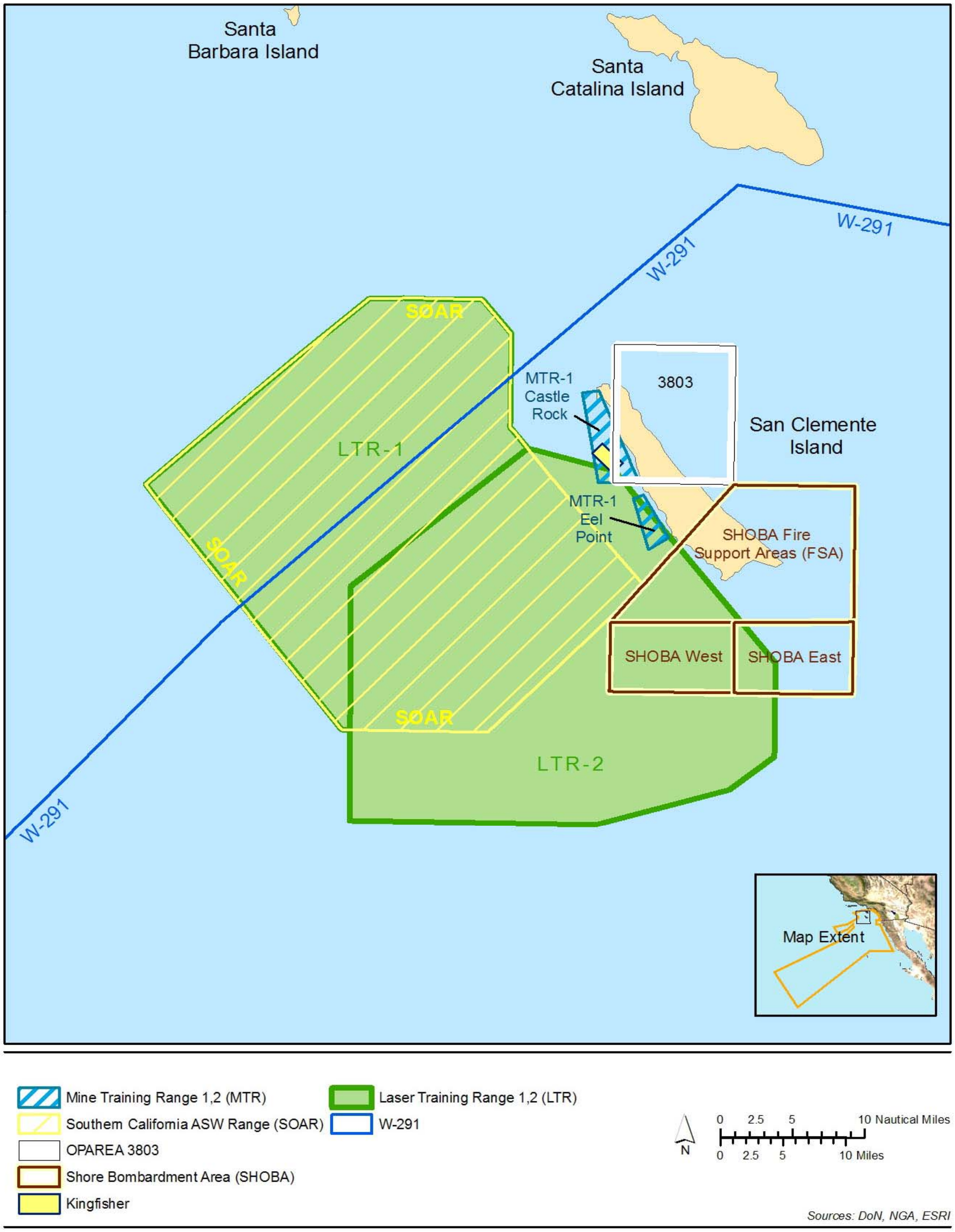

Figure ES-5: San Clemente Island Nearshore Range Areas

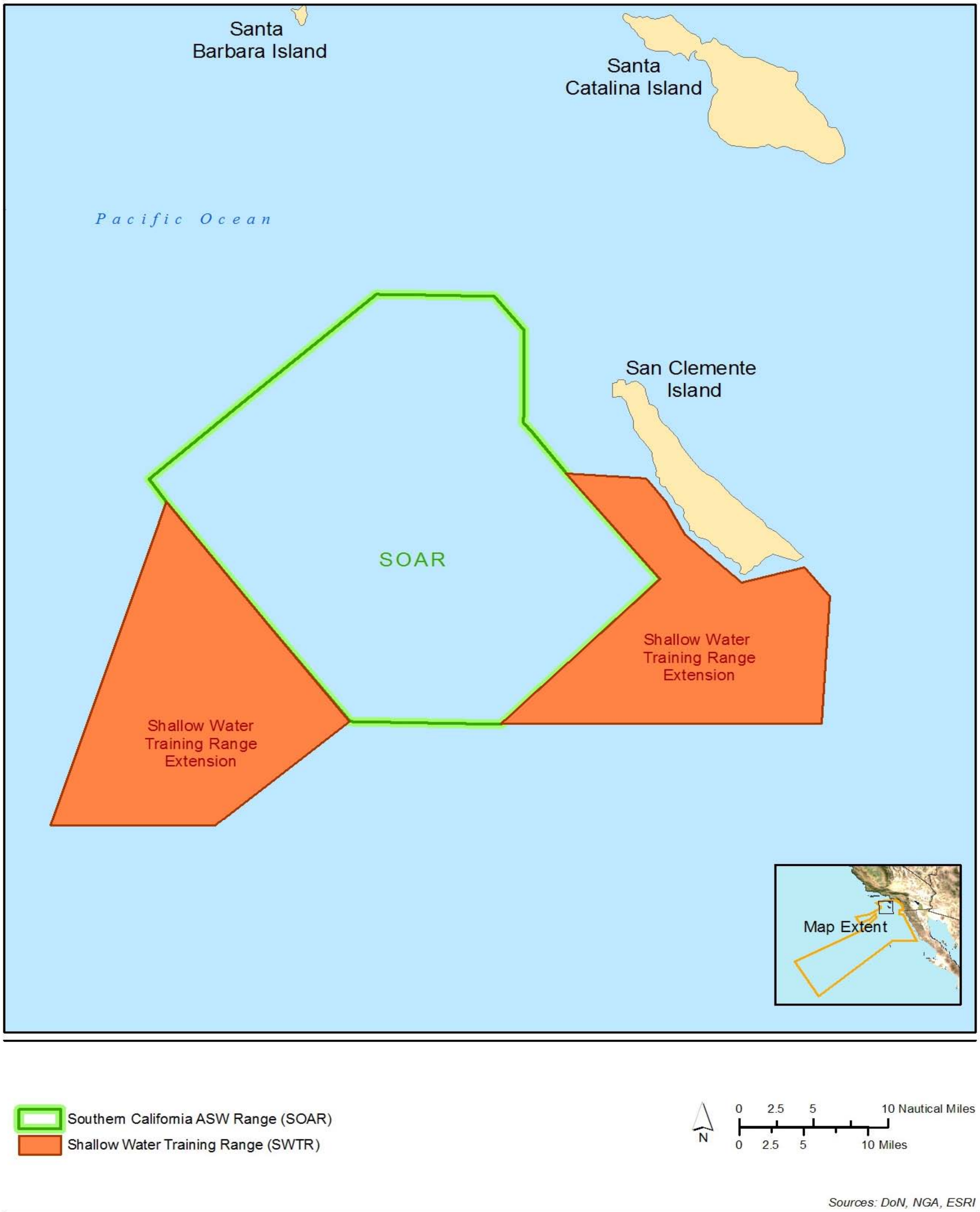

Figure ES-6: Proposed Location of Shallow Water Training Range

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There are no tables in this section.

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Acronyms and Abbreviations

A-A	Air-to-Air
AAMEX	Air-to-Air Missile Exercise
AAV	Amphibious Assault Vehicle
AAW	Anti-Air Warfare
ACHP	Advisory Council on Historic Preservation
ACM	Air Combat Maneuvering
ACTRLS	Acoustic Trials
ADCAP	Advanced Capabilities
ADEX	Air Defense Exercise
AESA	Airborne Electronically Scanned Array
AFP	Artillery Firing Points
AICUZ	Air Installation Compatible Use Zone
ALMDS	Airborne Laser Mine Detection System
AMNS	Airborne Mine Neutralization System
AMP	Artillery Maneuver Points
AMW	Amphibious Warfare
APZ	Accident Potential Zone
ARG	Amphibious Ready Group
ARG CERT	ARG Certification Exercise
ARPA	Archaeological Resources Protection Act
ARTCC	Air Route Traffic Control Center
ASBS	Areas of Special Biological Significance
ASBATS	At Sea Bearing Accuracy Tests
ASUW	Anti-Surface Warfare
ASW	Anti-Submarine Warfare
ATACMS	Army Tactical Missile System
AVMA	Assault Vehicle Maneuver Area
AVMC	Assault Vehicle Maneuver Corridor
AVMR	Assault Vehicle Maneuver Road
BATS	Ballistic Aerial Target System
BDU	Bomb Dummy Unit
BEU	Bachelor Enlisted Quarters
BFM	Basic Fighter Maneuvers
BIP	blow-in-place
BLT	Battalion Landing Team
BMP	Best Management Practice
BN Landing	Battalion Landing
BOMBEX	Bombing Exercise
BUDs	Basic Underwater Demolition School
°C	Degrees Celsius
C3F	Commander, Third Fleet
CAE	Control Area Extensions
Cal-EPA	California Environmental Protection Agency
CAS	Close Air Support
CCA	California Coastal Act
CDFG	California Department of Fish and Game
CDMG	California Division of Mines and Geology
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CEQ	Council on Environmental Quality
CFFC	Commander, United States Navy Fleet Forces Command
CFR	Code of Federal Regulations
CH_2O	formaldehyde
CH_4	methane
CHRIMP	Consolidated Hazardous Material Reutilization and Inventory Management Program
cm	centimeter
CNO	Chief of Naval Operations
CNRSW	Commander, Navy Region Southwest
CO	carbon monoxide
CO_2	carbon dioxide
COMNAVSURFPAC	Commander Naval Surface Force, U.S. Pacific Fleet
COMPACFLT	Commander, Pacific Fleet
COMPTUEX	Composite Training Unit Exercise
CPAAA	Camp Pendleton Amphibious Assault Area
CPAVA	Camp Pendleton Amphibious Vehicle Training Area
CPF	Commander, Pacific Fleet
CPG-3	Commander, Amphibious Group 3
CPS	Coastal Pelagic Species
CRRC	Combat Rubber Raiding Craft
CSAR	Combat Search and Rescue
CSG	Carrier Strike Group
CTF	Cable Termination Facility
CUPA	Certified Unified Program Agency
CW	Continuous Wave
CWA	Clean Water Act
CWC	California Water Code
CZMA	Coastal Zone Management Act
DACT	Dissimilar Air Combat Training
dB	decibel
dB/km	decibel per kilometer
dBA	decibel, A-weighted
DD(X)	Land Attack Destroyer
DHS	Department of Health Services
DoD	Department of Defense
DoN	Department of the Navy
EA	Environmental Assessment
EC	Electronic Combat
EFEX	Expeditionary Firing Exercise
EFH	Essential Fish Habitat
EFV	Expeditionary Fighting Vehicle
EIS	Environmental Impact Statement
EMATT	Expendable Mobile ASW Training Target
EMR	electromagnetic radiation
ENETA	Encinitas Naval Electronic Test Area
EO	Executive Order
EOD	Explosive Ordinance Disposal
EPA	Environmental Protection Agency
EPCRA	Emergency Planning and Community Right-to-Know Act
ESA	Endangered Species Act
ESG	Expeditionary Strike Group
ESQD	Explosive Safety Quantity-Distance
ESU	Evolutionary Significant Unit
EW	Electronic Warfare
EXTORP	Running Torpedo Exercise
°F	Degrees Fahrenheit
FAA	Federal Aviation Administration
FACSFAC	Fleet Area Control and Surveillance Facility
FCLP	Field Carrier Landing Practice
FeO	iron oxide
FIREX	Naval Surface Fire Support
FL	Flight Level
FLEETEX	Fleet Exercise
FLETA	Fleet Training Area
FM	Frequency Modulated
FONSI	Finding of No Significant Impact
FPT	Fleet Project Team
FRP	Fleet Response Plan
FRTP	Fleet Response Training Plan
FSAs	Fire Support Areas
FSCEX	Fire Support Coordination Center Exercise
ft	foot
FY	Fiscal Year
g/L	grams per liter
gal.	gallon
GBU	Glide Bomb Units
gpd	gallons per day
GUNEX	Gun Exercise
H_2	hydrogen gas
HABS	Historic American Building Survey
HAER	Historic American Engineering Record
HAPC	Habitat Area of Particular Concern

HCL	hydrogen chloride
HCN	hydrogen cyanide
HCOTA	Helicopter Offshore Training Area
HERO	Hazards of Electromagnetic Radiation to Ordnance
HMMWV	High Mobility Many Wheeled Vehicle
HMS	Highly Migratory Species
HMX	High Melting Explosive
HSO_3	hydrogen sulfate
Hz	Hertz
IAC	Integrated Anti-Submarine Warfare Course
ICRMP	Integrated Cultural Resources Management Plan
IFH	Improved Flex Hose
IFR	Instrument Flight Rules
I MARDIV	First Marine Division
I MEF	First Marine Expeditionary Force
INRMP	Integrated Natural Resources Management Plan
IRP	Installation Restoration Program
IOA	Infantry Operations Area
ISE	Independent Steaming Exercise
ISR	Intelligence, Surveillance and Reconnaissance
JNTC	Joint National Training Capability
JSOW	Joint Standoff Weapons
JTFEX	Joint Task Force Exercise
K_2CO_3	potassium carbonate
KB(X)	Kernel Blitz Experimental
kg	kilogram
kHz	kilohertz
km	kilometer
km^2	kilometers, square
KOH	potassium hydroxide
KTR	Kingfisher Training Range
L	liter
L_{10}	noise level exceeded 10 percent of the time
L_{50}	noise level exceeded 50 percent of the time
L_{90}	noise level exceeded 90 percent of the time
LAAW	Light Anti-Armor-Weapon
LANDNAV	Land Navigation
LASM	Land Attack Standard Missile
LAV	Light Armored Vehicle
lb	pound
LCAC	Landing Craft Air Cushion
LCS	Littoral Combat Ship
LCU	Landing Craft, Utility
L_{dn}	Day-Night Average Sound Level
L_{eq}	Equivalent Sound Level
LGTR	Laser Guided Training Round
LiBr	lithium bromide
L_iSO_2	lithium sulfur oxide
L_{max}	maximum sound level
L_{min}	minimum sound level
LMRS	Long-Term Mine Reconnaissance System
Lpd	liters per day
LTR	Laser Training Range
m	mile
MAGTF	Marine Air Ground Task Force
MARFORPAC	Marine Forces Pacific
MAROPS	marine operations
MCM	Mine Countermeasures
MEU	Marine Expeditionary Unit
mg/L	milligrams per liter
mi.	mile
MINEX	Mine Laying Exercise
MIR	Missile Impact Range
MISR	Missile Range
MISSILEX	Missile Exercise
MIW	Mine Interdiction Warfare
mL/L	milliliters per liter
mm	Millimeter
MMPA	Marine Mammal Protection Act
MMR	Military Munitions Rule
MMS	Minerals Management Service
MOA	Military Operating Area
MPA	Maritime Patrol Aircraft
MPCD	Marine Pollution Control Device
MPRSA	Marine Protection, Research, Sanctuaries Act
MRE	major range exercise
MSFCMA	Magnuson-Stevens Fisheries Conservation Management Act
MSL	Mean Sea Level
mt	metric tons
MTR	Mine Training Range
n.d.	no date
n.e.w.	net explosive weight
N_2	nitrogen gas
NAGPRA	Native American Grave Protection and Repatriation Act
NALF	Naval Auxiliary Landing Field
NAOPA	Northern Air Operating Area
NAS	Naval Air Station
NASNI	Naval Air Station North Island
NAVSEA	Naval Sea Systems Command
NAVSPECWAR	Naval Special Warfare
NAWCWPNS	Naval Air Warfare Center Weapons Division
NAWQC	National Ambient Water Quality Concentrations
NB	Naval Base
NBC	Naval Base Coronado
NEPA	National Environmental Policy Act
NERRS	National Estuarine Research Reserve System
NGA	National Geospatial Intelligence Agency
NGF	Naval Gunfire
NH_3	ammonia
NH_4ClO_4	ammonium perchlorate
NHPA	National Historic Preservation Act
nm	Nautical Miles
nm^2	Square Nautical Miles
NMFS	National Marine Fisheries Service
NO_2	nitrogen dioxide
NOAA	National Oceanographic and Atmospheric Administration
NOI	Notice of Intent
NOTAM	Notice to Airmen
NOTMAR	Notice to Marines
NOTS	Naval Ordinance Test Station
NPDES	National Pollutant Discharge Elimination System
NPS	National Park Service
NRHP	National Register of Historic Places
NRO	Natural Resources Office
NS	Nearshore
NSFS	Naval Surface Fire Support
NSM	New Strike Missile
NSW	Naval Special Warfare
NSWG-1	Naval Special Warfare Group One
NUWC	Navy Undersea Warfare Center
OAMCM	Organic Airborne Mine Countermeasures
OASIS	Organic Airborne and Surface Influence Sweep
OCE	Officer Conducting the Exercise
OCM	Oil Content Monitor
OEA	Overseas Environmental Assessment
OEIS	Overseas Environmental Impact Statement
OMCM	Organic Mine Countermeasures
OP	Observation Post
OPA	Oil Pollution Act of 1990
OPAREA	Operating Area
OPFOR	Opposition Force
OPNAVISNT	Chief of Naval Operations' Instructions
OS	Offshore
OTB	Over the Beach
PA	Programmatic Agreement
PAH	Polycyclic Aromatic Hydrocarbons
PBX	plastic bonded explosives
pH	alkalinity

PL	Public Law
PMAP	Protective Measures Assessment Protocol
PMAR	Navy Primary Mission Area
PMG	Preliminary Remediation Goals
ppb	parts per billion
PRBO	Point Reyes Bird Observatory
QA	Quality Assurance
QC	Quality Control
RAMCIS	Rapid Airborne Mine Clearance System
RCD	Required Capabilities Document
RCRA	Resource Conservation and Recovery Act
RDT&E	Research, Development, Test and Evaluation
RDX	Royal Demolition Explosive
REWS	Range Electronic Warfare Stimulator
REXTORP	Non-Running Torpedo Exercise
RF	Radio Frequency
RMS	Remote Mine Hunting System
ROC	Range Operations Center
ROD	Record of Decision
RPV	Remotely Piloted Vehicle
RSL	Range Safety Locker
RSO	Range Safety Officer
RWQCB	Regional Water Quality Control Board
S-A	Surface-to-Air
SAM	surface-to-air missile
SARA	Superfund Amendment and Reauthorization Act
SAT	Sensory Accuracy Test
SBBG	Santa Barbara Botanic Garden
SBUs	Special Boat Units
SCAB	South Coast Air Basin
SCB	Southern California Bight
SCI	San Clemente Island
SCIC	San Clemente Island Range Complex
SCIUR	San Clemente Island Underwater Range
SCORE	Southern California Offshore Range
SCS	Soil Conservation Service
SCUBA	Self-Contained Underwater Breathing Apparatus
SDAB	San Diego Air Basin
SDWA	Safe Drinking Water Act
SEAL	Sea, Air, Land
SEL	Sound Exposure Level
SFH	Strong Flex Hose
SHOBA	Shore Bombardment Area
SHPO	State Historic Preservation Officer
SINKEX	Sinking Exercise
SIP	State Implementation Plan
SLAM	Sea-Launched Anti-Air Missile
SLC	State Lands Commission
SO_2	sulfur dioxide
SOA	Small Object Avoidance
SOAR	Southern California ASW Range
SOC	Special Operations Capable
SOCAL	Southern California
SOCCERT	Special Operations Capable Certifications
SOP	Standard Operating Procedure
SPAWAR's	Space and Naval Warfare Systems
SPAWARSYSCEN	Space and Naval Warfare Systems Center
SPCC	Spill Prevention, Control, and Countermeasures
SPCOA	San Pedro Channel Operating Area
S-S	Surface-to-Surface
SSG	Surface Strike Group
SSRNM	Surface Ship Radiated Noise Measurement
SSTC	Silver Strand Training Complex
STOM	Ship-to-Objective Maneuver
STW	Strike Warfare
SUA	Special Use Airspace
SUW	Surface Warfare
SWATs	Special Warfare Training Areas
SWCC	Special Warfare Combatant Crew
SWRCB	State Water Resources Control Board
SWS	SEAL Weapons System
SWTR	Shallow Water Training Range
TAP	Tactical Training Theater Assessment and Planning
TARs	Training Areas and Ranges
TLAM	Tomahawk Land Attack Missile
TMA	Tactical Maneuvering Areas
TORPEX	Torpedo Exercise
TRACKEX	Tracking Exercise
TSCA	Toxic Substances Control Act
TSD	Transfer, Storage, or Disposal
TWR	Torpedo Weapons Receiver
UAV	Unmanned Area Vehicle
µg/L	micrograms per liter
µPA	micro-Pascal
U.S.	United States
U.S.C.	United States Code
UAV	Unmanned Aerial Vehicle
UNDS	Uniform National Discharge Standards
USEPA	U.S. Environmental Protection Agency
USMC	United States Marine Corps
USW	Undersea Warfare
USWREF	Undersea Warfare Readiness Evaluation Facility
USWTR	Undersea Water Training Range
UTM	Universal Transverse Mercator
UUV	Unmanned Underwater Vehicle
UXO	Unexploded Ordinance
VBSS	Visit Board Search and Seizure
VDS	Variable Depth Sonar
VERTREP	Vertical Replenishment
VFR	Visual Flight Rules
V/STOL	Vertical/Short Take-Off and Landing
VTS	Vessel Traffic Service
W-291	Warning Area 291
WGS	World Geodetic System
WSAT	Weapon System Accuracy Trials
WSCOA	Western San Clemente Island Operating Area
yd.	yard

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1 Purpose and Need for Proposed Action

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1 PURPOSE AND NEED

1.1 INTRODUCTION

The National Environmental Policy Act of 1969 (NEPA) (42 U.S.C. § 4321 *et seq.*) requires Federal agencies to examine the environmental effects of major federal actions in an Environmental Impact Statement (EIS), which is a detailed public document that provides an assessment of the potential effects that a major Federal action might have on the human, natural, or cultural environment. Executive Order (EO) 12114, *Environmental Effects Abroad of Major Federal Actions*, directs Federal agencies to provide for informed decision-making for major Federal actions outside U.S. territory in an Overseas EIS (OEIS). The United States (U.S.) Department of the Navy (DoN) is preparing this Draft EIS/OEIS (hereafter referred to as "EIS/OEIS") to assess the potential environmental effects associated with ongoing and proposed naval activities (described in detail in Chapter 2) within the U.S. Navy's (Navy) existing Southern California (SOCAL) Range Complex. The Navy is the lead agency for the EIS/OEIS; the National Marine Fisheries Service (NMFS) is a cooperating agency.

The SOCAL Range Complex (Figures 1-1 and 1-2) encompasses surface and subsurface ocean operating areas (OPAREAs), over-ocean military airspace, and also includes San Clemente Island (SCI). An overview of the SOCAL Range Complex is provided in Section 1.3, and a detailed discussion is found in Chapter 2.

The Navy's mission is to organize, train, equip, and maintain combat-ready naval forces capable of winning wars, deterring aggression, and maintaining freedom of the seas. This mission is mandated by Federal law (Title 10 U.S. Code (U.S.C.) § 5062), which charges the Chief of Naval Operations (CNO) with responsibility for ensuring the readiness of the Nation's naval forces.[1] The CNO meets that directive, in part, by establishing and executing training programs, including at-sea training and exercises, and ensuring naval forces have access to the ranges, OPAREAs, and airspace needed to develop and maintain skills for the conduct of naval operations.

The purpose of the Proposed Action is to achieve and maintain fleet readiness using the SOCAL Range Complex to support and conduct current, emerging, and future training and Research, Development, Test, and Evaluation (RDT&E) operations, while enhancing training resources through investment on the ranges.

The need for the proposed action is to enable the Navy to meet its statutory responsibility to organize, train, equip, and maintain combat-ready naval forces and to successfully fulfill its current and future global mission of winning wars, deterring aggression and maintaining freedom of the seas. Activities involving RDT&E for naval systems are an integral part of this readiness mandate.

The existing SOCAL Range Complex plays a vital part in the execution of this naval readiness mandate. The region of San Diego, California is home to the largest concentration of U.S. naval forces in the world, and the SOCAL Range Complex is the most capable and heavily used Navy range complex in the eastern Pacific region. The Navy's Proposed Action is a step toward ensuring the continued vitality of this essential naval training resource.

[1] Title 10, Section 5062 of the United States Code provides: "The Navy shall be organized, trained, and equipped primarily for prompt and sustained combat incident to operations at sea. It is responsible for the preparation of Naval forces necessary for the effective prosecution of war except as otherwise assigned and, in accordance with Integrated Joint Mobilization Plans, for the expansion of the peacetime components of the Navy to meet the needs of war."

This EIS/OEIS provides an assessment of environmental effects associated with current and proposed training activities, force structure (to include new weapons systems and platforms), and range investments in the Range Complex. Chapter 2 provides a detailed description of the alternatives including the Proposed Action addressed in this EIS/OEIS. In summary, the Navy proposes to implement actions within the SOCAL Range Complex to:

- Increase training and RDT&E operations from current levels in order to support the Fleet Readiness Training Plan (FRTP);
- Accommodate mission requirements associated with force structure changes and introduction of new weapons and systems to the Fleet; and
- Implement enhanced range complex capabilities.

The No Action Alternative is required by regulations of the Council on Environmental Quality (CEQ) as a baseline against which the impacts of the Proposed Action are compared. In this EIS/OEIS, the No Action Alternative is represented by current activities (training and RDT&E operations at current levels), which provide the analytical baseline.

The Proposed Action would result in selectively focused but critical enhancements and increases in training activities and levels that are necessary if the Navy and Marine Corps are to maintain a state of military readiness commensurate with the national defense mission.

The mission of the SOCAL Range Complex is to serve as the principal U.S. Navy training venue in the eastern Pacific with the unique capability and capacity to support required current, emerging, and future training.

The purpose of the Proposed Action is to achieve and maintain Fleet readiness using the SOCAL Range Complex to support and conduct current, emerging, and future training and RDT&E operations, while enhancing training resources through investment on the ranges. The decision to be made by the Assistant Secretary of the Navy (Installations & Environment) is to determine both the scope of training and RDT&E to be conducted and the nature of range enhancements to be made within the SOCAL Range Complex.

To support an informed decision, the EIS/OEIS identifies objectives and criteria for naval activities in the SOCAL Range Complex. The core of the EIS/OEIS is the development and analysis of different alternatives for achieving the Navy's objectives. Alternatives development is a complex process, particularly in the dynamic context of military training. The touchstone for this process is a set of criteria that respond to the naval readiness mandate, as it is implemented in the SOCAL Range Complex. The criteria for developing and analyzing alternatives to meet these objectives are set forth in Section 2.2.1. These criteria provide the basis for the statement of the Proposed Action and alternatives and selection of alternatives for further analysis (Chapter 2), as well as analysis of the environmental effects of the Proposed Action and alternatives (Chapter 3).

This EIS/OEIS supersedes and significantly expands upon an initiative to assess environmental impacts of military activities on SCI. The SCI environmental analysis, which included within its scope the island and near-shore range areas, was initiated in 1996 but not completed. Rather, the Navy elected to expand the SCI effort to include the surrounding ocean areas and airspace of the SOCAL Range Complex. This expanded EIS/OEIS also gives the Navy an opportunity to review its procedures and ensure the benefits of recent scientific and technological advances are applied toward assessing environmental effects.

In February 2007, the Navy completed an Environmental Assessment (EA)/Overseas Environmental Assessment (OEA) for the Joint Task Force Training Exercises (JTFEX) and Composite Training Unit Exercises (COMPTUEX) conducted in southern California. The scope of the JTFEX/COMPTUEX EA/OEA includes 14 pre-deployment exercises conducted from February 2007 to January 2009. The SOCAL Range Complex EIS/OEIS addresses the continuation of these exercises in the baseline analysis, as well as the Navy and U.S. Marine Corp training that currently occurs or is proposed to occur in ocean areas, airspace and SCI land areas of the SOCAL Range Complex.

This EIS/OEIS is being prepared in compliance with NEPA; the Council on Environmental Quality (CEQ) Regulations for Implementing the Procedural Provisions of NEPA (Title 40) Code of Federal Regulations [C.F.R.] §§ 1500-1508); Department of the Navy Procedures for Implementing NEPA (32 C.F.R. § 775); Executive Order (EO) 12114, *Environmental Effects Abroad of Major Federal Actions*. The NEPA process ensures that environmental impacts of proposed major Federal actions are considered in agency decision-making. EO 12114 requires consideration of environmental impacts of actions outside the United States such as in non-territorial ocean areas. This EIS/OEIS satisfies the requirements of both NEPA and EO 12114.

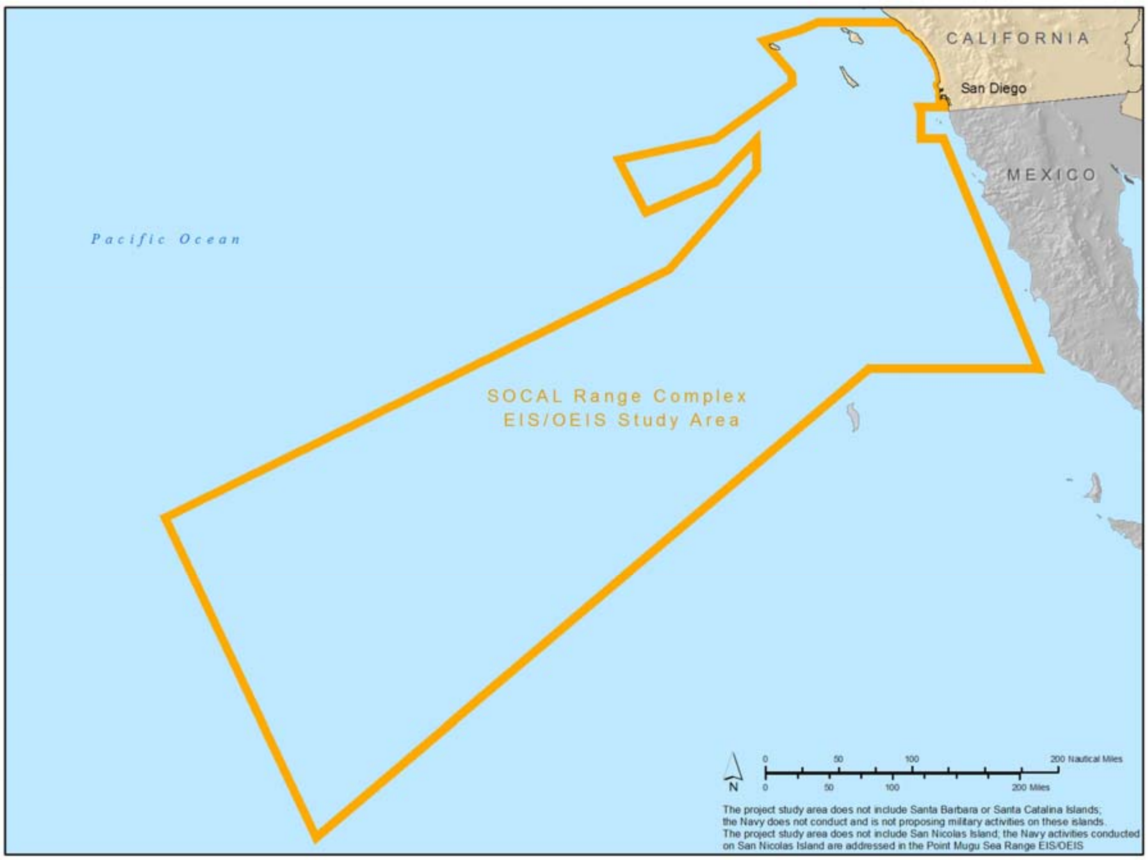

Figure 1-1: SOCAL Range Complex (EIS/OEIS Study Area)

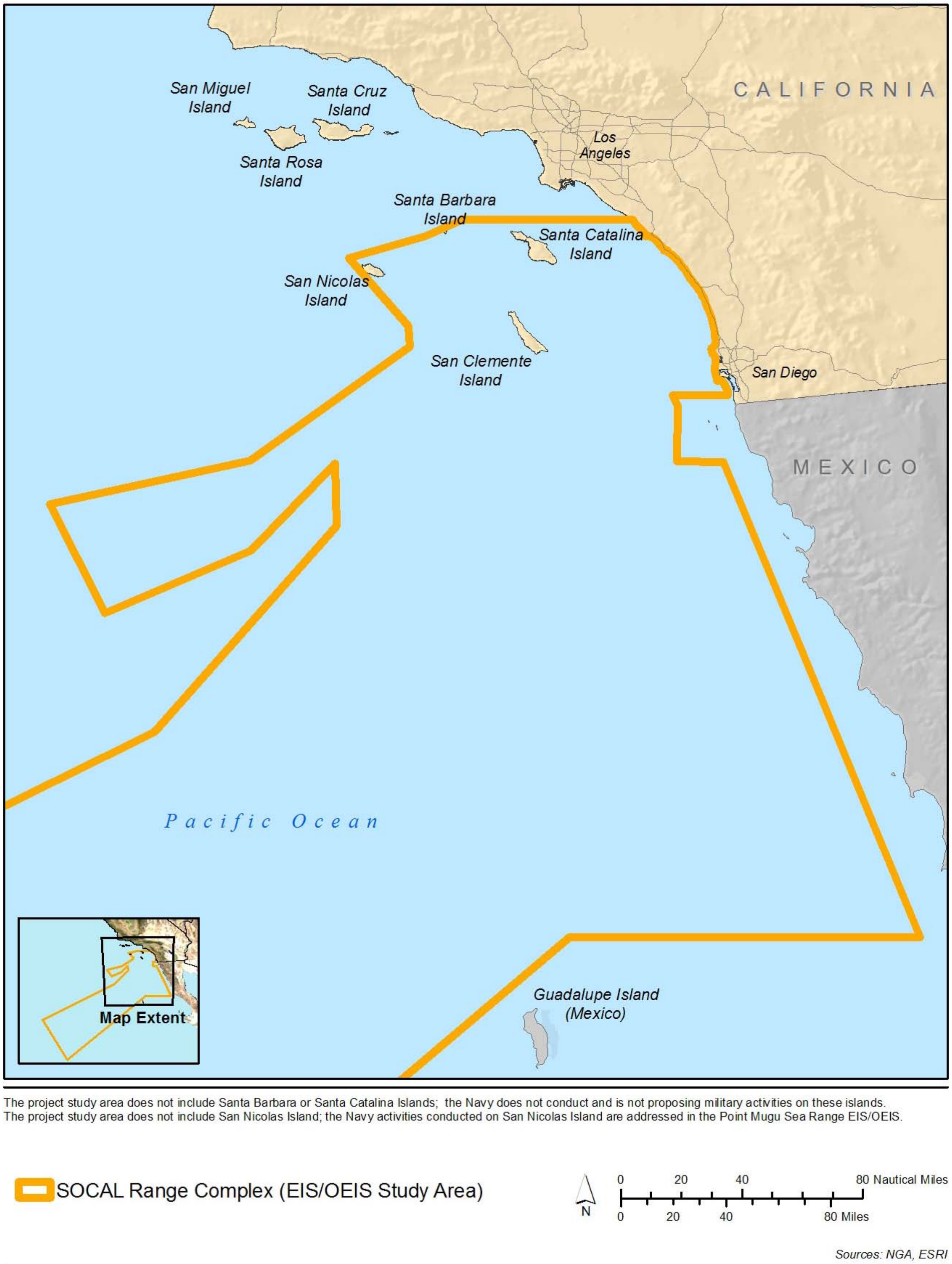

Figure 1-2: Detail of SOCAL Range Complex

1.2 BACKGROUND

The U.S. Navy has been training and operating in the area now defined as the SOCAL Range Complex for over 70 years. The land, air, and sea space of the Range Complex has provided and continues to provide a safe and realistic training and testing environment for naval forces charged with defense of the Nation.

1.2.1 Why the Navy Trains

The United States military is maintained to ensure the freedom and safety of all Americans both at home and abroad. In order to do so, Title 10 of the United States Code requires the Navy to "maintain, train and equip combat-ready naval forces capable of winning wars, deterring aggression and maintaining freedom of the seas". Modern war and security operations are complex. Modern weaponry has brought both unprecedented opportunity and innumerable challenges to the Navy. Smart weapons, used properly, are very accurate and actually allow us to accomplish our mission with greater precision and far less destruction than in past conflicts. But these modern smart weapons are very complex to use. U.S. military personnel must train regularly with them to understand their capabilities, limitations, and operation. Modern military actions require teamwork between hundreds or thousands of people, and their various equipment, vehicles, ships, and aircraft, all working individually and as a coordinated unit to achieve success. Navy training addresses all aspects of the team, from the individual to joint and coalition teamwork. To do this, the Navy employs a building block approach to training. Training doctrine and procedures are based on operational requirements for deployment of naval forces. Training proceeds on a continuum, from teaching basic and specialized individual military skills, to intermediate skills or small unit training, to advanced, integrated training events, culminating in multi-service (Joint) exercises or pre-deployment certification events.

In order to provide the experience so important to success and survival, training must be as realistic as possible. The navy often employs simulators and synthetic training to provide early skill repetition and to enhance teamwork, but live training in a realistic environment is vital to success. This requires sufficient sea and airspace to maneuver tactically, realistic targets and objectives, simulated opposition that creates a realistic enemy, and instrumentation to objectively monitor the events and learn to correct errors.

Range complexes provide a controlled and safe environment with threat representative targets that enable our forces to conduct realistic combat-like training as they undergo all phases of the graduated buildup needed for combat ready deployment. Navy's ranges and operating areas provide the space necessary to conduct controlled and safe training scenarios representative of those that our men and women would have to face in actual combat. The range complexes are designed to provide the most realistic training in the most relevant environments, replicating to the best extent possible the operational stresses of warfare. The integration of undersea ranges and OPAREAs with land training ranges, safety landing fields, and amphibious landing sites are critical to this realism, allowing execution of multi-dimensional exercises in complex scenarios. They also provide instrumentation that captures the performance of our tactics and equipment in order to provide the feedback and assessment that is essential for constructive criticism of personnel and equipment. The live-fire phase of training facilitates assessment of our ability to place weapons on target with the required level of precision while under a stressful environment. Live training, most of it accomplished in the waters off the nation's East and West Coasts and the Caribbean Sea, will remain the cornerstone of readiness as we transform our military forces for a security environment characterized by uncertainty and surprise.

Navy training activities focus on achieving proficiency in each of several functional areas encompassed by Navy operations. These functional areas, known as Primary Mission Areas (PMARs), are: Anti-Air Warfare (AAW), Amphibious Warfare (AMW), Anti-Surface Warfare

(ASUW), Anti-submarine Warfare (ASW), Mine Warfare (MIW), Strike Warfare (STW), Electronic Combat (EC), and Naval Special Warfare (NSW). Each training event addressed in the EIS/OEIS is categorized under one of the PMARS.

The SOCAL Range Complex is used for training of operational forces, RDT&E of military equipment, and other military activities. As with each Navy range complex, the primary mission of the SOCAL Range Complex is to provide a realistic training environment for naval forces to ensure that they have the capabilities and high state of readiness required to accomplish assigned missions.

Training is focused on preparing for worldwide deployment. Naval forces generally deploy in specially organized units called Strike Groups. A Strike Group may be organized around one or more aircraft carriers, together with several surface combatant ships and submarines, collectively known as a Carrier Strike Group (CSG). A naval force known as a Surface Strike Group (SSG) consists of three or more surface combatant ships. A Strike Group may also be organized around a Marine Expeditionary Unit (MEU)[2] embarked on amphibious ships accompanied by surface combatant ships and submarines, known as an Expeditionary Strike Group (ESG). The Navy and Marine Corps deploy CSGs, SSGs, and ESGs on a continuous basis. The number and composition of Strike Groups deployed, and the schedule for deployment, is determined based on the worldwide requirements and commitments.

Pre-deployment training is governed by the Navy's Fleet Readiness Training Plan (FRTP). The FRTP sets a deployment cycle for the Strike Groups that includes three phases: (1) basic, intermediate, and advanced pre-deployment training and certification, (2) deployment, and (3) post-deployment sustainment, training, and maintenance. While several Strike Groups are always deployed to provide a global naval presence, Strike Groups must also be ready to "surge" on short notice in response to directives from the National Command Authority. One objective of the FRTP is to provide this surge capability. The FRTP calls for the ability to train and deploy six CSGs in a very short time, and two more in stages soon thereafter. Established in 2003, the FRTP calls for changes in the Fleet training cycle, including acceleration of the cycle and near-simultaneous execution of similar training events. Deployment schedules are not fixed, but must remain flexible and responsive to the Nation's security needs. The capability and capacity of ranges such as the SOCAL Range Complex to support the entire training continuum must be available when and as needed.

1.2.2 Tactical Training Theater Assessment and Planning (TAP) Program

The TAP Program serves as the Navy's range sustainment program. The purpose of TAP is to support Navy objectives that: (1) promote use and management of ranges (such as the SOCAL Range Complex) in a manner that supports national security objectives and a high state of combat readiness, and (2) ensures the long-term viability of range assets while protecting human health and the environment. The TAP Program focuses specifically on the sustainability of ranges, OPAREAs, and airspace areas that support the FRTP.

The Navy's Required Capabilities Document (RCD) is a product of the TAP program. The purpose of the RCD is to quantitatively define the required range capabilities that would allow Navy ranges to support mission- essential training and RDT&E. The RCD provides guidelines

[2] The MEU (Special Operations Capable) is a task organized unit of a type known as a Marine Air Ground Task Force or MAGTF. MAGTFs consist of ground combat, aviation combat, combat logistics, and command and control elements, and vary in size depending on the nature of the intended mission.

for range requirements, but is not range-specific. The Navy therefore has developed an analysis of its requirements for each range complex. These analyses:

- Provide comprehensive descriptions of ranges, OPAREAs and training areas within a given range complex;
- Assess training and RDT&E activities currently conducted within the range complex;
- Identify investment needs and strategy for maintenance, range improvement and modernization;
- Develop a strategic vision for range operations with a long-term planning horizon; and
- Provide range complex sustainable management principles and practices, to include environmental stewardship and community outreach.
- Identify encroachments on ranges, and evaluate the potential impacts of encroachments on training and RDT&E.

For the SOCAL Range Complex, this analysis serves as a useful planning tool for developing the Proposed Action and alternatives to be assessed in this EIS/OEIS.

1.2.3 The Strategic Importance of the Existing SOCAL Range Complex

The SOCAL Range Complex is characterized by a unique combination of attributes that make it a strategically important range complex for the Navy. These attributes include:

Proximity to the Homeport of San Diego. Southern California is home to the Nation’s largest concentration of naval forces. One-third of the U.S. Pacific Fleet makes its homeport in San Diego, including two aircraft carriers, over seventy surface combatant ships, amphibious ships, and submarines; several aviation squadrons; and their officers and crews. Major commands in the San Diego area include: Commander, U.S. THIRD Fleet; Commander, Strike Force Training Pacific; CSG-7 and CSG-11 (when not deployed); Amphibious Group 3, which includes four ESGs (at least one of which is always deployed); Commander, Naval Air Forces; Commander, Naval Surface Forces; Commander, Submarine Squadron 11; Naval Special Warfare Command; and Commander, Navy Region Southwest. Several formal Navy training schools also are located in the San Diego region, including the Expeditionary Warfare Training Group Pacific, the Naval Special Warfare entry-level school, and the Afloat Training Group.

Marine Corps Base Camp Pendleton and Marine Corps Air Station Miramar, both in San Diego County, are home to the Marines and Sailors of I Marine Expeditionary Force (I MEF). These forces, from which is drawn the Marine component of the ESGs, require ready access to the SOCAL Range Complex to conduct required training. Camp Pendleton also is home to formal military schools, including the Assault Amphibian Vehicle School.

CSGs and ESGs continuously utilize the SOCAL Range Complex in their pre-deployment certification training. Moreover, the component elements of these war fighting organizations and the formal military schools continuously utilize the Range Complex for their basic, intermediate, or advanced training events. Proximity of these forces and commands to the training resources of the SOCAL Range Complex is vital to efficient execution of each phase of the training continuum.

Proximity of the SOCAL Range Complex to naval facilities in San Diego supports non-training efficiencies as well, such as access to ship and aircraft maintenance functions and access to alternate airfields when circumstances preclude carrier landings of aircraft at sea.

Proximity to Military Families. The region of San Diego is home to thousands of military families. The Navy and Marine Corps strive, and in many cases are required by law, to track and where possible limit “personnel tempo,” meaning the amount of time Sailors and Marines spend deployed away from home. Personnel tempo is an important factor in family readiness, morale, and retention. The availability of the SOCAL Range Complex as a "backyard" training range is critical to Navy efforts in these areas.

Proximity to Other Training Ranges in the Southwest. The SOCAL Range Complex is the ocean portion of a unique national military training capability in the southwestern U.S., including the National Training Center, Fort Irwin, California; Nevada Test and Training Range; Marine Corps Air Ground Combat Center, 29 Palms, California; the Bob Stump Training Range Complex in California and Nevada; Camp Pendleton, California; China Lake Range Complex, California; and Fallon Range Complex, Nevada.

Training Terrain. The SOCAL Range Complex includes "terrain" features that present opportunities for realistic training unequaled by any other Navy range complex. Combined, the features provide an ideal naval training environment that is not replicated elsewhere in the U.S. range inventory.

Crucial to Navy deployment preparations is the ability to train in underwater topography that is similar to the "littoral" areas of the world. Figures 1-3 and 1-4 show the underwater topography, known as bathymetry, of the SOCAL Range Complex. This uneven, mountainous bathymetry is essential to Navy training in Anti-submarine Warfare (ASW). Seamounts such as those depicted in Figure 1-4 are used by submarines to hide or mask their presence, requiring the need to train in this complex ocean environment. The SOCAL Range Complex provides precisely the type of area needed by the Navy to train with mid-frequency active sonar (MFAS). This uneven bathymetry also provides shallow-water areas, specifically in the areas of Tanner Bank and Cortes Bank (Figure 1-3). Sound propagates differently in shallower water, which provides an extremely "noisy" and hence complex marine training environment. Modern diesel-electric submarines would be expected, in a real world event, to operate and hide in the noise of shallow[3] waters. Without the critical training near shore that ASW exercises provide, crews will not have the experience needed to successfully operate SONAR in these types of waters, impacting vital military readiness.

The terrain of the SOCAL Range Complex also is critical to Strike Group certification, which involves the multi-dimensional coordination of air, surface, subsurface, and amphibious operations. To be effective, Strike Group training must be integrated; training effectiveness is compromised significantly if exercises are not closely coordinated in a single training area. ESGs conduct vital training between SCI and Camp Pendleton (where the landing beaches and training ranges to support amphibious assaults are located). CSG training and certification also demands access to the littoral areas and bathymetry of the SOCAL Range Complex. CSGs transit in the vicinity of SCI to simulate a strait transit which enables training to deal with coastal defense cruise missiles (simulated by emitters on SCI), small boat attacks, adversary submarines, and aircraft defense in restricted waters.

The Navy trains to the greatest threat, which is in the littoral environment at this time. Training in a deep water environment would not provide the unique challenges the Navy faces in the littoral regions, and would not provide realistic training for expected operational environments. Training in deep water areas when the requirement is to conduct training and operations in littorals would be analogous to practicing for a basketball game on a football field. The SOCAL Range Complex provides the terrain that is uniquely suited to the Navy's training requirements.

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[3] In the context of naval operations, specifically submarine operations, the term "shallow water" is a relative term, denoting depths of up to 100 fathoms (or 600 ft), which are considered "shallow" compared to the depth of the ocean.

SCI land areas are an integral component of the SOCAL Range Complex training environment. SCI provides numerous dedicated live-fire range capabilities away from inhabited areas, extensive range instrumentation, and landing beaches. SCI is the only location on the west coast of the U.S. that supports live naval gunfire training coordinated with amphibious landings. SCI is particularly critical to training of NSW forces. Every SEAL[4] receives basic training on SCI. SCI is the only training venue on the west coast that supports live-fire over-the-beach events critical to NSW training, and live-fire from water onto land in training of Special Boat Teams.

The weather of southern California also is an important consideration in assessing the suitability of the training environment. Prevailing weather and ocean surface (sea state) conditions are conducive to year-round flight operations and operational safety.

Figures 1-3 and 1-4 graphically depict the littoral and shallow water aspects of the SOCAL Range Complex, and its proximity to the Fleet home port of San Diego.

1.3 OVERVIEW OF THE SOCAL RANGE COMPLEX

1.3.1 Mission

The mission of the SOCAL Range Complex is to serve as the principal U.S. Navy training venue in the eastern Pacific with the unique capability and capacity to support required current, emerging, and future training.

1.3.2 Primary Components

The SOCAL Range Complex consists of three primary components: ocean operating areas, special-use airspace, and the land of SCI. The Range Complex is situated between Dana Point and San Diego, and extends more than 600 nm (1,111 km) southwest into the Pacific Ocean (Figure 1-1). The components of the SOCAL Range Complex encompass 120,000 nm^2 (411,588 km^2) of sea space, 113,000 nm^2 (387,500 km^2) of SUA, and over 42 nm^2 (144 km^2) of land area (SCI). For range management and scheduling purposes, the SOCAL Range Complex is divided into numerous sub-component ranges or training areas which are described in detail in Chapter 2.

SOCAL Ocean OPAREAs. The ocean areas of the Range Complex include surface and subsurface operating areas extending generally southwest from the coastline of southern California between Dana Point and San Diego for a distance of approximately 600 nm into international waters west of the coast of Baja California, Mexico.

Special Use Airspace. The SOCAL Range Complex includes military airspace designated as Warning Area 291, or W-291. W-291 comprises 113,000 nm^2 (209,276 km^2) of SUA that overlays the ocean extending seaward to the southwest beginning approximately 12 nm (22 km) off the coast for a distance of approximately 600 nm (1,111 km). W-291 also overlays SCI. W-291 is the largest component of SUA in the Navy range inventory, facilitating realistic training involving high speed military aircraft with the capability to traverse extensive airspace very quickly.

[4] NSW personnel designated as "SEALs" take their name from the elements in and from which they operate (Sea-Air-Land) Their methods of operation allow them to conduct multiple missions requiring specialized training against targets that other forces cannot approach undetected.

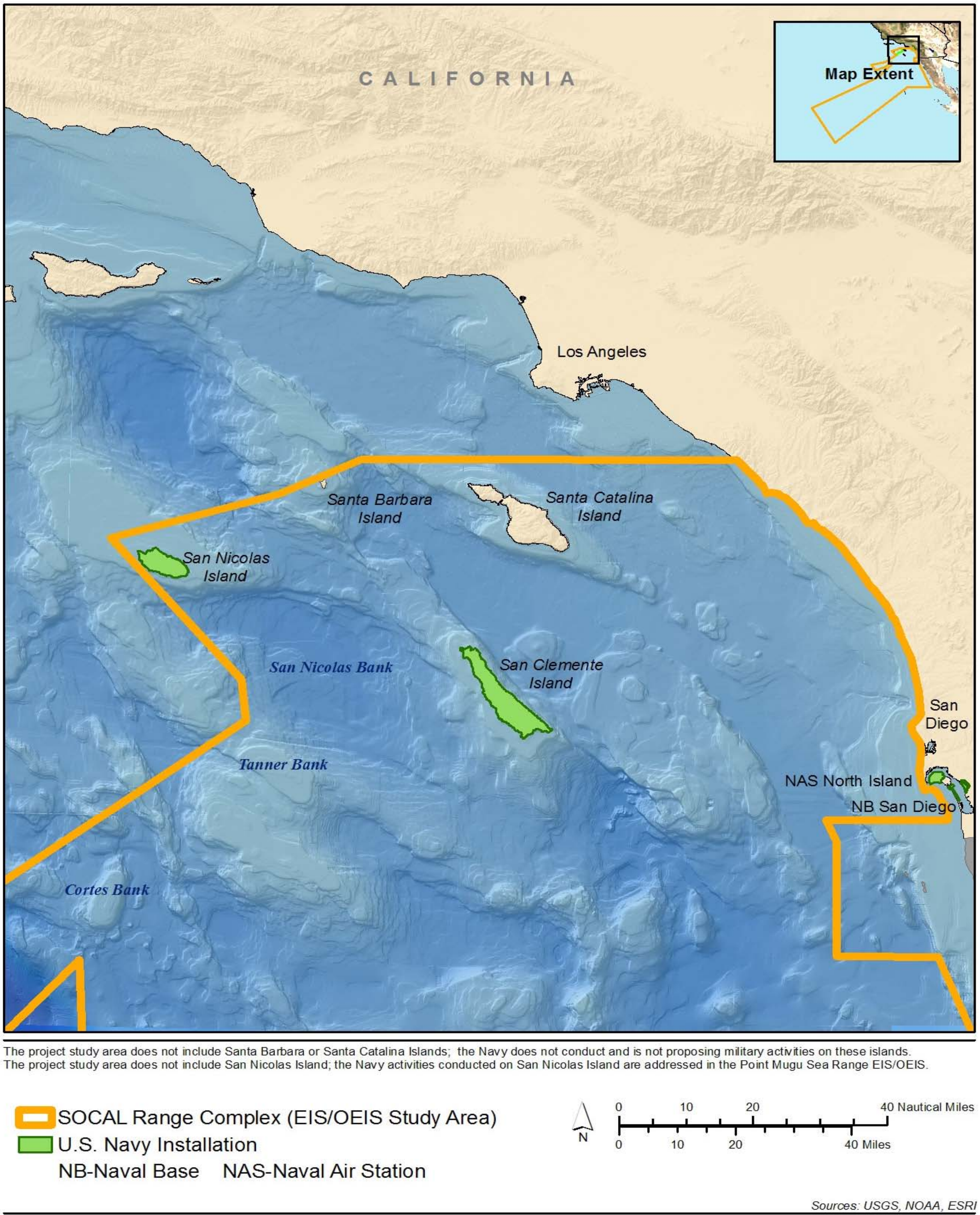

Figure 1-3: Bathymetry and Topography of the SOCAL Range Complex (Northeast Portion)

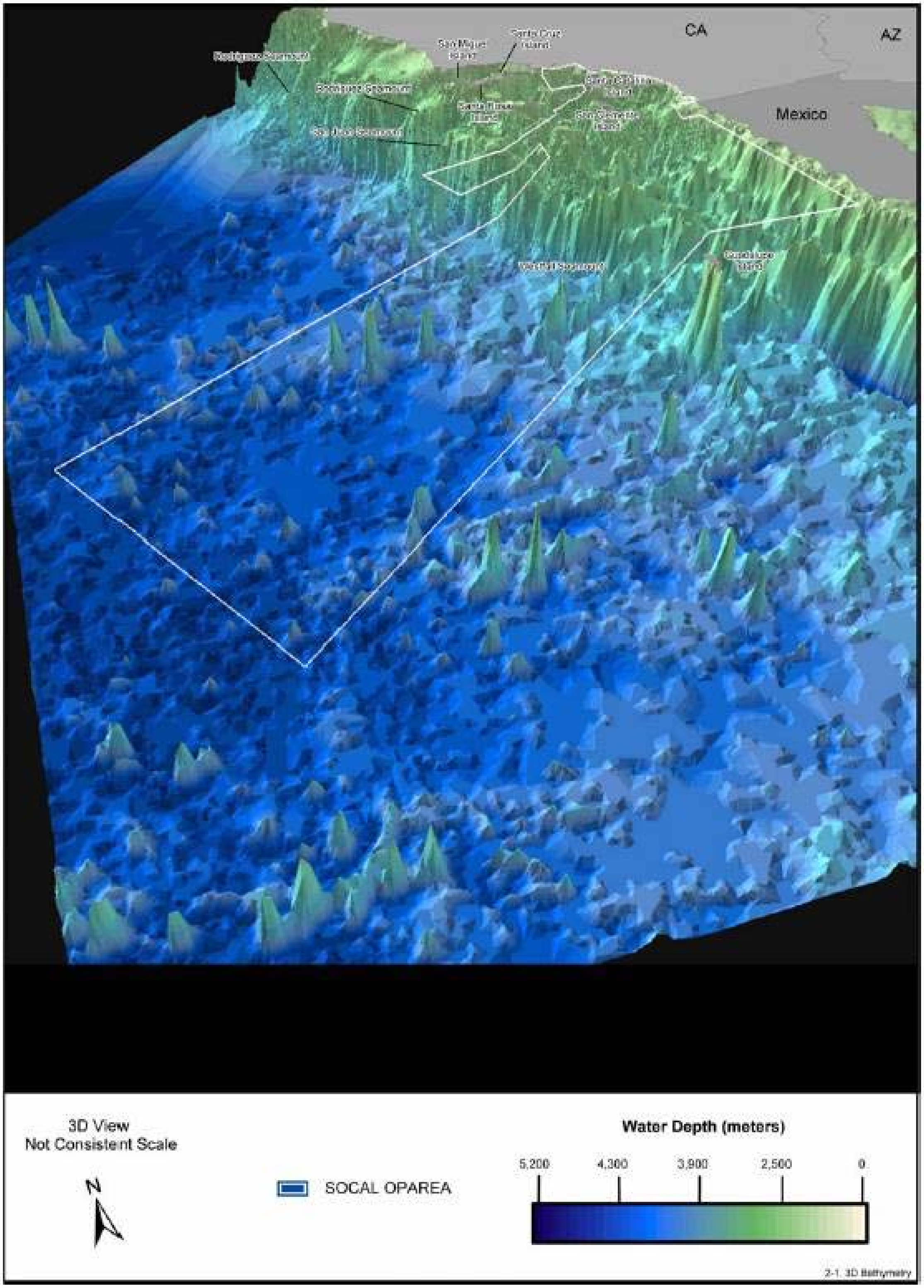

Figure 1-4: Detailed Bathymetry and Topography of the SOCAL Range Complex

SCI. SCI provides an extensive suite of range capabilities for use in tactical training. SCI includes a Shore Bombardment Area (SHOBA), landing beaches, several live-fire training areas and ranges (TARs) for small arms, maneuver areas, and other dedicated ranges for the conduct of training. SCI includes extensive instrumentation, and provides opposing force simulation and targets for use in land, sea-based, and air live-fire training. SCI also contains an airfield and other infrastructure for training and logistical support.

1.3.3 Relationship to Point Mugu Sea Range

The SOCAL Range Complex, with its ocean areas, airspace, and SCI ranges, lies generally south of, and adjacent to, a separate and distinct Navy range complex known as the Point Mugu Sea Range. (See Figure 1-5.) The Point Mugu Sea Range (Sea Range) is comprised of ocean areas, including surface and subsurface area, and military airspace covering 27,278 nm^2. The Sea Range includes sophisticated range instrumentation centered on San Nicolas Island, a Channel Island owned by the Navy. The Sea Range also includes extended, over-ocean range areas that are utilized for specialized RDT&E activities. These extended ocean areas cover approximately 221,000 nm^2.

The primary mission of the Point Mugu Sea Range is supporting naval RDT&E activities, while the SOCAL Range Complex is primarily a training range. Notwithstanding, the SOCAL Range Complex supports limited numbers of RDT&E activities, and the Point Mugu Sea Range supports training events. This EIS/OEIS covers all Navy activities on the SOCAL Range Complex. A separate EIS / OEIS has been prepared for the Sea Range. The Point Mugu Sea Range EIS/OEIS addresses both the RDT&E activities and Fleet training activities that occur on the Sea Range. SONAR activities occurring on the southern portion of the Sea Range are not, however, addressed in the Point Mugu EIS/OEIS. Specifically, ASW training that occurs or would occur as part of the Proposed Action in the southern portion of the Point Mugu Sea Range near the boundary with the SOCAL Range Complex is not addressed in the Point Mugu EIS/OEIS. Such training is therefore addressed in the SOCAL Range Complex EIS/OEIS. Figure 1-5 depicts the "overlap" area into which such training extends from the SOCAL Range into the Point Mugu Sea Range. This area of approximately 1,000 nm^2 is identified in this EIS/OEIS for the limited purpose of analyzing ASW training occurring there.[5]

1.3.4 Shortfalls of the SOCAL Range Complex

The SOCAL Range Complex provides strategically vital training attributes (see Section 1.2.3). Nevertheless, certain shortfalls in the capabilities of the range complex constrain the Navy's ability to support required training. There are numerous identified deficiencies at this range that adversely affect the quantity and quality of training activities.6 Current shortfalls include effective targets, instrumentation, and training systems for the conduct of submarine, ASW, and MIW training. Correcting these shortfalls would provide the enhanced training environment required by the naval forces that utilize the Range Complex. The capabilities of the SOCAL Range Complex would be sustained, upgraded, and modernized to address these deficiencies under the Proposed Action. Moreover, the Navy would have the flexibility to adapt and transform the training environment as new weapons systems are introduced, new threat capabilities emerge, and new technologies offer improved training opportunities. Training capacity, meaning adequate

[5] With the inclusion of the portion of Point Mugu addressed in this EIS/OEIS, the study area encompasses 121,000 nm^2 (SOCAL Range Complex: 120,000 nm^2, Point Mugu extension: 1000 nm^2).

[6] U.S. Government Accountability Office, *Military Training: Better Planning and Funding Priority Needed to Improve Conditions of Military Training Ranges* (GAO 2005 at 15).

space to train on the land, sea, and in the air is an ongoing concern throughout the Navy. Training capacity concerns are particularly acute for SCI, which provides a unique training venue for live-fire training of Navy and Marine Corps forces. Preserving and enhancing access to training space on SCI and throughout the Range Complex is critical to maintaining adequate training capacity on t Shortfalls of the SOCAL Range Complex

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1.4 THE SOCAL RANGE COMPLEX PURPOSE AND NEED FOR THE PROPOSED ACTION

Given the vital importance of the SOCAL Range Complex to the readiness of naval forces, the unique training environment provided by the Range Complex and the shortfalls in the Range Complex that affect the quality of training, the Navy proposes to take actions for the purposes of:

- Achieving and maintaining Fleet readiness using the SOCAL Range Complex to support and conduct current, emerging, and future training and RDT&E activities;
- Expanding warfare missions supported by the SOCAL Range Complex, consistent with the requirements of the FRTP; and
- Upgrading and modernizing existing range capabilities to address shortfalls and deficiencies in current training ranges (see discussion of shortfalls in Section 1.3.4).

The Proposed Action is needed to provide a training environment consisting of ranges, training areas, and range instrumentation with the capacity and capabilities to fully support required training tasks for operational units and military schools. The Navy has developed alternatives criteria based on this statement of the purpose and need for the Proposed Action (see Section 2.2).

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[7] U.S. Government Accountability Office, *Military Training: Better Planning and Funding Priority Needed to Improve Conditions of Military Training Ranges* (GAO 2005 at 15).

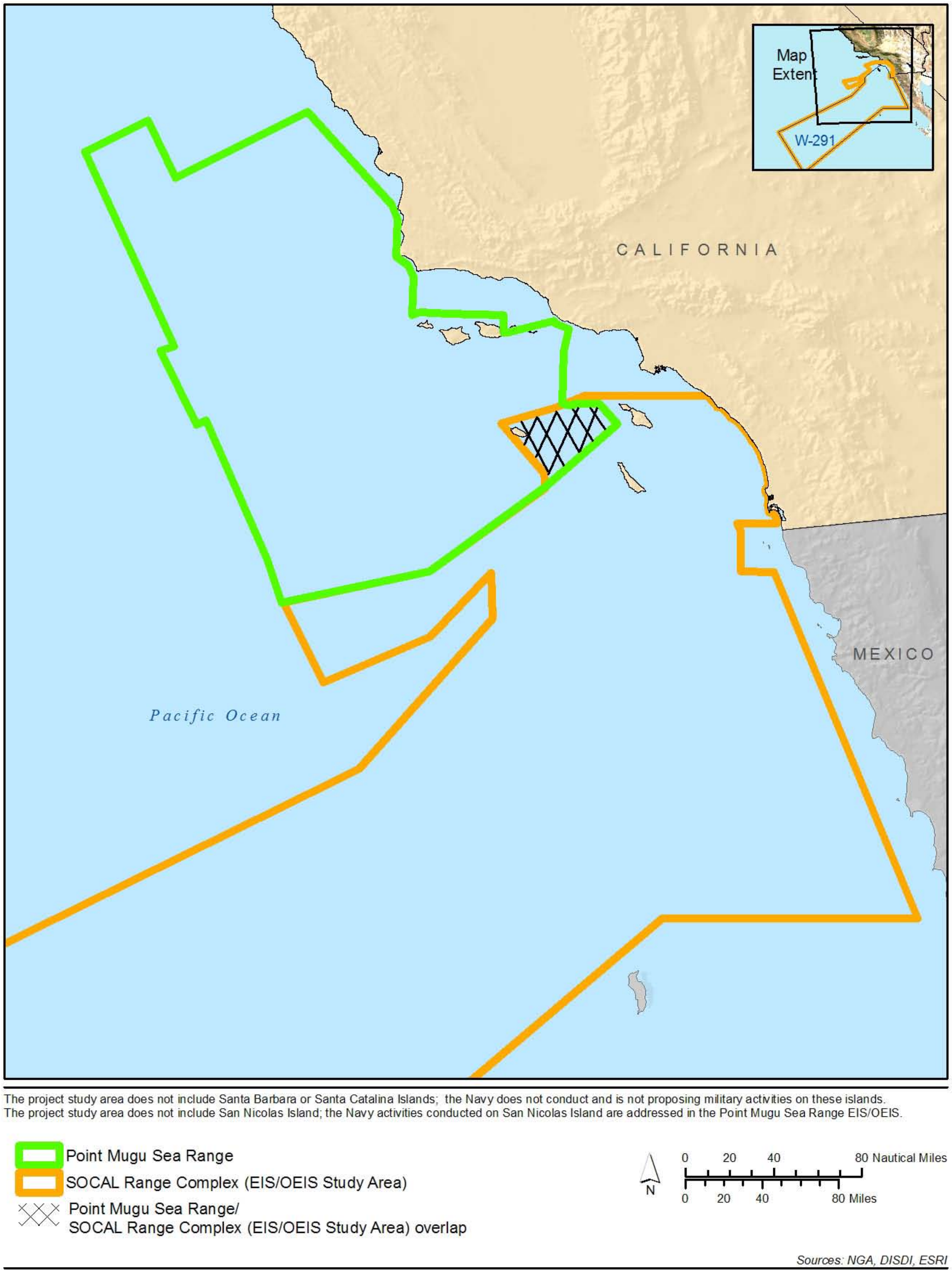

Figure 1-5: SOCAL Range Complex and Point Mugu Sea Range

In this regard, the SOCAL Range Complex furthers the Navy's execution of its roles and responsibilities under Title 10. To comply with its Title 10 mandate, the Navy needs to:

- Maintain current levels of military readiness by training in the SOCAL Range Complex;
- Accommodate future increases in operational training tempo in the SOCAL Range Complex and support the rapid deployment of naval units or Strike Groups;
- Achieve and sustain readiness of ships and squadrons using the SOCAL Range Complex so that the Navy can quickly surge significant combat power in the event of a national crisis or contingency operation, consistent with the FRTP;
- Support the acquisition and implementation into the Fleet of advanced military technology using the SOCAL Range Complex to conduct RDT&E and implementation of training events for new platforms and associated weapons systems (LCS, MV-22 Osprey aircraft, EA-18G Growler aircraft, P-8 Poseidon aircraft, MH-60R/S Seahawk helicopter, Landing Platform-Dock [LPD] 17 amphibious assault ship, and the DDG 1000 [Zumwalt Class] destroyer;
- Identify shortfalls in range capabilities, particularly training infrastructure and instrumentation, and address through range investments and enhancements; and
- Maintain the long-term viability of the SOCAL Range Complex as a premiere Navy training and testing area while protecting human health and the environment, and enhancing the capabilities and safety of the range complex.

1.5 THE ENVIRONMENTAL REVIEW PROCESS

The National Environmental Policy Act of 1969 requires Federal agencies to examine the environmental effects of their Proposed Actions. An EIS is a detailed public document that provides an assessment of the potential effects that a major Federal action might have on the human, natural, or cultural environment. Navy undertakes environmental planning for Navy actions occurring in, or affecting the 50 states, territories, and possessions of the U.S. Additionally, as a matter of policy, Navy applies NEPA to those proposed actions that could produce significant effects in the U.S. territorial sea, which extends seaward 12 nm pursuant to Presidential Proclamation 5928 of 27 December 1988. Navy therefore includes areas of the SOCAL Range Complex that lie within 12 nm of the coast, in its analysis under NEPA.

Environmental effects in the areas that are beyond of the U.S. territorial sea are analyzed under EO 12114 and associated implementing regulations.

1.5.1 NEPA

The first step in the NEPA process is the preparation of a notice of intent (NOI) to develop the EIS. The NOI provides an overview of the Proposed Action and the scope of the EIS. The NOI for this project was published in the *Federal Register* on December 21, 2006, and for five days in three local newspapers: *San Diego Union Tribune*, the *North County Times* (San Diego County); and the *Daily Breeze* (San Pedro, California). The NOI and newspaper notices included information about comment procedures, a list of information repositories (public libraries), the project website address (www.socalrangecomplexeis.com), and the dates and locations of the scoping meetings.

Scoping is an early and open process for developing the "scope" of issues to be addressed in the EIS and for identifying significant issues related to a Proposed Action. The scoping process for this EIS was initiated by the publication of the NOI in the *Federal Register* and local newspapers noted above. During scoping, the public helps define and prioritize issues and convey these issues to the Navy through written comments. Scoping meetings were held in three locations: Coronado Public Library in Coronado, San Diego County, California; Civic Center Public Library in Oceanside, San Diego County, California; and Cabrillo Marine Aquarium in San Pedro, Los Angeles County, California. As a result of the scoping process, the Navy received comments from the public, which have been considered in the preparation of this EIS.

Comments received from the public during the scoping process are categorized and summarized in Table 1-1.

Subsequent to the scoping process, this EIS/OEIS was prepared to assess the potential effects of the Proposed Action and alternatives on the environment. A notice of availability was published in the *Federal Register* and notices were placed in the aforementioned newspapers announcing the availability of the EIS/OEIS. The EIS/OEIS is now available for general review and is being circulated for review and comment. Public meetings will be advertised and held to receive public comments on the EIS/OEIS.

A Final EIS/OEIS will be prepared that responds to all public comments received on the EIS. Responses to public comments may take various forms as necessary, including correction of data, clarifications of and modifications to analytical approaches, and inclusion of additional data or analyses. The Final EIS will then be made available to the public.

Finally, a Record of Decision (ROD) will be issued, no less than 30 days after the Final EIS is made available to the public. The ROD will summarize the Navy's decision and identify the selected alternative, describe the public involvement and agency decision-making processes, and present commitments to specific mitigation measures.

Table 1-1: Public Scoping Comment Summary

Category	Commentator	Comment Summary
Marine Mammal Focus	California Coastal Commission (CCC) Non-Governmental Organization U.S. EPA Channel Islands National Park Private Citizen	Recommend common, Navy-wide approach to addressing potential impacts of sonar use on marine mammals
Coastal Consistency	CCC	Identified need for consistency review in connection with EIS
Airspace Concerns	FAA California Department of Fish and Game (re: aerial surveys) San Diego County Private citizen	Seeking clarification that the Proposed Action does not contemplate expanding military airspace (Note: The Navy is not proposing expanded airspace.)
Air Quality	U.S. EPA	General comment on regulatory process for air quality matters
Ship traffic	Liquefied Natural Gas (LNG) proponent (commercial entity)	Identifies possibility of conflict between military activities and certain LNG operations in ocean areas
Requests for Information	Los Angeles County Private Citizen	General information requests

1.5.2 EO 12114

Executive Order (EO) 12114, *Environmental Effects Abroad of Major Federal Actions*, directs Federal agencies to provide for informed decision-making for major Federal actions outside the U.S. territorial sea, including actions within the Exclusive Economic Zone (EEZ) of, but not including actions within the territorial sea of, a foreign nation. For purposes of this EIS/OEIS, areas outside U.S. territorial sea are considered to be areas beyond 12 nautical miles (nm) from shore. This EIS/OEIS satisfies the requirements of EO 12114, as analysis of operations or impacts occurring, or proposed to occur, outside of 12 nm is provided. Table 1-2 presents a list of training and RDT&E activities and indicates whether a given activity is addressed pursuant to NEPA (because it occurs within U.S. territory, including the territorial sea) or pursuant to EO 12114 (because it occurs outside the territorial sea).

For the majority of resource sections addressed in this EIS/OEIS, projected impacts outside of U.S. territory would be similar to those within the territorial sea. In addition, the baseline environment and associated impacts to the various resource areas analyzed in this EIS/OEIS are not substantially different within or outside the 12 nm jurisdictional boundary. Therefore, for these resource sections, the impact analyses contained in the main body of the EIS/OEIS is comprehensive and follow both NEPA and EO 12114 guidelines. The description of the affected environment addresses areas both within and beyond U.S. territorial sea.

Table 1-2: Training and RDT&E Analyzed under NEPA and EO 12114

Training Operations		NEPA	EO 12114
Anti-Air Warfare (AAW)	Aircraft Combat Maneuvers	X	X
	Air Defense Exercise	X	X
	Surface-to-Air Missile Exercise	X	X
	Surface-to-Air Gunnery Exercise	X	X
	Air-to-Air Missile Exercise	X	X
Anti-Submarine Warfare (ASW)	ASW Tracking Exercise-Helicopter	X	X
	ASW Torpedo Exercise-Helicopter	X	X
	ASW Tracking Exercise-Maritime Patrol Aircraft (MPA)	X	X
	ASW Torpedo Exercise-MPA	X	X
	ASW Tracking Exercise-Surface Ship	X	X
	ASW Torpedo Exercise-Surface Ship	X	X
	ASW Tracking Exercise-Submarine	X	X
	ASW Torpedo Exercise-Submarine	X	X
Anti-Surface Warfare (ASUW)	Visit Board Search and Seizure	X	X
	Air-to-Surface Missile Exercise	X	X
	Air-to-Surface Bombing Exercise	X	X
	Air-to-Surface Gunnery Exercise	X	X
	Surface-to-Surface Gunnery Exercise	X	X
	Sink Exercise (SINKEX)		X
Amphibious Warfare (AMW)	Naval Surface Fire Support	X	X
	Expeditionary Fires Exercise	X	
	Expeditionary Assault-Battalion Landing	X	
	Stinger Firing Exercise	X	
	Amphibious Landings and Raids	X	
	Amphibious Operations-CPAAA	X	X
Electronic Combat (EC)	Electronic Combat Exercises	X	X
Mine Warfare (MIW)	Mine Countermeasures	X	
	Mine Neutralization	X	X
	Mine Laying Exercise	X	X
Naval Special Warfare (NSW)	NSW Land Demolition	X	
	Underwater Demolition-single charge	X	X
	Underwater Demolition-multiple charge (mat weave)	X	
	Small Arms Training	X	X
	Land Navigation	X	
	UAV Operations	X	X
	Insertion/Extraction	X	X
	NSW Boat Operations	X	X
	SEAL Platoon Operations	X	X
	NSW Direct Action	X	X
Strike	Bombing Exercise (BOMBEX) - Land	X	

Training Operations		NEPA	EO 12114
Warfare (STW)	Combat Search & Rescue (CSAR)	**X**	**X**
EOD	Explosive Ordnance Disposal	**X**	
Coast Guard	U.S. Coast Guard Training	**X**	**X**
SCI Airfield	Naval Auxiliary Landing Field (NALF) Activities	**X**	
RDT&E	Ship Torpedo Tests	**X**	**X**
	Unmanned Underwater Vehicles	**X**	
	Sonobuoy QA/QC Testing	**X**	**X**
	Ocean Engineering	**X**	
	Marine Mammal Mine Shape Location/Research	**X**	
	Missile Flight Tests	**X**	**X**
	Underwater Acoustics Testing	**X**	**X**
	Other Tests		**X**

1.5.3 Other Environmental Requirements Considered

The Navy must comply with a variety of other Federal environmental laws, regulations, and EOs. These include (among other applicable laws and regulations):

- Marine Mammal Protection Act;
- Endangered Species Act;
- Migratory Bird Treaty Act;
- Coastal Zone Management Act;
- Rivers and Harbors Act;
- Magnuson-Stevens Fishery Conservation and Management Act;
- Clean Air Act;
- Federal Water Pollution Control Act (Clean Water Act);
- National Historic Preservation Act;
- EO 12898, Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations; and
- EO 13045, Environmental Health and Safety Risks to Children.

In addition, laws and regulations of the State of California appropriate to Navy actions are identified and addressed in this EIS/OEIS. This EIS/OEIS will facilitate compliance with applicable, appropriate state laws and regulations.

1.6 RELATED ENVIRONMENTAL DOCUMENTS

According to CEQ regulations for implementing NEPA, material relevant to an EIS may be incorporated by reference with the intent of reducing the size of the document (40 C.F.R. § 1502.21). Some of the programs and projects at the SOCAL Range Complex that have undergone, or are undergoing, environmental review and documentation to ensure NEPA compliance, and which are identified below and incorporated herein by reference.

- U.S. Department of the Navy (2003), Final EIS for Advanced Amphibious Assault Vehicle.
- U.S. Department of the Navy (2007), Final Programmatic EA for the Joint Force Training Exercise (JTFEX), Commander in Chief, U.S. Pacific Fleet.
- U.S. Department of the Navy (2003), EA and BO for San Clemente Island Training Areas and Ranges (TARs).
- U.S. Department of the Navy (2000), EA for the testing of the SABRE/DET systems in Horse Beach Cove at San Clemente Island.
- U.S. Department of the Navy (2006), EA for Southern California ASW Range (SOAR) Refurbishment.
- U.S. Department of the Navy (1998), EA, Tomahawk Flight Test Operations on the West Coast of the United States.
- U.S. Department of the Navy (1996), EA for Joint Standoff Weapons (JSOW) testing.
- U.S. Department of the Navy (2006) EA for San Clemente Island Wildland Fire Management Plan.
- U.S. Department of the Navy (2004), EA on Naval Ordnance Test Station (NOTS) Pier, San Clemente Island.
- U.S. Department of the Navy (2002), EA on Norwegian Anti-ship Missile Flight Test.
- U.S. Department of the Navy (2007), Programmatic Overseas Environmental Assessment for MK 48 Advanced Capability Torpedo Service Weapons Tests and Sinking Exercises in waters offshore of Hawaii, California, and Washington.
- U.S. Department of the Navy (2000), Final Environmental Impact Statement for Developing Home Port Facilities for Three NIMITZ Class Aircraft Carriers (CVN's).

2 Description of Proposed Action and Alternatives

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2 DESCRIPTION OF PROPOSED ACTION AND ALTERNATIVES

The Navy proposes to implement actions within the SOCAL Range Complex to:

- Increase training and RDT&E operations from current levels as necessary to support Fleet Readiness Training Plan (FRTP);
- Accommodate mission requirements associated with force structure changes and introduction of new weapons and systems to the Fleet; and
- Implement enhanced range complex capabilities.

The No Action Alternative is required by regulations of the Council on Environmental Quality (CEQ) as a baseline against which the impacts of the Proposed Action are compared. In this Draft Environmental Impact Statement (EIS)/Overseas Environmental Impact Statement (OEIS) (hereafter referred to as "EIS/OEIS"), the No Action Alternative is represented by baseline training and Research, Development, Test, and Evaluation (RDT&E) operations at current levels.

The Proposed Action would result in selectively focused but critical increases in training, and range enhancements to address test and training resource shortfalls, as necessary to ensure the SOCAL Range Complex supports Navy and Marine Corps training and readiness objectives.

Actions to support current, emerging, and future training and RDT&E in the SOCAL Range Complex, including implementation of range enhancements, will be evaluated in this EIS/OEIS. These actions include:

- Increase numbers of training operations of the types currently being conducted in the SOCAL Range Complex.
- Expand the size and scope of amphibious landing training exercises in the SOCAL Ocean Operating Areas (OPAREAS) and at San Clemente Island (SCI) to include a battalion-sized landing of 1,500+ Marines with weapons and equipment (to be conducted up to two times per year).
- Expand the size and scope of Naval Special Warfare (NSW) training activities in Training Areas and Ranges (TARs), Special Warfare Training Areas (SWATs), and nearshore waters of SCI.
- Install a shallow water training range (SWTR), a proposed extension into shallow water[1] of the existing instrumented deepwater anti-submarine warfare (ASW) range (known as "SOAR").
- Conduct operations on the SWTR.
- Increase Commercial Air Services support for Fleet Opposition Forces (OPFOR) and Electronic Warfare (EW) Threat Training.
- Construct a Shallow Water Mine Field (at depths of 40 to 420 feet (ft) (76-128 meters [m])) in offshore and near-shore areas in the vicinity of SCI.
- Conduct operations on the Shallow Water Minefield.
- Conduct Mine Neutralization Exercises.

[1] In the context of naval training activities, the term "shallow water" is a relative term, denoting depths of as much as 2.400 ft (730 m).

- Support training for new systems and platforms, specifically, Littoral Combat Ship (LCS), MV-22 Osprey aircraft, the EA-18G Growler aircraft, the SH-60R/S Seahawk Multi-mission Helicopter, the P-8 Poseidon Multi-mission Maritime Aircraft, the Landing Platform-Dock [LPD] 17 amphibious assault ship, the DDG 1000 [Zumwalt Class] destroyer, and an additional aircraft carrier, USS CARL VINSON, proposed for homeporting in San Diego.

This chapter is divided into the following major subsections: Section 2.1 provides a detailed description of the SOCAL Range Complex. Sections 2.2 through 2.5 describe the major elements of the Proposed Action and alternatives to the Proposed Action including the No Action Alternative.

2.1 DESCRIPTION OF THE SOCAL RANGE COMPLEX

Military activities in SOCAL Range Complex occur (1) on the ocean surface, (2) under the ocean surface, (3) in the air, and (4) on land at SCI. For purposes of scheduling and managing these activities and the ranges, the Range Complex is divided into multiple components.

2.1.1 W-291 and Associated Ocean OPAREAS and Ranges

W-291 is the Federal Aviation Administration (FAA) designation of the Special Use Airspace (SUA) of the SOCAL Range Complex. This SUA extends from the ocean surface to 80,000 ft (24,384 m) above mean sea level (MSL) and encompasses 113,000 nm^2 (209,276 km^2) of airspace. The ocean area underlying the W-291 forms the majority of the ocean OPAREAs of the SOCAL Range Complex. This OPAREA extends to the seafloor.

Within the area defined by the lateral bounds of W-291, the Range Complex encompasses specialized range or training areas in the air, on the surface, or undersea. Depending on the intended use, these specialized range areas may encompass only airspace or may extend from the seafloor to 80,000 ft MSL. A designated air-to-air combat maneuver area is an example of specialized airspace-only range area. Range areas designated for helicopter training in ASW or submarine missile launches, for example, extend from the ocean floor to 80,000 ft (24,384 m) MSL. The W-291 airspace and associated OPAREAs, including specialized range areas, are described in Table 2-1 and depicted in Figures 2-1 and 2-2.

2.1.2 Ocean OPAREAs and Ranges not Located within the Bounds of W-291

There are several OPAREAS in the SOCAL Range Complex that do not underlie W-291. These OPAREAS are used for ocean surface and subsurface training. Military aviation activities may be conducted in airspace that is not designated as military SUA. Military aviation activities therefore occur in the SOCAL Range Complex outside of W-291. These aviation activities do not include use of live or non-explosive ordnance. For example, amphibious operations involving helicopters and carrier flight operations occur in the Range Complex outside of W-291. Ocean OPAREAS and ranges that are not within W-291 are described in Table 2-2 and depicted in Figure 2-3.

2.1.3 San Clemente Island

A component part of the SOCAL Range Complex, SCI is comprised of existing land ranges and training areas that are integral to training of Pacific Fleet air, surface, and subsurface units; First Marine Expeditionary Force (I MEF) units; Naval Special Warfare (NSW) units; and selected formal schools. SCI provides instrumented ranges, operating areas and associated facilities to conduct and evaluate a wide range of exercises within the scope of naval warfare. SCI also provides range areas and services to RDT&E activities. Over 20 Navy and Marine Corps commands conduct training and testing activities in the SCI. Due to its unique capabilities to provide support for multiple training operations, SCI capabilities encompass operations from every Navy Primary Mission Area (PMAR), and SCI provides critical training resources for

Expeditionary Strike Group (ESG), Carrier Strike Group (CSG), and MEU (SOC) certification exercises. SCI land ranges are described in Table 2-3 and depicted in Figures 2-4 and 2-5.

2.1.4 Overlap with Point Mugu Sea Range for Certain ASW Training

ASW training conducted in the course of major range events occurs across the boundaries of the SOCAL Range Complex into the Point Mugu Sea Range. These cross-boundary events are addressed in this EIS/OEIS. As noted, activities occurring on the Point Mugu Sea Range are addressed in a separate EIS (see Section 1.3.2), which does not, however, address such cross-boundary ASW training. The area of "overlap" where these training events occur on the Point Mugu Sea Range is depicted in Figure 1-4.

Table 2-1: W-291 and Associated OPAREAs

Area Designation	Description
Warning Area (W-291)	W-291 encompasses 113,000 nm^2 (209,276 km^2) located off of the southern California coastline (Figure 2-1), extending from the ocean surface to 80,000 ft above MSL. W-291 supports aviation training and RDT&E conducted by all aircraft in the Navy and Marine Corps inventories. Ordnance use is permitted.
Tactical Maneuvering Areas (TMA) (Papa 1-8)	W-291 airspace includes eight TMAs (designated Papa 1-8) extending from 5,000 to 40,000 ft (1,524 to 12,192 m) MSL. Exercises conducted include Air Combat Maneuvering (ACM), air intercept control aerobatics, and AA gunnery. Ordnance use is permitted.
Air Refueling Areas	W-291 airspace includes three areas that are designated for aerial refueling.
Class "E" airspace (Area Foxtrot)	W-291 airspace includes Class "E" airspace designated as Area Foxtrot, which is activated by the FAA for commercial aviation use as needed (such as during periods of inclement weather or when Lindbergh Field International Airport is utilizing Runway 09).
Fleet Training Area Hot (FLETA HOT)	FLETA HOT is an open ocean area that extends from the ocean bottom to 80,000 ft (24,384 m). The area is used for hazardous operations, primarily surface-to-surface, surface-to-air and air-to-air ordnance. Types of exercises conducted include AAW, ASW, NSW, underway training, and Independent Steaming Exercises (ISE). Ordnance use is permitted.
Over-water parachute drop zones	Three parachute drop zones used by Navy and Marine Corps units are designated within the SOCAL Range Complex. Two of these (Neptune and Saint) lie within the bounds of W-291. One (Leon) lies between W-291 and Naval Base Coronado (NBC).
Missile Range 1 and 2 (MISR-1/MISR-2)	MISR-1 and MISR-2 are located about 60 nm (111 km) south and southwest of NBC, and extend from the ocean bottom up to 80,000 ft MSL. Exercises conducted include rocket and missile firing, ASW, carrier and submarine operations, fleet training, ISE, and surface and air gunnery. Ordnance use is permitted.
Northern Air Operating Area (NAOPA)	The NAOPA is located east of SCI and approximately 90 nm (167 km) west of NBC. It extends from the ocean bottom to 80,000 ft (24,384 m). Exercises in NAOPA include fleet training, multi-unit exercises, and individual unit training. Ordnance use is permitted.

Area Designation	Description
Electronic Warfare (EW) Range	The EW Range utilizes advanced technology to simulate electronic attacks on naval systems from sites on SCI. The range is not defined as a designated location. Rather it is defined by the electronic nature and extent of the training support it provides. The EW Range supports 50 types of electronic warfare training events for ships and aircraft operating in W-291 airspace and throughout the OPAREAS.
Kingfisher Training Range (KTR)	KTR is a 1-by-2 nm (1.85 x 3.7 km) area in the waters approximately 1 nm (1.85 km) offshore of SCI. The range provides training to surface warfare units in mine detection and avoidance. The range consists of mine-like shapes moored to the ocean bottom by cables.
Laser Training Range (LTR)	LTRs 1 and 2 are offshore water ranges northwest and southwest of SCI, established to conduct over-the-water laser training and testing of the laser-guided Hellfire missile.
Mine Training Range (MTR)	Two MTRs and two mine laying areas are established in the nearshore areas of SCI. MTR-1 is the Castle Rock Mining Range off the northwestern coast of the island. MTR-2 is the Eel Point Mining Range off the midpoint of the southwestern side. In addition, mining training takes place in the China Point area, off the southwestern point of the island, and in the Pyramid Head area, off the island's southeastern tip. These ranges are used for training of aircrews in offensive mine laying by delivery of inert mine shapes (no explosives) from aircraft.
OPAREA 3803	OPAREA 3803 is an area adjacent to SCI extending from the seafloor to 80,000 ft. Operations in OPAREA 3803 include aviation training and submarine training events during JTFEX and COMPTUEX. The SCI Underwater Range lies within OPAREA 3803.
San Clemente Island Underwater Range (SCIUR)	SCIUR is a 5-nm^2 (9.3-km^2) area northeast of SCI. The range is used for ASW training and RDT&E of undersea systems. The range contains six passive hydrophone arrays mounted on the seafloor.
Southern California ASW Range (SOAR)	SOAR is located offshore to the west of SCI. The underwater tracking range covers over 670 nm^2 (1,241 km^2), and consists of seven subareas. The range has the capability of providing three-dimensional underwater tracking of submarines, practice weapons, and targets with a set of 84 acoustic sensors (hydrophones) located on the seafloor. Communication with submarines is possible through use of an underwater telephone capability. SOAR supports various ASW training scenarios that involve air, surface, and subsurface units.
SOAR Variable Depth Sonar (VDS) No-Notice Area	The VDS area is used as an unscheduled and no-notice area for training with surface ships' sonar devices. The vertical dimensions are from the surface to a maximum depth of 400 ft (122 m). The VDS overlaps portions of the SOAR and the MINEX training range.
SOCAL Missile Range	SOCAL Missile Range is not a permanently designated area, but is invoked by the designation of portions of the ocean OPAREAS and W-291 airspace, as necessary, to support Fleet live-fire training missile exercises. The areas invoked vary, depending on the nature of the exercise, but generally are extensive areas over water south/southwest of SCI.
Fire Support Areas (FSAs) I and II.	FSAs are designated locations offshore of SCI for the maneuvering of naval surface ships firing guns into impact areas located on SCI. The offshore FSAs and the region of the onshore impact areas together are designated as the Shore Bombardment Area (SHOBA).

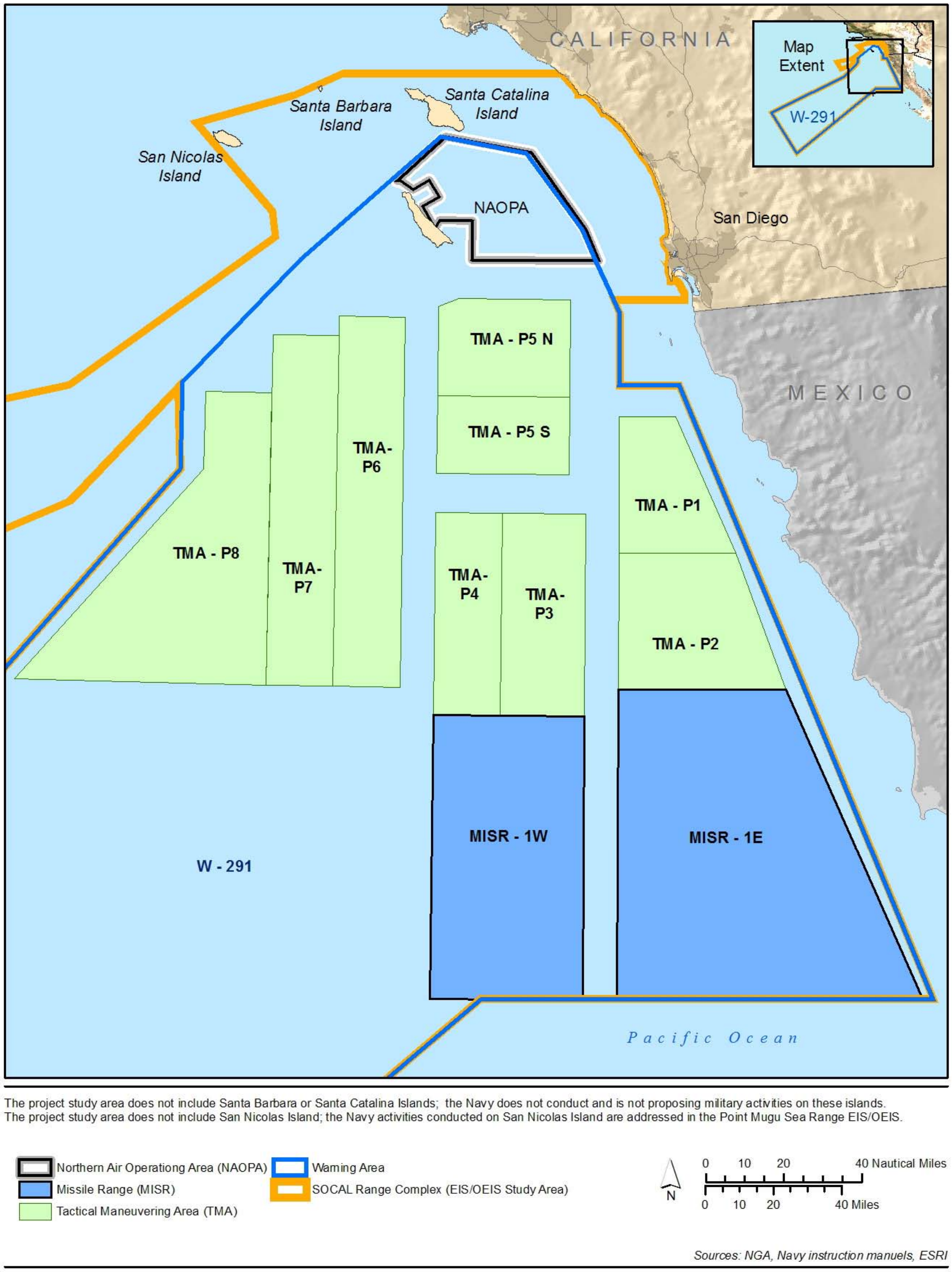

Figure 2-1: SOCAL Range Complex W-291 (portion) and Ocean OPAREAs

Table 2-2: Ocean OPAREAs Outside W-291

Ocean Area	Description
Advance Research Projects Agency (ARPA) Training Minefield	The ARPA Training Minefield lies within the Encinitas Naval Electronic Test Area (ENETA), and extends to a depth of 400 ft. Exercises conducted are mine detection and avoidance. Ordnance use is not permitted.
Encinitas Naval Electronic Test Area (ENETA)	The ENETA is located about 20 nm (37 km) northwest of NBC. The area extends from the ocean bottom up to 700 ft (213 m) MSL. Exercises conducted include fleet training and ISE. Ordnance use is not permitted.
Helicopter Offshore Training Area (HCOTA)	Located in the ocean area off NBC, the HCOTA is divided into five “dipping areas” (designated A/B/C/D/E), and extends from the ocean bottom to 1,000 ft (305 m) MSL. This area is designed for ASW training for helicopters with dipping sonar. Ordnance use is not permitted.
San Pedro Channel Operating Area (SPCOA)	The SPCOA is an open ocean area about 60 nm (111 km) northwest of the NBC, extending to the vicinity of Santa Catalina Island, from the ocean floor to 1,000 ft (305 m) MSL. Exercises conducted here include fleet training, mining, mine countermeasures, and ISE. Ordnance use is not permitted.
Western San Clemente Operating Area (WSCOA)	The WSCOA is located about 180 nm (333 km) west of NBC. It extends from the ocean floor to 5,000 ft (1,524 m) MSL. Exercises conducted include ISE and various fleet training events. Ordnance use is not permitted.
Camp Pendleton Amphibious Assault Area (CPAAA) and Amphibious Vehicle Training Area (CPAVA)	CPAAA is an open ocean area located approximately 40 nm (74 km) northwest of NBC, used for amphibious operations. Ordnance use is not permitted. CPAVA is an ocean area adjacent to the shoreline of Camp Pendleton used for near-shore amphibious vehicle and landing craft training. Ordnance use is not permitted.
Extension Area into Point Mugu Sea Range.	The extension area consists of 1000 nm2 of surface and subsurface sea space. While this area encompasses two Channel Islands (Santa Barbara and San Nicolas), training events addressed in this EIS / OEIS occur only at sea. Ordnance use is not permitted.

Table 2-3: SCI Range Areas

SCI Ranges	Description
SHOBA Impact Areas	SHOBA is the only range in the United States that supports naval surface fire support training using on-the-ground spotters and surveyed targets. The southern one-third of SCI contains Impact Areas I and II, which comprise the onshore portion of SHOBA. (The offshore component provides designated locations [FSAs] for firing ships to maneuver.). The main training activities that occur in SHOBA are naval gun firing, artillery, and air-to-ground bombing. A variety of munitions, both live and inert, are expended in SHOBA. NSW operations also occur in this area.
Naval Special Warfare Training Areas (SWATs)	SCI contains six SWATs. Each includes contiguous land and water areas. The land areas range in size from 100 to 4,400 acres [ac] (.4 to 18 km^2) and are used as ingress and egress to specific Training Areas and Ranges (TARs). Basic and advanced special operations training is conducted within these areas by Navy and Marine Corps units.
NSW Training Areas and Ranges (TARs)	TARs are littoral operating areas that support demolition, over-the-beach, and tactical ingress and egress training for NSW personnel. Identification of TARs and SWATs, as depicted in Figure 2-4, facilitates range scheduling and management.
Artillery Firing Points (AFP)	An AFP is a location from which artillery weapons such as the 155mm howitzer are positioned and used in live-fire employment of munitions. Guns are towed by trucks along primary roads, often in convoy with munitions trucks and HMMWVs.
Old Airfield (VC-3)	The Old Airfield, called VC-3, located within TAR 15, is approximately 6 nm (11 km) from the northern end of the island. The presence of a number of buildings allows for training of forces in a semi-urban environment. It is suitable for small unit training by NSW and Marine Corps forces.
Missile Impact Range (MIR)	The MIR, located within TAR 16, is in the north-central portion of the island, just south of VC-3. It is situated at the ridge crest of the island's central plateau. The MIR is 3,200 by 1,000 ft (305 by 975 m) at an elevation of 1,000 ft (305 m) MSL. The MIR contains fixed targets, and is equipped with sophisticated instruments for recording the flight, impacts, and detonations of weapons. Weapons expended on the MIR include the Joint Standoff Weapon (JSOW) and the Tomahawk Land Attack Missile (TLAM).
Naval Auxiliary Landing Field (NALF)	The NALF, located at the northern end of the island, has a single runway of 9,300 ft (2,835 m) equipped with aircraft arresting gear.

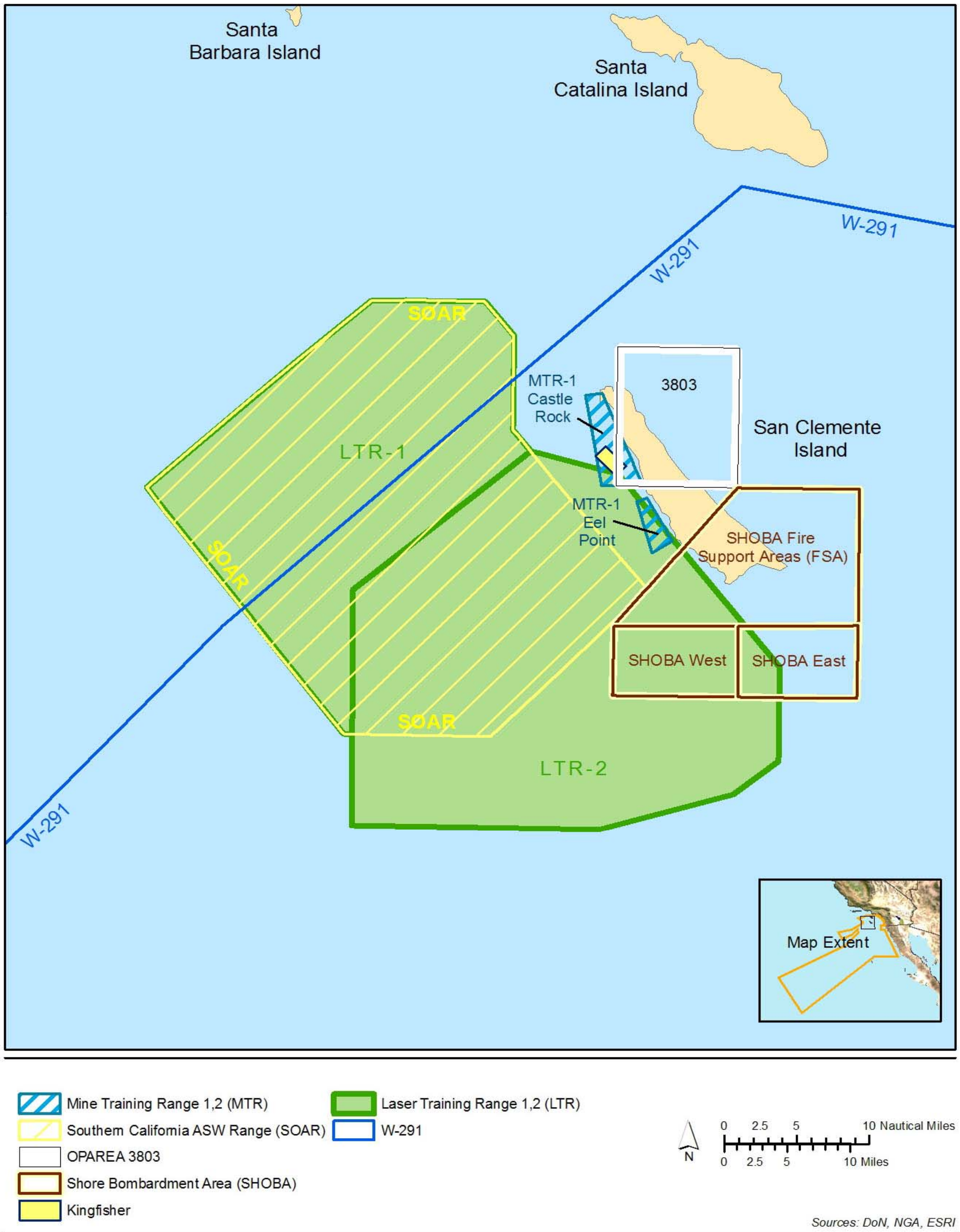

Figure 2-2: San Clemente Island Nearshore Range Areas

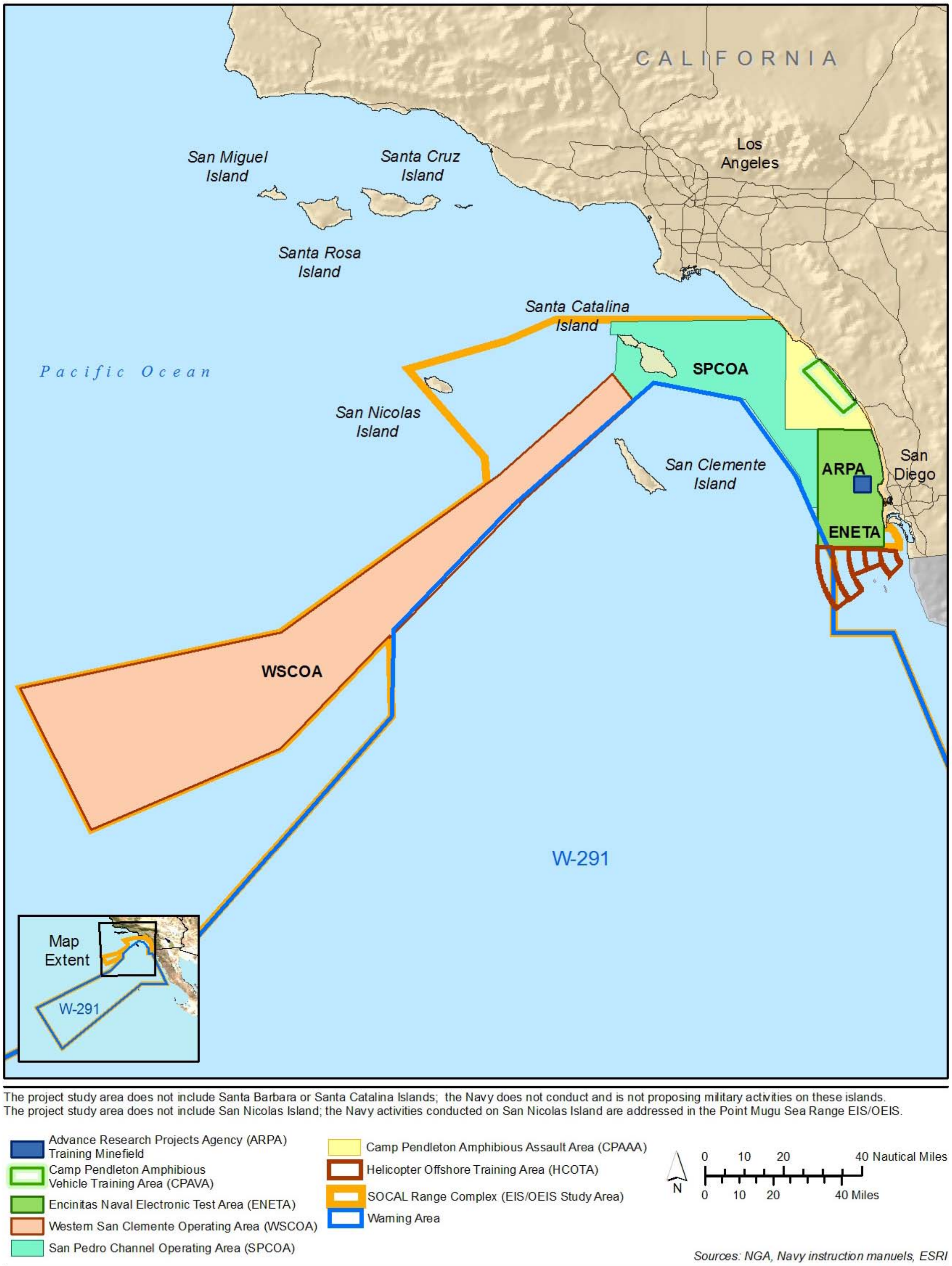

Figure 2-3: Ocean OPAREAs Outside W-291

Figure 2-4: SCI Ranges: SWATs, TARs, and SHOBA Impact Areas

Figure 2-5: San Clemente Island: Roads, Artillery Firing Points, Infrastructure

2.2 PROPOSED ACTION AND ALTERNATIVES

2.2.1 Alternatives Development

NEPA implementing regulations provide guidance on the consideration of alternatives in an EIS. These regulations require the decision-maker to consider the environmental effects of the Proposed Action and a range of alternatives to the Proposed Action (40 C.F.R. § 1502.14). The range of alternatives includes reasonable alternatives, which must be rigorously and objectively explored, as well as other alternatives that are eliminated from detailed study. To be "reasonable," an alternative must meet the stated purpose of and need for the Proposed Action.

The purpose of including a No Action Alternative in environmental impact analyses is to ensure that agencies compare the potential impacts of the proposed major Federal action to the known impacts of maintaining the status quo.

With regard to the No Action Alternative, it currently exists in the EIS/OEIS as a baseline, where the action presented represents a regular and historic level of activity on the SOCAL Range Complex to support this type of training and exercises. The No Action Alternative serves as a baseline, or representative "status quo" when studying levels of range use and activity. For this reason, the EIS/OEIS's baseline, or No Action Alternative, stands as no change from current levels of training usage. The potential impacts of the current level of training and RDT&E activity on the SOCAL Range Complex (defined by the No Action Alternative) are compared to the potential impacts of activities proposed under Alternative 1 and Alternative 2.

Alternatives considered in this EIS/OEIS were developed by the Navy after careful assessment by subject -matter experts, including units and commands that utilize the ranges, range management professionals, and Navy environmental managers and scientists. The Navy has developed a set of criteria for use in assessing whether a possible alternative meets the purpose of and need for the Proposed Action. Each of these criteria assumes implementation of mitigation measures for the protection of natural resources as appropriate. Any alternative considered for future analysis should support or employ:

1. All requirements of the FRTP;
2. Achievement of training tempo requirements based on Fleet deployment schedules;
3. Advanced-level training that fully exercises naval capabilities in a training environment that replicates the dynamic nature of modern naval warfare;
4. Large-scale Joint training events;
5. Training requirements of formal military schools located at Navy and Marine Corps installations throughout the greater San Diego region;
6. Navy RDT&E activities;
7. Allied military training and RDT&E activities;
8. State-of-the-art training technologies for live-fire, instrumented, and force-on-force training, including instrumented range facilities in a shallow water environment for ASW and MIW training for ships, aircraft, and submarines;

9. Alignment of the SOCAL Range Complex infrastructure with Naval Force structure, including training with new weapons, systems, and platforms (vessels and aircraft) as they are introduced into the Fleet;

10. Enhancement and development of training resources and capabilities of SCI to provide realistic training opportunities for naval and Joint forces;

11. Use of existing range infrastructure, resources, and facilities to the maximum extent possible;

12. Sustainable range management practices that protect and conserve natural and cultural resources; and

13. Preservation of access to training areas for current and future training requirements, while addressing potential encroachments that threaten to impact range capabilities.

NEPA regulations require that the Federal action proponent study means to mitigate adverse environmental impacts by virtue of going forward with the proposed action or an alternative (40 C.F.R. § 1502.16). Additionally, an EIS is to include study of appropriate mitigation measures not already included in the proposed action or alternatives (40 C.F.R. § 1502.14 [h]). Each of the alternatives, including the Proposed Action considered in this EIS/OEIS, includes mitigation measures intended to reduce the environmental effects of Navy activities. Mitigation measures are discussed throughout this EIS/OEIS in connection with affected resources, and are also addressed in Chapter 5.

2.2.2 Alternatives Eliminated From Further Consideration

Having identified criteria for generating alternatives for consideration in this EIS/OEIS (see Section 2.2.1), the Navy eliminated several alternatives from further consideration. Specifically, the alternatives described in Sections 2.2.2.1-2.2.2.4 were not considered further because, after careful consideration of each in light of the identified criteria, the Navy determined that none meets the Navy's purpose and need for the Proposed Action.

2.2.2.1 Alternative Range Complex Locations

The SOCAL Range Complex is a unique national range asset that derives its value and high utility for training of naval forces from its location off the coast of southern California. Factors that make the SOCAL Range Complex uniquely suited to its mission are discussed in Section 1.2.3. These factors include:

- Proximity to other range complexes in the southwestern United States, including ranges designated with the SOCAL Range Complex as part of the Joint National Training Capability (JNTC).
- Unique training ranges: SOAR is the only instrumented deep-water range in the west coast of the U.S.; SHOBA is the only range in the U.S. that supports Naval Surface Fire Support (NSFS) live-fire training with on-the-ground spotters and the capability to integrate NSFS with amphibious operations.
- Proximity to the region of San Diego, and the Navy commands, ships, submarines, and aircraft units and Marine Corps forces stationed there.
- Proximity to military families, in light of the readiness benefits derived from aggressively managing the length of time Sailors and Marines spend deployed away from home.

- Training terrain (bathymetry, topography, and weather) that maximizes the realism of training while enhancing operational safety.

The uniquely interrelated nature of the component parts to the existing SOCAL Range Complex results in training, and RDT&E support for complex military activities. There is no other series of integrated ranges in the eastern Pacific Ocean that afford this level of operational support and comprehensive integration for range activities. There is no other potential training location where land ranges (such as provided by SCI and MCB Camp Pendleton), OPAREAs, undersea terrain and ranges, and military airspace are available in a single Range Complex. The SOCAL Range Complex with its supporting operational environments allows multi-dimensional training to be conducted, as is necessary to properly build skills required for deploying naval forces and to develop systems for their use.

There are no integrated training resources comparable to the SOCAL Range Complex elsewhere on the west coast of the U.S., or in the western Pacific Ocean. Established naval training sites of the Hawaii Range Complex (HRC) and the Northwest Training Range Complex (NWTRC) already are used extensively for some training activities. These range complexes, however, do not provide the capability to support all of the types of training events conducted on the SOCAL Range Complex, nor do they provide the capacity to support the level of training required to meet the FRTP. Moreover, the HRC and NWTRC are widely separated from most units and forces that routinely utilize the SOCAL Range Complex. For these forces to transit extended distances to train on a regular basis would: (1) increase deployment times and personnel tempo to unacceptable levels, (2) adversely impact FRTP training cycles; (3) impose substantial additional training costs (such as fuel costs), and (4) overburden maintenance facilities for ships, submarines, and aircraft at HRC or NWTRC. Neither the HRC nor the NWTRC are feasible alternative sites for training units that routinely utilized the SOCAL Range Complex. Likewise, Navy range complexes on the east coast of the U.S. are not feasible alternative sites to the SOCAL Range Complex. For these reasons, alternative sites do not meet the purpose and need of the proposal, and therefore were eliminated from further study and analysis.

2.2.2.2 Reduced Training

The Navy's requirements for training have been developed through many years of iteration to ensure sailors achieve levels of readiness to ensure they are prepared to properly respond to the many contingencies that may occur during an actual mission. These training requirements are designed to provide the experience and proficiency needed to ensure Sailors are properly prepared for operational success. Notwithstanding the identification of minimum training requirements, combat experience teaches, and experienced leaders of Sailors and Marines attest, that there is no such thing as "enough" training, and that incremental increases in proficiency save ships, save aircraft, save lives, and win battles. There is no "extra" training built in to the Navy training program. Any reduction of training would not allow the Navy to achieve satisfactory levels of proficiency and readiness required to accomplish assigned missions. For this reason, alternatives that would reduce training would not meet the purpose and need of the proposal, and therefore were eliminated from further study and analysis.

2.2.2.3 Temporal or Geographic Constraints on Use of the SOCAL Range Complex

The Navy has established policy governing the composition and required mission capabilities of deployable naval units, focused on maintaining flexibility in the organization and training of forces. Central to this policy is the ability of naval forces of any size to operate independently, or to merge into a larger naval formation to confront a diverse array of challenges. Training requirements are determined by a number of factors. The composition of the force to be trained, the nature of its mission upon deployment, the time available to conduct training, range requirements and required training terrain, and the commander's assessment of training priorities are all factors that determine the nature and scope of a given training program or training exercise. Accommodating these factors in the context of the Navy's national security mission is a complex undertaking that requires continuous planning and the flexibility to execute a broad spectrum of events at any given time.

Any alternative that would impose limitations on training locations within the SOCAL Range Complex would not be acceptable. As explained in Section 1.2.3, the SOCAL Range Complex provides a unique training environment necessary for mission-essential training. Training terrain provided by bathymetry and subsurface features of the Range Complex OPAREAs are vital to effective submarine and ASW training. W-291 likewise is integral to the Range Complex, providing the extended airspace needed for modern naval operations. SCI is a cornerstone feature of the Range Complex that provides impact areas, beaches, ranges, and other training areas used in conjunction with ocean OPAREAs and SUA to provide an integrated training capability. The geographic convergence of these several features provides the ideal venue for multi-dimensional training. Limitations on access to any component of the Range Complex would threaten the ability of the Navy to integrate its training across all warfare areas. For this reason, alternatives that would impose geographic constraints on training within the SOCAL Range Complex would not meet the purpose and need of the proposal, and therefore were eliminated from further study and analysis.

Any alternative that would impose seasonal or temporal restrictions on training within the SOCAL Range Complex would likewise not be acceptable. As explained in Section 1.2.1, pre-deployment training is governed by the Navy's FRTP. The FRTP sets the deployment training cycle for Strike Groups, which are continuously deployed to provide a global naval presence, and must also be ready to "surge" on short notice in response to directives from the National Command Authority. Seasonal or other temporal restrictions on use of any component of the Range Complex would threaten the ability of the Navy to execute the FRTP. For this reason, alternatives that impose temporal constraints on training would not meet the purpose and need of the proposal, and therefore were eliminated from further study and analysis.

2.2.2.4 Simulated Training

Navy and Marine Corps training includes extensive use of computer-simulated virtual training environments, and conducts command and control exercises without operational forces (constructive training) where possible. These training methods have substantial value in achieving limited training objectives. Computer technologies provide excellent tools for implementing a successful, integrated training program while reducing the risk and expense typically associated with live military training. However, virtual and constructive training are an adjunct to, not a substitute for, live training, including live-fire training. Unlike live training, these methods do not provide the requisite level of realism necessary to attain combat readiness, and cannot replicate the high-stress environment encountered during an actual contingency situation.

The Navy and Marine Corps continue to research new ways to provide realistic training through simulation, but there are limits to realism that simulation can provide, most notably in dynamic environments involving numerous forces, and where the training media is too complex to accurately model, such as sound behavior in the ocean.

Current simulation technology does not permit ASW training with the degree of fidelity required to maintain proficiency. Basic training of sonar technicians does take place using simulators, but beyond basic levels, simulation is of limited utility. A simulator cannot match the dynamic nature of the environment, either in bathymetry, sound propagation properties, or oceanography. Specifically, coordinated unit level and Strike Group Training activities require multiple crews to interact in a variety of acoustic environments that cannot be simulated. Moreover, it is a training imperative that crews actually utilize the equipment they will be called upon to operate. In addition, the majority of RDT&E activities also must be conducted in a variety of acoustic environments to ensure the safe and effective use of the active sonar system.

Sonar operators and crews must train regularly and frequently to develop the skills necessary to master the process of identifying underwater threats in the complex subsurface environment. They cannot reliably simulate this training through current computer technology because the actual marine environment is too complex. Sole reliance on simulation would deny Navy strike groups the training benefit and opportunity to derive critical lessons learned in the employment of active sonar in the following specific areas:

- bottom bounce and other environmental conditions;
- mutual sonar interference;
- interplay between ship and submarine target; and
- interplay between ASW teams in the strike group.

Currently, these factors cannot be adequately simulated to provide the fidelity and level of training necessary in the employment of active sonar. Further, like any combat skill, employment of active sonar is a perishable skill that must be exercised – in a realistic and integrated manner - in order to maintain proficiency. Eliminating the use of active sonar during the training cycle would cause ASW skills to atrophy and thus put U.S. Navy forces at risk during real world operations.

This alternative--substitution of simulation for live training--fails to meet the purpose of and need for the Proposed Action and was therefore eliminated from detailed study.

2.2.3 Alternatives Considered

Three alternatives are analyzed in this EIS/OEIS:

- The No Action Alternative - Current Operations;
- Alternative 1-Increase Operational Training and Accommodate Force Structure Changes, and
- Alternative 2-Increase Operational Training, Accommodate Force Structure Changes, and Implement Range Enhancements. Alternative 2 is the preferred alternative.

As noted in Section 1.4, the purpose of the Proposed Action is to achieve and maintain Fleet readiness using the SOCAL Range Complex to support current and future training operations. The Navy proposes to:

- Increase training and RDT&E operations from current levels as necessary to support Fleet Readiness Training Plan (FRTP);
- Accommodate mission requirements associated with force structure changes and introduction of new weapons and systems to the Fleet; and
- Implement enhanced range complex capabilities.

The components that make up the Proposed Action are discussed in the following sections.

2.3 No Action -- Current Training Operations within the SOCAL Range Complex

The Navy has been operating in the SOCAL Range Complex for over 70 years. Under the No Action Alternative, training operations and major range events would continue at current levels. The SOCAL Range Complex would not accommodate an increase in training operations required to execute the FRTP or implement proposed force structure changes, nor would it implement investments identified as necessary by the Navy. Evaluation of the No Action Alternative in this EIS/OEIS provides a baseline for assessing environmental impacts of Alternative 1 and Alternative 2 (Preferred Alternative), as described in the following subsections.

Operations currently conducted on the SOCAL Range Complex are described below. Table 2-4 provides additional detail about operations conducted on the SOCAL Range Complex, including a summary of the operation and the location within the range complex where the operation is conducted. Each military training activity described in this EIS/OEIS meets a requirement that can be ultimately traced to requirements from the National Command Authority. Training activities in the SOCAL Range Complex vary from basic individual or unit level events of relatively short duration involving few participants to integrated major range training events, such as JTFEX, which may involve thousands of participants over several weeks.

Over the years, the tempo and types of operations have fluctuated within the SOCAL Range Complex due to changing requirements, the dynamic nature of international events, the introduction of advances in warfighting doctrine and procedures, and force structure changes. Such developments have influenced the frequency, duration, intensity, and location of required training. The factors influencing tempo and types of operations are fluid in nature, and will continue to cause fluctuations in training activities within the SOCAL Range Complex. Accordingly, operational data used throughout this EIS/OEIS are a representative baseline for evaluating impacts that may result from the proposed training operations under the No Action Alternative.

With reference to criteria identified in Section 2.2.1, the No Action Alternative generally satisfies Fleet training requirements; however, because the No Action Alternative does not propose increases in operations it does not accommodate training associated with surge requirements of the FRTP. One goal of the Proposed Action is to implement range enhancements for ASW and MIW training. The No Action Alternative does not satisfy this purpose, because it does not propose establishment of new range facilities.

2.3.1 Description of Current Training Operations within the SOCAL Range Complex

For purposes of analysis, operations data for use in the EIS/OEIS are organized according to the seven Primary Mission Areas, or PMARs (described in Section 1.2.2 and 2.3.1.1 through 2.3.1.12). In addition, operations data include RDT&E events. Summary descriptions of current training activities conducted in the SOCAL Range Complex are provided in the following subsections. Table 2-3 contains summary data regarding these operations. Appendix A provides a more detailed summary of each of the training operations, including platforms involved, ordnance expended, and duration of the event. As stated earlier, the No Action Alternative stands as a baseline of current range usage, thus allowing a comparative analysis between the current tempo and desired new uses and accelerated tempo of use.

2.3.1.1 Anti-Air Warfare (AAW) Training

AAW is the PMAR that addresses combat operations by air and surface forces against hostile aircraft. Navy ships contain an array of modern anti-aircraft weapon systems, including naval guns linked to radar-directed fire-control systems, surface-to-air missile systems, and radar-controlled cannon for close-in point defense. Strike/fighter aircraft carry anti-aircraft weapons, including air-to-air missiles and aircraft cannon. AAW training encompasses events and exercises to train ship and aircraft crews in employment of these weapons systems against simulated threat aircraft or targets. AAW training includes surface-to-air gunnery surface-to-air and air-to-air missile exercises and aircraft force-on-force combat maneuvers

2.3.1.2 Anti-Submarine Warfare (ASW) Training

ASW involves helicopter and sea control aircraft, ships, and submarines, operating alone or in combination, in operations to locate, track, and neutralize submarines. Controlling the undersea battlespace is a unique naval capability and a vital aspect of sea control. Undersea battlespace dominance requires proficiency in ASW. Every deploying strike group and individual surface combatant must possess this capability.

Various types of active and passive sonars are used by the Navy to determine water depth, locate mines, and identify, track, and target submarines. Passive sonar "listens" for sound waves by using underwater microphones, called hydrophones, which receive, amplify and process underwater sounds. No sound is introduced into the water when using passive sonar. Passive sonar can indicate the presence, character and movement of submarines. However, passive sonar provides only a bearing (direction) to a sound-emitting source; it does not provide an accurate range (distance) to the source. Active sonar is needed to locate objects because active sonar provides both bearing and range to the detected contact (such as an enemy submarine).

Active sonar transmits pulses of sound that travel through the water, reflect off objects and return to a receiver. By knowing the speed of sound in water and the time taken for the sound wave to travel to the object and back, active sonar systems can quickly calculate direction and distance from the sonar platform to the underwater object. There are three types of active sonar: low frequency, mid-frequency, and high-frequency.

Low-frequency sonar operates below 1 kHz and is designed to detect extremely quiet diesel-electric submarines at ranges far beyond the capabilities of mid-frequency active sonars. There are only two ships in use by the U.S. Navy that are equipped with low frequency sonar; both are ocean surveillance vessels operated by Military Sealift Command. Low-frequency active sonar is not presently utilized in the SOCAL Range Complex, and use of low-frequency active sonar is not contemplated in the Proposed Action of the EIS/OEIS.

High-frequency active sonar, operates at frequencies greater than 10 kilohertz (kHz). At higher acoustic frequencies, sound rapidly dissipates in the ocean environment, resulting in short detection ranges, typically less than five nm. High-frequency sonar is used primarily for determining water depth, hunting mines and guiding torpedoes.

Mid-frequency active sonar (MFAS) operates between 1 and 10 kHz, with detection ranges up to 10 nautical miles (nm). Because of this detection ranging capability, MFAS is the Navy's primary tool for conducting ASW. Many ASW experiments and exercises have demonstrated that this improved capability for long range detection of adversary submarines before they are able to conduct an attack is essential to U.S. ship survivability. Today, ASW is the Navy's #1 war-fighting priority. Navies across the world utilize modern, quiet, diesel-electric submarines which pose the primary threat to the U.S. Navy's ability to perform a number of critically necessary missions. Extensive training is necessary if Sailors, ships, and strike groups are to gain proficiency in using MFAS sonar. If a strike group does not demonstrate MFAS proficiency, it cannot be certified as combat ready.

The Navy's ASW training plan, including the use of active sonar in at-sea training scenarios, includes multiple levels of training. Individual-level ASW training addresses basic skills such as detection and classification of contacts, distinguishing discrete acoustic signatures including those of ships, submarines, and marine life, and identifying the characteristics, functions, and effects of controlled jamming and evasion devices. More advanced, integrated ASW training exercises involving active sonar is conducted in coordinated, at-sea operations during multi-dimensional training events involving submarines, ships, aircraft, and helicopters. This training integrates the full anti-submarine warfare continuum from detecting and tracking a submarine to attacking a target using either exercise torpedoes or simulated weapons. Training events include detection and tracking exercises (TRACKEX) against "enemy" submarine contacts; torpedo employment exercises (TORPEX) against the target; and exercising command and control tasks in a multi-dimensional battlespace.

ASW sonar systems are deployed from certain classes of surface ships, submarines, helicopters, and fixed-wing maritime patrol aircraft (Table 2-4). The surface ships used are typically equipped with hull-mounted sonars (passive and active) for the detection of submarines. Helicopters equipped with dipping sonar or sonobuoys are utilized to locate suspect submarines or submarine targets within the training area. In addition, fixed-wing MPA are used to deploy both active and passive sonobuoys to assist in locating and tracking submarines during the duration of the exercise. Submarines are equipped with hull-mounted sonars sometimes used to locate and prosecute other submarines and/or surface ships during the exercise. The types of tactical sonar sources employed during ASW sonar training exercises are identified in Table 2-4.

Table 2-4: ASW Sonar Systems and Platforms

System	*Frequency*	*Associated Platform*
AN/SQS-53	MF	DDG and CG hull-mounted sonar
AN/AQS-13 or AN/AQS-22*	MF	Helicopter dipping sonar
AN/SQS-56	MF	FFG hull-mounted sonar
MK-48 Torpedo	HF	Submarine fired exercise torpedo
MK-46 Torpedo	HF	Surface ship and aircraft fired exercise torpedo
AN/SLQ-25 (NIXIE)	MF	DDG, CG, and FFG towed array
AN/BQQ-10	MF	Submarine hull-mounted sonar
Tonal sonobuoy (DICASS) (AN/SSQ-62)	MF	Helicopter and MPA deployed
CG – Guided Missile Cruiser; DDG – Guided Missile Destroyer; DICASS – Directional Command-Activated Sonobuoy System; FFG – Fast Frigate; HF – High-Frequency; MF – Mid-Frequency.		

2.3.1.3 Anti-Surface Warfare (ASUW) Training

ASUW is a type of naval warfare in which aircraft, surface ships, and submarines employ weapons, sensors, and operations directed against enemy surface ships or boats. Aircraft-to-surface ASUW is conducted by long-range attacks using air-launched cruise missiles or other precision guided munitions, or using aircraft cannon. ASUW also is conducted by warships employing torpedoes, naval guns, and surface-to-surface missiles. Submarines attack surface ships using torpedoes or submarine-launched, anti-ship cruise missiles. Training in ASUW includes surface-to-surface gunnery and missile exercises, air-to-surface gunnery and missile exercises, and submarine missile or torpedo launch events. Training generally involves expenditure of ordnance against a towed target. A sinking exercise (SINKEX) is a specialized training event that provides an opportunity for ship, submarine, and aircraft crews to deliver live ordnance on a deactivated vessel, which is deliberately sunk using multiple weapons systems.

ASUW also encompasses maritime interdiction, that is, the interception of a suspect surface ship by a Navy ship for the purpose of boarding-party inspection or the seizure of the suspect ship. Training in these tasks is conducted in Visit, Board, Search and Seizure exercises.

2.3.1.4 Amphibious Warfare (AMW) Training

AMW is a type of naval warfare involving the utilization of naval firepower and logistics, and Marine Corps landing forces to project military power ashore. AMW encompasses a broad spectrum of operations involving maneuver from the sea to objectives ashore, ranging from reconnaissance or raid missions involving a small unit, to large-scale amphibious operations involving over one thousand Marines and Sailors, and multiple ships and aircraft embarked in a Strike Group.

AMW training includes tasks at increasing levels of complexity, from individual, crew, and small unit events to large task force exercises. Individual and crew training include the operation of amphibious vehicles and naval gunfire support training. Small-unit training operations include events leading to the certification of a Marine Expeditionary Unit (MEU) as “Special Operations Capable” (SOC). Such training includes shore assaults, boat raids, airfield or port seizures, and reconnaissance. Larger-scale amphibious exercises involve ship-to-shore maneuver, shore bombardment and other naval fire support, and air strike and close air support training.

2.3.1.5 Electronic Combat (EC) Training

EC is the mission area of naval warfare that aims to control use of the electromagnetic spectrum and to deny its use by an adversary. Typical EC activities include threat avoidance training, signals analysis for intelligence purposes, and use of airborne and surface electronic jamming devices to defeat tracking systems.

2.3.1.6 Mine Warfare (MIW) Training

MIW is the naval warfare area involving the detection, avoidance, and neutralization of mines to protect Navy ships and submarines, and offensive mine laying in naval operations. A naval mine is a self-contained explosive device placed in water to destroy ships or submarines. Naval mines are deposited and left in place until triggered by the approach of or a contact with an enemy ship, or are destroyed or removed. Naval mines can be laid by purpose-built minelayers, other ships, submarines, or airplanes. MIW training includes Mine Countermeasures (MCM) Exercises and Mine Laying Exercises (MINEX).

2.3.1.7 Naval Special Warfare (NSW) Training

NSW forces (SEALs and Special Boat Units [SBUs]) train to conduct military operations in five Special Operations mission areas: unconventional warfare, direct action, special reconnaissance, foreign internal defense, and counterterrorism. NSW training involves specialized tactics, techniques, and procedures, employed in training events that include: insertion/extraction operations using parachutes rubber boats, or helicopters; boat-to-shore and boat-to-boat gunnery; demolition training on land or underwater; reconnaissance; and small arms training.

2.3.1.8 Strike Warfare (STW) Training

STW operations include training of fixed-wing fighter/attack aircraft in delivery of precision guided munitions, non-guided munitions, rockets, and other ordnance against land targets in all weather and light conditions. Training events typically involve a simulated strike mission with a flight of four or more aircraft. The strike mission may simulate attacks on “deep targets” (i.e., those geographically distant from friendly ground forces), or may simulate close air support of targets within close range of friendly ground forces. Laser designators from aircraft or ground personnel may be employed for delivery of precision guided munitions. Some strike missions involve no-drop events in which prosecution of targets is simulated, but video footage is often obtained by onboard sensors.

Combat Search and Rescue (CSAR) is a strike warfare operation with the purpose of training aircrews to locate, protect, and evacuate downed aviation crew members from hostile territory. The operation can include reconnaissance aircraft to find the downed aircrew, helicopters to conduct the rescue, and fighter aircraft to perform close air support to protect both the downed aircrews and the rescue helicopters.

2.3.1.9 Explosive Ordnance Disposal (EOD) Activities

The EOD mission area involves employment of skills, tactics, and equipment designed to safely render unexploded ordnance (UXO). EOD personnel are highly trained and operate in both tactical and administrative capacities. Tactical missions include safe disposal of improvised explosive devices. Administrative missions include range clearance and ordnance safety in support of operational forces.

2.3.1.10 U.S. Coast Guard Training

Coast Guard Sector San Diego, a shore command within the Coast Guard 11th District, carries out its mission to serve, protect and defend the American public, maritime infrastructure and the environment. The Sector San Diego Area of Responsibility (AOR) extends southward from the Dana Point harbor to the border with Mexico. Equipment utilized by the Coast Guard includes 25-ft response boats, 41-ft utility boats and 87-ft patrol boats, as well as HH-60 helicopters. Training events include: search and rescue, maritime patrol training, boat handling, and helicopter and surface vessel live-fire training with small arms.

2.3.1.11 Naval Auxiliary Landing Field (NALF) SCI Airfield Activities

NALF SCI provides opportunities for aviation training and aircraft access to the island. The airfield is restricted to military aircraft and authorized contract flights. There are no permanently assigned aircraft, and aviation support is limited essentially to refueling. NALF SCI has the primary mission of training Naval Air Force Pacific aircrews in Field Carrier Landing Practice (FCLP). FCLP involves landing on a simulated aircraft carrier deck painted on the surface of the runway near its eastern end. Other military activities include visual and instrument approaches and departures, aircraft equipment calibration, survey and photo missions, range support, exercise training, RDT&E test support, medical evacuation, and supply and personnel flights.

2.3.1.12 RDT&E Events

Space and Naval Warfare Systems Center (SPAWARSYSCEN) conducts RDT&E, engineering, and fleet support for command, control, and communications systems and ocean surveillance. Space and Naval Warfare System's (SPAWAR's) tests on SCI include a wide variety of ocean engineering, missile firings, torpedo testing, manned and unmanned submersibles, Unmanned aerial vehicles (UAVs), EC, and other Navy weapons systems. Specific events include:

- Ship Tracking and Torpedo Tests;
- Unmanned Underwater Vehicle (UUV) Tests;
- Sonobuoy Quality Assurance (QA)/Quality Control (QC) Tests;
- Ocean Engineering Tests;
- Marine Mammal Mine Shape Location and Research; and
- Missile Flight Tests;

The San Diego Division of the Naval Undersea Warfare Center is a Naval Sea Systems Command (NAVSEA) organization supporting the Pacific Fleet. NUWC operates and maintains the SCI Underwater Range (SCIUR). NUWC conducts tests, analysis, and evaluation of submarine USW exercises and test programs. NUWC also provides engineering and technical support for Undersea Warfare (USW) programs and exercises, design cognizance of underwater weapons acoustic and tracking ranges and associated range equipment, and provides proof testing and evaluation for underwater weapons, weapons systems, and components.

2.3.2 Naval Force Structure

The Navy has established policy governing the composition and required mission capabilities of deployable naval units, focused on maintaining flexibility in the organization and training of forces. Central to this policy is the ability of naval forces of any size to operate independently or to merge into a larger naval formation to confront a diverse array of challenges. Thus, individual units may combine to form a Strike Group, and Strike Groups may combine to form a Strike Force. Composition of the Strike Groups and Strike Forces is discussed below, in Section 2.3.2.1.

2.3.2.1 "Baseline" Naval Force Composition

Navy policy defines the "baseline" composition of deployable naval forces. The baseline is intended as an adaptable structure to be tailored to meet specific requirements. Thus, while the baseline composition of a Carrier Strike Group (CSG) calls for a specified number of ships, aviation assets, and other forces, a given CSG may include more or fewer units, depending on the dictates of the mission. The baseline naval force structures established by Navy policy are described below.

Carrier Strike Group Baseline

- One Aircraft Carrier
- One Carrier Air Wing
  - Four Strike Fighter Squadrons
  - One Electronic Combat Squadron
  - Two Combat Helicopter Squadrons
  - Two logistics aircraft
- Five Surface Combatant Ships
  - "Surface Combatant" refers to guided missile cruisers, destroyers, and frigates, and future DDG 1000 and Littoral Combat Ship platforms.
- One attack submarine
- One logistic support ship

Expeditionary Strike Group Baseline

- Three Amphibious Ships
  - Landing Craft Units
- Three Surface Combatant Ships
- Three Combat Helicopter Detachments
- One attack submarine
- One Marine Expeditionary Unit (Special Operations Capable) of 2200 Marines

- Ground Combat and Combat Logistics Elements
- Composite aviation squadron of fixed wing aircraft and helicopters

Surface Strike Group Baseline

- Three Surface Ships
  - Surface Combatants
  - Amphibious Ships
- One Combat Helicopter Detachment
- One attack submarine

Expeditionary Strike Force (ESF)

- Combined forces of more than one CSG, ESG, and / or SSG

2.3.3 Integrated, Multi-Dimensional Training

The Navy must execute training involving ships, aircraft, submarines, and Marine Corps forces operating in multiple dimensions (at sea, undersea, in the air, and on land) in order to ensure the readiness of naval forces. Unit training proceeds on a continuum, ranging from events involving a small number of ships, submarines, or aircraft engaged in training tailored to specific tasks, to large-scale pre-deployment or readiness exercises involving Strike Groups. Exercises involving an entire Strike Group are referred to as major range events, described in Section 2.3.3.1. Smaller, unit-level integrated exercises are described in Section 2.3.3.2.

To facilitate analysis, this EIS/OEIS examines the individual activities of each integrated unit-level training event or major range event, rather than examining the exercise as a whole. Given the complexity of these exercises, particularly major range events, analyzing potential impacts over numerous resource areas requires the exercises to be broken down into temporally and spatially manageable components. Moreover, exercise design may differ from event to event, depending on factors such as the composition of the force to be trained and the expected mission of that force. For these reasons, and to ensure consistency, the tables of operations that follow throughout this EIS/OEIS include the individual activities that are conducted as part of a larger event. It is useful to view individual training events as a menu from which a larger, integrated unit training exercise or major range event can be constructed.

2.3.3.1 Major Range Events

The Navy conducts large-scale exercises, or major ranges events, in the SOCAL Range Complex. These exercises are required for pre-deployment certification of naval formations. The composition of the force to be trained, and the nature of its mission upon deployment, determines the scope of the exercise. The Navy currently conducts up to fourteen major range events per year.

Major range events bring together the component elements of a Strike Group or Strike Force (that is, all of the various ships, submarines, aircraft, and Marine Corps forces) to train in complex command, control, operational coordination, and logistics functions.

Major range events require vast areas of sea space and airspace for the exercise of realistic training, as well as land areas for conducting land attack training events. The training space required for these events is a function of naval warfighting doctrine, which favors widely dispersed units capable of projecting forces and firepower at high speeds across distances of up to several hundred miles in a coordinated fashion, to concentrate on an objective. The three-dimensional space required to conduct a major range event involving a CSG or ESG is a complicated polygon covering an area as large as 50,000 nm^2. The space required to exercise an ESF is correspondingly larger.

A major range event is comprised of several "unit level" range operations conducted by several units operating together while commanded and controlled by a single commander. These exercises typically employ an exercise scenario developed to train and evaluate the Strike Group/Force in required naval tactical tasks. In a major range event, most of the operations and activities being directed and coordinated by the Strike Group commander are identical in nature to the operations conducted in the course in individual, crew, and smaller-unit training events. In a major range event, however, these disparate training tasks are conducted in concert, rather than in isolation.

For example, within a single exercise scenario a CSG could conduct a coordinated ASW operation in which several ships and aircraft work together to find and "destroy" an "enemy" submarine, while Marine forces, surface combatant ships, and / or aircraft conduct a coordinated air and amphibious strike operation against objectives ashore. While exercise scenarios for different major range events would be similar in some or many operational respects, they would not be identical. Operations are chosen to be included in a given major range event based on the anticipated operational missions that would be performed during the Strike Group's deployment, and other factors such as the commander's assessment of the participating units' state of readiness.

Major range events include:

- Composite Training Unit Exercise (COMPTUEX). The COMPTUEX is an Integration Phase, at-sea, major range event. For the CSG, this exercise integrates the aircraft carrier and carrier air wing with surface and submarine units in a challenging operational environment. For the ESG, this exercise integrates amphibious ships with their associated air wing, surface ships, submarines, and MEU. Live-fire operations that may take place during COMPTUEX include long-range air strikes, Naval Surface Fire Support (NSFS), and surface-to-air, surface-to-surface, and air-to-surface missile exercises. The MEU also conducts realistic training based on anticipated operational requirements and to further develop the required coordination between Navy and Marine Corps forces. Special Operations training may also be integrated with the exercise scenario. The COMPTUEX is typically 21 days in length. The exercise is conducted in accordance with a schedule of events, which may include two 1-day, scenario-driven, "mini" battle problems, culminating with a scenario-driven 3-day Final Battle Problem. COMPTUEX occurs three to four times per year.
- JTFEX. The JTFEX is a dynamic and complex major range event that is the culminating exercise in the Sustainment Phase training for the CSGs and ESGs. For an ESG, the exercise incorporates an Amphibious Ready Group (ARG) Certification Exercise (ARG CERT) for the amphibious ships and a Special Operations Capable Certification (SOCCERT) for the MEU. When schedules align, the JTFEX may be conducted concurrently for an ESG and CSG. JTFEX emphasizes mission planning and effective execution by all primary and support warfare commanders, including command and control, surveillance, intelligence, logistics support, and the integration of tactical fires. JTFEXs are complex scenario-driven exercises that evaluate a strike group in all warfare areas. JTFEX is normally 10 days long, not including a 3-day in-port Force Protection Exercise, and is the final at-sea exercise for the CSG or ESG prior to deployment. JTFEX occurs three to four times per year.

Major range events would utilize the SOCAL Range Complex and may also utilize other military range areas in California, Arizona, and Nevada, including the Point Mugu Sea Range, Marine

Corps Base Camp Pendleton, Fallon Range Complex, and China Lake Range Complex in California; Bob Stump Training Range Complex in California and Arizona, and Nevada Test and Training Range (Nellis AFB). Utilization of these other range complexes in the course of a major range event is and would be limited and relatively infrequent. Table 2-5 identifies Navy range complexes in addition to the SOCAL Range Complex at which portions of a Major Range Event can occur, depending on the exercise scenario.

2.3.3.2 Integrated Unit-Level Training Events

Integrated unit-level training events, which pursue tailored training objectives for components of a Strike Group, include:

- Ship ASW Readiness and Evaluation Measuring (SHAREM). SHAREM is a Chief of Naval Operations (CNO) chartered program with the overall objective to collect and analyze high-quality data to quantitatively "assess" surface ship ASW readiness and effectiveness. The SHAREM will typically involve multiple ships, submarines, and aircraft in several coordinated events over a period of a week or less. A SHAREM may take place once per year in SOCAL.
- Sustainment Exercise. Included in the FRTP is a requirement to conduct post-deployment sustainment, training, and maintenance. This ensures that the components of a Strike Group maintain an acceptable level of readiness after returning from deployment. A sustainment exercise is an exercise designed to challenge the strike group in all warfare areas. This exercise is similar to a COMPTUEX but of shorter duration. One to two sustainment exercises may occur each year in SOCAL.
- Integrated ASW Course (IAC) Phase II. IAC exercises are combined aircraft and surface ship events. The IAC Phase II consists of two 12-hour events conducted primarily on SOAR over a 2-day period. The typical participants include four helicopters, two P-3 aircraft, two adversary submarines, and two Mk 30 or Mk 39 targets. Frequently, IACs include the introduction of an off-range Mk 30 target. Four IAC Phase II exercises may occur per year.

Table 2-5: Navy Ranges Used in Major Range Events

Range / Area	Description
SOCAL Range Complex	SOCAL offshore training areas, ranges, and airspace (W-291), and ranges at SCI.
Point Mugu Sea Range	Major Range Events may make limited use of the a portion of the Point Mugu Sea Range airspace and ocean area that abuts the SOCAL Range Complex, and supporting resources of the Sea Range, as identified below: Extension Area (see Section 1.3.2) used for ASW events utilizing sonar Warning Area 289 (W-289)
China Lake Range	Includes Naval Air Weapons Station (NAWS) China Lake and is surrounded by the larger Restricted Airspace 2508 (R-2508)
Fallon Range Training Complex (FRTC)	FRTC consists of ranges associated with Naval Air Station (NAS) Fallon
Bob Stump Training Range Complex (BSTRC)	BSTRC includes ranges associated with the Naval Air Facility El Centro

Table 2-6 identifies typical training operations conducted in the SOCAL Range Complex, categorized by PMAR. This table also groups operations according to the location within the range complex where the operation is generally conducted. For descriptions and locations of the OPAREA, range areas, and airspace within the SOCAL Range Complex, refer to Tables 2-1 through 2-3, and Figures 2-1 through 2-5.

Table 2-6: SOCAL Range Complex- Operations by Warfare Area and Location

Navy Warfare Area	No.	Operation Type	Summary	Location of Activity
Anti-Air Warfare	**1**	Aircraft Combat Maneuvers	Trains fighter crews in basic flight maneuvers and advanced air combat tactics. Participants are from two or four aircraft. No weapons are fired.	W-291 (PAPA Areas)
	2	Air Defense Exercise	Coordinated operations involving surface ships and aircraft, training in radar detection, and simulated airborne and surface firing. No weapons are fired.	W-291
	3	Surface-to-Air Missile Exercise	Live-firing event from a surface ship to an aerial target. Weapons employed are Rolling Airframe Missile (RAM) and STANDARD missile. Aerial targets are drones recovered via parachute and small boat.	W-291
	4	Surface-to-Air Gunnery Exercise	Surface-to-air live-fire gunnery at aerial target that simulates a threat aircraft or missile. Weapons include the 5-inch naval gun, 76 mm and 20 mm cannon, and 7.62 machine guns.	W-291
	5	Air-to-Air Missile Exercise	Fighter/attack aircraft firing against an aerial target that simulates an enemy aircraft. Missiles include AIM-7 SPARROW, AIM-9 SIDEWINDER, and AIM-120 AMRAAM.	W-291
Anti-Submarine Warfare	**6**	Antisubmarine Warfare Tracking Exercise - Helicopter	Trains helicopter crews in anti-submarine search, detection, localization, classification and track. Two primary targets: recoverable MK 30 and expendable MK 39. The target simulates a submarine at varying depths and speeds. SH-60 crews drop sonobuoys to detect and localize the target.	SOCAL OPAREAs

Navy Warfare Area	No.	Operation Type	Summary	Location of Activity
	7	Antisubmarine Warfare Torpedo Exercise - Helicopter	Trains SH-60 crews in employment of air-launched torpedoes. Aircrew drops an inert, running exercise torpedo or a non-running practice torpedo against ASW targets.	SOAR/ SCIUR
	8	Antisubmarine Warfare Tracking Exercise - Maritime Patrol Aircraft	Trains patrol aircraft crews in anti-submarine search, detection, localization, classification and track. Employs multiple sensor systems against a submarine simulating a threat.	SOCAL OPAREAs
	9	Antisubmarine Warfare Torpedo Exercise - Maritime Patrol Aircraft	Trains patrol aircraft crews in employment of air-launched torpedoes. Aircrew drops an inert, running exercise torpedo or a non-running practice torpedo against ASW targets.	SOAR/ SOCAL OPAREAs
	10	Antisubmarine Warfare EER / IEER sonobuoy employment	Trains patrol aircraft crews in deployment and use of Extended Echo Ranging (EER) and Improved EER (IEER) sonobuoy systems.	SOCAL OPAREAs
	11	Antisubmarine Warfare Tracking Exercise - Surface	Trains ship crews in anti-submarine search, detection, localization, classification, track and attack. ASW targets simulate a submarine at varying depths and speeds. Ships crews and SH-60 helicopter crews employ sensors to detect and localize the target.	SOCAL OPAREAs
	12	Antisubmarine Warfare Torpedo Exercise - Surface	Trains ship crews in anti-submarine search, detection, localization, classification, track and attack. One or more torpedoes are dropped/fired in this exercise. Includes Integrated ASW Phase 2 (IAC II).	SOAR/ SCIUR
	13	Antisubmarine Warfare Tracking Exercise - Submarine	Trains submarine crews in ASW using passive sonar (active sonar use is tactically proscribed), No ordnance expended in this exercise.	SOCAL OPAREAs

Navy Warfare Area	No.	Operation Type	Summary	Location of Activity
	14	Antisubmarine Warfare Torpedo Exercise - Submarine	Submarine exercise training Tactical Weapons Proficiency, lasting 1-2 days and multiple firings or exercise torpedoes. Attacking submarines use only passive sonar.	W-291
Anti-Surface Warfare	**15**	Visit Board Search and Seizure	Training in interception of a suspect surface craft by a naval ship for the purpose of inspection for illegal activities. Helicopters, surface ships and small boats participate. Small arms may be fired.	W-291, OPAREA 3803, SOAR
	16	Air-Surface Missile Exercise	Ships, helicopters and fighter/attack aircraft expend precision-guided munitions against maneuverable, high-speed, surface targets. The missiles used in this operation are the AGM-114 (Hellfire) and the Harpoon. Small arms are also fired from helicopters.	SOAR, MIR, SHOBA
	17	Air-to-Surface Bombing Exercise	Trains fighter or patrol aircraft crews in delivery of bombs against surface vessels. Involves in-flight arming and releasing of bombs in accordance with appropriate tactics and drop restrictions. These include; Laser-Guided Training Round (LGTR) and Glide Bomb Units (GBUs) 12, 16 and 32i.	SOAR, MIR, SHOBA
	18	Air-to-Surface Gunnery Exercise	Trains helicopter crews in daytime aerial gunnery operations with the GAU-16 (.50 cal) or M-60 (7.62 mm) machine gun.	W-291
	19	Surface-to-Surface Gunnery Exercise	Trains surface ship crews in high-speed engagement procedures against mobile seaborne targets, using 5-inch guns, 25 mm cannon, or .50 cal machine guns.	W-291, SHOBA
	20	Sink Exercise	Trains ship and aircraft crews in delivering live ordnance on a real, seaborne target, namely a large deactivated vessel, which is deliberately sunk using multiple weapon systems. The ship is cleaned,	W-291

Navy Warfare Area	No.	Operation Type	Summary	Location of Activity
			environmentally remediated and empty. It is towed to sea and set adrift at the exercise location. The precise duration of a SINKEX is variable, ending when the target sinks, whether after the first weapon impacts or and after multiple impacts.	
Amphibious Warfare	**21**	Naval Surface Fire Support	Trains ship crews in naval gunnery against shore targets. Training Naval Gunfire Spotters located ashore to direct the fires of naval guns.	SHOBA
	22	Expeditionary Fires Exercise	USMC field training in integration of close air support, naval gunfire, artillery, and mortars.	SCI, SHOBA, FSAs
	23	Expeditionary Assault - Battalion Landing	Proposed new exercises; not currently conducted (see discussion under Alternative 1, Section 2.4.1.1)	See Section 2.4.1.1
	24	Stinger Firing Exercise	Trains Marine Corps personnel in employment of man-portable air defense systems with the Stinger missile. This is a ground-launched missile firing exercise against a small aerial target.	SHOBA
	25	Amphibious Landings and Raids (on SCI)	Trains Marine Corps forces in small unit live-fire and non-live-fire amphibious operations from the sea onto land areas of SCI.	SCI (West Cove, Impact Areas, Horse Beach Cove, NW Harbor)
	26	Amphibious Operations - CPAAA	Trains Marine Corps small units including assault amphibian vehicle units and small boat units in amphibious operations.	CPAAA
Electronic Combat	**27**	Electronic Combat Operations	Signal generators on SCI and commercial air services provide air, surface and subsurface units with operating experience in electronic combat, using emitters and electronic and communications jammers to simulate threats .	SOCAL OPAREAs

Navy Warfare Area	No.	Operation Type	Summary	Location of Activity
Mine Warfare	**28**	Mine Countermeasures Exercise	Surface ship uses all organic mine countermeasures, including sonar, to locate and avoid mines. No weapons are fired.	Kingfisher, ARPA
	29	Mine Neutralization	Proposed new exercises; not currently conducted (see discussion under Alternative 1, Section 2.4.1.2)	See Section 2.4.1.2
	30	Mine Laying	Training of fighter/attack and patrol aircraft crews in aerial mine laying.	MTRs, Pyramid Cove
Naval Special Warfare	**31**	NSW Land Demolition	Training of NSW personnel in construction, emplacement and safe detonation of explosives for land breaching and demolition of buildings and other facilities.	SCI (Impact Areas, SWAT 1, SWAT 2, TARs).
	32	Underwater Demolition-Single Point Source Charge	Training of NSW personnel to construct, emplace and safety detonate single charge explosives for underwater obstacle clearance.	SCI nearshore (NW Harbor, TAR 2 and 3, Horse Beach Cove, SWATs) SOAR, FLETA HOT
	33	Underwater Demolition Multiple Charge - Mat Weave and Obstacle Loading	Training of NSW personnel to construct, emplace and safety detonate multiple charges laid in a pattern for underwater obstacle clearance.	NW Harbor, SWAT 2
	34	Small Arms Training and GUNEX	Training of NSW personnel in employment of small arms up to 7.62 mm.	SCI, FLETA HOT
	35	Land Navigation	Training of NSW personnel in land navigation techniques.	SCI
	36	NSW UAV / UAS Operations	Training of NSW personnel in employment of unmanned aerial vehicles over land areas.	SCI, W-291
	37	Insertion/Extraction	Training of NSW personnel in covert insertion and extraction into target areas, using boats, aircraft, and parachutes.	SCI, SOCAL OPAREAs, W-291
	38	NSW Boat Operations	Training of NSW Special Boat Teams in open-ocean operations, and firing from boats, including into land impact areas of SCI.	SCI, SOCAL OPAREAs, SHOBA, FSAs
	39	SEAL Platoon Operations	SEAL Platoon live-fire training in special operations tactics, techniques and procedures	SCI / SHOBA, FLETA HOT

Navy Warfare Area	No.	Operation Type	Summary	Location of Activity
	40	NSW Direct Action	Training of NSW personnel in live-fire events involving insertion, movement to and actions on the objective, and extraction. May engage close air support and NSFS.	SCI, SOCAL OPAREAs
Strike	**41**	Bombing Exercise (Land)	Training of fighter/attack crews in bombing of land targets on SCI, using precision guided munitions and unguided munitions. Typical event involves 2-4 aircraft.	SHOBA, MIR
	42	Combat Search & Rescue	Training of aircrews, submarine, an NSW forces in rescue of military personnel in a simulated hostile area.	SCI
Explosive Ordnance Disposal	**43**	Explosive Ordnance Disposal SCI	Training of EOD teams to locate and neutralize or destroy unexploded ordnance.	SCI
U.S. Coast Guard	**44**	Coast Guard Training	Training in SOCAL OPAREA.	SOCAL OPAREAs, W-291
Air Operations-Other	**45**	NALF Airfield Activities	Flight training (e.g., landing and takeoff practice) of aircrews utilizing NALF airfield.	SCI (NALF)
RDT&E	**46**	Ship Torpedo Tests	Test event for reliability, maintainability, and performance of torpedoes used in training (REXTORPS and EXTORPS) and operational torpedoes.	SOAR, SCIUR, OPAREA 3803,
	47	Unmanned Underwater Vehicles	Development and operational testing of UUVs.	NOTS Pier Area, SOAR
	48	Sonobuoy QA/QC Testing	Test event for reliability, maintainability, and performance of lots of sonobuoys.	SCIUR
	49	Ocean Engineering	Test event for reliability, maintainability, and performance of marine designs.	NOTS Pier Area
	50	Marine Mammal Mine Shape Location/Research	Events in which marine mammals (primarily porpoises) are trained to locate and mark inert mine shapes.	MTR 1 and 2, NOTS Pier, SCIUR, SOAR,
	51	Missile Flight Tests	Missile testing; land attack missiles launched from within SOCAL Range Complex, impact at SCI or at range complex outside SOCAL.	SCI, SOCAL OPAREAs, W-291

Navy Warfare Area	No.	Operation Type	Summary	Location of Activity
	52	NUWC Underwater Acoustics Testing	Test events to evaluate acoustic and non-acoustic ship sensors.	SCIUR
	53	Other Tests	Diverse RDT&E activities.	SOAR, SHOBA, Kingfisher, OPAREA 3803
Major Range Events	**NA**	Major exercises	Comprised of multiple range events, identified above*	SOCAL Range Complex Point Mugu (ASW)
*As discussed in Section 2.3.3, major range events are comprised of multiple range operations conducted by several units operating together while commanded and controlled by a single Strike Group commander. In a major range event, most of the operations and activities being directed and coordinated by the Strike Group commander are identical in nature to the operations conducted in the course of individual, crew, and smaller-unit training events. (i.e., the events identified in items 1-45 of this table). In a major range event, however, these disparate training tasks are conducted in concert, rather than in isolation.				

2.4 ALTERNATIVE 1: INCREASE OPERATIONAL TRAINING AND ACCOMMODATE FORCE STRUCTURE CHANGES

Alternative 1 is a proposal designed to meet Navy and DoD current and near-term operational training requirements. If Alternative 1 were to be selected, in addition to accommodating training operations currently conducted, the SOCAL Range Complex would support an increase in training operations including Major Range Events and force structure changes associated with introduction of new weapons systems, vessels, and aircraft into the Fleet. Under Alternative 1, baseline-training operations would be increased. Two new types of training events would be conducted, namely, a battalion-sized amphibious landing and additional amphibious training events at SCI, and mine neutralization exercises in the SOCAL OPAREAs. In addition, training and operations associated with force structure changes would be implemented for the LCS, MV-22 Osprey, the EA-18G Growler, the SH-60R/S Seahawk Multi-Mission Helicopter, the P-8 Poseidon Maritime Multi-mission Aircraft, the Landing Platform-Dock [LPD] 17 amphibious assault ship, and the DDG 1000 [Zumwalt Class] destroyer. Force structure changes associated with new weapons systems would include MCM systems. Force Structure changes also would include training and operations associated with the proposed homeporting of the aircraft carrier USS CARL VINSON at Naval Base (NB) Coronado.[2]

While Alternative 1 would meet the Navy's purpose and need, Alternative 1 does not optimize the training capabilities of the Range Complex. With reference to the criteria identified in Section 2.2.1, Alternative 1 only partially satisfies criteria 1, 2, 5, 6, and 7 (relating to support for the full spectrum of training requirements), because it does not fully accommodate surge training needs. Moreover, Alternative 1 does not support criteria 10 (relating to range enhancements for ASW and MIW training) because it does not propose establishment of new range facilities.

[2] This EIS/OEIS addresses only training activities associated with the homeporting of a third aircraft carrier at NB Coronado; separate environmental analysis is being conducted with regard to potential impacts of facilities, personnel, and support activities that might be associated with the homeporting proposal.

2.4.1 Proposed New Operations

Alternative 1 proposes the conduct of two types of training events that are not presently conducted in the SOCAL Range Complex. Under Alternative 1, these types of training would be conducted, as discussed below. Alternative 1 also proposes to increase the scope and intensity of currently–conducted training (described above in Section 2.3.1 under the No Action Alternative). Table 2-7 identifies the proposed increases in such training events.

2.4.1.1 Large Amphibious Landings at SCI

The Navy and Marine Corps have identified a requirement to conduct large-scale amphibious landing exercises at SCI. (Presently, large-scale amphibious landings are not conducted at SCI. Marine Corps training on SCI is limited to individual and small unit training, primarily in naval gunfire support tasks, reconnaissance and raids, and small-unit over-the-beach operations). Specifically, it is proposed to significantly expand the size and scope of amphibious training exercises at San Clemente Island (SCI) to include a battalion-sized landing of approximately 1,500 Marines with weapons and equipment. Under Alternative 1, this exercise would be conducted once annually. (Under Alternative 2, this exercise would be conducted up to two times per year [see Section 2.5.1).

The landing force, proposed to be 1,500 personnel, organized into a Marine Air Ground Task Force, or MAGTF, consisting of battalion-sized ground combat element, an aviation combat element, and logistics and command forces. The forces would land by air utilizing helicopters or MV-22 tilt-rotor airplanes, and across beaches from the sea utilizing various landing craft and amphibious vehicles (LCAC, AAV, EFV, and LCU). In this exercise, forces would land at the VC-3 airfield, West Cove, Wilson Cove, Northwest Harbor, or Horse Beach (see Figure 2-6). The exercise force would execute live-fire and maneuver operations in accordance with exercise scenarios developed to meet the commander's training mission. Proposed amphibious training would include amphibious vehicle assault, reconnaissance, helicopter assault, combat engineer training, and armored vehicle operations.

A battalion-sized exercise of would require identification and development of additional training areas on SCI capable of supporting maneuver by infantry, armored vehicles, and trucks. Training areas proposed to support this scale of exercise are identified in Table 2-7, and depicted in Figure 2-6.

Table 2-7: Proposed Amphibious Operations Training Areas

SCI Ranges	Description
Assault Vehicle Maneuver Area (AVMA)	Four AVMAs are proposed for designation. An AVMA is an area in which off-road vehicle use, including tracked vehicle use, would be authorized,
Assault Vehicle Maneuver Corridor (AVMC)	The proposed AVMC would include proposed AVMAs linked by a proposed Assault Vehicle Maneuver Road (AVMR) generally along the track of an existing road.
Artillery Maneuver Points (AMP)	AMPs would be sited at designated locations for use in training for the emplacement and displacement of artillery weapons.
Infantry Operations Area (IOA)	An IOA would be generally located on either side of the AVMC, on the upland plateau, and would be designated for foot traffic by military units. No vehicles would be authorized in off-road areas.

Figure 2-6: Proposed Assault Vehicle Maneuver Corridor / Areas / Road, Artillery Maneuvering Points, and Infantry Operations Area

2.4.1.2 Mine Neutralization Exercises

Mine neutralization exercises would involve training using Organic Airborne Mine Countermeasures (OAMCM) systems employed by helicopters in simulated threat minefields with the goal of clearing a safe channel through the minefield for the passage of friendly ships. Once a mine shape is located, mine neutralization is simulated. Helicopters engaged in MCM training would be configured with one or more of the following systems:

- AN/AQS-20 Mine Hunting System: The AQS-20 is an active high resolution, side-looking, multibeam sonar system used for mine hunting of deeper mine threats along the ocean bottom. It is towed by a helicopter. A small diameter electromechanical cable is used to tow the rapidly-deployable system that provides real-time sonar images to operators in the helicopter.
- AN/AES-1 Airborne Laser Mine Detection System (ALMDS): ALMDS is a helicopter-mounted system that uses Light Detection and Ranging (LIDAR) blue-green laser technology to detect, classify, and localize floating and near-surface moored mines in shallow water.
- AN/ALQ-220 Organic Airborne Surface Influence Sweep (OASIS). OASIS is a helicopter deployed, towed-body, 10 ft long and 20 inches in diameter, that is self-contained, allowing for the emulation of magnetic and acoustic signatures of the ships.
- Airborne Mine Neutralization System (AMNS): AMNS is a helicopter-deployed underwater vehicle that searches for, locates, and destroys mines. This vehicle is a self-propelled, unmanned, wire-guided munition with homing capability, that expends itself during the mine destruction process.
- AN/AWS-2 Rapid Airborne Mine Clearance System (RAMICS): RAMICS is a helicopter-borne weapon system that fires a 30mm projectile from a gun or cannon to neutralize surface and near-surface mines. RAMICS uses LIDAR technology to detect mines.

Mine neutralization exercises also would involve shipboard MCM systems, including the Remote Minehunting System (RMS). The RMS is an unmanned, semi-submersible vehicle that tows a variable-depth sensor to detect, localize, classify and identify mines. The RMS includes a shipboard launch and recovery system.

Mine neutralization exercises also would involve submarine-deployed MCM systems, the Long-term Mine Reconnaissance System (LMRS). The LMRS employs a self-propelled underwater vehicle equipped with forward-looking search sonar and side-looking classification sonar.

Under Alternative 1, 732 mine neutralization training events would be conducted annually. Locations proposed for mine neutralization training are:

- Pyramid Cove,
- Northwest Harbor,
- Kingfisher Training Range,
- MTR-1,
- MTR-2, and
- ARPA.

(Note that under Alternative 2, the Navy proposes to establish a new Shallow Water Minefield in the vicinity of Tanner Bank, which also would support mine neutralization training. The proposed Shallow Water Minefield is described in Section 2.5.2.2.)

2.4.2 Force Structure Changes

The SOCAL Range Complex is required to accommodate and support training with new ships, aircraft, and vehicles as they become operational in the Fleet. In addition, the SOCAL Range Complex is required to support training with new weapons/sensor systems. The Navy has identified several future platforms and weapons/sensor systems that are in development and likely will be incorporated into the Navy and Marine Corps training requirement within the 10-year planning horizon. Several of these new technologies are in early stages of development, and thus specific concepts of operations, operating parameters, or training requirements are not available.

Specific force structure changes within the SOCAL Range Complex are based on the Navy's knowledge of future requirements for the use of new platforms and weapons systems and based on the level of information available to evaluate potential environmental impacts. Therefore, this EIS/OEIS, to the extent feasible, evaluates potential environmental impacts associated with training to be conducted upon the introduction of the platforms and weapons/sensor systems identified in this section. The EIS/OEIS does not, however, address environmental effects of fielding and basing decisions for these platforms. Separate environmental documentation has been or will be prepared to address fielding and basing actions.

2.4.2.1 New Platforms/Vehicles

Aircraft Carrier USS CARL VINSON

The Navy currently has two NIMITZ Class Aircraft Carriers (CVN's), USS NIMITZ (CVN 68) and USS RONALD REAGAN (CVN 76), homeported at NB Coronado. The Navy has announced that in early 2010 it proposes to homeport a third aircraft carrier, USS CARL VINSON (CVN 70), on the west coast with a preferred location in San Diego. Accordingly, the Navy is preparing a Supplemental Environmental Impact Statement (SEIS) to the 1999 Final Environmental Impact Statement (1999 FEIS) for Developing Home Port Facilities for Three NIMITZ Class Aircraft Carriers (CVN's) in Support of the U.S. Pacific Fleet. The SEIS will augment traffic effects analysis and address infrastructure and site improvements and alterations for the CARL VINSON. The SEIS does not address training activities in which the CARL VINSON will participate; these are addressed in Alternative 1 and 2 of this EIS/OEIS.

Littoral Combat Ship

The Littoral Combat Ship (LCS) is a specialized surface combatant ship designed for operations in littoral (shallow/nearshore) waters. The LCS would operate with CSGs and SSGs, in groups of other similar ships, or independently for diplomatic and presence missions. Additionally, the LCS would have the capability to operate cooperatively with the U.S. Coast Guard and allies. The primary missions of the LCS will include ASW, ASUW, and MIW. Initiated in 2002, the Navy's LCS acquisition program is designing and developing two LCS variants, and one ship of each variant is under construction. The first, USS FREEDOM (LCS-1) is expected to be commissioned in 2008. The Navy will base the first four ships of the LCS class in San Diego. Fielding and homeporting of the LCS in San Diego will be addressed in separate environmental documentation. Training activities for future training in the SOCAL Range Complex involving the LCS are addressed in this EIS/OEIS.

MV-22 Osprey

The MV-22 is a tilt rotor vertical/short takeoff and landing (V/STOL), multi-mission aircraft developed to replace current Marine Corps assault helicopters in the medium lift category (CH-

46E and CH-53D). It is designed for combat and combat support roles worldwide. The ability to rapidly self-deploy and fly significant distances at high speeds provides rapid response to crisis situations and will extend the operational reach for ship-to-objective-maneuver and sustained operations ashore. Transition to the MV-22 began in 2006. and 2 Marine Corps helicopter squadrons per year will transition to the MV-22. Presently (mid-2008), there are no operational MV-22 squadrons that regularly utilize the SOCAL Range Complex; however, training activities for future training in the SOCAL Range Complex involving the MV-22 are addressed in this EIS/OEIS.

EA-18G Growler

The EA-18G Growler is an electronic combat version of the FA-18 E/F designed to replace the EA-6B Prowler. The Growler will have an integrated suite of advanced EC and communications systems. It is scheduled for introduction to the Fleet in 2009. The Growler combines the capabilities of the FA-18 strike aircraft with enhanced EC systems. Training activities involving this aircraft are addressed in this EIS/OEIS.

MH-60R/S Seahawk Multi-Mission Helicopter

The MH-60R/S Seahawk Multi-mission Helicopter is a planned conversion of existing SH-60B and SH-60F helicopters. Primary missions include troop transport, vertical replenishment, and MIW. These aircraft will feature advanced sensors and weapons systems incuding new OAMCM systems (see Sections 2.4.1.2 and 2.4.2.2). Training activities involving this aircraft are addressed in this EIS/OEIS.

P-8 Poseidon Multimission Maritime Aircraft

The P-8 Poseidon is a multimission aircraft, based on a variant of the Boeing 737-800 airframe, designed to conduct ASW, ASUW, and EC missions. A replacement for the P-3 Orion ASW patrol aircraft, the Poseidon will carry an array of sensors and weapons systems including sonobuoys, torpedoes, anti-ship missiles, and other weapons and systems. This class of aircraft is undergoing design and development, and is not expected to be introduced to the Fleet before 2013. Training activities involving this aircraft are addressed in this EIS/OEIS.

LPD 17 San Antonio Class Amphibious Assault Ship

The LPD 17 *San Antonio* Class of amphibious transport dock ships are planned as the functional replacement for four classes of amphibious ships currently in use. It is the first class of ship designed to accommodate all three elements of the Marine Corps' "mobility triad," the new tilt-rotor MV-22 Osprey aircraft, the expeditionary fighting vehicle (EFV), and the landing craft air cushion (LCAC). It is designed to support embarking, transporting, and landing elements of a Marine landing force in an assault by helicopters, landing craft, amphibious vehicles, and by a combination of these methods to conduct primary amphibious warfare missions. USS SAN ANTONIO was commissioned in 2006. Training activities involving this class of ship are addressed in this EIS/OEIS.

DDG 1000 Zumwalt Class Destroyer

The DDG-1000 Zumwalt is the lead ship in a class of next-generation, multi-mission surface combatants tailored for land attack and littoral dominance, with capabilities designed to defeat current and projected threats as well as improve Strike Group defense. This class of ship is undergoing design and development, and is not expected to be introduced to the Fleet before 2012. Training activities involving this class of ship are addressed in this EIS/OEIS.

2.4.2.2 New Weapons Systems

Training in use of MCM systems being introduced into the Navy inventory are addressed in this EIS/OEIS. These include helicopter-deployed OAMCM systems (AN/AQS-20 Mine Hunting System, ALMDS; AMNS, OASIS, and RAMICS); shipboard MCM systems (RMS); and submarine-deployed MCM systems (LMRS). These systems are described in Section 2.4.1.2 in the context of proposed mine neutralization exercises.

2.4.3 Summary: Proposed Increases in Additional Operations

Table 2-8 identifies the baseline and proposed increases in operations in the SOCAL Range Complex, over and above the No Action Alternative baseline, if Alternative 1 were to be implemented.

Table 2-8: Baseline and Proposed Increases in Operations: Alternative 1

Navy Warfare Area	No.	Operation Type	Location of Activity	# of Operations per year	
				No Action (baseline)	Alt 1
Anti-Air Warfare	1	Aircraft Combat Maneuvers	W-291 (PAPA Areas)	3,608	3,970
	2	Air Defense Exercise	W-291	502	520
	3	Surface-to-Air Missile Exercise	W-291	1	4
	4	Surface-to-Air Gunnery Exercise	W-291	262	350
	5	Air-to-Air Missile Exercise	W-291	13	13
Anti-Submarine Warfare	6	Antisubmarine Warfare Tracking Exercise - Helicopter	SOCAL OPAREAs	544	1,690
	7	Antisubmarine Warfare Torpedo Exercise - Helicopter	SOAR/ SCIUR	187	245
	8	Antisubmarine Warfare Tracking Exercise - Maritime Patrol Aircraft	SOCAL OPAREAs	25	28
	9	Antisubmarine Warfare Torpedo Exercise - Maritime Patrol Aircraft	SOAR/ SOCAL OPAREAs	15	16
	10	Antisubmarine Warfare EER / IEER sonobuoy employment	SOCAL OPAREAs	2	3
	11	Antisubmarine Warfare Tracking Exercise – Surface	SOCAL OPAREAs	847	900

Navy Warfare Area	No.	Operation Type	Location of Activity	# of Operations per year	
				No Action (baseline)	Alt 1
	12	Antisubmarine Warfare Torpedo Exercise - Surface	SOAR/ SCIUR	21	25
	13	Antisubmarine Warfare Tracking Exercise - Submarine	SOCAL OPAREAs	34	40
	14	Antisubmarine Warfare Torpedo Exercise - Submarine	W-291	18	22
Anti-Surface Warfare	15	Visit Board Search and Seizure	W-291, OPAREA 3803, SOAR	56	78
	16	Anti-Surface Missile Exercise	SOAR, MIR, SHOBA	47	50
	17	Air-to-Surface Bombing Exercise	SOAR, MIR, SHOBA	32	35
	18	Air-to-Surface Gunnery Exercise	W-291	47	50
	19	Surface-to-Surface Gunnery Exercise	W-291, SHOBA	315	350
	20	Sink Exercise	W-291	1	2
Amphibious Warfare	21	Naval Surface Fire Support	SHOBA	47	50
	22	Expeditionary Fires Exercise	SCI, SHOBA, FSAs	6	7
	23	Expeditionary Assault - Battalion Landing	See Section 2.4.1.1	0	1
	24	USMC Stinger Firing Exercise	SHOBA	0	3
	25	Amphibious Landings and Raids (on SCI)	SCI (West Cove, Impact Areas, Horse Beach Cove, NW Harbor)	7	34
	26	Amphibious Operations - CPAAA	CPAAA	2,205	2,271
Electronic Combat	27	Electronic Combat Operations	SOCAL OPAREAs	748	755
Mine Warfare	28	Mine Countermeasures	Kingfisher, ARPA	44	46
	29	Mine Neutralization	See Section 2.4.1.2	0	732
	30	Mine Laying	MTRs, Pyramid Cove	17	17
Naval Special Warfare	31	NSW Land Demolition	SCI (Impact Areas, SWAT 1, SWAT 2, TARs).	90	101

Navy Warfare Area	No.	Operation Type	Location of Activity	# of Operations per year	
				No Action (baseline)	Alt 1
	32	Underwater Demolition-Single Point Source Charge	SCI nearshore (NW Harbor, TAR 2 and 3, Horse Beach Cove, SWATs) SOAR, FLETA HOT	72	85
	33	Underwater Demolition Large Charges- Mat Weave and Obstacle Loading	NW Harbor, SWAT 2	14	16
	34	Small Arms Training and GUNEX	SCI, FLETA HOT	171	205
	35	Land Navigation	SCI	99	118
	36	NSW UAV / UAS Operations	SCI, W-291	72	1176
	37	Insertion/Extraction	SCI, SOCAL OPAREAs, W-291	5	10
	38	NSW Boat Operations	SCI, SOCAL OPAREAs, SHOBA, FSAs	287	320
	39	SEAL Platoon Operations	SCI / SHOBA, FLETA HOT	340	512
	40	NSW Direct Action	SCI, SOCAL OPAREAs	156	163
Strike Warfare	**41**	Bombing Exercise (Land)	SHOBA, MIR	176	197
	42	Combat Search & Rescue	SCI	7	8
Explosive Ordnance Disposal	**43**	Explosive Ordnance Disposal SCI	SCI	4	5
U.S. Coast Guard	**44**	Coast Guard Training	SOCAL OPAREAs, W-291	1,022	1,022
Air Operations-Other	**45**	NALF Airfield Activities	SCI (NALF)	26,376	28,000
RDT&E	**46**	Ship Torpedo Tests	SOAR, SCIUR, OPAREA 3803,	22	15
	47	Unmanned Underwater Vehicles	NOTS Pier Area, SOAR	10	10
	48	Sonobuoy QA/QC Testing	SCIUR	117	117
	49	Ocean Engineering	NOTS Pier Area	242	242
	50	Marine Mammal Research	MTR 1 and 2, NOTS Pier, SCIUR, SOAR,	5	20

Navy Warfare Area	No.	Operation Type	Location of Activity	# of Operations per year	
				No Action (baseline)	Alt 1
	51	Missile Flight Tests	SCI, SOCAL OPAREAs, W-291	5	15
	52	NUWC Underwater Acoustics Testing	SCIUR	44	83
	53	Other Tests	SOAR, SHOBA, Kingfisher, 3803	36	15
Major Range Events	As discussed in Section 2.3.3, major range events are comprised of multiple range operations conducted by several units operating together while commanded and controlled by a single Strike Group commander. Operations that comprise major range events are included in the number of operations identified in this table for the No Action Alternative and Alternative 1.				

2.5 ALTERNATIVE 2: INCREASE OPERATIONAL TRAINING, ACCOMMODATE FORCE STRUCTURE CHANGES, AND IMPLEMENT RANGE ENHANCEMENTS)

Implementation of Alternative 2 would include all elements of Alternative 1 (accommodating training operations currently conducted, increasing training operations [including Major Range Events], and accommodating force structure changes). In addition, under Alternative 2:

- In order to optimize training throughput and meet the FRTP, training operations of the types currently conducted would be increased over levels identified in Alternative 1 (see Table 2-8);
- Range enhancements would be implemented, to include an increase in Commercial Air Services, establishment of a shallow water minefield; and establishment of the Shallow Water Training Range (SWTR) in the SOAR extensions, as described in Section 2.5.2.

Alternative 2 is the preferred alternative, because it would optimize the training capability of the SOCAL Range Complex. Alternative 2 fully meets the criteria identified in Section 2.2.1

2.5.1 Additional Operations

Table 2-9 identifies the baseline and proposed increases in operations in the SOCAL Range Complex under Alternative 2.

Table 2-9: Baseline and Proposed Increases in Operations: Alternative 2

Navy Warfare Area	No.	Operation Type	Location of Activity	# of Operations		
				No Action (baseline)	Alt 1	Alt 2
Anti-Air Warfare	1	Aircraft Combat Maneuvers	W-291 (PAPA Areas)	3,608	3,970	3,970
	2	Air Defense Exercise	W-291	502	520	550
	3	Surface-to-Air Missile Exercise	W-291	1	4	6
	4	Surface-to-Air Gunnery Exercise	W-291	262	350	350
	5	Air-to-Air Missile Exercise	W-291	13	13	13
Anti-Submarine Warfare	6	Antisubmarine Warfare Tracking Exercise - Helicopter	SOCAL OPAREAs	544	1,690	1,690
	7	Antisubmarine Warfare Torpedo Exercise - Helicopter	SOAR/ SCIUR	187	245	245
	8	Antisubmarine Warfare Tracking Exercise - Maritime Patrol Aircraft	SOCAL OPAREAs	25	28	29
	9	Antisubmarine Warfare Torpedo Exercise - Maritime Patrol Aircraft	SOAR/ SOCAL OPAREAs	15	16	17
	10	Antisubmarine Warfare EER / IEER sonobuoy employment	SOCAL OPAREAs	2	3	3
	11	Antisubmarine Warfare Tracking Exercise - Surface	SOCAL OPAREAs	847	900	900
	12	Antisubmarine Warfare Torpedo Exercise - Surface	SOAR/ SCIUR	21	25	25
	13	Antisubmarine Warfare Tracking Exercise - Submarine	SOCAL OPAREAs	34	40	40
	14	Antisubmarine Warfare Torpedo Exercise - Submarine	W-291	18	22	22
Anti-Surface Warfare	15	Visit Board Search and Seizure	W-291, OPAREA 3803, SOAR	56	78	90
	16	Anti-Surface Missile Exercise	SOAR, MIR, SHOBA	47	50	50
	17	Air-to-Surface Bombing Exercise	SOAR, MIR, SHOBA	32	35	40

Navy Warfare Area	No.	Operation Type	Location of Activity	# of Operations		
				No Action (baseline)	Alt 1	Alt 2
	18	Air-to-Surface Gunnery Exercise	W-291	47	50	60
	19	Surface-to-Surface Gunnery Exercise	W-291, SHOBA	315	350	350
	20	Sink Exercise	W-291	1	2	2
Amphibious Warfare	**21**	Naval Surface Fire Support	SHOBA	47	50	52
	22	Expeditionary Fires Exercise	SCI, SHOBA, FSAs	6	7	8
	23	Expeditionary Assault - Battalion Landing	See Section 2.4.1.1	0	1	2
	24	Stinger Firing Exercise	SHOBA	0	3	4
	25	Amphibious Landings and Raids (on SCI)	SCI (West Cove, Impact Areas, Horse Beach Cove, NW Harbor)	7	34	66
	26	Amphibious Operations - CPAAA	CPAAA	2,205	2,271	2,276
Electronic Combat	**27**	Electronic Combat Operations	SOCAL OPAREAs	748	755	775
Mine Warfare	**28**	Mine Countermeasures	Kingfisher, ARPA	44	46	48
	29	Mine Neutralization	See Section 2.4.1.2	0	732	732
	30	Mine Laying	MTRs, Pyramid Cove	17	17	18
Naval Special Warfare	**31**	NSW Land Demolition	SCI (Impact Areas, SWAT 1, SWAT 2, TARs).	354	674	674
	32	Underwater Demolition-Single Charge	SCI nearshore (NW Harbor, TAR 2 and 3, Horse Beach Cove, SWATs) SOAR, FLETA HOT	72	85	85
	33	Underwater Demolition- Mat Weave	NW Harbor, SWAT 2	14	16	18
	34	Small Arms Training	SCI, FLETA HOT	171	205	205
	35	Land Navigation	SCI	99	118	118
	36	NSW UAV / UAS Operations	SCI, W-291	72	1176	1176
	37	Insertion/Extraction	SCI, SOCAL OPAREAs, W-291	5	10	15
	38	NSW Boat Operations	SCI, SOCAL OPAREAs, SHOBA, FSAs	287	320	320

Navy Warfare Area	No.	Operation Type	Location of Activity	# of Operations		
				No Action (baseline)	Alt 1	Alt 2
	39	SEAL Platoon Operations	SCI / SHOBA, FLETA HOT	340	512	668
	40	NSW Direct Action	SCI, SOCAL OPAREAs	156	163	190
Strike	41	Bombing Exercise (Land)	SHOBA, MIR	176	197	216
	42	Combat Search & Rescue	SCI	7	8	8
Explosive Ordnance Disposal	43	Explosive Ordnance Disposal SCI	SCI	4	5	10
U.S. Coast Guard	44	Coast Guard Operations	SOCAL OPAREAs, W-291	1,022	1,022	1,022
Air Operations-Other	45	NALF Airfield Activities	SCI (NALF)	26,376	28,000	33,000
RDT&E	46	Ship Torpedo Tests	SOAR, SCIUR, OPAREA 3803,	22	15	20
	47	Unmanned Underwater Vehicles	NOTS Pier Area, SOAR	10	10	15
	48	Sonobuoy QA/QC Testing	SCIUR	117	117	120
	49	Ocean Engineering	NOTS Pier Area	242	242	242
	50	Marine Mammal Mine Shape Location/Research	MTR 1 and 2, NOTS Pier, SCIUR, SOAR,	5	20	30
	51	Missile Flight Tests	SCI, SOCAL OPAREAs, W-291	5	15	20
	52	NUWC Underwater Acoustics Testing	SCIUR	44	83	139
	53	Other Tests	SOAR, SHOBA, Kingfisher, OPAREA 3803	36	15	20
Major Range Events	As discussed in Section 2.3.2, major range events are comprised of multiple range operations conducted by several units operating together while commanded and controlled by a single Strike Group commander. Operations that comprise major range events are included in the number of operations identified in this table for the No Action Alternative, Alternative 1 and Alternative 2.					

2.5.2 SOCAL Range Complex Enhancements

The Navy has identified specific investments and recommendations to optimize range capabilities required to adequately support training for all missions and roles assigned to the SOCAL Range Complex. Investment recommendations were based on capability shortfalls (or gaps) (see Section 1.3.3) and were assessed using the Navy and Marine Corps range required capabilities as defined by the RCD. Proposed enhancements for the SOCAL Range Complex are discussed below and analyzed in this EIS/OEIS.

2.5.2.1 Commercial Air Services Increase

Under the Proposed Action, an increase in Commercial Air Services would be implemented. This is necessary because Fleet aircraft are no longer being funded to provide opposition forces (OPFOR) for the CSG and ESG exercises including major range events. In order to provide the required training for CSGs and ESGs, a corresponding increase in Commercial Air Services acting as OPFOR would be required. This would provide for an increase in the number of supersonic and subsonic aircraft within the SOCAL Range Complex. Implementation of the increase is necessary to mitigate for the loss of Fleet aircraft funding and to meet Navy OPFOR requirements for training events.

Navy records documented a total of 1,072 Air Combat Maneuvering (ACM) operations in the SOCAL Range Complex during FY 2003. ACM skills are perishable and need to be practiced often to maintain the degree of proficiency expected of frontline forces. Most ACM is practiced between aircraft of the same type (e.g. F/A-18 vs. F/A-18). A subset of ACM is Dissimilar Air Combat Training (DACT). As the name implies, DACT means practicing ACM against aircraft of different types. The majority of the world's air forces are composed of non-US built aircraft and, as such, their capabilities and limitations vary greatly from their US counterparts. The ability to recognize the adversary's capabilities, adapt one's tactics, and overcome the opponent during the intensity of air combat is essential to the survival of any fighter pilot. Due to the current US basing structure, the loss of fleet aircraft funding, the capabilities commonality among US fighter aircraft, and geographical distances between bases of different fighter aircraft, DACT for US fighters is extremely limited and almost non-existent against non-US type aircraft. Under the Proposed Action, the investment to increase Commercial Air Services would meet this deficiency. Five dedicated OPFOR aircraft are required for daily operations. This would result in an overall increase in ACM operations of 20 percent (1,286 operations). This estimate is based upon several considerations: 1) current training trends placing an emphasis on precision strike missions (bomb dropping); 2) the FRP for six west coast CSGs; and 3) the acknowledgement that a percentage of ACM operations would be a one-for-one swap between an active duty aircraft and an OPFOR aircraft.

2.5.2.2 Shallow Water Minefield

Currently, the Navy conducts mine countermeasures (MCM) training on two existing ranges in the SOCAL Range Complex: the Kingfisher Range off SCI and the Advanced Research Project Agency (ARPA) Training Minefield (approximately three miles off the coast of San Diego / La Jolla, Figure 2-3). The Navy has identified a need for additional range capabilities to conduct MCM training in shallow water. Site requirements for an MCM range include:

- ocean depths from 40-420 ft (13-128 m) to provide the desired shallow water training environment;
- a sandy bottom with a relatively flat contour to facilitate placement of mine shapes used for training; and
- an area relatively free from high swells and waves.

Multiple site options for establishing new MCM ranges have been considered, including Tanner Bank, Cortes Bank, and offshore from Point Loma. In addition, consideration has been given to expanding usage of the ARPA. The Navy has determined that establishing a new MCM range at Tanner Bank and expanding use of the ARPA best meet the requirement for enhance MCM training.

The ARPA has historically been used for shallow water submarine and MCM training, and is the desired location for expanding MCM training. ARPA currently supports the submarine training requirement for a shallow water minefield to train in small object avoidance. Use of the ARPA shallow water minefield would be expanded from its current use by submarines to include surface ships and helicopters.

On the ARPA, 35 mine shapes approximately 30-35 inches in diameter, constructed of cylinders weighted with cement, are placed approximately 500-700 yards apart, either moored (no drilling is required) or simply set on the sea floor. Mine shapes are recoverable and replaceable, and typically need maintenance or cleaning every two years.

In addition to expanded use of the ARPA, the Navy proposes to establish an offshore shallow water minefield on Tanner Banks (Figure 1-3). The training area would be approximately 2 by 3 nm in size. Mine shapes like those used at ARPA would be placed on the ocean floor, with a total of 15 mine shapes in three rows of five. This offshore MCM range would be utilized by surface ships training to detect, classify and localize underwater mines.

MCM training involving ships or helicopters typically employ mid- to high- frequency navigation and mine detecting sonar systems. Once a mine shape is located, mine neutralization is simulated. Surface ships engaged in MCM training at ARPA and Tanner Banks MCM ranges would utilize the RMS (see Section 2.4.1.2). The RMS is an unmanned, semi-submersible vehicle that will be deployed from both the DDG-51 Class destroyer and the LCS. The RMS is launched and recovered by the host ship using a davit system. After deployment, the RMS enters the target zone to perform reconnaissance for bottom-laid mines. An area search is conducted following an operator-programmed search pattern. The RMS searches using low-power (<85dB) acoustic sonar. Upon detecting a mine, the RMS unit will localize and photograph the object for classification, and then continue on its programmed search. When the search portion of the mission is completed, the RMS will proceed to a programmed location for recovery.

2.5.2.3 West Coast Shallow Water Training Range

In 1999, the Navy formally identified the requirement for a SWTR on the west coast of the U.S. This requirement, validated in an Operational Requirements Document (ORD) (DoN 1999), identifies criteria for the SWTR. These include:

- Shallow water depth criteria
- Located within existing OPAREA and beneath SUA;
- Capability to interface with air and surface tracking systems to permit the conduct of multi-dimensional training;
- Availability of range infrastructure, logistics support, and exercise control services
- Located near a current deep-water range to support related training and maximize training efficiency
- Seamless tracking of exercise participants moving between existing deep water range and SWTR
- Proximity to Fleet homeports and air stations to facilitate access by training units and management of personnel tempo

Multiple site options for establishing the SWTR have been considered, including sites in the HRC and NWTRC. The Navy has determined that the SOCAL Range Complex, in the vicinity of SCI and the existing SOAR range, is the most suitable location for the SWTR. This location provides the necessary shallow water training environment, is readily accessible to Fleet units in San Diego, maximizes use of existing training support structure, including communications infrastructure and logistics support services, and otherwise maximizes training and support efficiencies.

The SWTR component of the Proposed Action would provide underwater instrumentation for two additional areas of the current SOAR, one 250nm^2 (463-km^2) area to the west of the already instrumented (deep water) section, in the area of Tanner/Cortes Banks, and one 250nm^2 (463-km^2) area between the deep water section and the southern section of SCI (See Figure 2-7). If installed in these areas, use of the SWTR would increase the use of these areas for ASW training involving MFAS.

The proposed instrumentation would be in the form of undersea cables and sensor nodes. The cables and sensors would be similar to those that instrument the current deep water range (SOAR). The new areas would form an integral SWTR capability for SOAR. The combination of deep water and shallow water instrumentation would support a seamless tracking interface from deep to shallow water, which is an essential element of effective ASW training. The instrumented area would be connected to shore via multiple trunk cables.

The SWTR instrumentation would be an undersea cables system integrated with hydrophone and underwater telephone sensors, called nodes, connected to each other and then connected by up to 8 trunk cable(s) to a land-based facility where the collected range data are used to evaluate the performance of participants in shallow water (120'-600'deep) training exercises. The basic proposed features of the instrumentation and construction follow

The transducer nodes are capable of both transmitting and receiving acoustic signals from ships operating within the instrumented areas of SOAR (a transducer is an instrument that converts one form of energy into another [in this case, underwater sound into an electrical signal or vice-versa]). Some nodes are configured to only support receiving signals, some can both transmit and receive, and others are transmit-only versions. The acoustic signals that are sent from the exercise participants (e.g. submarines, torpedoes, ships) to the receive-capable range nodes allow the position of the participants to be determined and stored electronically for both real-time and future evaluation. The transmit-capable nodes allow communication from the range to ships or other devices that are being tracked. More specifically:

- The SWTR extension would consist of no more than 500 sensor nodes spread on the ocean floor over a 500nm^2 area. The distance between nodes would vary between 0.5nm and 3nm, depending on water depth. Each sensor node would be similar on construction to the existing SOAR instrumentation. The sensor nodes are small spherical shapes of less than 6 inches in diameter. The sensors would be either suspended up to 15 ft (4.5 m) in the water column or lie flat on the seafloor. Sensor nodes located in shallow water with a presence of commercial fishing activity would have an additional protective device surrounding or overlaying a sensor. These mechanical protective devices would be 3-4 ft (1 m) round or rectangular with a shallow height. The final physical characteristics of the sensor nodes would be determined based upon local geographic conditions and to accommodate man-made threats such as fishing activity. Sensor nodes would be connected to each other by interconnect cable (standard submarine telecommunications cable with diameters less than 1 inch). Approximately 900nm of interconnect would be deployed.
- A series of sensor nodes would be connected via the interconnect cable to an underwater junction box(es) located in diver-accessible water depths. A junction box is rectangular in shape with dimensions of 10-15 ft (3-4.5 m) on each side. The junction box(es) would connect to a shore-based facility via trunk cable(s) (submarine

cables up to 2 inch diameter with additional data capacity). The trunk cable(s) eliminate the need to have numerous interconnect cables running to shore. Up to 8 trunk cables with a combined length of 375nm would be employed. Trunk cables would be protected in the sea-shore area by horizontally directionally drilled pipes running beneath the shoreline.

- The interconnecting cables and trunk cables would be deployed using a ship with a length overall up to 300 ft (91 m). The trunk cable paths would be routed through the deep water as much as is possible. Trunk cable deployed in shallow water may require cable burial. Burial equipment would cut (hard bottom) or plow (soft sediment) a furrow 4 inches (10 cm) wide by up to 36 inches deep. Burial equipment (tracked vehicle or towed plow) would be deployed from a ship. The trunk cable, which passes through the sea-shore area, would terminate in SCORE's current cable termination facility (CTF) at West Cove. From there, information gathered on the SWTR would be transmitted via an existing microwave datalink to the SCORE ROC on Naval Air Station North Island. The adjacent SOAR has a single junction box located outside the nearshore area and places the trunk cable in a horizontally directionally drilled bore that terminates on shore. The size of the SWTR may require up to 8 junction boxes and 8 trunk cables. Multiple horizontal bores are in the SOAR. Every effort would be made to take advantage of any excess bore capacity available in the SOAR.
- The in-water instrumentation system would be structured to achieve a long operating life, with a goal of 20 years and with a minimum of maintenance and repair throughout the life-cycle. This is due to the high cost of performing at-sea repairs on transducer nodes and cables, the inherently long lead-time to plan, permit, fund and conduct such repairs (6-18 months) and the loss of range capability while awaiting completion. The long life performance would be achieved by using high quality components, proven designs, and multiple levels of redundancy in the system design. This includes back-up capacity for key electronic components and fault tolerance to the loss of individual sensors or even an entire sensor string. The use of materials capable of withstanding long term exposure to high water pressure and salt water-induced corrosion is also important. Periodic inspection and maintenance in accessible areas also extends system life.

SCORE would submit cable area coordinates to the National Geospatial Intelligence Agency (NGA) and request that the combined SWTR/SOAR area be noted on charts within the appropriate warning area. This area would be noted in the U.S. Coast Pilot as a Military Operating Area (MOA), as are other areas on the West Coast. The Navy may promulgate a Notice to Mariners (NOTMAR) and a Notice to Airmen (NOTAM) within 72 hours of the training activities, as appropriate.

Installation of the SWTR instrumentation array may be done in phases. For example, the Tanner Bank area could be installed first, followed by the eastern area. The decision as to whether or not to proceed in phases, how many phases, and the order in which the phases are executed is based on multiple factors, including weather, ship availability and capacity, production schedules for nodes and cable, installation time, total environmental impact of installation, funding availability, and efficiency.

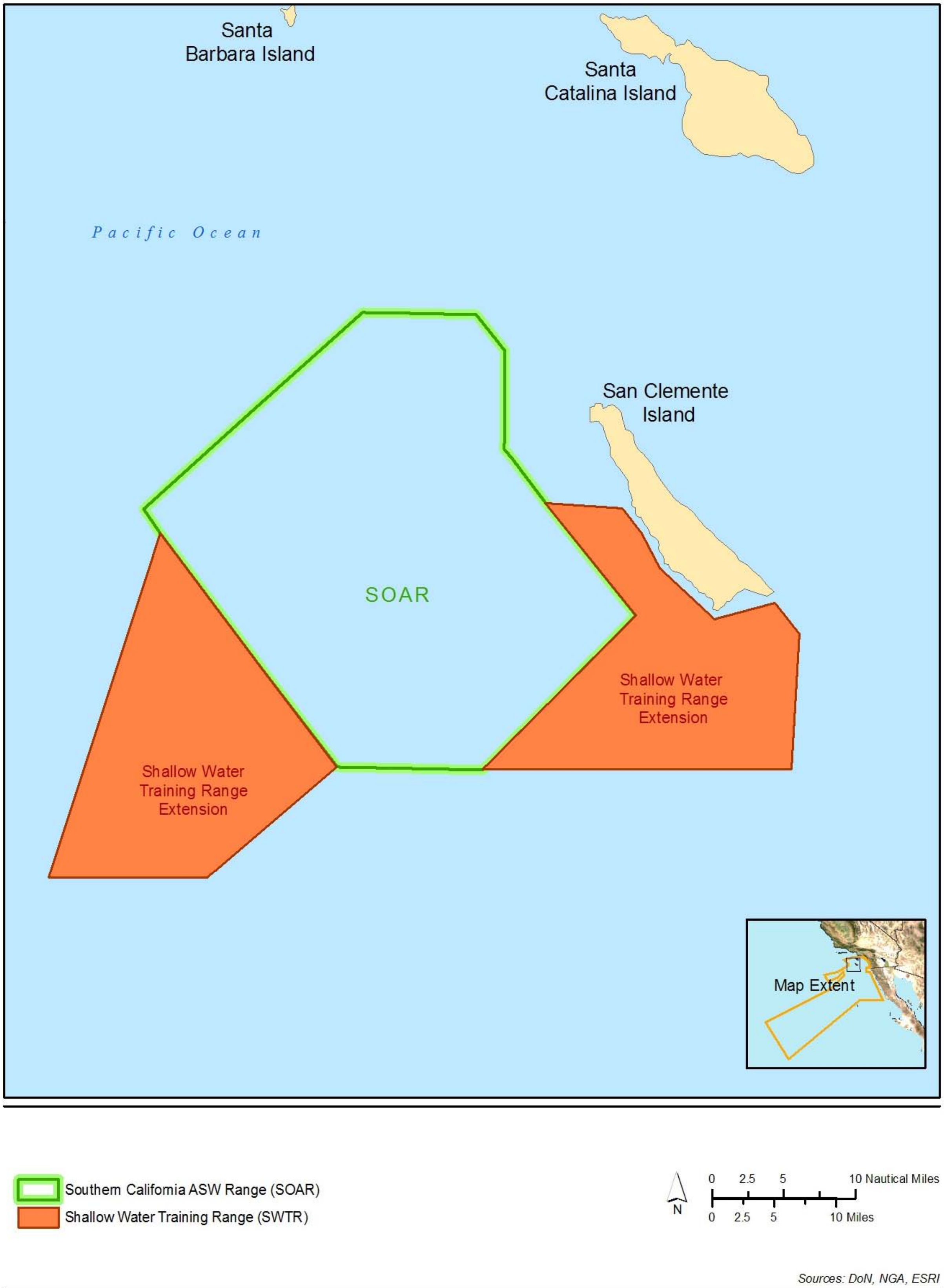

Figure 2-7: Proposed Location of Shallow Water Training Range Extensions of the SOAR

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3.0 Affected Environment and Environmental Consequences

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3 AFFECTED ENVIRONMENT AND ENVIRONMENTAL CONSEQUENCES

This chapter describes existing environmental conditions for resources potentially affected by the Proposed Action and alternatives described in Chapter 2. This chapter also identifies and assesses the environmental consequences of the Proposed Action and alternatives. As discussed in Chapter 2 (Section 2.3) under the No Action Alternative training operations used continue at current levels. The No Action Alternative is required by NEPA and is the environmental baseline. The affected environment and environmental consequences are described and analyzed according to categories of resources. The categories of resources addressed in this Draft Environmental Impact Statement (EIS)/Overseas Environmental Impact Statement (OEIS) are:

Geology and Soils (3.1)	Air Quality (3.2)
Hazardous Materials and Wastes (3.3)	Water Quality (3.4)
Acoustic Environment (3.5)	Marine Plants and Invertebrates (3.6)
Fish (3.7)	Sea Turtles (3.8)
Marine Mammals (3.9)	Sea Birds (3.10)
Terrestrial Biological Resources (3.11)	Cultural Resources (3.12)
Traffic (3.13)	Socioeconomics (3.14)
Environmental Justice & Protection of Children (3.15)	Public Safety (3.16)

In the environmental impact analysis process, the resources analyzed are identified and the expected geographic scope of potential impacts for each resource, known as the resource's region of influence (ROI), is defined. The discussion and analysis, organized by resource area, covers the ocean areas of the SOCAL Range Complex (referred to as SOCAL OPAREAs), Special Use Airspace (SUA), and the land area of San Clemente Island (SCI) to the extent affected resources or potential impacts are present.

In describing and analyzing affected resources and environmental consequences, this chapter identifies current mitigation measures such as Standard Operating Procedures (SOPs), Best Management Practices (BMPs), and Conservation Measures that are integral to the activities covered by the Proposed Action and alternatives. This chapter also identifies further measures not currently being undertaken that would mitigate environmental impacts to a given resource. All mitigation measures are listed in Chapter 5.

Included in the resource-specific assessments of potential impacts is a discussion of cumulative impacts on that resource. The discussion under the Affected Environment includes past and present environmental impacts. The approach taken in the analysis of cumulative impacts follows the objectives of the National Environmental Policy Act (NEPA) of 1969, Council on Environmental Quality (CEQ) regulations and CEQ guidance. CEQ regulations (40 C.F.R. §§ 1500-1508) provide the implementing procedures for NEPA. The regulations define cumulative impacts as:

> The impact on the environment which results from the *incremental impact of the action when added* to *other past, present, and reasonably foreseeable future actions* regardless of what agency (Federal or non-Federal) or person undertakes such other actions (40 C.F.R. § 1508.7) (*emphasis added*).

Reasonably foreseeable actions with the potential for creating cumulative impacts when combined with potential impacts from implementation of the Proposed Action were also reviewed. A summary of cumulative impacts and reasonably foreseeable actions are also listed in Chapter 4 (Cumulative Impacts).

3.1 Geology and Soils

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3.1 GEOLOGY AND SOILS

This section addresses geologic formations, topography, and soils on San Clemente Island (SCI). Marine geology, bathymetry, and sediment quality are addressed under Water Resources.

The major earth resources of an area are its bedrock and soils. For the purpose of this Environmental Impact Statement (EIS) / Overseas EIS (OEIS), the terms soil and rock refer to unconsolidated and consolidated materials, respectively.

3.1.1 Affected Environment-San Clemente Island

3.1.1.1 Existing Conditions

SCI, the southernmost of the chain of Channel Islands located off the coast of California, lies entirely on the Pacific Plate. Tectonic mechanisms have created a complex system of faults in this area that have fragmented the landscape, combining rocks of vastly different source materials and forming unique geologic features. The complex bathymetry and sediment transport processes in the Southern California Bight are described in Section 3.4, Water Resources.

3.1.1.1.1 Geologic Formations and Topography

Geology

SCI is the exposed portion of an uplifted fault block composed primarily of a stratified sequence of submarine volcanic rock (andesite, dacite, and rhyolite). The volcanic rock is over 1,969 feet (ft.) (600 meters [m]) thick. These volcanic rocks are overlain and interbedded with local sequences of marine sediments.

Topography

The topography of SCI includes coastal terraces, upland marine terraces, a plateau, an escarpment, major canyons, and sand dunes. The steep escarpment in the northeastern portion of SCI rises dramatically from the ocean, contrasting sharply with the more-gently sloping southwestern portion (Soil Conservation Service [SCS] 1982). The plateau is moderately rolling, upland terrain that encompasses roughly the middle one-third of SCI. The highest point on SCI is about 2,000 ft. (610 m) above mean sea level (MSL), at a point southeast of the center of SCI. Elevations gradually slope toward the northern and southern ends of SCI (Olmsted 1958). Steep, narrow canyons are located all over SCI, but are more common in its southern half. Some of these canyons are over 500 ft. (152 m) deep, dropping sharply into the sea (SCS 1982).

The steep east-facing cliffs in the northeastern portion of SCI are part of San Clemente Escarpment, which borders the entire eastern side of SCI. The Escarpment extends from Pyramid Head at the extreme southeastern end of SCI to Wilson Cove near its northwestern end, with an isolated segment between Wilson Cove and Lighthouse Point (Dolphin Bay) farther north. Elevations of the eastern Escarpment range from sea level to 1,965 ft. (599 m) above MSL.

The coastal and upland marine terraces dominate the western side of SCI, as well as its northern and southern ends, and include over 20 distinct wave-cut marine terraces. These terraces are considered among the most well-defined examples of such landscape features (Yatsko 1989). The coastal terrace is made up of the first two marine terraces, gently sloping from sea level to about 98 ft. (30 m) above MSL, where it meets the upland marine terrace. The latter includes up to 19 marine terraces in some areas, and ranges from 394 ft. (120 m) MSL in the southern portion of SCI to 1,476 ft. (450 m) MSL mid-island and 902 ft. (275 m) MSL at the southern end of SCI.

Seismicity and Faults

SCI is located in a highly active seismic zone with several faults. San Clemente Escarpment is bounded on the northeast by San Clemente Fault, a major active fault. San Clemente Fault is at least 131 mi. (210 km) long, and exhibits right lateral and vertical offset faulting. Several small, unnamed faults that exhibit a similar faulting pattern are located on SCI, as well as in the offshore area near SCI. In contrast to the predominantly northwest-trending offshore faults, several north-northeast-trending faults have been mapped onshore.

3.1.1.1.2 Soils

Most of SCI's soils are finely textured and highly friable. They are well drained, with slow permeability, and are subject to severe shrink-swell characteristics that can damage roads, dams, building foundations, and other structures. SCI soils were formed by a complex series of geologic processes, including tectonic uplift, rainfall, weathering, eolian deposition, and salt-spray deposition. SCI exhibits three general soil orders, including vertisols, alfisols, and eolian dune deposits (Figure 3.1-1).

Vertisols are heavy, light-colored soils with high clay contents that dominate the older, upper marine terraces and plateau in the southern portion of SCI, including the Shore Bombardment Area (SHOBA). These soils tend to swell with rain and develop deep, wide cracks during dry periods. Alfisols are fine, light-colored soils with subsurface horizons of clay accumulation but lower clay content than vertisols; they are the dominant soil on SCI's lower, younger marine terraces and alluvial fans.

In the northern portion of SCI, both the lower and upper marine terraces are overlain by eolian dune deposits of differential age. The dune deposits are highly calcareous, consisting mostly of fragmented marine shell. The older upland dune deposits are characterized by well-developed, reddish alfisols with thick, high-clay subsurface horizons, some containing significant caliche horizons. Dune deposits on the lower, younger terraces exhibit a lesser degree of soil development, and some still exist as active dunes.

Erosion Potential

The condition of the affected environment (existing conditions) includes effects on soils of past and present natural processes and human activities.

Soil erosion is a natural process occurring on all land. Erosion processes include sheet and rill erosion, gullying, and wind erosion. Accelerated soil erosion is defined as a net loss of soil due to land use. (DoN 2007)

Soils in southern California are especially vulnerable to erosion because vegetation growth and rainfall are out of phase. At the onset of the rainy season in the fall, the ground generally has less protection than in the spring or summer because most native trees and shrubs drop their leaves during the summer drought. Rain storms occur primarily in the winter, when vegetative cover is at a minimum. (DoN 2007)

Terrain on SCI is generally steep, with a highly dissected landscape that creates small watersheds draining directly to the ocean. A century of grazing while SCI was managed by the Department of Commerce, ending with the removal of feral goats in the early 1990's, left many areas with sparse vegetation to protect soils from wind and water erosion. Numerous drainages have eroded into canyons hundreds of feet deep. Figure 3.1-2 shows the relative water erosion potential on SCI by drainage. (DoN 2007).

Soils on SCI are subject to a process called piping. Sea spray increases the salt content of soils, which increases the friability of the soil. During the dry season, the soil in areas with little or no vegetation shrinks and large longitudinal cracks develop. When it rains, the surface water flows concentrate in these cracks and widen them into gullies. During the rainy season, concentrated storm water runoff degrades roadbeds and forms gullies along the edges because of piping.

Figure 3.1-1: San Clemente Island Soils

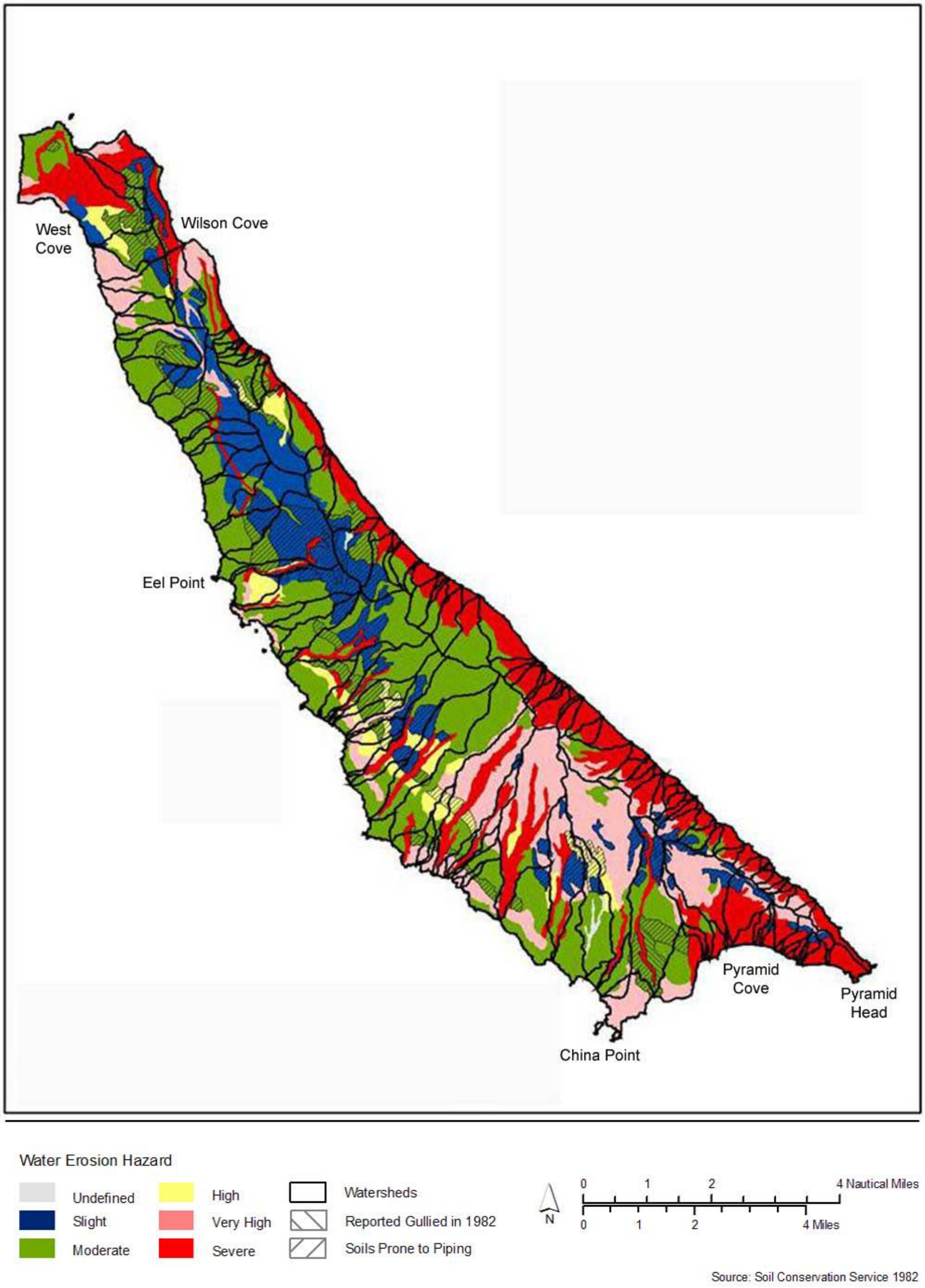

Figure 3.1-2: Water Erosion Potential

SCI also experiences substantial wind erosion. The surface layer of many SCI soils appears to have been deposited by wind, and the particle sizes of soils are considered highly erodible by wind. Wind erosion occurs on SCI mostly during the dry season. During this portion of the year, the predominant erosion factors are wind and vehicle disturbance on unpaved roads. Figure 3.1-3 shows the relative wind erosion hazard on SCI by drainage. (DoN 2007).

3.1.1.2 Current Mitigation Measures

SCI is managed as a federal property, so island operations are required to comply with the federal Soil Conservation Act. Federal land owners are required to control and prevent erosion by conducting surveys and implementing conservation measures (Soil Conservation Act, 16 United States Code [U.S.C.] Section [§] 5901). The Department of the Navy (DoN) is studying sedimentation and erosion processes associated with watersheds on SCI, in order to identify and mitigate sedimentation and erosion problems associated with military use of SCI.

Existing plans and policies limit the effects of training on the soils of SCI. The Integrated Natural Resources Management Plan (INRMP) identifies erosion as a primary management issue, and presents policies to reduce the impacts of erosion on SCI. The INRMP notes that “erosion and sedimentation continue, arising from inadequately constructed or maintained roads, or from ongoing damage instigated by past overgrazing by feral goats, exterminated around 1991” (DoN 2002). Policies generally pertain to road construction and vehicle travel on existing unpaved roads. These policies include:

- Ground-disturbing activities are located on previously disturbed sites whenever possible,
- Project work areas, including transit routes necessary to reach sites, are clearly identified or marked and vehicular activities are restricted to designated/previously identified areas,
- Existing borrow pits approved for construction are used at SCI,
- Erosion control is managed through the Site Approval Process, whereby the Navy reviews each proposed project for its erosion potential, and involves the Natural Resource Specialist in the process, and
- Off-road vehicle use is not permitted except in designated off-road areas or on established trails

3.1.2 Environmental Consequences

3.1.2.1 Approach to Analysis

Impacts of the Proposed Action on the soils of SCI are addressed below. Activities under each Alternative were analyzed for their effects on soils, particularly soil erosion and deposition of expended training materials.

The first step in developing an approach to analysis is to identify how the Proposed Action could affect SCI soils. Training can affect soils by depositing unexploded ordnance (UXO) and ordnance remnants, with the potential for soil contamination, and by surface disturbance and subsequent erosion of soils. Vehicle travel on unpaved roads also can disturb soils and affect erosion rates. Either surface disturbance or ordnance impacts could increase the erosion potential of soils depending on conditions in the specific area. A substantial increase in soil contamination or a substantial increase in erosion potential, associated with the Proposed Action, would be considered a significant impact.

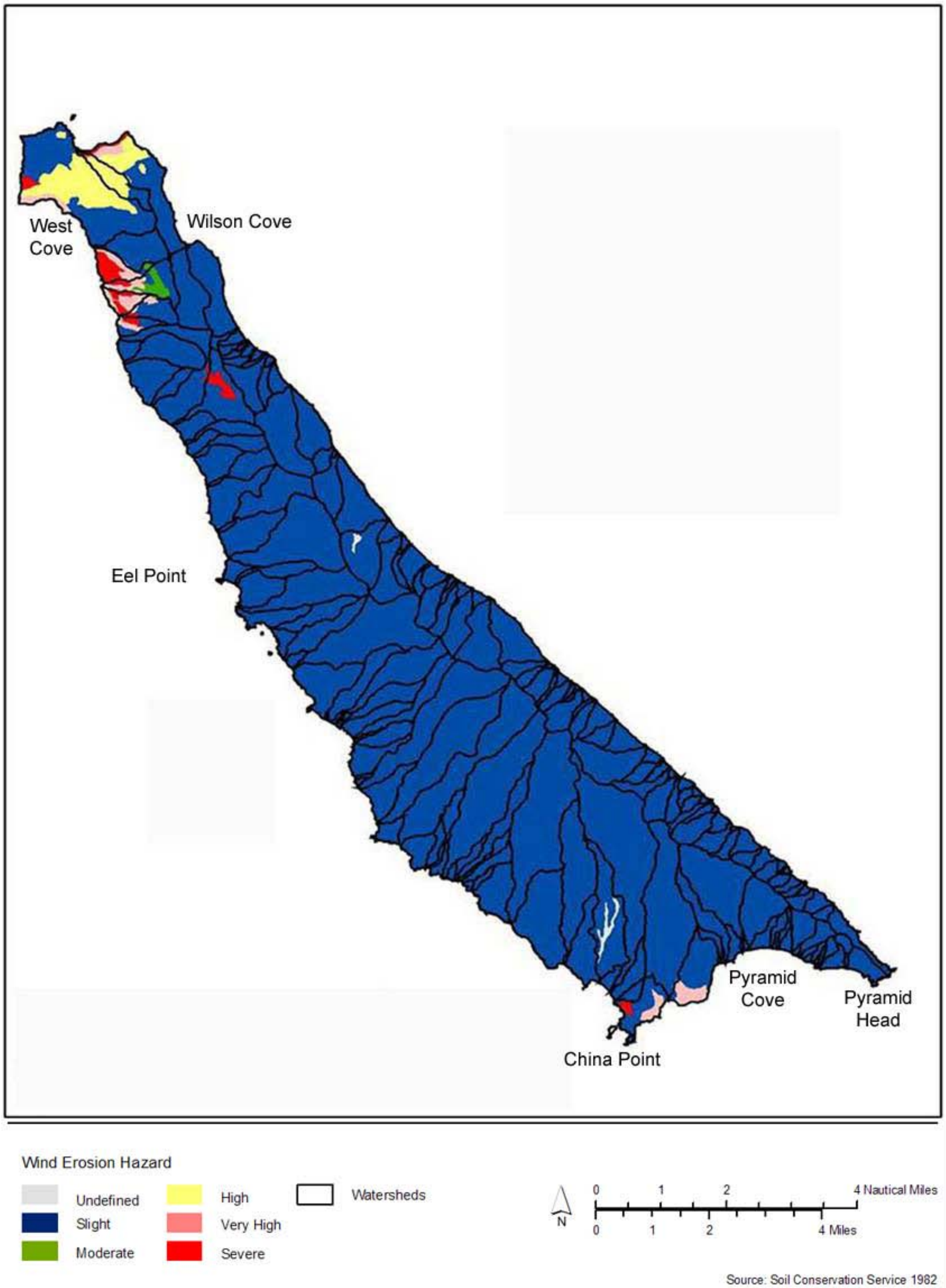

Figure 3.1-3: Wind Erosion Potential

To address the potential for soil contamination, quantitative estimates of the concentrations of these materials in surface soils, by weight, were made. The actual footprint of expended training materials on SCI is not known, however; even within a training range, only portions of the area are exposed to expended training materials. For purposes of analysis, an assumption was made that essentially all of the expended training materials (>99 percent) are deposited on just 20 percent of the land area of SCI, and area of about 7,200 acres (ac) (2,835 hectares [ha]).

The impact analysis focuses on those training activities that have some potential to either increase soil contamination or increase erosion potential on SCI. Land-based training activities excluded from the following analysis because they have no potential to adversely affect soils are: Unmanned Aerial Vehicle training, Combat Search and Rescue, Radio Frequency Tests, Missile Flight Tests, and UAV Tests. Given the lack of contact with SCI soils, the absence of any planned expenditure of training materials, and the low probability of any unplanned releases of materials into the environment, they would have a negligible effect on SCI soils under any proposed scenario.

3.1.2.2 No Action Alternative

The discussion below addresses the impacts of ongoing training and test activities on the soils of SCI. Elements of the No Action Alternative that affect SCI soils are addressed below. Infantry Battalion-sized amphibious landing exercises and Stinger Firing Exercises do not occur under the No Action Alternative, and are not addressed in this subsection.

3.1.2.2.1 Expended Training Materials

The overall effects of discarded training materials from SCI soils, primarily in SHOBA, are related to the numbers and mass of training items deposited on the surface. About 2.6 million training items, weighing about 347 tons (T) (315 metric tons [MT]), are expended annually under the No Action Alternative (see Table 3.3-9), or about 95 pounds (lb) per ac (105 kilograms [kg] / ha) per year assuming that >99 percent of the discarded materials are deposited on no more than 20 percent of the island (about 7,200 ac, or 2,835 ha). About 98 percent of these items are small arms. The amount of expended training materials that are recovered from SCI ranges during explosives ordnance disposal (EOD) sweeps averages about 140 T (127 MT) per year, based on data for Fiscal Years 2005 - 2007 (FY05-07). In addition, many training events include cleanup after the exercise.

The hazardous constituents of small arms and other ordnance residues include metals, such as lead, nickel, chromium, cadmium, and copper. They also include explosive and propellant residues and their degradation products. The effects and fate of these soil contaminants are discussed in Section 3.3, Hazardous Materials and Wastes.

3.1.2.2.2 Erosion

Training activities under the No Action Alternative, especially ordnance impacts, foot traffic, and vehicle travel on unpaved roads, affect the soils of SCI. Soil displacement and disturbance from ordnance impacts and explosives detonations are limited to the training ranges on SCI, but within those areas the loose soils are at risk for accelerated erosion. Foot traffic in various areas of SCI compacts soils and disrupts the growth of ground cover that normally protects soils from rain and wind erosion. Vehicle travel on unpaved roads likewise compacts soils, and generates dust that contributes to wind erosion. Amphibious landings on SCI's beaches disturb soils and disrupt vegetation, also contributing to erosion. However, a recent erosion study of SCI found that, on a watershed-wide basis, erosion rates were not, in general, substantially influenced by the level of Navy activity (DoN 2006).

3.1.2.2.3 Shore Bombardment Area (SHOBA) Training

Typical training exercises in SHOBA include Naval Surface Fire Support (NSFS), Bombing Exercises (BOMBEXs), various gun exercises (e.g., Naval Special Warfare [NSW] raids), mortar and artillery fire, and small arms training. Composite Training Unit Exercise (COMPTUEX), Joint Task Force Exercise (JTFEX), Expeditionary Firing Exercise (EFEX), and amphibious landings also occur in SHOBA. Other SHOBA training activities include ground spotting, naval gun fire air spotting, helicopter support missions, radar beacon support, landing beach preparation, and landing zone preparation.

Light foot traffic, vehicle travel on unpaved roads, and other minor surface disturbance from training activities affect soils primarily through compaction and trampling of vegetation. These activities are infrequent, and are located in designated, previously disturbed areas. They do not increase the rate or extent of erosion on SCI above baseline levels.

Heavy high explosive ordnance (e.g., naval gun shells, bombs, artillery shells, missiles) impacts create craters and otherwise disturb soils in SHOBA. Heavy long-term use of the Impact Areas in SHOBA has extensively disturbed its soils. Ordnance items may bury themselves up to four feet deep in alluvial soils, or remain on the surface where the soil is thin or rocky. Because many of the items impact the same area, disturbing the same volume of soil over and over, however, there is no direct relationship between the number of impacts and the degree of disturbance.

Soils transported horizontally by wind erosion or sheet flow (unchannelized water flow) tend to fill in craters and gradually return the surface topography to a more "natural" state. Soils in portions of the range not disturbed for long periods will gradually stabilize and vegetation will re-establish itself. The rooting depths of plants, and thus their contribution to soil stability, will be less in disturbed areas than in undisturbed areas. Because of the ongoing effects of the dynamic processes described above, however, only a general description of the range's condition at a given point in time is possible.

SHOBA's Impact Area I is in an area of moderate erosion potential, where soil disturbance does not substantially accelerate soil erosion. Impact Area II, however, is in an area of very high to severe soil erosion (see Figure 3.1-2), where additional soil disturbance may substantially accelerate soil erosion.

3.1.2.2.2 Amphibious Warfare (AMW)

NSFS, EFEX, and Amphibious Landings and Raids occur under the No Action Alternative. Impacts of small boat raids on soils are limited to infrequent surface disturbance from rubber boats and foot traffic. AMW activities result in the annual expenditure of about 4,500 naval gun shells, 886 cannon and mortar shells, about 14,100 small arms projectiles, 151 missiles and rockets, and 344 bombs. These items add about 172 T (156 MT) per year of expended training materials, mostly metals, to surface soils. Assuming for purposes of analysis that all of these materials are expended in SHOBA and that SHOBA has an area of about 1,500 ac (607 ha), then about 229 lb/ac (255 kg/ha) per year of expended materials will be deposited by these activities. Individual AMW training activities are described below.

Naval Surface Fire Support Exercise

Impact Areas I and II have been bombarded with high explosive ordnance for about 60 years. During NSFS, surface ship naval guns (usually the 5-inch MK-45, the largest gun now fitted on Navy ships) bombard surface targets with high explosive ordnance in Impact Areas I and II of SHOBA. Under the No Action Alternative, 4,700 5-inch shells are expended in Impact Areas I and II annually during NSFS.

Ordnance impacts create craters, loosen soils, and eliminate some of the (already sparse) vegetation, exposing new areas of soils to water and wind erosion. Effects on soils are greatest in those areas of concentrated use, and are least around the edges of the impact areas. The effects of additional ordnance impacts are less than proportional to the increase in activity because a shell may impact an area that already is disturbed. Continued use of Impact Area I will not substantially accelerate soil erosion. Continued use of Impact Area II, however, may accelerate soil erosion.

Expeditionary Firing Exercise (EFEX)

Soils on SCI are affected during EFEXs by ordnance expended in SHOBA by surface ships, artillery, mortars, and aircraft. Under the No Action Alternative, ordnance expended in SHOBA during EFEXs includes 155-millimeter (mm) artillery shells, 5-inch/54-caliber naval gun shells, 20/25-mm cannon shells, 81-mm mortar rounds, bombs, and small arms. Ordnance expended in Impact Areas I and II creates shallow craters and disturbs soil, but the effects of additional ordnance impacts are less than proportional to the increase because many of the items affect areas that already are disturbed. The effects of cratering and soil disturbance from ordnance use in Impact Areas I and II are addressed above under SHOBA.

Amphibious units land in either West Cove or Northwest Harbor, and the United States Marine Corps (USMC) artillery batteries (5-T trucks and 155-mm howitzers) travel to SHOBA via Ridge Road. Vehicles traveling between West Cove and SHOBA via Ridge Road follow established guidelines for the use of vehicles on SCI (e.g., use of established roads to reduce erosion and rutting) to limit their effects on soils. West Cove and Northwest Harbor are both located near the northwestern end of SCI. Both landing areas have sandy beaches.

Marine Corps units typically come ashore in Landing Craft, Air Cushion (LCACs) and Amphibious Assault Vehicles (AAVs). Both vehicles are able to ride onto the beach; the LCAC weighs 169 T (about 153 MT) and the AAV weighs 23 T (about 21 MT). Amphibious landings can disturb sandy beaches. Near-shore sediments will be stirred up by turbulence from amphibious landing craft. The LCAC is an air-cushion vehicle, however, creating less turbulence than the AAV. Displaced soils fill in quickly due to the nature of sand, wave action, and frequent winds.

USMC Stinger Firings

This activity has been conducted in the past; however, it has not been conducted recently. Therefore, the baseline for this event is zero.

Amphibious Landings and Raids

Ordnance expended during amphibious landing and raid training under the No Action Alternative consists primarily of 7.62-mm; 20-mm; and 30-mm rounds. Expenditures of ordnance in SHOBA are addressed above. Beach soils also are disturbed by foot traffic and, along the shoreline, by the beaching of small boats. Displaced soils fill in quickly due to the non-cohesive nature of sand, wave action, and frequent winds.

3.1.2.2.3 Naval Special Warfare (NSW)

NSW activities result in the annual expenditure of about 234 mortar shells, about 2.5 million small arms projectiles, and 379 flares and smoke canisters. These items add about 30 T (27 MT) per year of expended training materials, mostly metals, to surface soils. Assuming for purposes of analysis that all of the mortar rounds were expended in SHOBA and that SHOBA has an area of about 1,500 ac (607 ha), then about 0.6 lb/ac (0.7 kg/ha) per year of expended materials will be deposited by these activities. Individual NSW training activities are described below.

Basic Training—BUD/S

Detonating explosives on the NSW Center Land Demolition Range affects soils. Detonations in this area range from small point-source charges to large line charges that disturb soils and can create craters. The expenditure of small arms rounds during training deposits metals in soils. NSW Center Land Navigation training in SHOBA is limited to light foot traffic.

NSW Group ONE (NSWG-1) SEAL Platoon Operations

SEAL platoon training activities use Training Areas and Ranges (TARs) throughout the island, as well as other areas on SCI. Activities include target assault, land demolitions, Over-the-Beach, strategic reconnaissance, direct action tactical training, immediate action drills, small arms live-fire, Military Operations in Urban Terrain, helicopter landings, Unmanned Aerial Vehicle, convoy/mounted, and parachute drops. All activities include limited small arms live-fire or ordnance. Impacts on soils similar to those described above under SHOBA Training result from foot traffic, expenditure of small-scale ordnance, and support operations such as vehicle traffic on unpaved roads.

TAR 6 (White House Training Area), TAR 7 (Saint Offshore Parachute Drop Zone), Tar 8 (Westside Nearshore Parachute Drop Zone), and TAR 15—VC-3 Airfield Training Area are not individually discussed below because no aspect of existing or proposed uses of these areas could affect soils on SCI.

TAR 1—Demolition Range Northeast Point. TAR 1 includes a state-of-the-art demolition area with OTB capabilities. SEAL Platoon exercises include conducting OTB, target assault, and land demolitions. Demolitions have created craters within the training area. However, demolitions occur in a previously disturbed area specifically designed for that purpose. They generally affect less than 0.25 ac. The range is cleaned up after each training exercise, in accordance with standing range instructions, so these activities result in only minor deposition of residue on the range. Soils are generally sandy at this location, and the terrain is gently sloping to flat. Erosion potential at this location is rated "very high" (see Figure 3.1-2).

TAR 2 – Graduation Beach Underwater Demolition Range. This site is used as an underwater demolition range. Vehicle and foot traffic on the existing access road, in the demolition staging area, and in the demolition preparation area have a minimal effect on surface soils. The erosion potential in the access and staging areas is rated "very high" (see Figure 3.1-2).

TAR 3—BUD/S Beach Underwater Demolition Range. This site is used as an underwater demolition range. Vehicle and foot traffic on the existing access road, in the demolition staging area, and in the demolition preparation area have a minimal effect on surface soils. The erosion potential in the access and staging areas is rated "very high" to "severe" (see Figure 3.1-2).

TAR 4—Whale Point/Castle Rock. Training activities in TAR 4 are similar to, but more extensive than, those described for TAR 1. Erosion potential at this location is rated "moderate" (see Figure 3.1-2). The range is cleaned up after each training exercise, in accordance with standing range instructions, so these activities result in only minor deposition of residue on the range.

TAR 5—West Cove Amphibious Assault Training Area. Amphibious landings and beach insertion and extraction activities affect soils primarily as a result of foot and vehicle traffic. Impacts on sandy sediments are temporary, and are eventually offset by natural processes. The range is cleaned up after each training exercise, in accordance with standing range instructions, so these activities result in only minor deposition of residue on the range. Erosion potential in this area is rated "high" to "very high" (see Figure 3.1-2).

TAR 9—Photo Lab Training Area. This site is developed. All small arms are fired into bullet traps, greatly limiting the amount of expended training materials left on the range. Impacts of training activities on soils consist of surface disturbance from foot traffic. Because the type of use limits surface disturbance and the erosion potential for the area is classified as "slight" (see Figure 3.1-2), training at this location does not result in substantial soil erosion. The range is cleaned up after each training exercise, in accordance with standing range instructions, so these activities result in only minor deposition of residue on the range.

TAR 10—Demolition Range West. Only 1.5 ac. of this approximately 43.3-ac. area is used. This area was previously used as a demolition and a weapons range, and is pockmarked with evidence of these past uses. Three disturbed areas (approximately 13 ac. total) remain from previous uses of this site.

SEALs use TAR 10 for safe, operationally realistic live-fire and high-explosive demolition training on patrol to other land-based TAR objectives. As part of their training, the SEALs place explosive charges on temporary targets and demolish them. The range is cleaned up after each training exercise, in accordance with standing range instructions, so these activities result in minor deposition of demolition residues on the range.

Impacts from use of TAR 10 are similar to impacts of other OTB and land training activities. High-explosive ordnance is used in these activities. Erosion potential in this area is rated "moderate" (see Figure 3.1-2).

TAR 11—Surveillance Training Area. Exercise components at TAR 11 include inserting and extracting personnel and equipment, tactical environmental movement, direct action, reconnaissance, helicopter hover personnel insertion (Fast Rope), and SEAL team raid. Ground disturbance from training activities is primarily from foot traffic. Erosion potential in this area is rated "very high" to "severe" (see Figure 3.1-2). The range is cleaned up after each training exercise, in accordance with standing range instructions, so these activities cause only minor deposition of training materials on the range.

TARs 12—Radar Site Training Area and *13—Randall Radar Site Training Area*. Erosion potential in this area is rated "severe" (see Figure 3.1-2), similar to conditions at TAR 11. Training activities and anticipated soil impacts in these areas are comparable to those described under TAR 11.

TAR 14—VC-3 Onshore Parachute DZ. This site is developed. Impacts of training on soils consist of surface disturbance from foot traffic and the use of small arms and demolitions. Erosion potential in this area is rated "slight" (see Figure 3.1-2). The range is cleaned up after each training exercise, in accordance with standing range instructions, so these activities result in minor deposition of training materials on the range.

TAR 16—South VC-3 (Missile Impact Range). This TAR is designated for live-fire. Erosion potential at this site is rated "slight." Erosion potential in this area is rated "slight" with "soils prone to piping" (see Figure 3.1-2). The range is cleaned up after each training exercise, in accordance with standing range instructions, so these activities result in only minor deposition of residue on the range.

TAR 17—Eel Point Tactical Training Range. TAR 17 is located in an area previously used for small arms and hand grenade training. Soils are disturbed by SEAL platoon approaches and demolitions. Erosion potential at this site is rated "moderate" (see Figure 3.1-2). The range is cleaned up after each training exercise, in accordance with standing range instructions, so these activities result in minor deposition of training materials on the range. Impacts are comparable to those of other land-based and OTB training activities.

TAR 18—Close Quarter Battle Training Complex and *TAR 19—Simulated Prisoner of War Camp and Surface to Air Missile (SAM) Site.* Surface areas are disturbed by SEAL platoon approaches and demolitions. Erosion potential is rated "severe" at TAR 18 and "moderate" at TAR 19. The range is cleaned up after each training exercise, in accordance with standing range instructions, so these activities result in minor deposition of training materials on the range. Impacts are comparable to those of other land-based and OTB training activities.

TAR 20—Pyramid Cove Training Area. This TAR is located in Impact Area I. Small arms fire and onshore demolitions in this 167-ac TAR may disturb soils. Erosion potential in this area is rated "severe" (see Figure 3.1-2). Topographic changes and erosion impacts are negligible, however, because of the focused nature of the proposed activity. The range is cleaned up after each training exercise, in accordance with standing range instructions, so these activities result in minor deposition of training materials on the range.

TAR 21—Horse Beach Cove Training Area. Impacts of training on soils in this 50-ac TAR are similar to those described above for TAR 3 and TAR 20. The erosion potential at this location is rated "moderate," so impacts are less than in TAR-20. The range is cleaned up after each training exercise, in accordance with standing range instructions, so these activities result in minor deposition of training materials on the range.

TAR 22—China Cove Training Area. Impacts of training on soils in this 289-ac TAR are similar to those described above for TAR 20. The erosion potential at this location is rated "moderate," so impacts are less than in TAR 20. The range is cleaned up after each training exercise, in accordance with standing range instructions, so these activities result in minor deposition of training materials on the range.

In summary, ongoing training on existing TARs may disturb the surface, which (depending upon the erosion potential of the site) may incrementally increase wind and water erosion of soils.

Direct Action

Direct Action consists of small groups of personnel being inserted, and later extracted, by helicopter, small boat, or other vehicles. Activities include raids, ambushes, standoff attacks, target designation, deception operations, and sabotage. Because these activities are carried out by small groups whose intent is to disturb their surroundings as little as possible, these activities have de minimus effects on soils. Under the No Action Alternative, about 156 Direct Action activities occur per year. Light foot traffic and surface disturbance (by vehicles associated with these activities, such as helicopters or combat rubber raiding craft) will have no substantial effect on soils.

3.1.2.2.4 Strike Warfare—STW

Soils on SCI are affected by bombs dropped by aircraft during Air Strikes. In this exercise, three types of bombs typically are used: the non-explosive 25-lb (11.3-kg) MK-76; the 500-lb (226-kg) MK-82; the 1,000-lb (454-kg) MK-83; and the 2,000-lb (908-kg) MK-84. The MK-82 and MK-83, and any other ordnance weighing over 500 lb (226 kg), are dropped in the Heavy Ordnance Area located in Impact Area II. The MK-76 and other non-explosive practice bombs, as well as any explosive ordnance weighing up to 500 lb (226 kg), are dropped in Impact Areas I and II.

The heavy ordnance dropped on land areas during this activity creates craters, but the craters and soil disturbance occur in previously disturbed areas. Impact Area I is in an area of moderate erosion potential, where such disturbance will not substantially accelerate soil erosion. Impact Area II, however, is in an area of very high to severe soil erosion (see Figure 3.1-2), where additional soil disturbance may accelerate soil erosion.

Overall, about 5,600 small arms projectiles, 14 flares and smoke canisters, 173 missiles and rockets, and about 1,870 bombs totaling about 169 T (154 MT) will be expended each year for

Strike Warfare (STW). If all of these training materials are deposited in SHOBA, then about 225 lb/ac (253 kg/ha) per year will be deposited on the range by STW activities.

3.1.2.2.5 Research, Development, Test, and Evaluation (RDT&E)

Research, Development, Test, and Evaluation (RDT&E) activities will expend about 195 naval gun shells and 7 missiles per year, weighing about 5.9 T (5.4 MT). If all of these training materials are deposited in SHOBA, then about 8 lb/ac (9 kg/ha) per year will be deposited on the range by RDT&E activities.

3.1.2.2.6 Non-Combat Operations - EOD Disposal

Under the No Action Alternative, Explosive Ordnance Disposal (EOD) includes 5 events per year, each consisting of a 25-person platoon equivalent (ground units). These events are conducted in the SHOBA Impact Areas, primarily Impact Area II, and entail the detonation of 5-inch/54-caliber high explosive naval gun shells. These events disturb soils, but the impact is minimal because the ground is only disturbed near the detonation and because these activities usually occur in previously disturbed areas.

3.1.2.2.7 Vehicle Travel on Unpaved Roads

Vehicle travel on unpaved roads on SCI is a substantial source of wind and soil erosion. Vehicle travel both compacts soils - decreasing infiltration of rainfall and thus increasing runoff - and suspends fine particulates in the air, where they are picked up by the wind and blown downwind. In recognition of the severity of soil erosion on unpaved roads, the Navy is installing erosion control features along unpaved SCI roads.

The No Action Alternative results in continued vehicle travel on unpaved roads. With the widespread installation of the planned engineered erosion control features and structures, however, erosion from unpaved roads will substantially decrease.

3.1.2.3 Alternative 1

Alternative 1 would include Battalion-sized amphibious exercises / landings, which do not occur under the No Action Alternative.

The overall effects of discarded materials from training activities on soils on SCI, primarily in SHOBA, would be related to the numbers and mass of training items deposited on the surface. About 5.2 million training items, weighing about 440 T (400 MT), would be expended per year under Alternative 1 (see Table 3.3-11). This would be an increase of about 27 percent over the No Action Alternative. The deposition rate of expended training materials would be about 123 lb/ac (135 kg/ha) per year (assuming that >99 percent of the expended materials are deposited on no more than 20 percent of the island, or about 7,200 ac). Based on clearance data for FY05 - FY07, about 136 T (126 MT) per year of expended training materials would be recovered from SHOBA during EOD sweeps.

The hazardous constituents of small arms and other ordnance residues include metals, such as lead, nickel, chromium, cadmium, and copper. They also include explosive and propellant residues and their degradation products. The effects and fates of these soil contaminants are discussed in Section 3.3, Hazardous Materials and Wastes.

The types of soil impacts that would result from training activities under Alternative 1, such as those resulting from ordnance impacts, foot traffic, and vehicle travel on unpaved roads, would be similar to those described under the No Action Alternative (Section 3.1.2.2).

The increases in land training and testing activities proposed under Alternative 1 (roughly 45 percent over the No Action Alternative) could incrementally increase rates of soil erosion in portions of those watersheds where training ranges or impact areas are located. In areas of heavy use for training, visible increases in soil disturbance and soil erosion may be observed over small areas. For example, training activities in the AVMA, alone, under Alternative 1 would result in losses of an additional 2,130 T (1,940 MT) per year of soils from erosion.

The subsections below addresses the impacts of the individual activities proposed under Alternative 1 on the soils of SCI.

3.1.2.3.1 Shore Bombardment Area (SHOBA) Training

Typical activities in SHOBA would include NSFS, BOMBEX, various gun exercises (e.g., NSW raids), mortar and artillery fire, and small arms training. COMPTUEX, JTFEX, EFEX, and amphibious landings also would be conducted in SHOBA several times per year. The effects of training activities in SHOBA, including the effects of ordnance impacts in SHOBA's Impact Areas I and II, are described in Section 3.1.2.2.1. In comparison to the No Action Alternative, heavy ordnance impacts in SHOBA would increase by about 7 percent, and deposition of expended ordnance materials would increase by about 22 percent, under Alternative 1. The types of soil impacts resulting from foot traffic, vehicle travel on unpaved roads, ordnance impacts, and other surface disturbances associated with Navy training activities are generally described under the No Action Alternative in Section 3.1.2.2.1.

3.1.2.3.2 Amphibious Warfare

NSFS, EFEX, Battalion Landings, Stinger Missile training, and Amphibious Landings and Raids would occur under Alternative 1. Impacts on soils from small boat raids would be limited to infrequent surface disturbance from rubber boats and foot traffic. AMW activities would result in the annual expenditure of about 4,990 naval gun shells, 1,590 cannon and mortar shells, about 130,000 small arms projectiles, 277 missiles and rockets, and 401 bombs. These items would add about 216 T (196 MT) per year of expended training materials, mostly metals, to soils. Assuming for purposes of analysis that all of these materials were expended in SHOBA and that SHOBA has an area of about 1,500 ac (607 ha), then about 288 lb/acre (320 kg/ha) per year of expended materials would be deposited by these activities. Individual AMW training activities are described below.

Naval Surface Fire Support Exercise

The frequency of NSFS against surface targets in Impact Areas I and II of SHOBA would increase from 47 events under the No Action Alternative to 50 events per year under Alternative 1, a 6-percent increase. The impacts in Impact Areas I and II of specific activities are difficult to quantify due to the ongoing nature of these areas as active bombing ranges. A 6-percent increase in ordnance impacts, however, would not substantially increase surface disturbance in Impact Areas I and II above baseline (No Action Alternative) levels.

Expeditionary Firing Exercise (EFEX)

EFEX events would increase from 6 events per year under the No Action Alternative to 7 events per year under Alternative 1, a 17-percent increase. This is a major exercise, generating a substantial amount of vehicle travel, foot traffic, and ordnance impacts. Potential effects range from displaced soils to mild cratering; however, the effects of the increased training tempo would be offset by existing mitigation measures.

Battalion Landing

The USMC proposes to add to its amphibious landing events on SCI with a full Battalion Landing Team (BLT) of the Marine Expeditionary Unit (MEU). The BLT of 1,500 infantry personnel would land by helicopters; Landing Craft Air Cushions (LCACs); and Landing Crafts, Utility (LCUs). Landings could occur at Wilson Cove, Northwest Harbor, West Cove, or

SHOBA. Naval guns, artillery, and aircraft could support the landings at SHOBA. Ordnance would include 155-mm artillery shells, a variety of naval gun shells, cannon shells, mortars and grenades, and small arms rounds. Infantry personnel would be supported by approximately 20 Light Armored Vehicles (LAVs), up to two High Mobility Multipurpose Wheeled Vehicles (HMMWVs), eight 7-T trucks, and up to four M-1 tanks. One battalion-sized, approximately five-day amphibious landing exercise would be conducted annually under Alternative 1. Existing plans, policies, and regulations identified in Section 3.1.1.2 would continue to be implemented island-wide to minimize the potential for and effects of erosion.

Cratering and surface disturbance in SHOBA from ordnance impacts would be shallow and would be confined to Impact Areas I and II. The effects of training activities in SHOBA, including the effects of ordnance impacts in SHOBA's Impact Areas I and II, are described in Section 3.1.2.2.1.

Amphibious vehicles and foot traffic would disturb sandy beaches during amphibious landings, but displaced soils would fill in quickly due to the frequent winds and wave action. Once off the beach, all wheeled vehicles would be restricted to established roads. Infantry exercises would use the Infantry Operations Area designated in the guidelines and planning sessions, and personnel would remain out of canyons. Existing policies and adherence to erosion minimization measures, outlined in the SCI INRMP, would minimize adverse effects.

Tracked vehicles would be restricted to the Assault Vehicle Maneuver Road (AVMR) and other designated areas associated with the Assault Vehicle Maneuver Corridor (AVMC). Vehicle travel along existing and future sections of the AVMR (AVMR and AVMR-SHOBA respectively), and foot traffic at AMPs and AFPs, also could disturb surfaces and increase wind and water erosion. Some of the AVMAs (area associated with the derelict World War [WW] II rifle range) have steep slopes or drainage heads, and disturbance would increase their susceptibility to erosion. AVMAs proposed near the Naval Auxiliary Landing Field (NALF) airfield and Old Airfield at VC-3 are generally flat and more heavily disturbed. Use of these areas by tracked vehicles would increase their erosion potential. Sediment could accumulate in low areas or travel beyond the designated training areas; particularly during heavy rains. Vehicle maneuvers in the AVMC would increase island-wide erosion by about 2,130 T per year (DoN 2007). However, mitigation measures identified in the INRMP would reduce the potential for wind and water erosion below this estimated amount.

USMC Stinger Firings

Under Alternative 1, USMC Stingers would be fired from positions onshore in SHOBA. Surface materials would be disturbed by the construction of firing positions at China Point and to the west toward Impact Area II, near the shoreline. Construction of the firing points and the associated changes in surface runoff patterns and amounts could result in accelerated erosion in the vicinity of these sites. Training and test activities at previously prepared firing points would not substantially increase the level of surface disturbance or accelerate erosion.

Amphibious Landings and Raids

The number of amphibious landings and raids would increase from 7 under the No Action Alternative to 34 under Alternative 1, about a 386-percent increase. This activity would include amphibious landings by LCUs at Northwest Harbor, vehicle travel by HMMWVs and 5-T trucks, and demolition activities in the Northwest Harbor demolition training area. The amphibious landings would be the same as those described above. Potential effects include cratering and rutting, and displaced soils, increasing the erosion potential. Erosion control measures already are in place to counteract the potential negative effects of these actions. Vehicle travel would be restricted to established roads. Established guidelines for the use of vehicles on SCI would limit impacts on soils. With implementation of existing protective measures, these activities would not substantially increase surface disturbance.

3.1.2.3.3 Naval Special Warfare

NSW activities under Alternative 1 would result in the annual expenditure of about 245 mortar shells, about 5.0 million small arms projectiles, and 488 flares and smoke canisters. These items would add about 31 T (28 MT) per year of expended training materials, mostly metals, to surface soils. Assuming for purposes of analysis that all of the mortar rounds were expended in SHOBA and that SHOBA has an area of about 1,500 ac (607 ha), then about 0.6 lb/ac (0.7 kg/ha) per year of expended materials would be deposited by these activities. Individual NSW training activities are described below.

Basic Training—BUD/S

NSW Center Land Demolitions training would increase from 354 events per year under the No Action Alternative to 674 events per year under Alternative 1, a 90-percent increase. Small Arms training would increase from 171 to 205 events per year, a 20-percent increase. The effects on soils would be similar to those described under the No Action Alternative because the nature of the training activities would be the same and the footprints of these activities also would be the same. The frequency with which heavily used and well-controlled areas would be used is not expected to affect soil erosion rates. Small arms ranges and demolition areas would be regularly policed to collect expended training materials, minimizing accumulations of these materials on the ranges. Impacts of NSW Center Land Navigation in SHOBA, which would increase from 99 events under the No Action Alternative to 118 events under Alternative 1 (a 19-percent increase) would consist of minor soil disturbance from foot traffic.

NSW Group ONE (NSWG-1) SEAL Platoon Operations

SEAL platoon training would increase from 340 events per year under the No Action Alternative to 512 events per year under Alternative 1, an approximately 51-percent increase.

TAR 1—Demolition Range Northeast Point. TAR 1 includes a state-of-the-art demolition area with OTB capabilities. SEAL Platoon exercises would include conducting OTB, target assault, and land demolitions, similar to those described under the No Action Alternative. Under Alternative 1, the frequency of training would be 28 events per year, compared to 23 events per year under the No Action Alternative.

Demolitions would create craters within the training area. However, demolitions would occur in a previously disturbed area specifically designed for that purpose. They generally would affect less than 0.25 ac.; the amount of disturbed area would not increase under Alternative 1. The range would be cleaned up after each training exercise, in accordance with standing range instructions, so these activities would result in only minor deposition of residue on the range.

Soils are generally sandy at this location, and the terrain is gently sloping to flat. Erosion potential at this location is rated "very high" (see Figure 3.1-2). The increased frequency of training would increase the potential for surface erosion, but disturbances would continue to be local and minor.

TAR 2 – Graduation Beach Underwater Demolition Range. This site is used as an underwater demolition range. Under Alternative 1, the frequency of training would be 24 events per year, compared to 5 events per year under the No Action Alternative. Proposed site improvements would include erosion controls on the existing access road, a telephone line, a demolition staging area, and a demolition preparation area. Construction of these proposed improvements would have minor, temporary impacts. The constructed erosion control features, however, would have a positive long-term effect.

TAR 3—BUD/S Beach Underwater Demolition Range. This site is used as an underwater demolition range. Under Alternative 1, the frequency of training would not change as compared to the No Action Alternative. Proposed site improvements, activities, and impacts would be similar to those described above for TAR 2. Proposed improvements in erosion control and maintenance of the demolition area and demolition staging area would be beneficial. Impacts of training activities would be similar to those described for TAR 2.

TAR 4—Whale Point/Castle Rock. Training activities in TAR 4 would be similar to, but more extensive than, those described for TAR 1. Under Alternative 1, training frequency would increase to 240 events per year, an 8-percent increase over the 222 events under the No Action Alternative. The increase in surface disturbance would be less than proportional to the increase in training tempo, however, because most of the activities would take place in previously disturbed areas. Erosion potential at this location is rated "moderate" (see Figure 3.1-2). The range would be cleaned up after each training exercise, in accordance with standing range instructions, so these activities would result in only minor deposition of residue on the range. Environmental effects would be similar to those occurring under the No-Action Alternative.

TAR 5—West Cove Amphibious Assault Training Area. Amphibious landings and beach insertion and extraction activities could affect soils, primarily as a result of foot and vehicle traffic. Impacts on sandy sediments would be temporary, and would be eventually offset by natural processes. The area of disturbance would not increase under Alternative 1. Under Alternative 1, the frequency of training would be 25 events per year, compared to 10 events per year under the No Action Alternative. These activities would not deposit much training materials on the range, and the range would be cleaned up after each training exercise, in accordance with standing range instructions. Erosion potential in this area is rated "high" to "very high" (see Figure 3.1-2).

TAR 9—Photo Lab Training Area. This site is developed. Under Alternative 1, the frequency of training would be 32 events per year, compared to 23 events per year under the No Action Alternative. All small arms would be fired into bullet traps, greatly limiting the amount of expended training materials left on the range. Impacts of training activities on soils would consist of surface disturbance from foot traffic. The area of disturbance would not increase under Alternative 1. Because the type of use would limit surface disturbance, the area of disturbance would not increase, and the erosion potential for the area is classified as "slight" (see Figure 3.1-2), training at this location would not result in substantial soil erosion.

TAR 10—Demolition Range West. Only 1.5 ac. of this approximately 43.3-ac. area would be used. This area was previously used as a demolition and a weapons range, and is pockmarked with evidence of these past uses. Three disturbed areas (approximately 13 ac. total) remain from previous uses of this site. The area of disturbance would not increase under Alternative 1. Under Alternative 1, the frequency of training would be 20 events per year, compared to 3 events per year under the No Action Alternative.

Construction of support facilities and target structures could affect soils. Proposed facilities at this TAR would include two concrete block structures, a 200-square foot (ft^2) personnel safety bunker and a 1,000-ft^2 range building, along with erosion control measures on the access roads and in the demolition area. Construction would disturb surface materials, but impacts would be minor and temporary. Erosion control measures would be incorporated into construction, further reducing construction impacts.

SEALs would use TAR 10 for safe, operationally realistic live-fire and high explosive demolition training on patrol to other land-based TAR objectives. As part of their training, the SEALs would place explosive charges on temporary targets and demolish them. The range would be cleaned up after each training exercise, in accordance with standing range instructions, so these activities would result in minor deposition of demolition residues on the range.

Impacts from use of TAR 10 would be similar to impacts of other OTB and land training activities. High explosive ordnance would be used in these activities. Erosion potential in this area is rated "moderate" (see Figure 3.1-2). Ground disturbance would not substantially increase the potential for erosion.

TAR 11—Surveillance Training Area. Under Alternative 1, environmental effects would result from light SEAL training. No facilities would be constructed and no high explosive ordnance would be used. Under Alternative 1, the frequency of training would be 17 events per year, compared to 4 events per year under the No Action Alternative. Exercise components would include inserting and extracting personnel and equipment, tactical environmental movement, direct action, reconnaissance, helicopter hover personnel insertion (Fast Rope), and SEAL team raid. Ground disturbance from training activities would be primarily due to foot traffic. Erosion potential in this area is rated "very high" to "severe" (see Figure 3.1-2), but the increase in frequency and intensity disturbance would be minor, and the area of disturbance would be no greater than under the No Action Alternative. The range would be cleaned up after each training exercise, in accordance with standing range instructions, so these activities would result in minor deposition of training materials on the range.

TARs 12—Radar Site Training Area and *13—Randall Radar Site Training Area*. Erosion potential in this area is rated "severe" (see Figure 3.1-2), similar to conditions at TAR 11. Under Alternative 1, the frequency of training would be 12 events per year, compared to 11 events per year under the No Action Alternative. Training activities and anticipated soil impacts in these areas would be comparable to those described under TAR 11.

TAR 14—VC-3 Onshore Parachute DZ. This site is developed. Under Alternative 1, the frequency of training would be 30 events per year, compared to 20 events per year under the No Action Alternative. Its use would expand under Alternative 1 to include use of small arms and small-scale ordnance. Impacts of training on soils would consist of surface disturbance from foot traffic and the use of small arms and demolitions. The area of disturbance would not increase under Alternative 1. The range would be cleaned up after each training exercise, in accordance with standing range instructions, so these activities would result in minor deposition of training materials on the range.

TAR 16—South VC-3 (Missile Impact Range). This TAR is designated for live-fire. Under Alternative 1, the frequency of training would be 41 events per year, compared to 25 events per year under the No Action Alternative. The area of disturbance would not increase. Therefore, Alternative 1 would have no additional effect at this location. Erosion potential at this site is rated "slight."

TAR 17—Eel Point Tactical Training Range. TAR 17 would be located in an area previously used for small arms and hand grenade training. Under Alternative 1, the frequency of training would be 31 events per year, compared to 15 events per year under the No Action Alternative. Soils would be disturbed by SEAL platoon approaches and demolitions, but no new areas would be disturbed. Erosion potential at this site is rated "moderate" (see Figure 3.1-2). The range would be cleaned up after each training exercise, in accordance with standing range instructions, so these activities would result in minor deposition of training materials on the range. Impacts under Alternative 1 would be comparable to those of other land-based and OTB training activities. Based on activities occurring in previously disturbed areas, disturbance being limited to small arms and demolition training, and a moderate erosion potential, training would not increase the rate of erosion at this site.

TAR 18—Close Quarter Battle Training Complex and *TAR 19—Simulated Prisoner of War Camp and Surface to Air Missile (SAM) Site.* Under Alternative 1, the frequency of training would be 25 events per year, compared to zero events per year under the No Action Alternative. Surface areas would be disturbed by SEAL platoon approaches and demolitions, but no new areas would be disturbed. Erosion potential is rated "severe" at TAR 18 and "moderate" at TAR 19. The range would be cleaned up after each training exercise, in accordance with standing range instructions, so these activities would result in minor deposition of training materials on the range. Impacts under Alternative 1 would be comparable to those of other land-based and OTB training activities.

TAR 20—Pyramid Cove Training Area. This TAR would be located in Impact Area I. Under Alternative 1, the frequency of training would be 50 events per year, compared to 44 events per year under the No Action Alternative. Small arms fire and onshore demolitions in this 167-ac TAR could disturb soils. Erosion potential in this area is rated "severe" (see Figure 3.1-2). Topographic changes and erosion impacts would be negligible, however, because of the focused nature of the proposed activity. The range would be cleaned up after each training exercise, in accordance with standing range instructions, so these activities would result in minor deposition of training materials on the range.

TAR 21—Horse Beach Cove Training Area. Impacts of training on soils in this 50-ac TAR would be similar to those described above for TAR 3 and TAR 20. Under Alternative 1, the frequency of training would be 91 events per year, compared to 79 events per year under the No Action Alternative. The erosion potential at this location is rated "moderate," so impacts would be less than in TAR-20. The range would be cleaned up after each training exercise, in accordance with standing range instructions, so these activities would result in minor deposition of training materials on the range.

TAR 22—China Cove Training Area. Impacts of training on soils in this 289-ac TAR would be similar to those described above for TAR 20. The erosion potential at this location is rated "moderate," so impacts would be less than in TAR-20. Under Alternative 1, the frequency of training would be 200 events per year, compared to 96 events per year under the No Action Alternative. The range would be cleaned up after each training exercise, in accordance with standing range instructions, so these activities would result in minor deposition of training materials on the range.

Direct Action

Direct Action activities would increase from 156 per year under the No Action Alternative to 163 per year under Alternative 1, increasing ordnance expenditure by about 5 percent. Additional surface disturbance from increased ordnance expenditures would not substantially increase erosion potential. Existing mitigation measures identified in Section 3.1.1.2 would continue to be implemented island-wide to minimize the potential for and effects of erosion.

3.1.2.3.4 Strike Warfare

Air Strikes would increase from 176 events per year under the No Action Alternative to 197 events per year under Alternative 1, a 12-percent increase. This change in frequency would increase the amounts of ordnance that would be dropped in Impact Areas I and II by about 12 percent. About 6,270 small arms projectiles, 16 flares and smoke canisters, 194 missiles and rockets, and about 2,100 bombs, weighing a total of about 189 T (172 MT), would be expended annually under Alternative 1, mostly in SHOBA. Ordnance over 500 lb. (226 kg) would continue to be limited to the Heavy Ordnance Area in Impact Area II. Although the frequency of events would increase, the resulting disturbances would not substantially increase the potential for erosion. The effects of ordnance impacts in previously disturbed areas are less than proportional to the increase in their numbers.

3.1.2.3.5 Research, Development, Test, and Evaluation (RDT&E)

Under Alternative 1, RDT&E activities would expend about 81 naval gun shells and 18 missiles per year, weighing about 7.4 T (6.7 MT). If all of these training materials were deposited in SHOBA and not picked up, then about 10 lb/ac (11 kg/ha) per year would be deposited on the range by RDT&E activities.

3.1.2.3.6 Non-Combat Operations - Explosive Ordnance Disposal

EOD activities would be the same under Alternative 1 as under the No Action Alternative, and would use the same types of ordnance (i.e., 5-inch/54-caliber shells and other explosives) as under the No Action Alternative. Thus, effects of this activity on soils disturbance and training residue deposition would be the same as described under the No Action Alternative.

3.1.2.3.7 Vehicle Travel on Unpaved Roads

The contribution of existing ground vehicle traffic to wind and water erosion of SCI soils is not known. Quantitative information on on-island vehicle miles traveled on unpaved SCI roads is not available. On the assumption that vehicle miles traveled on unpaved roads on SCI would be proportional to the general increase in training tempo associated with on-island training activities, then vehicle miles traveled on unpaved SCI roads would increase by about 45 percent under Alternative 1. Soil compaction, wind erosion, and water erosion from unpaved roads would likely increase, although the amounts are unknown. Neither soil compaction nor erosion have a linear relationship to vehicle miles traveled, so increases in erosion from increased vehicle travel would be somewhat less than the estimated percentage increase in vehicle travel. Any substantial increases in soil erosion on SCI could degrade training facilities or require the implementation of more stringent management measures, affecting the quality of the training environment.

3.1.2.4 Alternative 2

Alternative 2 would include additional Battalion-sized amphibious exercises / landings, which do not occur under the No Action Alternative.

The overall effects of discarded materials from training activities on soils on SCI, primarily in SHOBA, would be related to the numbers and mass of training items deposited on the surface. About 6.3 million training items, weighing about 481 T (437 MT), would be expended per year under Alternative 2. This would be an increase of about 39 percent over the No Action Alternative. The deposition rate of expended training materials would be about 134 lb/ac (149 kg/ha) per year (assuming that >99 percent of the discarded materials are deposited on no more than 20 percent of SCI, or about 7,200 ac (2,915 ha). About 98 percent of these items are small arms. Based on clearance data for FY05 - FY07, about 140 T (127 MT) per year of expended training materials would be recovered from SHOBA during EOD sweeps.

The hazardous constituents of small arms and other ordnance residues include metals, such as lead, nickel, chromium, and copper. They also include explosive and propellant residues and their degradation products. The effects and fates of these soil contaminants are discussed in Section 3.3, Hazardous Materials and Wastes.

The types of impacts to soils from training activities under Alternative 2, including impacts from ordnance, foot traffic, vehicle travel on unpaved roads, and amphibious landings are similar to those described under Alternative 1.

The increases in land training and testing activities proposed under Alternative 2 (roughly 62 percent over the No Action Alternative) could incrementally increase rates of soil erosion in portions of those watersheds where training ranges or impact areas are located. In areas of heavy use for training, visible increases in soil disturbance and soil erosion may be observed over small areas. For example, training activities in the AVMA, alone, under Alternative 2 would result in losses of an additional 2,130 T (1,940 MT) per year of soils from erosion.

The subsections below addresses the impacts of the individual activities proposed under Alternative 2 on the soils of SCI.

3.1.2.4.1 Shore Bombardment Area Training

Activities in SHOBA include NSFS, BOMBEX, various gun exercises (e.g., NSW raids), mortar and artillery fire, and small arms training. COMPTUEX, JTFEX, EFEX, and amphibious landing activities are also conducted in SHOBA. The effects of training activities in SHOBA, including the effects of ordnance impacts in SHOBA's Impact Areas I and II, are described in Section 3.1.2.2.1. Heavy ordnance impacts in SHOBA would increase by about 19 percent under Alternative 2. Deposition of expended ordnance materials would increase by about 19 percent under Alternative 2. The types of soil impacts resulting from foot traffic, vehicle travel on unpaved roads, ordnance impacts, and other surface disturbances associated with Navy training activities are generally described under the No Action Alternative in Section 3.1.2.2.1.

3.1.2.4.2 Amphibious Warfare

NSFS, EFEX, Battalion Landings, Stinger Missile training, and Amphibious Landings and Raids would occur under Alternative 2. Impacts on soils from small boat raids are limited to infrequent surface disturbance from rubber boats and foot traffic. AMW activities result in the annual expenditure of about 5,400 naval gun shells, 2,720 cannon and mortar shells, about 244,000 small arms projectiles, 369 missiles and rockets, and 459 bombs. These items add about 248 T (225 MT) per year of expended training materials, mostly metals, to surface soils. Assuming for purposes of analysis that all of these materials were expended in SHOBA and that SHOBA has an area of about 1,500 ac (590 ha), then about 331 lb/ac (367 kg/ha) per year of expended materials would be deposited by these activities. Individual AMW training activities are described below.

Naval Surface Fire Support Exercise

NSFS activities would increase from 47 events under the No Action Alternative to 52 events per year under Alternative 2, an approximately 11-percent increase. The impacts in Impact Areas I and II of specific activities are difficult to quantify due to the ongoing nature of these areas as active bombing ranges. An 11-percent increase in ordnance impacts, however, would not substantially increase surface disturbance in Impact Areas I and II above baseline (No Action Alternative) levels.

Expeditionary Firing Exercise (EFEX)

EFEX exercises would increase from 6 events per year under the No Action Alternative to 8 events per year under Alternative 2, a 33-percent increase. This is a major exercise, generating a substantial amount of vehicle travel, foot traffic, and ordnance impacts. Surface disturbance from artillery shells, naval gun shells, cannon shells, mortars and grenades, and small arms rounds would increase proportionately. Potential effects range from displaced soils to mild cratering. These impacts would be confined to Impact Areas I and II. The effects of the increased ordnance impacts would be offset by existing mitigation measures.

Battalion Landing

Under Alternative 2, the USMC would add two battalion-sized landings per year to its SCI training activities (this activity is not conducted under the No Action Alternative). The elements of this operation and the nature of its environmental effects would be as described under Alternative 1. The extent of Battalion Landing effects on SCI soils would be substantially greater under Alternative 2 than under Alternative 1, however, because soils would be disturbed twice per year rather than once per year, and the amount of expended training materials also would double. Cratering and surface disturbance from ordnance expenditures in SHOBA would be confined to Impact Areas I and II. Appropriate mitigation measures to control erosion, as described in the SCI INRMP, would continue to be implemented to reduce the severity of impacts from vehicle travel between sites.

USMC Stinger Firings

Under Alternative 2, Stinger training activities would occur up to four times per year. Disturbance onshore from setting up firing positions and traveling to firing positions, generally from foot traffic or HMMWV, would be temporary and would affect a small area. All disturbances would be short in duration and limited in extent.

Amphibious Landings and Raids

The number of amphibious landings and raids would increase from 7 under the No Action Alternative to 66 under Alternative 2, about a 840-percent increase. This activity would include amphibious landings by two LCUs at Northwest Harbor, vehicle travel by three HMMWVs and one 5-T truck, and demolition activities in the Northwest Harbor demolition training area. The amphibious landings would be the same as those described above. Potential effects include cratering and rutting, and displaced soils, increasing the erosion potential. Erosion control measures already are in place to counteract the potential negative effects of these actions. Vehicle travel would be restricted to established roads. Established guidelines for the use of vehicles on SCI would limit impacts on soils. With implementation of existing protective measures, these activities would not substantially increase surface disturbance.

3.1.2.4.3 Naval Special Warfare

NSW activities under Alternative 2 would result in the annual expenditure of about 285 mortar shells, about 6.0 million small arms projectiles, and 453 flares and smoke canisters. These items would add about 43 T (39 MT) per year of expended training materials, mostly metals, to surface soils. Assuming for purposes of analysis that all of the mortar rounds were expended in SHOBA and that SHOBA has an area of about 1,500 ac (607 ha), then about 0.8 lb/ac (0.9 kg/ha) per year of expended materials would be deposited by these activities. Individual NSW training activities are described below.

Basic Training—BUD/S

NSW Center Land Demolitions activities under Alternative 2 would be identical to those described under Alternative 1 (i.e., frequency, location, type, and amount of ordnance used). Small Arms activities under Alternative 2 would be identical to those described under Alternative 1 (i.e., frequency, location, type, and amount of ordnance used). Impacts of NSW Center Land Navigation in SHOBA would consist of soil disturbance from foot traffic.

NSW Group ONE (NSWG-1) SEAL Platoon Operations

SEAL platoon training would increase from 340 events under the No Action Alternative to 668 events per year under Alternative 2, an approximately 97-percent increase. The proposed TAR locations, conditions, and scopes of activities would be identical to those described under Alternative 1 (see Section 3.1.2.3.3). Under Alternative 2, foot traffic and small arms use would be proportionately greater than under the No Action Alternative. The amount of expended training materials and remnants left on the range would not be proportionately greater than under the No Action Alternative, however, because post-exercise cleanup of the ranges would still account for most of the expended training materials. Erosion would not be proportionately greater than described for the No Action Alternative because the additional training events would occur in previously disturbed areas, and mitigation measures, as described in Section 3.1.2.3.3, would be used.

Direct Action

Direct Action events would increase from 156 per year under the No Action Alternative to 190 per year under Alternative 2, an increase of about 22 percent. This increase in ordnance expenditures would result in some additional disturbance, but would not substantially increase erosion potential. Existing mitigation measures identified in Section 3.1.1.2 would continue to be implemented island-wide to minimize the potential for and effects of erosion.

3.1.2.4.4 Strike Warfare

Air Strikes would increase from 176 per year under the No Action Alternative to 216 events per year under Alternative 2, a 23-percent increase. This change in frequency would increase the total amounts of ordnance that would be dropped in Impact Areas I and II. About 6,870 small arms projectiles, 16 flares and smoke canisters, 212 missiles and rockets, and about 2,300 bombs, weighing a total of about 190 T (173 MT), would be expended annually under Alternative 2, mostly in SHOBA. All ordnance over 500 lb. (226 kg) would continue to be dropped in the Heavy Ordnance Area in Impact Area II. Although the frequency of activities would increase, the resulting disturbances would be limited, and would not substantially increase the potential for erosion. As discussed above, the effects of ordnance impacts in previously disturbed areas are less than proportional to the increase in their numbers.

3.1.2.4.5 Research, Development, Test, and Evaluation (RDT&E)

Under Alternative 2, RDT&E activities would expend about 109 naval gun shells and 28 missiles per year, weighing about 10.7 T (9.7 MT). If all of these training materials were deposited in SHOBA and not picked up, then about 14 lb/acre (16 kg/ha) per year would be deposited on the range by RDT&E activities.

3.1.2.4.6 Non-Combatant Operations - Explosive Ordnance Disposal

EOD activities would increase from 4 per year under the No Action Alternative to 10 events per year Under Alternative 2, but would use the same types of ordnance (i.e., 5-inch/54-caliber shells and explosives) as under the No Action Alternative. The total area disturbed by these activities would still be very small, so the change in the potential for erosion would be negligible.

3.1.2.4.7 Vehicle Travel On Unpaved Roads

The contribution of existing ground vehicle traffic to wind and water erosion of SCI soils is not known. Quantitative information on on-island vehicle miles traveled on unpaved SCI roads is not available. On the assumption that vehicle miles traveled on unpaved roads on SCI would be proportional to the general increase in training tempo associated with on-island training activities, then vehicle miles traveled on unpaved SCI roads would increase by about 62 percent under Alternative 2. Soil compaction, wind erosion, and water erosion from unpaved roads would likely increase although the amounts are unknown. Neither soil compaction nor erosion have a linear relationship to vehicle miles traveled, however, so increases in erosion from increased vehicle travel would be somewhat less than the estimated percentage increase in vehicle travel. Any substantial increases in soil erosion on SCI could degrade training facilities or require the implementation of more stringent management measures, affecting the quality of the training environment.

3.1.3 Mitigation Measures

3.1.3.1 Deposition of Expended Training Materials

Bi-annual UXO sweeps and cleanups after exercises would continue to mitigate the effects of training materials deposition on land ranges on SCI. Impacts on surface soils from the hazardous constituents of expended training materials are addressed in Section 3.3, Hazardous Materials and Wastes.

3.1.3.2 Soil Erosion

On-going mitigation measures for soil erosion on SCI are described in Section 3.1.1.2. Additional potential mitigation measures are discussed below.

One prudent measure would be to monitor, and provide a means for adaptive management of, erosion associated with the existing roads and ranges. Under this measure, the erosion-related conditions of the Missile Impact Range (MIR) and firebreak road would be reviewed annually in coordination with the region's Natural Resources Officer (NRO). Examples of possible control measures include placing riprap in problem areas to dissipate the energy of concentrated runoff from the MIR and the firebreak road, or placing water bars to prevent runoff from concentrating to the point where erosion could occur. A representative from NRO would be consulted to ensure that proposed erosion control efforts did not adversely affect cultural resources.

As a result of the 2008 SCI Terrestrial Biological Assessment, the Navy proposes to develop a plan that would address soil erosion associated with planned military operations in the AVMA, AFPs, AMPs and IOA. Control of erosion would promote sustainable land use in support of military operations in these areas. The goals of the plan are to:

1) minimize soil erosion in each of these operational areas and minimize off-site impacts;
2) prevent soil erosion from affecting federally listed or proposed species or their habitats; and
3) prevent soil erosion from substantially affecting other sensitive resources, including sensitive plants and wildlife and their habitats, jurisdictional wetlands and non-wetland waters, the Area of Special Biological Significance (ASBS) surrounding SCI, and cultural resources.

The plan would describe the U.S. Navy's approach to assessing and reducing soil erosion in the AVMA, AMPs, AFPs, and Infantry Operations Area, as well as on routes used to access these areas. The plan would consider the variety of available erosion control measures and determine the most appropriate measure(s) to control erosion in each area. The plan would include an adaptive management approach, and would contain the following essential elements:

- Site-specific Best Management Plans (BMPs) to minimize soil erosion on site and minimize off site impacts, which could include:
    - Setbacks or buffers from steep slopes, drainages, and sensitive resources,
    - Engineered or bio-engineered structures to reduce soil erosion and off-sit transport of sediment,
    - Revegetation,
    - Maps defining boundaries of operational areas that provide appropriate setbacks, and
    - A BMP maintenance schedule.
- A plan to monitor soil erosion and review the effectiveness of BMPs.
- A mechanism for determining and implementing appropriate remedial measures and refining BMPs should the need arise.

3.1.4 Unavoidable Adverse Environmental Effects

The main scientific factors considered in determining the residual (i.e., unavoidable) environmental effects of the Proposed Action on soils include the net deposition rate of training materials and the degree to which erosion processes would be accelerated.

The Proposed Action would have no unavoidable adverse environmental effects on soil erosion because proposed erosion control measures, structures, and procedures could, if appropriately implemented, completely control or offset increases in erosion from training activities.

The Proposed Action would result in an unavoidable, gradual increase in the soil concentrations of metals, including heavy metals such as lead, cadmium, chromium, copper, and nickel, in SHOBA and other training areas. These effects are unavoidable because, even if discernable residues and fragments of expended training materials are regularly collected from the ranges and disposed, some residues from detonations of high explosive ordnance and some corrosion and degradation products of materials left on the range for extended periods would be indistinguishable from soil particles, and no cost-effective technology exists for removal of these materials.

3.1.5 Summary of Effects by Alternative

Table 3.1-1 summarizes the impacts of the No Action Alternative, Alternative 1, and Alternative 2 on geology and soils.

Table 3.1-1: Summary of Effects by Alternative

Alternative	NEPA (On-Land and U.S. Territorial Waters)	EO12114 (Non-U.S. Territorial Waters)
No Action Alternative	• Only previously disturbed areas are affected. Cratering and erosion occur in SHOBA; however, soil changes are minor and affect only portions of the area. • Some sandy beaches are disturbed; however, the impacts are temporary and do not affect sensitive resources. • Ongoing training on some TARs causes minor increases in surface disturbance, which increases erosion potential.	• All operations are within the territory limits of the U.S.; E.O. 12114 does not apply.
Alternative 1	• Proposed training activities would be comparable to existing activities, but the weight of expended training ordnance would increase by about 22 percent. The level of disturbance of surfaces would increase accordingly. • Surface disturbance over large areas for long periods, associated with the designation of the AVMC, would increase erosion potential that would be limited by site-specific mitigation measures and measures presented in the INRMP. • One Battalion Landing would disturb soils over a wider area than TARs; beach disturbance would be temporary, soil impacts would be minimal, and comparable to existing levels of activities. Vehicle use would	• All operations are within the territory limits of the U.S.; E.O. 12114 does not apply.

	be limited to designated areas.	
Alternative 2	• Proposed training activities would be comparable to existing activities, but the weight of expended training ordnance would increase by about 33 percent. The level of disturbance of surfaces would increase accordingly. • Surface disturbance over large areas for long periods, associated with the designation of the AVMC, would increase erosion potential that would be limited by site-specific mitigation measures and measures presented in the INRMP. • Two Battalion Landings would disturb soils over a wider area than TARs; beach disturbance would be temporary, topographic changes would be minimal, and comparable to existing levels of activities. Vehicle use would be limited to designated areas.	• All operations are within the territory limits of the U.S.; E.O. 12114 does not apply.
Mitigation Measures	• The Department of the Navy (DoN) is studying sedimentation and erosion associated with watersheds on SCI. • The Erosion Control Plan identifies measures to reduce the impacts of erosion on SCI. • The Integrated Natural Resources Management Plan (INRMP) identifies presents policies to reduce the impacts of erosion on SCI. • Bi-annual sweeps and cleanup after exercises	• All operations are within the territory limits of the U.S.; E.O. 12114 does not apply.

3.2 Air Quality

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TABLE 3.2-15: SUMMARY OF EFFECTS BY ALTERNATIVE 3.2-23

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3.2 AIR QUALITY

Air quality is determined with reference to ambient air concentrations of seven major pollutants determined by the U.S. Environmental Protection Agency (USEPA) to be of concern with respect to the health and welfare of the general public. These pollutants, called “criteria pollutants,” are carbon monoxide (CO), sulfur dioxide (SO_2), nitrogen dioxide (NO_2), ozone (O_3), suspended particulate matter less than or equal to 10 microns in diameter (PM_{10}), fine particulate matter less than or equal to 2.5 microns in diameter ($PM_{2.5}$), and lead.

Ambient air quality is measured by determining the atmospheric concentration of a specific compound that occurs at a particular geographic location. Ambient air quality data are generally reported as a mass per unit volume (e.g., micrograms per cubic meter of air) or as a volume fraction (e.g., parts per million [ppm] by volume). The USEPA has established National Ambient Air Quality Standards (NAAQS) for these pollutants. Areas that violate a Federal air quality standard are designated as non-attainment areas. The California Air Resources Board (CARB) has established California Ambient Air Quality Standards (CAAQS), which generally are more stringent than NAAQS. Table 3.2-1 shows both the Federal and State ambient air quality standards.

Areas within California in which ambient air concentrations of a pollutant exceed the State and/or Federal standard are considered to be non-attainment areas for that pollutant. Non-attainment areas may be classified as basic, serious, severe, or extreme non-attainment areas for a given criteria pollutant. Non-attainment areas are required to develop and execute plans, known as State Implementation Plans (SIPs) that show how the area will meet Federal and State air quality standards. Areas that have achieved attainment may be designated as “maintenance areas,” which are subject to maintenance plans showing how the area will continue to meet Federal and State air quality standards.

The ambient air quality levels measured at a particular location are determined by the interactions of emissions, chemical properties and reactions that occur in the atmosphere, and meteorology. Emission considerations include the types, amounts, and locations of pollutants emitted into the atmosphere. Chemical reactions can transform pollutant emissions into criteria pollutants. Meteorological considerations include wind and precipitation patterns affecting the distribution, dilution, and removal of pollutant emissions.

Pollutant emissions typically refer to the amount of pollutants or pollutant precursors introduced into the atmosphere by a source or group of sources. Pollutant emissions contribute to the ambient air concentrations of criteria pollutants, either by directly affecting the pollutant concentrations measured in the ambient air or by interacting in the atmosphere to form criteria pollutants. Pollutants such as CO, SO_2, lead, and some particulates that are emitted directly into the atmosphere from emission sources are referred to as primary pollutants. Some criteria pollutants such as O_3, NO_2, and some particulates, are formed through atmospheric chemical reactions that are influenced by meteorology, ultraviolet light, and other atmospheric processes. Criteria pollutants formed through these processes are referred to as secondary pollutants. Emissions that lead to formation of secondary pollutants are considered precursors. Thus, for example, Reactive Organic Gases (ROG) and oxides of nitrogen [NO_x] are considered precursors for $O_{3.}$ In general, emissions that are considered precursors to secondary pollutants are evaluated and regulated to control the levels of associated criteria pollutants in the ambient air. PM_{10} and $PM_{2.5}$ are generated as primary pollutants by various mechanical processes (for example, abrasion, erosion, mixing, or atomization) or combustion processes. However, PM_{10} and $PM_{2.5}$ can also be formed as secondary pollutants through chemical reactions or by gaseous pollutants condensing into fine aerosols.

Table 3.2-1: National and California Ambient Air Quality Standards

Pollutant	Averaging Time	NAAQS[note 1]		CAAQS[note 2]
		Primary[note 3]	Secondary[note 4]	Concentration[note 5]
Ozone (O_3)	1-Hour	-	Same as Primary Standard	0.09 ppm (180 $\mu g/m^3$)
	8-Hour	0.08 ppm		0.070 ppm (137 $\mu g/m^3$)[note 7]
Carbon Monoxide (CO)	8-Hour	9.0 ppm (10 mg/m^3)	None	9.0 ppm (10 mg/m^3)
	1-Hour	35 ppm (40 mg/m^3)		20 ppm (23 mg/m^3)
Nitrogen Dioxide (NO_2)[note 6]	Annual Average	0.053 ppm (100 $\mu g/m^3$)	Same as Primary Standard	0.030 ppm (56 $\mu g/m^3$)
	1-Hour	-		0.18 ppm (338 $\mu g/m^3$)
Sulfur Dioxide (SO_2)	Annual Average	80 $\mu g/m^3$ (0.03 ppm)	-	-
	24-Hour	365 $\mu g/m^3$ (0.14 ppm)	-	0.04 ppm (105 $\mu g/m^3$)
	3-Hour	-	1300 $\mu g/m^3$ (0.5 ppm)	-
	1-Hour	-	-	0.25 ppm (655 $\mu g/m^3$)
Suspended Particulate Matter (PM_{10})	24-Hour	150 $\mu g/m^3$	Same as Primary Standard	50 $\mu g/m^3$
	Annual Arithmetic Mean	-		20 $\mu g/m^3$
Fine Particulate Matter ($PM_{2.5}$)	24-Hour	35 $\mu g/m^3$	Same as Primary Standard	-
	Annual Arithmetic Mean	15 $\mu g/m^3$		12 $\mu g/m^3$
Lead (Pb)[note 7]	30-Day Average	-	-	1.5 $\mu g/m^3$
	Calendar Quarter	1.5 $\mu g/m^3$	Same as Primary Standard	-
Hydrogen Sulfide (HS)	1-Hour	No Federal Standards		0.03 ppm (42 $\mu g/m^3$)
Sulfates (SO_4)	24-Hour			25 $\mu g/m^3$
Visibility Reducing Particles	8-Hour (10 am to 6 pm, Pacific Standard Time)			In sufficient amount to produce an extinction coefficient of 0.23 per kilometer due to particles when the relative humidity is less than 70 percent.
Vinyl chloride[7]	24 Hour			0.01 ppm (26 $\mu g/m^3$)

[1] NAAQS (other than O_3, particulate matter, and those based on annual averages or annual arithmetic mean) are not to be exceeded more than once a year. The O_3 standard is attained when the fourth highest 8-hour concentration in a year, averaged over 3 years, is equal to or less than the standard. For PM_{10}, the 24-hour standard is attained when 99 percent of the daily concentrations, averaged over 3 years, are equal to or less than the standard. For $PM_{2.5}$, the 24-hour standard is attained when 98 percent of the daily concentrations, averaged over 3 years, are equal to or less than the standard. Contact the USEPA for further clarification and current federal policies.

[2] California Ambient Air Quality Standards for O_3, CO (except Lake Tahoe), SO_2 (1- and 24-hour), NO_2, PM_{10}, and visibility reducing particles, are values that are not to be exceeded. All others are not to be equaled or exceeded.

[3] National Primary Standards: The levels of air quality necessary, with an adequate margin of safety, to protect the public health.

[4] National Secondary Standards: The levels of air quality necessary to protect the public welfare from any known or anticipated adverse effects of a pollutant.

Note: $\mu g/m^3$ = milligrams per cubic meter

Source: CARB 2007a, USEPA 2005.

[5] Concentration expressed first in units in which it was promulgated. Ppm in this table refers to ppm by volume or micromoles of pollutant per mole of gas.

[6] The Air Resources Board has approved new NO_2 standards. The new 1-hour CAAQS will be 0.18 ppm, and the new annual CAAQS will be 0.030 ppm. The standards are in the process of implementation.

[7] The CARB has identified lead and vinyl chloride as 'toxic air contaminants' with no threshold level of exposure for adverse health effects determined. These actions allow for the implementation of control measures at levels below the ambient concentrations specified for these pollutants.

In addition to those pollutants that are designated criteria pollutants, additional pollutants that are considered to have the potential for health effects are categorized as hazardous air pollutants (HAPs) under Section 112 of the Clean Air Act (CAA). The USEPA has identified 188 substances as HAPs. Examples of HAPs include benzene, which is found in gasoline; perchloroethylene, which is emitted from some dry cleaning facilities; and methylene chloride, which is used as a solvent and paint stripper in some industries. HAPs are regulated under the Clean Air Act provisions, including the National Emission Standards for Hazardous Air Pollutants, which apply to specific sources of HAPs, and the Urban Air Toxics Strategy, which applies to area sources. The California EPA has also adopted rules governing HAPS, including the Air Toxics “Hot Spots” Information and Assessment Act (AB 2588), and local rules governing toxics new source review.

In addition to criteria pollutants and HAPs, combustive emission sources are also source of carbon dioxide (CO_2) and minor amounts of nitrous oxide (N_2O) and methane (CH_4), which are considered greenhouse gases. The USEPA does not currently regulate greenhouse gases. Notwithstanding the lack of USEPA regulation of GHG emissions, in 2006, the California Legislature adopted Assembly Bill (AB 32), the California Global Warming Solutions Act of 2006. AB 32 requires the CARB, the State agency charged with regulating statewide air quality, to adopt rules and regulations that would achieve GHG emissions equivalent to statewide levels in 1990 by 2020. As the policy making process continues, CARB is considering a broader set of mitigation measures, including carbon sequestration projects and best management practices that are technologically feasible and cost-effective. Greenhouse gases as defined under AB 32 include: CO_2, CH_4, N_2O, hydrofluorocarbons, perfluorocarbons, and sulfur hexafluoride. The provisions of AB 32 do not specifically address military operations; however, military operations are not specifically exempted by the legislation and may be addressed through implementation of future programs developed by CARB.

3.2.1 Affected Environment

The Southern California (SOCAL) Range Complex encompasses the surface and subsurface ocean operating areas (OPAREAs), over-ocean military airspace, and San Clemente Island (SCI). Portions of the SOCAL Range Complex lie within two different air quality regulatory jurisdictions, and portions are not within any air quality regulatory jurisdiction. SCI lies within the South Coast Air Basin (SCAB)[1]. Coastal waters within 3 nm of a shoreline are part of the same air quality jurisdiction as the contiguous land area.[2] Therefore, the waters within 3 nm of SCI lie within the SCAB. Portions of the OPAREAs lie within 3 nm of the shoreline of San Diego County; these ocean areas are within the San Diego Air Basin (SDAB). Portions of the SOCAL OPAREAs that lie outside coastal waters and beyond 3 nm of a coastline (i.e., that are not part of the SCAB or SDAB) are not within any air quality jurisdiction.

[1] SCI is in the County of Los Angeles.

[2] The regulations of the CARB define “California Coastal Waters” the “area between the California coastline and a line starting at the California-Oregon border at the Pacific Ocean thence to 42.0 north, 125.5 west; thence to 41.0 north, 125.5 west; thence to 40.0 north, 125.5 west; thence to 39.0 north, 125.0 west; thence to 38.0 north, 124.5 west; thence to 37.0 north, 123.5 west; thence to 36.0 north, 122.5 west; thence to 35.0 north, 121.5 west; thence to 34.0 north, 120.5 west; thence to 33.0 north, 119.5 west; thence to 32.5 north, 118.5 west.

3.2.1.1 SOCAL OPAREAs

3.2.1.1.1 Existing Conditions

The condition of the Affected Environment (existing conditions) includes impacts on Air Quality from past and present natural causes and man-made activities. The following discussion describes some of these factors.

The SCAB is comprised of Orange County and substantial portions of Los Angeles, Riverside, and San Bernardino Counties, and includes the largest urban area in the western United States. With 15 million inhabitants, the SCAB encompasses 43 percent of California's population, and accounts for 40 percent of all vehicle miles traveled, and one-third of all air pollutant emissions in the State (CARB 2006). Motor vehicles are the largest emission sources of carbon monoxide (CO), nitrogen oxides (NOx), and reactive organic gases (ROG). There is a heavy concentration of industrial facilities, several major airports, two major shipping ports, and a dense freeway and surface street network.

The SDAB is comprises of San Diego County, and encompasses eight percent of the state's population; with a growth rate of 54 percent since 1981, San Diego is one of the fastest growing areas in the state. San Diego accounts for about nine percent of vehicle miles driven in California, and includes industrial facilities, an international airport and a significant seaport. Presently, seven percent of California's air pollution is generated within the SDAB (CARB 2006).

The climate of southern California is characterized by warm, dry summers and mild, wet winters. One of the main determinants of the climatology is a semi-permanent high-pressure area (the Pacific High) in the eastern Pacific Ocean. In the summer, this pressure center is located well to the north, causing storm tracks to be directed north of California. This high-pressure cell maintains clear skies in southern California for much of the year. When the Pacific High moves southward during the winter, this pattern changes, and low-pressure centers migrate into the region, causing widespread precipitation. The Pacific High also influences the wind patterns of California. The predominant wind directions are westerly and west-southwesterly during all four seasons, and the average annual wind speed is 5.6 mi./hr. (8.2 m./sec.).

A common atmospheric condition known as a temperature inversion affects air quality in southern California. During an inversion, air temperatures get warmer with increasing height. Subsidence inversions occur during the warmer months (May through October) as descending air associated with the Pacific high-pressure cell comes into contact with cool marine air. The boundary between the layers of air represents a temperature inversion that traps pollutants below it. Inversion layers are important elements of local air quality because they inhibit the dispersion of pollutants, thus resulting in a temporary degradation of air quality.

Coastal waters within the SDAB are classified as a basic non-attainment area for the 8-hour NAAQS for O_3, and a maintenance area for CO. The SCAB, which includes waters contiguous to SCI, is classified as a severe non-attainment area for the 8-hour NAAQS for O_3, a serious non-attainment area for CO, a maintenance area for NO_2, a serious non-attainment area for PM_{10}, and a non-attainment area for $PM_{2.5}$. It should be noted, however, that in the Draft Final 2007 Air Quality Management Plan (AQMP), the South Coast Air Quality Management District (SCAQMD) states they are requesting to be redesignated to an extreme non-attainment area for the 8-hour NAAQS for O_3. Redesignation would allow the SCAQMD additional time to attain the standard.

As discussed in Section 1.3.2, a separate Draft Environmental Impact Statement (EIS)/Overseas Environmental Impact Statement (OEIS) (hereafter referred to as "EIS/OEIS") has been prepared to address Navy activities on the Point Mugu Sea Range; however, certain training activities, specifically those involving use of sonar, occurring on the southern portion of the Sea Range are not addressed in the Point Mugu EIS/OEIS. These training activities and associated emissions are addressed in this air quality impacts analysis.

There are no stationary sources of emissions within the SOCAL OPAREAs (outside of SCI).

3.2.1.1.2 Current Mitigation Measures

Equipment used by military organizations within the SOCAL OPAREAs, including ships and other marine vessels, aircraft, and other equipment, are properly maintained in accordance with applicable Navy and Marine Corps requirements thus reducing potential impacts to air quality. Operating equipment meets federal and state emission standards, where applicable.

3.2.1.2 San Clemente Island

3.2.1.2.1 Existing Conditions

General climatic conditions at SCI are the same as for the SOCAL OPAREAs (see Section 3.2.1.1). At SCI, the precipitation averages about 4 to 9 in. (10 to 23 cm) annually. The mean temperature is 62.2 ^{o}F (16.8 ^{o}C), and the mean maximum and mean minimum temperatures are 75.7 ^{o}F (24.3 ^{o}C) and 48.5 ^{o}F (9.2 ^{o}C), respectively.

SCI is within SCAB, which is classified as a severe non-attainment area for the 8-hour NAAQS for O_3, a serious non-attainment area for CO, a maintenance area for NO_2, a serious non-attainment area for PM_{10}, and a non-attainment area for $PM_{2.5}$. As discussed in Section 3.2.1.1.1, the Draft Final 2007 AQMP includes a request for redesignation to an extreme non-attainment area for the 8-hour NAAQS for O_3.

Stationary sources of emissions at SCI include the generators at the main power plant in Wilson Cove, as well as other SCI generators identified as emergency generators, including the Range Electronic Warfare Station (REWS) power plant in the Shore Bombardment Area (SHOBA), boilers and water heaters, internal combustion engines, and gas turbine engines. Emissions estimates were obtained from the AQMD 2004-2005 Air Emissions Report (SCAQMD 2005) to establish an air quality baseline. Emissions from stationary sources on SCI are summarized in Table 3.2-2.

Emissions from the main power plant have been exempted from the SCAQMD's RECLAIM program (SCAQMD Regulation) because the source has been evaluated with respect to impacts to the SCAB and has been determined to have an insignificant impact on the air quality in the basin (SCAQMD 1997).

Table 3.2-2: Estimated Emissions from Stationary Sources

Stationary Sources	Emissions, tons/year				
	CO	NOx	ROG	SOx	PM_{10}
Total Permitted Emissions	31.58	114.66	11.97	2.36	2.76
Total Non-Permitted Emissions	0.23	1.05	0.30	0.08	0.06
Total	31.81	115.71	12.27	2.44	2.82

Non-stationary sources operating at SCI include sources involved in military activities such as aircraft and marine vessels, and ground vehicles. Emissions from ground vehicles are not regularly inventoried, and no current estimate of ground vehicle emissions on SCI is available. Emissions associated with aircraft and marine vessels operating at SCI are included in the State Implementation Plan (SIP) emissions budget and are discussed below.

State Implementation Plan: Emissions from Military Activities at SCI and Contiguous Waters and Airspace

The SCAQMD is responsible for the development of the SIP for the SCAB. The SIP contains estimates of emissions for criteria pollutants, known as the emissions inventory. The purpose of the SIP emissions inventory is to provide input to the attainment demonstration, which documents that the emissions can be accommodated in the air basin without hindering further progress toward attainment. The SCAQMD develops its portion of the California SIP in the Air Quality Management Plan (AQMP). The AQMP is updated approximately every 3 years. The most recent approved plan is the 2003 AQMP, which contains emission forecasts for military activities at SCI and in the waters and airspace contiguous to SCI (to 3 nm, below 3000 ft MSL). The emission forecasts for 2006 included in the 2003 AQMP (SCAQMD 2002) and the updated 2007 AQMP are presented in Table 3.2-3. On March 13, 2002, the SCAQMD confirmed by letter to the Navy that the emissions associated with military activities at SCI and its contiguous waters were included in the update to the SIP inventory (SCAQMD 2002). Furthermore, the SCAQMD has included in the SIP a 1 percent growth factor in allowable emissions from Navy and Marine Corps activities at SCI and contiguous waters and airspace to account for future increases in operational tempo.

In addition to the SIP budget for SCI, the SCAQMD has included emissions associated with the replacement of the AAVs with EFVs. The SIP budget includes emissions for fiscal years 2007/2008, and additional emissions for 2009 for the EFVs.

Table 3.2-3: SCI Emissions Included in 2007 AQMP

Emission Source	Emissions, tons/year				
	CO	NOx	ROG	SOx	PM_{10}
Aircraft – Range Operations	4.57	5.66	0.48	0.31	3.39
Surface Ships	17.94	29.05	10.66	6.13	1.16
Ordnance	21.20	0.07	0.01	0.00	0.26
NALF Aircraft	333.15	55.71	106.43	3.66	61.35
SCI Emissions Total	**376.86**	**90.49**	**117.58**	**10.10**	**66.16**
EFVs	4.51	9.62	1.44	0.18	36.20
Total	**381.37**	**100.11**	**119.02**	**10.28**	**102.36**

As discussed above, emissions for SCI are projected to grow by 1 percent per year starting in the year 2006.

Emission factors for greenhouse gases are not currently available for aircraft, ships, and ordnance operations. As state and federal regulatory requirements develop in the future, the Navy may be required to quantify and address greenhouse gas emissions from military operations. The total CO_2-equivalent emissions in the state of California were estimated at 492 million metric tons in 2004, and total U.S. emissions were estimated at 7,074 million metric tons.

3.2.1.2.2 Current Mitigation Measures

Equipment used within the SCI, including marine vessels, aircraft, ground vehicles, and other equipment, are properly maintained in accordance with applicable Navy and Marine Corps requirements, this reducing potential impacts to air quality. Operating equipment meets federal emission standards, where applicable.

3.2.2 Environmental Consequences

3.2.2.1 Approach to Analysis

The evaluation of potential air quality impacts includes two separate analyses. Effects of air pollutant emissions from SOCAL range operations occurring within U.S. Territory (i.e., within 12 nm of the coastline) are assessed under NEPA. Effects of air pollutant emissions from SOCAL range operations occurring outside U.S. Territory are assessed under EO 12114. For the purposes of assessing air quality effects under NEPA, all operations involving the use of aircraft, vessels, and ground equipment at or below 3,000 ft in those areas within U.S. territorial waters were included in the emissions estimates. This includes all operations on SCI. For the purposes of assessing air quality effects under EO 12114, only those aircraft, vessels, and missiles/targets operations occurring at or below 3,000 ft and outside of U.S. territorial waters were considered in the evaluation.

The NEPA analysis involves estimating emissions generated from the proposed activities and assessing potential impacts on air quality, including an evaluation of potential exposures to toxic air pollutant emissions. Trace amounts of air toxics emissions would be generated from combustion sources and use of ordnance. Air toxics emissions include hazardous air pollutants not covered under the ambient air quality standards. Potential hazardous air pollutant sources are associated with missile and target operations and include rocket motor exhaust and unspent missile fuel vapors. These emissions would be minor and would not result in adverse impacts due to the distance from sensitive receptors that could be affected by air toxics and the negligible levels of emissions.

The NEPA analysis includes a Clean Air Act (CAA) General Conformity Analysis in order to make an applicability determination pursuant to the General Conformity Rule (40 C.F.R. § 93[B]), by focusing on operations that could potentially impact non-attainment areas within the ROI. As noted, the EIS Study Area lies partially within two air basins. The SCAB and SDAB have different SIP requirements. In evaluating conformity with the respective SIP components for each air basin, emissions were allocated between the SCAB and SDAB, based on the location of the emission within the SOCAL Range Complex. The CAA Conformity Applicability Analysis is presented in Section 3.2.3 and includes an analysis of the applicability of the General Conformity Rule.

The EO-compliant analysis involves estimating emissions generated from the proposed activities and assessing potential impacts on air quality outside U.S. Territory. The General Conformity Rule does not apply since the CAA is not applicable to actions outside the United States.

The data for the air quality analysis is based, wherever possible, on parametric information from the Southern California Offshore Range (SCORE) records and data files. The primary source is the SCORE Participants data as supplemented by additional range data and interviews with Subject Matter Experts (SMEs) on military operations. These data were used to estimate numbers and types of aircraft, surface ships and vessels, submarines, and ordnance that would be involved in each alternative. Each of these constitutes a potential source of air emissions. The approach used to characterize emissions from each of the emission source categories is summarized below. An itemized list of emission sources and summary of the approach used to prepare emissions estimates for the No Action Alternative (baseline), Alternative 1, and Alternative 2 is presented below.

Aircraft Operations

The methodology for estimating aircraft emissions involves evaluating the type of operations for each type of aircraft, the number of hours of operation for each aircraft type, the type of engine in each aircraft, and the mode of operation for each type of aircraft engine. Emissions occurring or that would occur above 3,000 ft (915 m) were considered to be above the atmospheric inversion layer and therefore without impact on the local air quality. Aircraft flights, for the most part originate from onshore air stations, but some are from aircraft carriers offshore. It was assumed that all aircraft would be traveling from their home base to the SOCAL OPAREAs at an elevation above 3,000 ft (915 m), and that transit to the range would therefore not affect local air quality. Flights originating from the SCI Naval Auxiliary Landing Field (NALF) Airfield were assumed to be accounted for in the NALF Airfield Operations.

The types of aircraft and numbers of sorties for the No Action Alternative are derived from the Participants tables in the SCORE Participants data. For Alternatives 1 and 2, operational estimates of future aircraft use percentages were obtained based on evolutionary changes in the Navy force structure and mission assignments. Where there were no major changes in types of aircraft, future operations estimates were based on the percentage distribution of baseline operations. For operations where specific aircraft were not designated (i.e., where “other” aircraft were indicated), the SH-2 was used to represent rotary-wing aircraft and the F/A-18 was used to represent fixed-wing aircraft.

Time on range for the No Action Alternative was based on calculations of average times derived from range records. To estimate times on range for each aircraft operation in Alternatives 1 and 2, an average time was extrapolated from the data during the baseline year. Estimated altitudes of operations for all aircraft were obtained from SMEs (aircrew members) in operational squadrons. Helicopters, including the SH-60, CH-46, CH-53, and UH-1, were assumed to operate below 3,000 ft (915 m) elevation during their time in the SOCAL OPAREAs while participating in operations. To estimate times in the various air quality zones of interest, the locations of representative operations were analyzed, and their paths plotted. Time in the individual areas was then estimated based upon operational maneuvers and routine flight path analysis.

NALF SCI airfield operations include emissions from aircraft takeoffs and landings at the airfield, emissions from stationary sources, and emissions from ground vehicles and ground support equipment (GSE). Emissions from stationary sources and ground support equipment were assumed to be the same for all alternatives. Emissions from NALF operations were calculated based on the numbers of operations projected for each type of aircraft at the NALF on an annual basis.

Emissions were estimated based on times in mode, using the Navy’s Aircraft Emission Support Office (AESO) Memorandum Reports for individual aircraft categories (Aircraft Emission Estimates: Landing and Takeoff Cycle and Maintenance Testing, and Aircraft Emission Estimates: Mission Operations, AESO 1998a, 1998b, 1999a-1999q, 2000a-2000e). For aircraft for which AESO emission factors were not available (such as the Learjet aircraft), emission factors were obtained from the Federal Aviation Administration’s (FAA) Emission and Dispersion Modeling System (EDMS), which is the FAA’s approved model for military airfield and civilian airport operations (FAA 2005).

Surface Ship Operations

Naval vessel traffic in the SOCAL OPAREAs is composed of military ship and boat traffic, including support vessels providing services for military training exercises and tests. A number of non-military commercial vessels and recreational vessels are also regularly present within the

SOCAL OPAREAs. These vessels were not evaluated in the air quality analysis as they are not part of the Navy's action. The methodology for estimating marine vessel emissions involves evaluating the type of operation for each type of vessel, the number of hours of operation for each vessel type, the type of propulsion engine in each vessel, and the type of generator used onboard each type of vessel.

The types of surface ships and numbers of operations for the No Action Alternative are derived from the SCORE Participants data. For Alternatives 1 and 2, operational estimates of future ship use percentages were obtained based on evolutionary changes in the Navy force structure and mission assignments. Where there were no major changes in types of ships, future operations estimates were based on the percentage distribution of historical operations.

For surface ships, times for each operation were estimated by taking an average over the total number of operations for each type of training, as recorded by SCORE. Detailed estimates of operations for baseline operations and for future operations were obtained based on discussions with fleet SMEs.

To estimate times in the various air quality zones of interest, the locations of representative operations were analyzed, and their paths plotted. Time in the individual areas was then estimated based upon operational maneuvers. The resultant information provided an estimate for baseline and future operations of Navy vessels with respect to time operating on the range and the percentage of the time spent in each part of the SOCAL OPAREAs. In addition, information provided by fleet participants was used to develop a breakdown of time spent at each power level used during range operations in which marine vessels participated.

Emission factors for marine vessels were then obtained from the database developed for Naval Sea Systems Command (NAVSEA) by JJMA Consultants (JJMA 2001). Emission factors were provided for each marine vessel type and operational mode (i.e., power level). The resulting calculations provided information regarding the time spent at each power level in each part of the SOCAL OPAREAs, emission factors for that power level (in pounds [lb] of pollutant per hour), and total emissions for each marine vessel for each operational type and mode.

Submarine Operations

Since no U.S. submarines burn fossil fuel, it was assumed that they would have no airborne emissions associated with their operations.

Naval Gunfire and Missile Ordnance

Ordnance emissions emanate from naval gunfire, missiles, bombs, and other types of ordnance used in the various operations. To estimate emissions from use of ordnance, the number and type of each type of ordnance was totaled for each of the operations. Ordnance was classified by category and type. Where available, emission factors were derived from the Navy's Ordnance Data for Toxic Hazards Associated with Pyrotechnic Items (NAVSEA SW050-AC-ORD-010, NAVAIR 11-15-8, (DoN 1996). Where emission factors for specific types of ordnance were not available from this reference, USEPA's AP-42 emission factor database was used, with assumptions regarding the type of ordnance (USEPA 2006). Ordnance emissions were assumed to occur within U.S. Territory.

Ground Vehicles and Ground Support Equipment (GSE)

Some ground vehicles participate in operations at SCI. Ground vehicle emissions were estimated based on emission factors provided by the Navy and U.S. Marine Corps (USMC) for their vehicles. Where emission factors were not available (for the Fast Attack Vehicles [FAVs]), emissions were estimated based on EMFAC 2007 emission factors for light duty, diesel-powered trucks (CARB 2007b). To estimate emissions for FAVs, it was assumed that each vehicle would operate with four starts per day and would travel 5 miles (8 kilometers) per trip at an average speed of 25 mi per hour (40 km per hour).

SOCAL Range Complex Enhancements

The Navy has identified specific investments and recommendations to optimize range capabilities required to adequately support training for all missions and roles assigned to the SOCAL Range Complex under the Proposed Action. These enhancements include installation of the Shallow Water Training Range (SWTR). Potential emissions associated with SWTR construction are addressed in Section 3.2.2.4.3, below in the context of Alternative 2.

3.2.2.2 No Action Alternative

Under the No Action Alternative, there would be no increase in operations from baseline activities. The emissions levels would remain constant for those emission sources that are not affected by other Federal, State, or local requirements to reduce air emissions. Emissions associated with motor vehicles may decrease due to the implementation of Federal and California CAA requirements to reduce tailpipe emissions; however, motor vehicles do not constitute a large source of emissions in the SOCAL Range Complex.

Emissions for the No Action Alternative reflect baseline levels that are currently occurring in the SOCAL Range Complex. Emissions occurring in the offshore areas may be transported onshore and may affect the existing air basins. The impact of emissions occurring offshore is, however, small in comparison with onshore emission sources given the distance transported and the dispersion that occurs during transport. Any impacts are reflected in current background emissions in the affected air basins. Impacts for the No Action Alternative would not be different from the baseline impacts.

3.2.2.2.1 SOCAL OPAREAs

The total air emissions associated with the No Action Alternative are presented in Table 3.2-4 for emissions within the SOCAL OPAREAs. Table 3.2-4 presents a breakdown of emissions in the SOCAL OPAREAs subject to NEPA (within U.S. Territory) versus those subject to EO 12114 (outside U.S. Territory). Emissions were further segregated into those emissions occurring within 12 nm of SCI and those emissions occurring within 12 nm of the mainland (San Diego County). There is no increase in emissions above the baseline within U.S. Territory under the No Action Alternative.

The portion of the emissions occurring within 3 nm of SCI have been accounted for in the 2007 AQMP and are consistent with the SIP emissions budget for the SCAB as discussed in Section 3.2.1.2.1.

Table 3.2-4: Annual Air Emissions within SOCAL OPAREAs for No Action Alternative

Emission Source	Emissions, tons/year					
	CO	NOx	ROG	SOx	PM_{10}	$PM_{2.5}$
Within U.S. Territory – SCI						
Aircraft Operations	5.04	7.28	0.51	0.40	4.68	4.63
Marine Vessel Operations	65.01	45.42	7.92	22.52	3.55	3.51
Ordnance	25.12	1.15	0.00	0.01	2.66	1.89
Total	**95.17**	**53.85**	**8.43**	**22.93**	**10.89**	**10.03**
Within U.S. Territory – San Diego County						
Aircraft Operations	3.75	5.22	0.42	0.28	1.92	1.90
Marine Vessel Operations	204.57	511.55	21.22	224.04	29.72	29.42
Ordnance	0.09	0.01	0.00	0.00	0.00	0.00
Total	**208.41**	**516.78**	**21.64**	**224.32**	**31.64**	**31.32**
Outside U.S. Territory – Offshore San Diego Air Basin						
Aircraft Operations	16.45	40.16	1.85	1.81	23.16	22.93
Marine Vessel Operations	583.20	437.81	50.56	281.98	43.31	42.87
Total	**599.65**	**477.97**	**52.41**	**283.79**	**66.47**	**65.8**
Outside U.S. Territory – Offshore Mexico						
Aircraft Operations	2.41	1.94	0.45	0.10	1.15	1.14
Marine Vessel Operations	43.84	28.03	3.95	11.12	1.77	1.75
Total	**46.25**	**29.97**	**4.40**	**11.22**	**2.92**	**2.89**

3.2.2.2.2 San Clemente Island

The total air emissions associated with the No Action Alternative are presented in Table 3.2-5 for emissions occurring on SCI. For the purpose of this analysis, all ground vehicle operations and all NALF operations would occur on SCI. There is no increase in emissions above the baseline on SCI under the No Action Alternative.

Emissions occurring on SCI have been accounted for in the 2007 AQMP and are consistent with the SIP emissions budget for the SCAB as discussed in Section 3.2.1.2.1.

Table 3.2-5: Annual Air Emissions on SCI for No Action Alternative

Emission Source	Emissions, tons/year					
	CO	NOx	ROG	SOx	PM_{10}	$PM_{2.5}$
NALF Operations	132.86	37.97	33.63	1.89	28.11	27.83
Ground Vehicle Operations	0.10	0.02	0.01	0.00	0.00	0.00
Total	**132.96**	**37.99**	**33.64**	**1.89**	**28.11**	**27.83**

3.2.2.3 Alternative 1

To assess the potential for air quality impacts resulting from emissions that would result from increases in operations on the SOCAL Range Complex, impacts onshore in the non-attainment air basins should be addressed. The offshore area in which most of the SOCAL Range Complex operations occur is considered unclassifiable/attainment under U.S. EPA NAAQS. Direct impacts to the offshore areas would therefore be compared with Prevention of Significant Deterioration

(PSD) major source thresholds, as onshore areas that are unclassifiable/attainment areas regulated under PSD requirements. The PSD major source thresholds are 250 tons per year.

Emissions from the offshore coastal areas also have the potential to affect air quality on shore. Over the last decade, CARB has done a series of technical assessments of transport relationships between air basins in California. The assessments identify transport couples consisting of an upwind and a downwind area. CARB also characterizes the contribution of transported pollutants as overwhelming, significant, or inconsequential. The influence of transport on a downwind area can vary widely day by day, depending mostly on the weather. As a result, a transport couple can have multiple characterizations. CARB approved the initial assessment in 1990, and updated the assessment in 1993, 1996, and 2001. Transport from the SCAB to the SDAB has been identified as a transport couple by the CARB (CARB 2004).

The CARB and the SCAQMD has determined that emissions occurring at SCI do not affect the SCAB attainment status, and thus have exempted stationary and mobile sources at SCI from AQMP control measures designed to reduce emissions from sources operating solely on SCI. For example, the SCAQMD, in its Environmental Assessment of the RECLAIM Rule, states that "the associated impacts from the emission increases on SCI would not be transported to the South Coast Air Basin." (SCAQMD 1995).

It has been established through the Southern California Ozone Study (CARB 1997) that transport from the South Coast Air Basin to the San Diego Air Basin contributes to pollutant concentrations in the SDAB. General meteorological trends indicate that pollutants are transported southeasterly rather than to the northeast; hence emissions occurring in offshore areas would not be expected to contribute to pollutant concentrations in the SCAB. Thus emissions would be transported from the SOCAL OPAREAs to those air basins to the east and south. This would include the SDAB and Mexico.

As shown in Section 1, the SOCAL OPAREAs are mainly located to the west of the SDAB and Mexico. The only portions of the SOCAL OPAREAs directly offshore of the SDAB are the SPCOA and CPAAA. Based on the location of SOCAL OPAREAs, emissions occurring within the areas to the west of the SDAB would most likely contribute to pollutant concentrations onshore in the SDAB, with some transport south to Mexico. Emissions occurring on SCI, within the SCIRC, offshore of MCB Camp Pendleton and SSTC, in the northern portion of W-291, NAOPA, ARPA, ENETA, and potentially those emissions occurring within the WSCOA would have the potential to affect air quality in the SDAB. Emissions occurring within the southern portion of W-291, including the PAPA areas, FLETA HOT, and MISR areas would have the potential to affect air quality in Mexico.

The *de minimis* threshold for conformity for the SDAB is 100 tons per year for ozone precursors NOx and ROG, and maintenance pollutant CO. The *de minimis* thresholds have been set forth to identify emission levels above which a proposed action has the potential to adversely affect the air basin. Accordingly, to evaluate whether the offshore operations have the potential to adversely affect the SDAB, the 100 ton per year threshold was used as a screening threshold. The major source threshold for the Federal Operating Permits requirement is also 100 tons per year for all pollutants. This threshold was also applied to the onshore areas of Mexico for conservative purposes.

3.2.2.3.1 SOCAL OPAREAs

The total air emissions associated with Alternative 1 are presented in Table 3.2-6 for emissions within the SOCAL OPAREAs. Table 3.2-6 presents a breakdown of emissions in the SOCAL OPAREAs subject to NEPA (within U.S. Territory) versusthose subject to EO 12114 (outside U.S. Territory). Emissions within U.S. Territory were further segregated into those emissions occurring within 12 nm (66.6 km) of SCI and those emissions occurring within 12 nm (66.6 km) of the mainland coast of San Diego County. The table also breaks down those emissions occurring in the area offshore of the SDAB and the area offshore of Mexico.

3.2.2.3.2 San Clemente Island

The total air emissions associated with Alternative 1 are presented in Table 3.2-7 for emissions occurring on SCI. For the purpose of this analysis, all ground vehicle operations and all NALF operations would occur on SCI.

As a conservative assumption, all of the emissions occurring on SCI, the emissions occurring within 12 nm from the mainland coast of San Diego County, and emissions occurring offshore of the SDAB could have the potential to affect the air quality in the SDAB. Table 3.2-8 presents a summary of the air emissions under Alternative 1 that would have the potential for transport onshore to affect air quality in the SDAB, and a summary of those emissions that would have the potential to be transported onshore to Mexico. The total emission increases that have the potential to affect the SDAB are above the screening threshold of 100 tons per year for CO and NO_x assuming that all of the emissions would be transported from offshore areas onshore to affect the air basin.

It is unlikely that all of the emissions occurring on an annual basis would be transported onshore into one air basin. While prevailing winds in the area are generally from the west, emissions may be transported in any direction. Regardless, should emissions travel to the shore; emissions would be dispersed and would not affect a single location. Thus while emission increases above baseline would be above the screening thresholds for those emissions that have the potential to affect the SDAB, emissions occurring within the SOCAL Range Complex would not be anticipated to result in an adverse impact on the air quality in the SDAB or Mexico.

As discussed in Section 3.2.1.2.1, Existing Conditions, emission factors for greenhouse gases are not currently available for aircraft, ships, and ordnance operations. The total CO_2-equivalent emissions in the state of California were estimated at 492 million metric tons in 2004, and total U.S. emissions were estimated at 7,074 million metric tons. The contribution of Alternative 1 operations would be small in comparison with both the California and U.S. emission estimates and would not be anticipated to contribute substantially to global climate change.

Table 3.2-6: Annual Air Emissions within SOCAL OPAREAs for Alternative 1

Emission Source	Emissions, tons/year					
	CO	NOx	ROG	SOx	PM_{10}	$PM_{2.5}$
Within U.S. Territory – SCI Offshore						
Aircraft Operations	19.76	22.29	1.85	1.31	13.75	13.61
Marine Vessel Operations	72.65	56.36	10.51	29.48	9.78	9.68
Ordnance	39.66	1.97	0.00	0.02	3.37	2.36
Total	**132.07**	**80.62**	**12.36**	**30.81**	**26.90**	**25.65**
Net Increase over Baseline	**36.90**	**26.77**	**3.93**	**7.88**	**16.01**	**15.62**
Within U.S. Territory – San Diego County						
Aircraft Operations	4.17	5.83	0.47	0.31	2.11	2.09
Marine Vessel Operations	229.65	560.54	29.67	224.80	32.08	31.76
Ordnance	0.09	0.01	0.00	0.00	0.00	0.00
Total	**233.91**	**566.38**	**30.14**	**225.11**	**34.19**	**33.85**
Net Increase over Baseline	**25.50**	**49.60**	**8.50**	**0.79**	**2.55**	**2.53**
Outside U.S. Territory – Offshore San Diego Air Basin						
Aircraft Operations	28.69	55.15	2.93	2.69	32.66	32.33
Marine Vessel Operations	636.96	492.10	57.58	310.73	74.35	73.61
Total	**665.65**	**547.25**	**60.51**	**313.42**	**107.01**	**105.94**
Net Increase over Baseline	**66.00**	**69.28**	**8.1**	**29.63**	**40.54**	**40.14**
Outside U.S. Territory – Offshore Mexico						
Aircraft Operations	3.18	2.15	0.60	0.12	1.30	1.29
Marine Vessel Operations	49.73	32.19	4.50	13.14	2.11	2.09
Total	**52.91**	**34.34**	**5.10**	**13.26**	**3.41**	**3.38**
Net Increase over Baseline	**6.66**	**4.37**	**0.70**	**2.04**	**0.49**	**0.49**

Table 3.2-7: Annual Air Emissions on SCI for Alternative 1

Emission Source	Emissions, tons/year					
	CO	NOx	ROG	SOx	PM_{10}	$PM_{2.5}$
NALF Operations	153.67	47.18	35.98	2.30	29.14	28.85
Ground Vehicle Operations	0.19	0.21	0.02	0.00	0.01	0.01
Total	**153.86**	**47.39**	**36.00**	**2.30**	**29.15**	**28.86**
Net Increase over Baseline	**20.90**	**9.40**	**2.36**	**0.41**	**1.04**	**1.03**

Table 3.2-8: Total Annual Air Emissions, Alternative 1

Emission Source	Emissions, tons/year					
	CO	NOx	ROG	SOx	PM_{10}	$PM_{2.5}$
Emissions with the Potential to Affect the San Diego Air Basin						
Within U.S. Territory – SCI Offshore	132.07	80.62	12.36	30.81	26.90	25.65
Within U.S. Territory – San Diego County	233.91	566.38	30.14	225.11	34.19	33.85
Offshore	665.65	547.25	60.51	313.42	107.01	105.94
San Clemente Island	153.86	47.39	36.00	2.30	29.15	28.86
Total	**1185.49**	**1241.64**	**139.01**	**571.64**	**197.25**	**194.3**
Net Increase over Baseline	**135.06**	**150.02**	**21.23**	**40.34**	**59.59**	**58.78**
Emissions with the Potential to Affect Mexico						
Offshore	52.91	34.34	5.10	13.26	3.41	3.38
Total	**52.91**	**34.34**	**5.10**	**13.26**	**3.41**	**3.38**
Net Increase over Baseline	**6.66**	**4.37**	**0.70**	**2.04**	**0.49**	**0.49**

3.2.2.4 Alternative 2

To evaluate the potential for air quality impacts resulting from emission increases associated with increased operations under Alternative 2, the same thresholds were used as for Alternative 1.

3.2.2.4.1 SOCAL OPAREAs

The total air emissions associated with Alternative 2 are presented in Table 3.2-9 for emissions within the SOCAL OPAREAs. Table 3.2-9 presents a breakdown of emissions in the SOCAL OPAREAs subject to NEPA (within U.S. Territory) and those subject to EO 12114 (outside U.S. Territory). Emissions within U.S. Territory were further segregated into those emissions occurring within 12 nm (66.6 km) of SCI and those emissions occurring within 12 nm (66.6 km) of the mainland coast of San Diego County. The table also breaks down those emissions occurring in the area offshore of the SDAB and the area offshore of Mexico.

3.2.2.4.2 San Clemente Island

The total air emissions associated with Alternative 2 are presented in Table 3.2-10 for emissions occurring on SCI. For the purpose of this analysis, all ground vehicle operations and all NALF operations would occur on SCI. Net emissions are below the screening thresholds for all pollutants.

Table 3.2-11 presents a summary of the total air emissions under Alternative 2 that would have the potential for transport onshore to affect air quality in the SDAB, and a summary of those emissions that would have the potential to be transported onshore to Mexico. The total emission

Table 3.2-9: Annual Air Emissions within SOCAL OPAREAs for Alternative 2

Emission Source	Emissions, tons/year					
	CO	NOx	ROG	SOx	PM_{10}	$PM_{2.5}$
Within U.S. Territory – SCI Offshore						
Aircraft Operations	21.95	24.46	2.08	1.43	14.81	14.66
Marine Vessel Operations	83.45	64.95	12.64	34.86	13.02	12.89
Ordnance	48.26	2.59	0.00	0.02	4.44	3.11
Total	**153.66**	**92**	**14.72**	**36.31**	**32.27**	**30.66**
Net Increase over Baseline	**58.49**	**38.15**	**6.29**	**13.38**	**21.38**	**20.63**
Within U.S. Territory – San Diego County						
Aircraft Operations	4.31	6.00	0.49	0.32	2.16	2.14
Marine Vessel Operations	231.42	564.12	30.29	224.86	32.36	32.04
Ordnance	0.09	0.01	0.00	0.00	0.00	0.00
Total	**235.82**	**570.13**	**30.78**	**225.18**	**34.52**	**34.18**
Net Increase over Baseline	**27.41**	**53.35**	**9.14**	**0.86**	**2.88**	**2.86**
Outside U.S. Territory – Offshore San Diego Air Basin						
Aircraft Operations	29.40	57.41	3.04	2.79	33.91	33.57
Marine Vessel Operations	670.52	521.13	62.50	328.43	90.70	89.79
Total	**699.92**	**578.54**	**65.54**	**331.22**	**124.61**	**123.36**
Net Increase over Baseline	**100.27**	**100.57**	**13.13**	**47.43**	**58.14**	**57.56**
Outside U.S. Territory – Offshore Mexico						
Aircraft Operations	3.25	2.82	0.61	0.15	1.66	1.64
Marine Vessel Operations	55.85	35.60	5.03	14.24	2.28	2.26
Total	**59.10**	**38.42**	**5.64**	**14.39**	**3.94**	**3.90**
Net Increase over Baseline	**12.85**	**8.45**	**1.24**	**3.17**	**1.02**	**1.01**

Table 3.2-10: Annual Air Emissions on SCI for Alternative 2

Emission Source	Emissions, tons/year					
	CO	NOx	ROG	SOx	PM_{10}	$PM_{2.5}$
NALF Operations	165.78	54.63	37.75	2.65	31.72	31.40
Ground Vehicle Operations	0.25	0.36	0.03	0.00	0.02	0.02
Total	**166.03**	**54.99**	**37.78**	**2.65**	**31.74**	**31.42**
Net Increase over Baseline	**33.07**	**17.00**	**4.14**	**0.76**	**3.63**	**3.59**

Table 3.2-11: Total Annual Air Emissions, Alternative 2

Emission Source	Emissions, tons/year					
	CO	NOx	ROG	SOx	PM_{10}	$PM_{2.5}$
Emissions with the Potential to Affect the San Diego Air Basin						
Within U.S. Territory – SCI Offshore	153.66	92	14.72	36.31	32.27	30.66
Within U.S. Territory – San Diego County	235.82	570.13	30.78	225.18	34.52	34.18
Offshore	699.92	578.54	65.54	331.22	124.61	123.36
San Clemente Island	166.03	54.99	37.78	2.65	31.74	31.42
Total	**1255.43**	**1295.66**	**148.82**	**595.36**	**223.14**	**219.62**
Net Increase over Baseline	**199.02**	**200.52**	**29.8**	**64.84**	**83.42**	**82.06**
Emissions with the Potential to Affect Mexico						
Offshore	59.10	38.42	5.64	14.39	3.94	3.90
Total	**59.10**	**38.42**	**5.64**	**14.39**	**3.94**	**3.90**
Net Increase over Baseline	**12.85**	**8.45**	**1.24**	**3.17**	**1.02**	**1.01**

increases that have the potential to affect the SDAB are above the screening threshold of 100 tons per year for CO and NO_x assuming that all of the emissions would be transported from offshore areas onshore to affect the air basin.

It is unlikely that all of the emissions occurring on an annual basis would be transported onshore into one air basin. While prevailing winds in the area are generally from the west, emissions may be transported in any direction. Regardless, should emissions travel to the shore, emissions would be dispersed and would not affect a single location. Thus while emission increases above baseline would be above the screening thresholds for those emissions that have the potential to affect the SDAB, emissions occurring within the SOCAL Range Complex would not be anticipated to result in an adverse impact on the air quality in the SDAB or Mexico.

As discussed in Section 3.2.1.2.1, Existing Conditions, emission factors for greenhouse gases are not currently available for aircraft, ships, and ordnance operations. The total CO_2-equivalent emissions in the state of California were estimated at 492 million metric tons in 2004, and total U.S. emissions were estimated at 7,074 million metric tons. The contribution of Alternative 2 operations would be small in comparison with both the California and U.S. emission estimates and would not be anticipated to contribute substantially to global climate change.

3.2.2.4.3 SWTR

The SWTR would involve installation of underwater instrumentation in the form of undersea cables and sensor nodes. The installation activities have the potential to affect air quality, primarily due to use of cable-laying vessels and other construction activities. Installation of the SWTR instrumentation array will be done in phases determined by multiple factors, including: weather, ship availability and capacity, production schedules for nodes and cable, installation time, total environmental impact of installation, funding availability, and efficiency. For the SWTR extension, construction activities were assumed to be similar to the SOAR Refurbishment project; however, because the area over which the activities would occur would involve an area of 500 nm^2 vs. 670 nm^2 for the SOAR Refurbishment project. Table 3.2-12 presents a summary of temporary construction air emissions associated with the SWTR Enhancements.

Table 3.2-12: Construction Air Emissions, SWTR Enhancements

Emission Source	Emissions, tons/year					
	CO	NOx	ROG	SOx	PM_{10}	$PM_{2.5}$
SWTR Extension – Within U.S. Territory – SCI						
Horizontal Directional Drilling	0.65	4.35	0.12	0.17	0.13	0.13
Trunk Cable Installation Plus Array Installation	0.08	1.07	0.01	0.08	0.03	0.03
Offshore Survey	0.24	3.08	0.06	0.18	0.07	0.07
Total	**0.97**	**8.50**	**0.19**	**0.44**	**0.23**	**0.23**
SWTR Extension – Within U.S. Territory – Mainland						
Horizontal Directional Drilling	0.06	0.36	0.02	0.02	0.01	0.01
Offshore Survey	0.17	2.04	0.02	0.15	0.05	0.05
Trunk Cable Installation Plus Array Installation	0.31	2.37	0.07	0.12	0.07	0.07
Total	**0.54**	**4.77**	**0.10**	**0.29**	**0.13**	**0.13**

3.2.3 General Conformity Evaluation

Under the provisions of 40 C.F.R. Parts 51 and 93, Federal actions are required to conform with the approved SIP for those areas that are categorized as non-attainment or maintenance areas for any criteria pollutant. The purpose of the General Conformity Rule is to demonstrate that the Proposed Action would not cause or contribute to a violation of an air quality standard, and that the project would not adversely affect the air basin's ability to attain and maintain the ambient air quality standards.

3.2.3.1 South Coast Air Basin Activities

The Proposed Action includes activities in the SCAB, which is classified as a severe non-attainment area for the federal 8-hour ozone standard, a maintenance area for NO_2, and a non-attainment area for CO and PM_{10}. The provisions of the General Conformity Rule state that a Proposed Action is exempt from the requirements of a full conformity demonstration for those pollutants for which emissions increases are below the *de minimis* emissions levels specified in the applicable regulations. The SCAQMD has not yet developed and received approval for a SIP for the federal 8-hour ozone standard; the alternatives including the Proposed Action are therefore required to demonstrate conformity with the current approved SIP, which is based on the Federal 1-hour ozone standard. In accordance with the General Conformity Rule, as adopted by the SCAQMD in Regulation XIX, Rule 1901, the *de minimis* levels for ozone precursors, NO_2, CO, and PM_{10} are as follows:

Ozone precursors (NOx and ROGs)	25 tons (22,680 kg) per year
NO2	100 tons (90,720 kg) per year
CO	100 tons (90,720 kg) per year
PM10	70 tons (63,504 kg) per year

It should be noted that should the SCAB be redesignated as an extreme non-attainment area for the 8-hour NAAQS for O_3 as indicated in the Draft Final 2007 AQMP, the *de minimis* levels for ozone precursors NO_x and ROG would be 10 tons (9,072 kg) per year.

The SCAB also has been designated a non-attainment area for $PM_{2.5}$. In accordance with EPA guidelines for the General Conformity Rule 71 Fed. Reg. 17004-17009 (April 5, 2006). The EPA has established a *de minimis* level of 100 tons per year for both direct $PM_{2.5}$ emissions and emissions of $PM_{2.5}$ precursors. $PM_{2.5}$ precursors include SO_2, NOx, VOCs, and ammonia. Emissions of ammonia associated with Navy activities would be negligible and are not quantified in this evaluation.

Table 3.2-13 provides a summary of annual air emissions within 3 nm (5.6 km) from SCI. The estimated emissions for operations on SCI and within 3 nm (6 km) of SCI were estimated for the No Action Alternative, Alternative 1, and Alternative 2. Because ground vehicle emissions were included in the overall SCAQMD SIP emissions budget for the SCAB for mobile sources, ground vehicles were not included in the total budget for SCI operations that was submitted to the SCAQMD for inclusion in the update to the AQMP. Ground vehicle emissions are therefore not included in Table 3.2-13. The net emissions increase over the baseline case was then calculated. The results are shown in Table 3.2-13. As shown in the table, the net emissions increases for CO, NOx (as NO_2 precursor), ROG, PM_{10}, $PM_{2.5}$, and $PM_{2.5}$ precursors are below the *de minimis* thresholds for requiring a full conformity determination, and are therefore exempt from further analysis.

As discussed in Section 3.2.1.2.1, the SCAQMD has included SCI emissions in their most recent update to the ozone SIP emissions inventory, including a 1 percent growth factor to accommodated estimated increases in operational tempo at SCI and in contiguous waters within 3 nm (5.6 km).

Emissions associated with the No Action Alternative and Alternative 1 would be less than the *de minimis* thresholds for all pollutants, and would therefore not require a Conformity Determination. Should the SCAB be redesignated as an extreme non-attainment area for the 8-hour NAAQS for O_3, emissions of ROG would still be below the *de minimis* threshold of 10 tons per year. Emissions of NO_x would, however, be above the *de minimis* threshold of 10 tons per year for Alternative 1.

As shown in Table 3.2-13, NO_x emissions increases associated with Alternative 2 would likely be greater than the *de minimis* emission levels set by regulations, regardless of the designation of the SCAB as a “severe” or “extreme” non-attainment area for O_3. The total NO_x emissions for the SCI activities contained in the SIP emissions budget, including emissions from the EFVs, is 100.11 tons (90,818 kg) per year for 2006, with a 1 percent increase for each subsequent year. Under Alternative 2, while NO_x emissions would be above the *de minimis* thresholds, they would be within the SIP emissions budget. Also, should the SCAB be redesignated as an extreme non-attainment area for the 8-hour NAAQS for O_3, emissions under Alternative 1 would also be within the SIP emissions budget. The proposed action under both Alternatives 1 and 2 would therefore conform with the SIP.

Table 3.2-13: Annual Air Emissions within 3 nm from SCI

Emission Source	Emissions, tons/year					
	CO	NOx	ROG	SOx	PM_{10}	$PM_{2.5}$
No Action Alternative						
Aircraft Operations	1.13	1.76	0.12	0.10	1.14	1.13
Marine Vessels	8.69	12.84	3.22	7.22	1.16	1.15
Ordnance	25.12	1.15	0.00	0.01	2.66	1.89
NALF Operations	132.86	37.97	33.63	1.89	28.11	27.83
Total	**167.80**	**53.72**	**36.97**	**9.22**	**33.07**	**32.00**
Alternative 1						
Aircraft Operations	9.11	9.73	0.85	0.57	5.61	5.55
Marine Vessels	10.90	17.35	4.88	10.34	4.13	4.09
Ordnance	39.66	1.97	0.00	0.02	3.37	2.36
NALF Operations	153.67	47.18	35.98	2.30	29.14	28.85
Total	**213.34**	**76.23**	**41.71**	**13.23**	**42.25**	**40.85**
Alternative 2						
Aircraft Operations	11.10	11.63	1.06	0.68	6.50	6.44
Marine Vessels	12.09	19.82	5.99	12.03	5.51	5.45
Ordnance	48.26	2.59	0.00	0.02	4.44	3.11
NALF Operations	165.78	54.63	37.75	2.65	31.72	31.40
Total	**237.23**	**88.67**	**44.80**	**15.38**	**48.17**	**46.40**
Increase over Baseline						
Alternative 1	**45.54**	**22.51**	**4.74**	**4.01**	**9.18**	**8.85**
Alternative 2	**69.43**	**34.95**	**7.83**	**6.16**	**15.1**	**14.4**
De minimis limits	**100**	**25[a]/100[b]**	**25[a]/100[b]**	**100[b]**	**70**	**100**
SCAQMD SIP Budget	**381.37**	**100.11**	**119.02**	**10.28**	**102.36**	**101.34[c]**

[a]De minimis threshold for NO_x and ROGs would be 10 tons per year should the SCAB be redesignated to an extreme non-attainment are for the 8-hour NAAQS for O_3.

[b]As NO_2 (for NO_x) and $PM_{2.5}$ precursor.

[c]Assuming PM_{10} is comprised of 99% $PM_{2.5}$.

3.2.3.2 San Diego Air Basin Activities

The SOCAL Range Complex also includes activities that occur in the SDAB, which is classified as a basic non-attainment area for the federal 8-hour ozone standard, and a maintenance area for CO. In accordance with the General Conformity Rule, as adopted by the San Diego Air Pollution Control District (SDAPCD) in its Regulation XV, of which Rule 1501 applies to Federal Actions, the *de minimis* levels for ozone precursors (based on the current approved SIP) and CO are as follows:

Ozone precursors (NO_x and ROGs)	100 tons (90,720 kg) per year
CO	100 tons (90,720 kg) per year

The estimated emissions for operations within 3 nm (5.6 km) of the San Diego mainland coast were estimated for the No Action Alternative, Alternative 1, and Alternative 2. The net emissions increase over the baseline case was then calculated. The results are shown in Table 3.2-14. As shown in the table, the net emissions for CO, NOx, and ROG are below the *de minimis* thresholds for requiring a full conformity determination, and are therefore exempt from further analysis.

Table 3.2-14: Annual Air Emissions within 3 nm from the San Diego Air Basin

Emission Source	Emissions, tons/year		
	CO	NOx	ROG
No Action Alternative			
Aircraft Operations	2.60	3.59	0.30
Marine Vessels	104.07	234.73	12.64
Ordnance	0.09	0.01	0.00
Total	**106.76**	**238.33**	**12.94**
Alternative 1			
Aircraft Operations	2.91	4.03	0.34
Marine Vessels	106.77	236.91	13.36
Ordnance	0.09	0.01	0.00
Total	**109.77**	**240.95**	**13.7**
Alternative 2			
Aircraft Operations	3.02	4.16	0.35
Marine Vessels	107.27	237.93	13.54
Ordnance	0.09	0.01	0.00
Total	**110.38**	**242.1**	**13.89**
Increase over Baseline			
Alternative 1	**3.01**	**2.62**	**0.76**
Alternative 2	**3.62**	**3.77**	**0.95**
De minimis limits	**100**	**100**	**100**

3.2.3.3 Hazardous Air Pollutants

As discussed above, the USEPA has listed 188 substances that are regulated under Section 112 of the Clean Air Act, and the state of California has identified additional substances that are regulated under state and local air toxics rule. HAPs are emitted from a variety of processes that are associated with SOCAL Range Operations, including combustion sources and ordnance use. Trace amount of HAPs are emitted from sources participating in SOCAL range activities, including aircraft, marine vessels, ground vehicles, ground support equipment, and ordnance. The amounts that would be emitted are small in comparison with the emissions of criteria pollutants; emission factors for most HAPs from combustion sources are roughly three or more orders of magnitude lower than emission factors for criteria pollutants (CARB 2007c). Emissions of HAPs from ordnance use are smaller still, with emission factors ranging from roughly 10^{-5} to 10^{-15} lbs of individual HAP per item for cartridges to 10^{-4} to 10^{-13} lbs of individual HAPs per item for mines and smoke pots (USEPA 2006).

Emissions of HAPs would occur over the entire range and would be subject to deposition on the water and dispersion due to wind mixing and other dissipation factors. Because the majority of activities occur offshore where no sensitive receptors (i.e., residents, schools, hospitals, etc.) are located, and onshore activities within SCI occur within a restricted area, no health effects would be anticipated from emissions of HAPs.

3.2.4 Mitigation Measures

As noted above in Sections 3.1.1.1.2 and 3.1.1.2.2, the equipment used by military organizations within the SOCAL Range Complex, including ships and other marine vessels, aircraft, and other equipment, are properly maintained in accordance with applicable Navy and Marine Corps requirements. Operating equipment meets federal and state emission standards, where applicable.

Because potential air quality impacts would not exceed regulatory thresholds, no mitigation measures are required beyond the Navy's current SOPs and BMPs to reduce air emissions to the extent possible.

3.2.5 Unavoidable Adverse Environmental Effects

Increases in levels of operational activity in the SOCAL OPAREAs would impact air quality and would contribute air pollutant emissions to the San Diego, South Coast, and Mexico air basins. Emissions associated with operations that are under the jurisdiction of the SCAQMD have been accommodated in the SIP for the South Coast Air Basin. As the purpose of the SIP is to demonstrate that air quality standards would not be exceeded, the emissions occurring within the jurisdiction of the SCAQMD would not result in an exceedance of the air quality standards within the South Coast Air Basin. Operational activities within the SOCAL OPAREAs would also contribute emissions to the air in the San Diego Air Basin and the onshore areas of Mexico. The net emissions are within the major source thresholds and *de minimis* thresholds for air pollutants within the affected air basins and would not be anticipated to cause an exceedance of an air quality standard.

3.2.6 Summary of Effects by Alternative

As shown in Table 3.2-15, emissions associated with implementation of Alternatives 1 and 2 would result in increases in air emissions above baseline (No Action Alternative) conditions. Within U.S. Territory, emission increases are mainly associated with increased operations at the NALF, surface vessels, aircraft operations, and ordnance use. Outside U.S. Territory, emission increases are mainly associated with increased surface vessel operations, with additional contributions from aircraft operations. In conclusion, the reasonably foreseeable actions that could add incremental impacts to the past and present impacts to air quality are included in the analyses under the No Action Alternative, Alternative 1, and Alternative 2. All impacts that would result in increases in emissions of air pollutants, are not anticipated to result in exceedances of the air quality standards as discussed below. The reasonably foreseeable actions that could add incremental impacts to past and present impacts to air quality, discussed in this section, are included in the analysis under the No Action Alternative, Alternative 1, and Alternative 2.

Table 3.2-15: Summary of Effects by Alternative

Alternative	NEPA (On-Land and U.S. Territorial Waters)	EO 12114 (Non-U.S. Territorial Waters)
No Action Alternative	• The No Action Alternative involves maintaining operations at the baseline levels. Emissions for the No Action Alternative reflect baseline levels that are currently occurring. There is no increase in emissions above the baseline within U.S. Territory under the No Action Alternative.	• The No Action Alternative involves maintaining operations at the baseline levels. Emissions for the No Action Alternative reflect baseline levels that are currently occurring. There is no increase in emissions above the baseline outside the U.S. Territory under the No Action Alternative.
Alternative 1	• Within U.S. Territory, emission increases are mainly associated with increased operations at the NALF, surface vessels, aircraft operations, and ordnance use. • Emission increases over baseline for Alternative 1 that could affect the SDAB would be less than the screening thresholds of 100 tons per year for all pollutants. Emission increases would therefore not be considered major and would not result in an adverse impact on the air quality. • Emission increases over baseline for both Alternatives 1 within 3 nm (5.6 km) of shore would be subject to the requirements of the General Conformity Rule. Emission increases for CO, SOx, PM_{10}, and $PM_{2.5}$ and $PM_{2.5}$ precursors within 3 nm (5.6 km) of SCI would be less than the *de minimis* levels for these pollutants. Emission increases within 3 nm (5.6 km) of San Diego County would be below the *de minimis* levels for all pollutants. • Emission increases over baseline for NOx within 3 nm (5.6 km) of SCI for Alternative 1 are below the *de minimis* levels. The Proposed Action under Alternative 1 would therefore not be subject to a Conformity Determination under the General Conformity Rule. A Record of Non-Applicability has been prepared. Should the SCAB be redesignated as an	• Outside U.S. Territory, emission increases are mainly associated with increased surface vessel operations, with additional contributions from aircraft operations. • Although Alternative 1 would result in increases in emissions of air pollutants over the no action alternative, all air impacts outside U.S. territorial waters would not be expected to result in an exceedance of an air quality standard. • Emission increases over baseline for Alternative 1 that could affect Mexico would be less than the screening threshold. Emission increases would therefore not be considered major and would not result in an adverse impact on the air quality.

	extreme non-attainment area for the 8-hour NAAQS for O_3, emission increases over baseline for NOx would be above the *de minimis* levels but would be within the SCAQMD SIP emissions budget for the SCIC. The Proposed Action under Alternative 1 would therefore conform with the SIP under the General Conformity Rule.	
Alternative 2 (Preferred Alternative)	• Impacts would be the same as described under Alternative 1 plus the following: • Emissions associated with construction for the SWTR Enhancements would be less than the *de minimis* levels and would not substantially contribute to emissions during any single year. Emissions are temporary.	• Impacts would be the same as described under Alternative 1
Mitigation Measures	• Equipment used by the Navy, including marine vessels, aircraft, ground vehicles, and other equipment, are properly maintained in accordance with applicable Navy and Marine Corps requirements. Operating equipment meets federal emission standards, where applicable.	• Equipment used by the Navy, including marine vessels, aircraft, ground vehicles, and other equipment, are properly maintained in accordance with applicable Navy and Marine Corps requirements. Operating equipment meets federal emission standards, where applicable.

3.3 Hazardous Materials and Wastes

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3.3 HAZARDOUS MATERIALS AND WASTES

3.3.1 Introduction

Hazardous materials addressed in this Draft Environmental Impact Statement / Overseas Environmental Impact Statement (EIS/OEIS) (hereafter referred to as "EIS/OEIS") are broadly defined as substances that pose a substantial hazard to human health or the environment by virtue of their chemical or biological properties. The purpose of evaluating hazardous materials and hazardous wastes is to determine whether they pose a direct hazard to individuals or the environment; whether fresh or marine surface waters, soils, or ground water would be contaminated; and whether waste generation would exceed regional capacity of hazardous waste management facilities.

In general, the degree of hazard posed by these materials is related to their quantity, concentration, bioavailability, or physical state. Hazardous materials are often used in small amounts in high technology weapons, ordnance, and targets because they are strong, lightweight, reliable, long-lasting, or low cost. Hazardous materials also are required for maintenance and operation of equipment used by the Navy in training activities. These materials include petroleum products, coolants, paints, adhesives, solvents, corrosion inhibitors, cleaning compounds, photographic materials and chemicals, and batteries.

A hazardous waste may be a solid, liquid, semi-solid, or contained gaseous material that alone or in combination may (1) cause, or significantly contribute to, an increase in mortality or an increase in serious irreversible, or incapacitating reversible illness; or (2) pose a substantial present or potential hazard to human health or the environment when improperly treated, stored, transported, disposed of, or otherwise managed. Hazardous wastes are managed under the Resource Conservation and Recovery Act (RCRA), 42 United States Code (U.S.C.) § 6901 et seq.

For purposes of air, sea, or land transportation, the U.S. Department of Transportation defines a hazardous material as a substance or material that is capable of posing an unreasonable risk to health, safety, and property when transported in commerce. These materials include hazardous substances, hazardous wastes, and marine pollutants.

3.3.2 Regulatory Framework

Hazardous materials and wastes are regulated by several federal laws and regulations. The relevant laws include RCRA, the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), the Toxic Substances Control Act (TSCA), the Hazardous Materials Transport Act, the Emergency Planning and Community Right to Know Act (EPCRA), and the Oil Pollution Act (OPA). Together, the regulations adopted to implement these laws govern the storage, use, and transportation of hazardous materials and wastes from their origin to their ultimate disposal. The recovery and cleanup of environmental contamination resulting from accidental releases of these materials also are addressed in the regulations. State of California laws and regulations generally implement federal requirements, but broaden their application or impose additional regulatory requirements in some areas.

3.3.2.1 Federal Laws and Regulations

3.3.2.1.1 RCRA

Hazardous wastes are defined by the Solid Waste Disposal Act, as amended by RCRA, which was further amended by the Hazardous and Solid Waste Amendments. RCRA specifically defines a hazardous waste as a solid waste (or combination of wastes) that, due to its quantity, concentration, or physical, chemical, or infectious characteristics, can cause or significantly contribute to an increase in mortality. RCRA further defines a hazardous waste as one that can increase serious, irreversible, or incapacitating reversible illness or pose a hazard to human health or the environment when improperly treated, stored, disposed of, or otherwise managed. A solid waste is a hazardous waste if it is not excluded from regulation as a hazardous waste or if it exhibits any ignitable, corrosive, reactive, or toxic characteristics (40 CFR Part 261).

In 1997, USEPA published its Final Military Munitions Rule (MMR) (40 C.F.R. § 266.200-.206). The MMR identifies when conventional and chemical military munitions become hazardous wastes under RCRA, and provides for their safe storage and transport. Under the MMR, military munitions include, but are not limited to, the following items:

- confined gaseous, liquid, and solid propellants
- explosives
- pyrotechnics
- chemical and riot agents, and
- smoke canisters.

The MMR defines training; research, development, test, and evaluation (RDT&E); and clearance of unexploded ordnance and munitions fragments on active or inactive ranges as normal uses of the product. When military munitions are used for their intended purpose, they are not considered to be a solid waste for regulatory purposes. Under the MMR, wholly inert items and non-munitions training materials are not defined as military munitions. These materials are not excluded from regulation as hazardous wastes under RCRA.

Under RCRA, hazardous materials are considered solid wastes – and thus fall under the definition of hazardous wastes – if they are used in a manner constituting disposal rather than for their intended purpose. Military munitions become subject to RCRA when transported off-range for storage, reclamation, treatment, disposal; if buried or land filled on- or off-range; or if they land off-range and are not immediately rendered safe or retrieved. Transportation, storage, and disposal of these items are governed by RCRA.

3.3.2.1.2 CERCLA

Under CERCLA, as amended by the Superfund Amendments and Reauthorization Act, a hazardous substance is defined as any substance that, due to its quantity, concentration, or physical and chemical characteristics, poses a potential hazard to human health and safety or to the environment. CERCLA has established national policies and procedures to identify and clean up sites contaminated by hazardous substances.

3.3.2.1.3 TSCA

The Toxic Substances Control Act (TSCA) (15 United States Code 2601 *et. seq*.) requires that, prior to manufacturing a new substance which is to become an article of commerce, a facility must file a Pre-Manufacture Notice with the United States Environmental Protection Agency characterizing the toxicity of the substance. TSCA also regulates the disposal of polychlorinated biphenyls.

3.3.2.1.4 EPCRA

EPCRA requires federal, state, and local governments and industry to report on their use of hazardous and toxic chemicals. Access to this information contributes to improvements in chemical safety and protection of local communities.

3.3.2.1.5 OPA

OPA requires oil storage facilities and vessels to submit plans to the federal government describing how they will respond to large, unplanned releases. In 2002, the Oil Pollution

Prevention regulations were amended by the Oil Pollution Prevention and Response; Non-Transportation-Related Onshore and Offshore Facilities; Final Rule (40 C.F.R. Part 112). This Rule requires Spill Prevention, Control, and Countermeasure Plans and Facility Response Plans. These plans outline the requirements to plan for and respond to oil and hazardous substance releases. Oil and hazardous releases would be reported and remediated in accordance with current Navy policy.

3.3.2.2 State Laws and Regulations

The Navy complies with applicable state regulations under Executive Order 12088, Federal Compliance with Pollution Control Standards; Department of Defense Directive 4165.60, Solid Waste Management; and Navy guidelines for hazardous materials and wastes management.

At the State of California (State) level, the agency with general authority over hazardous materials and wastes is the California Environmental Protection Agency (Cal-EPA). Within Cal-EPA, the Department of Toxic Substances Control is responsible for the use, storage, transport, and disposal of hazardous materials. Cal-EPA delegates much of its responsibility for hazardous materials management, however, to local governments under the Certified Unified Program Agency (CUPA) program.

State law requires communities to form CUPAs to manage the acquisition, maintenance, and control of hazardous materials in their jurisdictions. In southern California, CUPAs have typically formed on a county-by-county basis. Navy ships operating in the SOCAL OPAREAs typically dock in San Diego, while San Clemente Island (SCI) is within Los Angeles County. In San Diego County, the CUPA is the San Diego Department of Environmental Health, which is responsible for hazardous materials and hazardous wastes regulation. In Los Angeles County, the County Fire Department is the CUPA. State hazardous materials and hazardous wastes laws are summarized below.

Table 3.3-1: State of California Laws

LAW / REGULATION	DESCRIPTION
Hazardous Materials Release Response Plans and Inventory Act	Requires facilities using hazardous materials to prepare Hazardous Materials Business Plans
Hazardous Waste Control Act	Regulates the generation, transportation, storage, treatment, and disposal of hazardous materials
Safe Drinking Water and Toxic Enforcement Act	Regulates the discharge of contaminants to ground water.
Emergency Services Act	Similar to the federal Emergency Planning and Community Right-to-Know Act

3.3.3 Affected Environment

3.3.3.1 SOCAL OPAREAs

The condition of the Affected Environment includes past and present impacts from natural and man-made pollutants and hazardous materials. As described more fully in Section 3.4, below, open ocean areas are typically considered to be relatively free of hazardous materials and hazardous wastes. Hazardous materials are transported on the ocean, however, as cargoes and as fuel, lubricants, and cleaning and maintenance materials for marine vessels and aircraft. Ships are basically industrial facilities that generate small to moderate amounts of hazardous wastes during maintenance and operations; these materials typically are stored onboard and offloaded at the next port. Infrequently, large hazardous materials leaks and spills - especially of petroleum products - have fouled the marine environment and adversely affected marine life. No quantitative information is available on the overall types and quantities of hazardous materials present in the SOCAL OPAREAs at a given time, nor on their distribution among the various categories of vessels.

Navy vessels present in the SOCAL OPAREAs represent a small fraction of the overall commercial and recreational boat traffic and, correspondingly, account for only a small fraction of the hazardous materials present in the open ocean areas of the Southern California Bight. As described above, Navy training activities in open ocean areas involve the use of fuel, lubricants, explosives, propellants, batteries, oxidizers, and other hazardous substances. The Navy makes every effort to minimize its use of hazardous materials during training, and recovers and reuses unexpended training materials to the maximum extent practicable.

Most of the hazardous materials released and hazardous wastes generated in the SOCAL OPAREAs by the Navy result from ship operations. Shipboard hazardous wastes are containerized and stored on-board, off-loaded while in port, and disposed of in accordance with State and federal laws and Navy regulations. Gunnery exercises expend large quantities of rounds, most of which are not high explosive. Missile firings introduce small amounts of spent rocket motor fuel into the ocean. Target drones and unmanned aerial vehicles could release small amounts of fuel, lubricants, and battery chemicals into the marine environment, but normally are recovered unless they are hit by a missile. Hazardous training materials left unrecovered in the SOCAL OPAREAs are addressed in Section 3.4, Water Resources.

3.3.3.1.1 Current Mitigation Measures

<u>Shipboard Management of Hazardous Materials</u>

Environmental compliance policies and procedures applicable to operations ashore are defined in the Chief of Naval Operations' Instructions (OPNAVISNT 5090.1C), along with environmental compliance polices and procedures applicable to shipboard operations afloat. These agency instructions reinforce the Clean Water Act’s prohibition against discharge of harmful quantities of hazardous substances into or upon U.S. waters out to 200 nm (371 km). These instructions include stringent hazardous waste discharge, storage, dumping, and pollution prevention requirements. Navy ships are required to conduct activities at sea in a manner that minimizes or eliminates any adverse impacts on the marine environment. The Consolidated Hazardous Material Reutilization and Inventory Management Program (CHRIMP) Manual also provides information on management of hazardous materials for both afloat and ashore. These documents provide a comprehensive compilation of procedures and requirements that are mandated by law, directive, or regulation. These documents have a compliance orientation to ensure safe and efficient control, use, transport, and disposal of hazardous waste. Any hazardous waste generated onboard ships will be stored in approved containers. The waste will be offloaded for proper disposal within five working days of arrival at a U.S. Navy port.

There are primarily two documents that provide guidelines on managing hazardous wastes in the SOCAL OPAREAs:

- Commander, Navy Region Southwest (CNRSW) Waste Management Plan and associated guidance documents. This plan covers Naval Base Coronado, Naval Base San Diego, and Naval Base Point Loma.
- CNRSW Explosive Hazardous Waste Management Plan. This plan covers all bases under CNRSW Area of Responsibility.

<u>Storage</u>

Navy ships are not allowed to discharge overboard untreated, used, or excess hazardous materials generated aboard ship within 200 nm of the coast. Ships must retain used and excess hazardous materials on board for shore disposal.

Recycling

Recycling is the reuse or reclamation of previously used materials that would become wastes and require disposal if not recycled. An aggressive recycling program is an important part of the Navy's Pollution Prevention Program. The Navy has an active Pollution Prevention Program that applies to all aspects of its activities. It is Navy policy to conduct its facility management and acquisition programs so as to reduce to the maximum extent possible the quantity of toxic chemicals entering the environment. Pollution prevention is not pollution control, but a comprehensive set of practices that reduce the volumes of wastes to be treated or transferred to the environment. The fundamental tenet of the Navy's Pollution Prevention Program is the reduction of hazardous materials and wastes at their source. This results in less hazardous waste for all waste streams. Pollution prevention practices include:

- Raw material substitution,
- Product reformulation,
- Process redesign or modification,
- Improved operation and maintenance, and
- Aggressive recycling programs.

Many of the activities are Research and Development in the weapons systems acquisition process, and these activities must be compliant with the overall Department of Defense (DoD) guidance on pollution prevention during weapons acquisition. DoD Instruction 5000.2-R mandates specific weapons acquisition policies and procedures. Pollution prevention requirements are covered by these regulations and are directive in nature to the military services. Executive Order (EO) 12856, EO 13101, and Chapter 4 of OPNAVINST 5090.1C also cover pollution prevention requirements. The regulation's major pollution prevention requirements are:

> In designing, manufacturing, testing, operation, maintaining, and disposing of systems, all forms of pollution shall be prevented or reduced at the source whenever feasible. Pollution that cannot be prevented shall be recycled. Pollution that cannot be prevented or recycled shall be treated in an environmentally safe manner. Disposal or other releases to the environment shall be employed only as the last resort.

3.3.3.2 San Clemente Island

3.3.3.2.1 Hazardous Materials

Various hazardous materials, oils, and hydraulic fuels are used to support aircraft, target, and vehicle maintenance performed on the island. Only the minimum amount of a hazardous material is obtained for a task to prevent disposing excess material as hazardous waste. Petroleum products such as diesel fuel and gasoline are delivered by regularly scheduled barge from Naval Air Station North Island (NASNI) to the Boat Ramp area in Wilson Cove, as discussed above. Hazardous materials used on SCI are ordered through NASNI and shipped to the island via barge or aircraft.

Other than fuel (e.g., gasoline, diesel fuel, aviation fuel, propane), materials reported for SCI in the NASNI EPCRA reports (hazardous chemicals present on-site greater than 10,000 pounds (lb.) (4,536 kilograms [kg]), or 500 lb. (227 kg) (or 55 gal. [208 L]) for an extremely hazardous substance) include fire-fighting foam, portland cement, and ethylene glycol. Approximately 15,000 gal. (56,800 L) of fire fighting foam is stored on the island, and approximately 100 gal. (379 L) are used each year.

Ordnance for training and research projects is stored at the Mills Circle Ordnance facility, just south of VC-3. The storage facility has seven magazines. All ordnance is ground transported from Red Label areas (ordnance loading pad) at the southern end of the airfield and VC3, and Wilson Cove to the magazines. From the magazines, ordnance is transported by vehicle to approved ready-service lockers at the user's site for temporary storage.

Hazardous materials are transported through the SOCAL OPAREAs to SCI. Transport of hazardous materials over the oceans is regulated by the federal Department of Transportation in 49 CFR. The International Maritime Dangerous Goods Code applies to ocean vessel shipments. To the extent possible, materials and equipment are prepared and tested before being shipped, to reduce the need to transport hazardous materials. However, fuel and gasoline must be transported from San Diego to SCI by barge. The largest volumes of hazardous material transported to SCI are aviation jet fuel (JP-5) and unleaded gasoline. In Fiscal Year (FY) 2004, SCI received 643,900 gallons (gal.) (2.44 million liters [L]) of JP-5, 678,000 gal. (2.57 million L) of diesel, 28,500 gal. (108,000 L) of unleaded fuel, and 126,000 gal. (477,000 L) of propane.

3.3.3.2.2 Current Mitigation Measures

Hazardous Wastes Management

There are several 90-day RCRA waste accumulation areas on SCI. Hazardous waste is containerized, transported to the pier, and shipped back to NASNI by barge. Upon arrival at San Diego, the waste is transported by NASNI's hazardous waste contractor to an approved Treatment, Storage, or Disposal facility. In the baseline year, about 374,063 lb. (170,000 kg) of hazardous wastes were shipped to NASNI from SCI. Most of the hazardous wastes were paint, waste oil, fuel, batteries, and grease. The types and amounts of hazardous waste now generated are assumed, for this analysis, to be similar to those generated in the baseline year.

Installation Restoration Program

The Installation Restoration Program (IRP) was established by the Navy to evaluate and clean up sites where past practices have resulted in contamination of soils, groundwater, or other media by hazardous substances. Seventeen Installation Restoration sites on SCI have been identified. These sites are generally not located in training areas, and will not be affected by the Proposed Action. Therefore, no further discussion of the IRP sites in this EIS/OEIS is warranted.

The Navy's general instructions (e.g., OPNAVINST 5090.1C) and training activity planning and review processes serve to ensure that hazardous materials and hazardous wastes are stored and handled appropriately. The *Consolidated Hazardous Material Reutilization and Inventory Management Program (CHRIMP) Manual*, Commander, Navy Region Southwest (CNRSW) *Hazardous Waste Management Plan* and associated guidance documents, and CNRSW *Explosive and Hazardous Waste Management Plan* provide additional guidance for users.

Range Sustainability Environmental Program Assessment (RSEPA)

The Range Sustainability Environmental Program Assessment (RSEPA) is a component of the Navy's Tactical Training Theater Assessment and Planning Program. RSEPA is a range compliance management process intended to ensure long-term sustainability of the range using a phased approach. Its purposes are to ensure compliance with applicable regulations and to assess the potential for off-site migration of munitions and their constituents.

The first phase of the RSEPA process is the Range Condition Assessment (RCA), which is to be conducted every five years. This is a qualitative and quantitative assessment of facility compliance with environmental regulations and evaluation of the status of munitions constituents on the site. If the RCA determines that further analysis is warranted, a Comprehensive Range Evaluation (CRE) is conducted to determine if an off-range release of munitions has occurred, or if there is a significant risk of such an occurrence. The third phase of the RSEPA process, the

Sustainable Range Oversight During Off-Range CERCLA Response (SRO) is intended to ensure the sustainability of range operations during a CERCLA response.

In 2003, the Navy conducted a RCA of SCI. The RCA included Pre-Site Visit Information Collection, Onsite Visit Information Collection and Review, and preparation of a final report. Operational range site models were developed for SWATs 1 and 2, MIR, and SHOBA. Potential releases of munitions constituents from high-order detonations, low-order detonations, and duds [items that failed to function] were estimated, based on recorded munitions use at SCI in Fiscal Years 2001 and 2002, and maximum soil concentrations of these constituents were estimated. The conclusions of the RCA were that (a) further steps were not required to maintain compliance with federal environmental regulations, and (b) further analysis was not required to assess the risks of off-range releases of munitions or their constituents.

The vertical and horizontal migration of some munitions constituents in SHOBA were modeled for the RCA, based upon their estimated maximum soil concentrations. This predictive analysis indicated that some constituents could migrate as much as 0.16 feet (0.05 meters) below the ground surface in detectable concentrations, and that perchlorate (the most mobile of the compounds that were modeled) could migrate vertically as far as the groundwater table (5.4 feet [1.6 meters] below the ground surface). Perchlorate could migrate horizontally in groundwater a distance of up to 300 meters (984 feet) beyond the boundary of the Impact Area over 400 years at a concentration of up to 0.6 micrograms per liter. This concentration is below current laboratory detection limits and no known human or ecological receptors would be exposed to the groundwater.

The potential transport of munitions constituents via overland flow in storm water runoff also was modeled. This analysis determined that TNT concentrations at the SHOBA shoreline could be up to 4.3 milligrams per liter and that perchlorate concentrations could be up to 0.001 micrograms per liter. The concentrations of these constituents would be further diluted by the seawater into which the storm water runoff would flow.

3.3.4 Environmental Consequences

3.3.4.1 Approach to Analysis

3.3.4.1.1 Hazardous Materials

The use of hazardous materials is an inherent part of the training and RDT&E activities that occur in the SOCAL Range Complex. The energetic materials used to fire projectiles, detonate explosive materials, and provide fuel and power for airborne, surface, and undersea training items all contain hazardous constituents. Ordnance casings and accessory materials also may contain hazardous constituents. Once these items are expended and their energetic materials are used up, the hazardous constituents remain in the residues and structural components.

Hazardous constituents such as lead may be used to increase the strength of materials, lighten weight, reduce the incidence of failure, lower life-cycle costs, or prolong the life of the ordnance. Hazardous features of these training items are understood by their users, and safe handling and pollution prevention measures are a routine part of systems programs to minimize and manage their effects. The components that contain hazardous constituents include propellants, batteries, flares and smoke, telemetry, igniters, jet fuel, diesel fuel, hydraulic fluid, and explosives.

Military munitions also may pose a physical hazard, both from fully charged and primed high explosive ammunition prior to use and from expended, but unexploded ordnance (UXO). For this reason, military munitions are considered to be hazardous materials in and of themselves as long as they contain unreacted energetic materials. Munitions constituents are found in torpedoes, targets; sonobuoys; munitions and demolition materials; and RDT&E ordnance (primarily missiles and targets). This EIS/OEIS addresses the types, amounts, and distribution of munitions constituents and wastes that affect the SOCAL OPAREAs.

Quantities of munitions and other expendable training materials estimated for this analysis are based on the items and per-event quantities provided in the Operations Data Book (DoN 2007) and the numbers of annual training events described in Chapter 2, Description of the Proposed Action and Alternatives. The types and quantities of hazardous constituents in these training materials, as well as failure rates and other characteristics of the materials, are as reported in Navy documents or other published sources; these sources are cited in the text below as appropriate. The following subsections provide additional information and assumptions about hazardous training materials, their constituents, and combustion byproducts and residues that were considered in the impact analysis.

Explosives

Trinitrotoluene (TNT) is an explosive that has been used since 1912 by the U.S. Navy. It is a nitroaromatic compound that continues to be used in modern military munitions.

Explosives in modern military ordnance are generally solid-cast explosive fills formed by melting the constituents and pouring them into steel or aluminum casings. Most new U.S. military formulations contain plastic-bonded explosives (PBX) that use plastic or other polymer binders to increase their stability (Janes 2005, 2006). Royal Demolition Explosive (RDX) / High Melting Explosive (HMX) blends have generally replaced TNT in plastic-bonded formulations.

Explosives become an environmental concern when expended ordnance fails to function as designed, and explosive compounds in the unexploded ordnance (UXO) are released into the environment. A complete failure to function (dud) typically leaves an ordnance item intact or lightly damaged from impacting the surface. A low-order detonation consumes some of the energetic materials and ruptures the casing, but leaves a portion of the explosive filler and other materials (e.g., propellant, spotting charge) in its original form. UXO may be found lying on the ground or may be buried up to 4 feet deep in the soil.

Munitions constituents of concern include nitroaromatics - principally TNT, its degradation products, and related compounds; and cyclonitramines, including RDX, HMX, and their degradation products. TNT degrades to dinitrotoluene (DNT) and subsequent degradation products from exposure to sunlight (photolysis) or bacteria (biodegradation). RDX also is subject to photolysis and biodegradation once exposed to the environment. As a group, military-grade explosives have low water solubility (see Table 3.3-2), and are relatively immobile in water. The degradation and dissolution of these materials may be further slowed by the physical structure and composition of blended explosives, which contain multiple chemical compounds, often with additional binding agents (see Table 3.3-3).

Table 3.3-2: Water Solubility and Degradation Products of Common Explosives

Compound	Water Solubility (milligrams per liter at 20°C)
salt (sodium chloride) [for comparison]	357,000
ammonium perchlorate	249,000
picric acid	12,820
nitrobenzene	1,900
dinitrobenzene	500
trinitrobenzene	335
dinitrotoluene (DNT)	160-161
trinitrotouene (TNT)	130
tetryl	51
pentaerythritoltetranitrate (PETN)	43
RDX	38
HMX	7
white phosphorus	4
Source: DoN 2007	

Table 3.3-3: Explosive Components of Munitions

Name	Composition	Use
Composition A	91% RDX	grenades, projectiles
Composition B	60% RDX, 39% TNT	projectiles, grenades, shells, bombs
Composition C-4	91% RDX, 9% plasticizer	demolition explosive
Explosive D	picric acid, ammonimum picrate	bombs, projectiles
Octol	70-75% HMX, 25-30% TNT	shaped and bursting charges
TNT	NA	projectiles, shells
Tritonal	80% TNT, 20% aluminum	bombs, projectiles
H6	80% Comp B, 20% aluminum	bombs, projectiles
Source: USEPA 2006		

Other Munitions Constituents

Other munitions constituents of concern include pyrotechnic (illumination and smoke) compounds, propellants, primers, and metals (e.g., iron, manganese, copper, lead, zinc, antimony, mercury) released from both initiation primers and ordnance casing corrosion. Nitrocellulose, nitroglycerin, perchlorate, nitroguanidine, and pentaerythritoltetranitrate (PETN) are commonly used in artillery, mortar, and rocket propellants. Common primers include lead azide, lead styphnate, and mercury fulminate. PETN is a major component of detonation cord and blasting caps. Phosphorus, potassium perchlorate, and metal nitrates are common ingredients of pyrotechnics, flares, and smokes. In particular, the heavy metals tend to accumulate in surface soils because of their generally low solubility and their elemental nature - they may oxidize or otherwise react with natural substances, but do not break down in the manner of organic compounds.

Explosives Byproducts

The explosive byproducts generated when ordnance does function as designed (high order detonation), or experiences a low-order detonation, also generate constituents of concern. The major explosive byproducts of organic nitrated compounds such as TNT and RDX include water, carbon dioxide, carbon monoxide, and nitrogen (Brinkley and Wilson 1943, John 1941 and 1943; Renner and Short, 1980; Cook and Spillman, 2000). High-order detonations result in almost complete conversion of explosives (99.997% or more [USACE 2003]) into such inorganic compounds, whereas low-order detonations result in incomplete conversion (i.e., a mixture of the original explosive and its byproducts). For example, Table 3.3-4 lists the calculated chemical byproducts of high-order underwater detonation of TNT, RDX, and related materials.

Table 3.3-4: Chemical Byproducts of Underwater Detonations

BYPRODUCT	PERCENT BY WEIGHT, BY EXPLOSIVE COMPOUND		
	TNT	RDX	Composition B
nitrogen	18.2	37.0	29.3
carbon dioxide	27.0	24.9	34.3
water	5.0	16.4	8.4
carbon monoxide	31.3	18.4	17.5
carbon (elemental)	10.6	-	2.3
ethane	5.2	1.6	5.4
hydrogen	0.2	0.3	0.1
propane	1.6	0.2	1.8
ammonia	0.3	0.9	0.6
methane	0.2	0.2	0.2
hydrogen cyanide	<0.0	<0.0	<0.0
methyl alcohol	<0.0	<0.0	-
formaldehyde	<0.0	<0.0	<0.0
other compounds	<0.0	<0.0	<0.0
Source: Renner and Short 1980			

High-order detonations spread micron-sized and submicron-sized particles over hundreds of square meters. Most of these materials are deposited on the soil surface, and remain there. Sampling of vertical soil profiles at military training ranges has shown that concentrations of munitions constituents drop off rapidly with depth (USEPA 2006). Field studies indicate that explosives residues include 0.003 percent or less of the original quantity of material, although the amounts of explosives residues vary among different types of ordnance (see Table 3.3-5).

Table 3.3-5: Per-Round Results of Live Fire Detonation Tests

MUNITION	PLUME AREA (m^2)	RESIDUE (milligrams)				TOTAL (%)
		RDX	HMX	TNT	Total	
60-mm mortar	214	0.076	ND	ND	0.076	2.0×10^{-5}
81-mm mortar	230	8.3	ND	1.1	9.4	1.0×10^{-3}
120-mm mortar	450	17.0	1.3	2.8	21.0	7.0×10^{-4}
105-mm howitzer	530	0.095	ND	0.17	0.27	1.3 x 10-5
155-mm howitzer	938	0.3	ND	0.009	0.31	4.4 x 10-6
Note: ND = Not Detectable						
Source: USACE 2007						

For purposes of cleaning up contaminated properties, the U.S. Environmental Protection Agency (USEPA) has identified maximum soil concentrations for explosives, propellants, and metals that are consistent with various types of land use (USEPA, 2004). While not directly applicable to military ranges, these Preliminary Remediation Goals (PRGs) are widely used, and provide a reasonable basis for determining the potential risk to the public and the environment from hazardous constituents deposited on the soils at military ranges. For purposes of evaluation, the most sensitive PRGs - those recommended for residential uses - are shown in Table 3.3-6.

Table 3.3-6: USEPA Preliminary Remediation Goals for Contaminated Soils

Hazardous Constituent	Preliminary Remediation Goal, Residential (ppm)
Barium	5,400
Cadmium	37
Chromium III	100,000
Copper and copper compounds	3,100
HMX	3.100
Lead	400
Mercury and mercury compounds	23
nickel and nickel compounds	1,600
perchlorate	7.8
RDX	4.4
TNT	16
Source: USEPA 2004	

Soil sampling at military ranges indicates that concentrations of explosives residues, while often detectable, generally are not present at concentrations that pose acute or chronic hazards. At Fort Greely, Alaska, the following soil concentrations of explosives were found (USACE 2001a):

- On the TOW missile range, RDX was detected at 0.002-0.17 ppm
- On the 40-mm grenade range, RDX was detected at 0.01-1.7 ppm
- The median concentration in soil was 0.021 ppm for RDX and 0.004 ppm for TNT.

At Fort Lewis, soil sampling of the artillery range determined that concentrations of explosives residues often were below the laboratory's detection limit, and soils at the hand grenade range had a median RDX concentration of 1.56 ppm (USACE 2001b). Soils sampled on the hand grenade range at Fort Richardson had a median RDX concentration of 0.029 ppm (USACE, 2001). Such concentrations of these organic compounds are below the USEPA's most restrictive PRGs, and thus pose no risk to human health or the terrestrial environment.

Unlike organic explosive and propellant compounds, inorganic metallic residues do not break down and are relatively immobile. Soil samples collected near anti-tank targets at Fort Ord contained elevated concentrations of lead and copper (USACE, 2004). Similarly, soil samples collected on the 40-millimeter (mm) grenade range at Fort Greely, Alaska contained elevated concentrations of lead and copper. Other than cadmium and mercury, however, the PRGs for toxic metals are an order of magnitude or greater than those for TNT and RDX. Studies to date suggest that, while concentrations of metals may be high in areas of concentrated use, such as around fixed targets, metals concentrations on military ranges generally are within acceptable limits.

Munitions constituents are deposited on the surface of the ocean during training and testing in amounts similar to those identified on land ranges. Laboratory studies have determined that TNT exhibits toxicity in the marine environment at concentrations of 0.9 to 11.5 mg/L, while RDX generally showed more limited toxicity. In marine sediments, TNT exhibits toxicity at concentrations of 159-320 ppm (i.e., about 40 percent to 80 percent of USEPA's residential PRG). RDX exhibits no sediment toxicity at the concentrations tested (Lotufo and Ludy, 2005; Rosen and Lotufo, 2005; Rosen and Lotufo 2007a, 2007b). In a series of tests mimicking a natural environment, Ek et al (2006) determined that, under environmental conditions typical of in-water UXO, no substantial toxicity or bioaccumulation of TNT munitions occurred. In general, munitions constituents in the marine environment appear to pose little risk to the environment.

Unexploded Ordnance (UXO) and Low-Order Detonations

Unexploded ordnance (UXO) is ordnance that fails to function as designed. This ordnance may remain capable of detonation, posing a physical risk to individuals in its vicinity. On land ranges controlled by the Navy, this risk is limited to military personnel who are trained in UXO avoidance. Explosive ordnance disposal (EOD) personnel periodically remove UXO from the range, or conduct a blow-in-place (BIP) operation to render it safe. UXO poses a risk to the public when ordnance lands off-range and is not immediately recovered, or when Navy training activities occur in areas accessible to the public.

The failure rate, or percentage of ordnance that fails to properly function, varies widely by ordnance type and by the circumstances under which the ordnance is used. Quality control (QC) testing of U.S. Army ordnance identified failure rates by ordnance type (see Table 3.3-7). These rates were determined under controlled conditions, however; average failure rates under field conditions were estimated to be about 10 percent. The authors of the QC tests report stated that they had observed failure rates of up to 25 percent and low-order detonation rates of up to 5 percent for mortars (USACE, 2007). These higher observed failure rates take into account operator error, missing the target, and other field conditions not present during the QC tests.

UXO and low-order detonations also account for much of the explosives residues on military ranges. Ordnance that does not detonate may break open upon impact or the casings may be compromised later by corrosion, releasing raw explosives into the environment. In low-order detonations, as much as 40 percent of the explosive material may remain, compared with about 0.003 percent for high-order detonations. For assessing impacts on the environment, an overall failure rate of 5 percent and an overall low-order detonation rate of 0.2 percent are assumed.

Table 3.3-7: Failure and Low-Order Detonation Rates of Military Munitions

MUNITION	FAILURE RATE (%)	LOW-ORDER RATE (%)
gun / artillery	4.68	0.16
hand grenade	1.78	NA
high explosive munitions	3.37	0.09
howitzer	3.75	NA
mortars	2.91	0.08
rocket	3.84	NA
submunition	8.23	NA
Sources: Rand Corporation 2005; USACE 2007		

3.3.4.1.2 Hazardous Wastes

The Navy has a process for managing hazardous materials and waste. Hazardous Materials Management in the SOCAL OPAREAs is the responsibility of the Naval Base Coronado program. No hazardous waste is disposed at SCI. Hazardous materials used on SCI for maintenance activities are ordered through NASNI. After materials are used, they are accumulated and managed based on their properties and the hazardous wastes (e.g., paints, adhesives, solvents, aerosols, batteries, and cleaning compounds) are shipped back to NASNI for processing. Expended ordnance materials are left on the range, until accumulations of expended materials need to be cleared to prevent interference with continued operations.

3.3.4.2 No Action Alternative

3.3.4.2.1 SOCAL OPAREAs

Hazardous Materials

Expended training materials containing hazardous constituents that will be deposited in the SOCAL OPAREAs are addressed in Section 3.4, Water Resources.

Hazardous Wastes

Used hazardous materials and chemical byproducts generated at sea are not considered to be hazardous wastes until offloaded in port. Under the No Action Alternative, the accumulation of used hazardous materials aboard ship will remain at baseline levels. Used and excess hazardous wastes will continue to be managed in compliance with OPNAVINST 5090.1C. The No Action Alternative will not affect hazardous materials management practices aboard ship.

The anticipated amounts of hazardous wastes generated are well within the capacity of the Navy's ashore hazardous waste management system. The anticipated amounts also are well within the existing capacities of hazardous waste transporters and treatment and disposal facilities.

3.3.4.2.2 San Clemente Island

Hazardous Materials

SHOBA

The major sources of hazardous materials on SCI are explosives and ordnance. Almost all of the ordnance used on SCI is expended in SHOBA, except for small arms and demolition training. Ordnance use in SHOBA can be broadly characterized for analytical purposes as:

- missiles, rockets, and aerial targets,
- artillery, naval gunfire, mortar rounds, and cannon rounds,
- bombs, and
- flares and smoke charges

Missiles, Rockets, and Aerial Targets

Approximately 330 guided munitions, missiles, rockets, and aerial targets are used in Expeditionary Firing Exercises (EFEXs), Strike Warfare, and other land training activities. In addition, as part of the EFEX, one BGM-71E TOW missile will be used under the No Action Alternative. The missile uses a solid propellant rocket motor for propulsion, and has a warhead containing approximately seven lb (3.1 kg) of explosives.

Artillery, Naval Gunfire, Mortar Rounds, and Cannon Rounds

Under the No Action Alternative, artillery shells, naval gun shells, mortar rounds, and 30-mm guns are used in training exercises. Most of the energetic materials are converted to gases when the item functions. Less than 25 percent of the original weight of the ordnance remains as solids and water. Total numbers of these training items are provided by warfare area in Table 3.3-9 below.

Bombs

Wholly inert and high explosive bombs are dropped in Impact Area II, the only target area where MK-80 Series bombs can be dropped. The solid emission products from high explosive bombs are mostly aluminum oxide and carbon, and the liquid emission product from detonation is water. Minor constituents include barium, magnesium, phosphorus, and lead. Only barium and lead are constituents of concern. About 2,220 bombs are used annually on SCI. An estimated 111 of these bombs will fail to function as designed, although most of them will be non-explosive practice bombs with only a spotting charge.

Flare and Smoke Charges

Approximately 300 flares and smoke charges per year are used in Direct Action exercises as signaling devices or illumination devices. Electronic combat, Land Demolition, and Combat Search and Rescue also use flares and smoke charges. Major constituents of these items are water, potassium, sodium, and calcium. Minor constituents include magnesium and lead. Of these constituents, only lead is considered to be hazardous.

Amphibious Warfare

Amphibious training events vary from small boat raids to larger activities with amphibious assault vehicles or landing craft. As shown below in Table 3.3-9, these activities require the annual use of about 4,500 naval shells, 886 cannon and mortar rounds, 14,100 small arms projectiles, 151 missiles and rockets, and 344 bombs. Highly explosive ordnance is not expended in over-the-beach amphibious assaults. No highly explosive ordnance is used, so no hazardous materials are expended in this exercise. No battalion landings occur under the No Action Alternative.

Naval Special Warfare

These training activities use demolition explosives, both on land and underwater, small arms firing on static ranges; land navigation training; and platoon-sized activities using high explosive ordnance in authorized areas. Under the No Action Alternative, about 2.6 million rounds of cannon and small arms projectiles are expended each year on SCI during NSW activities, including about 896 grenades (see Table 3.3-9). This ammunition deposits approximately 24 tons (about 22 metric tons) of solid and liquid detonation products on SCI. Of this amount, about 9 tons (8 metric tons) is lead. Other constituents include aluminum, barium, antimony, and magnesium. An estimated 90 percent of these materials are deposited on land, while an estimated 10 percent are deposited in the nearshore waters of SCI.

Under the No Action Alternative, approximately 79,700 lb (36,200 kg) of energetic materials is used by NSW for its explosives training. If these energetic materials consist of RDX (the primary ingredient of C-4), for example, then the major detonation products will include carbon dioxide (21,900 lb or 9,960 kg), carbon solids (5,360 lb or 2,430 kg), water (16,800 lb or 7,650 kg), and nitrogen (27,100 lb or 12,300 kg), all of which are common non-toxic substances. None of these materials are hazardous or toxic. Explosive support devices such as cable cutters, fuse cutters, time fuses, detonation cord, blasting caps, and claymore mines are included in this total.

Other Island Operations

Island non-combat operations include 4 Explosive Ordnance Disposal (EOD) events. EOD activities involve the explosive destruction of munitions, but the areas where these activities occur are very isolated (usually on VC-3). Detonation products from this small number of activities are very small, and the materials produced are similar to the emission products discussed under Naval Special Warfare, above, for explosives training.

Activities at NALF are generally restricted to military aviation and contract flights to bring personnel to SCI and return them to the mainland. The hazardous materials used and produced during airfield operations will be handled by the hazardous materials handling and processing procedures in place.

Research, Development, Test, and Evaluation (RDT&E)

SCI and its surrounding waters accommodate a variety of RDT&E activities. Most are benign activities that use little or no hazardous materials. The RDT&E events that have the most hazardous constituents are the testing of missiles and a few other systems. These tests include Standard Missiles, Joint Stand-Off Weapons (JSOW), UAVs, and sonobuoys. The constituents of sonobuoys and torpedoes are addressed in Section 3.4, Water Resources.

The components that contain hazardous constituents in missile flight tests include propellants, batteries, telemetry, igniters, jet fuel, hydraulic fluid, and explosives. For the No Action Alternative, three JSOWs and four Land Attack Standard Missiles (LASMs) were analyzed. The total amount of hazardous material remaining after the missile shots is shown in Table 3.3-8.

Table 3.3-8: Estimated Missile Impact Constituents

Missile		Amount, lb (kg)				
Type	Number	Propellant, Residual	Batteries	Igniters, Wiring, Etc.	Explosives	Total
JSOW	3	1.7 (0.8)	N.A	N.A	59 (27)	61 (28)
LASM	5	751 (341)	6 (3)	0.5 (0.2)	70 (32)	828 (376)
Source: DoN 1996, DoN 1998, DoN 2002						

Hazardous Wastes

Under the No Action Alternative, the on-island accumulation and storage, ocean transport, and ashore treatment or disposal of hazardous wastes will remain at baseline levels. Hazardous wastes will continue to be managed in compliance with OPNAVINST 5090.1C. The Navy's hazardous waste disposal practices also comply with federal, state, and local laws. The volume of wastes is well within the capacity of the Navy's hazardous waste management system, and commercial waste transporters and treatment and disposal facilities.

Summary

Hazardous Materials

Table 3.3-9 summarizes the training materials expended on SCI under the No Action Alternative. Most of these materials will be deposited in SHOBA. Based on the analysis presented above, most of the constituents and degradation products of the training materials expended on SCI are non-hazardous. However, several thousand pounds of hazardous metals, including lead, copper, and antimony, will be deposited on SCI ranges annually by Navy training activities. Periodic range clearances by EOD personnel reduce the likelihood of contaminant hot spots developing on land ranges.

The expended ordnance is likely to be concentrated at certain points within the range, such as around fixed targets, so some toxic hot spots of soil contamination could develop over time. Sediment transport processes will tend to move surface soils downslope over time; conveying metals and other insoluble constituents into nearby marine areas. An estimated 70 percent of eroded soils on SCI eventually are transported to the ocean (DON 2006).

Explosives and propellants decompose gradually due to sunlight and bacterial activity, and their water-soluble degradation products migrate vertically and horizontally in the soil. Where UXO or low-order detonations result in large deposits of these materials, a local "hot spot" of contamination could result, but soil concentrations of these hazardous constituents are not expected to approach actionable levels as a result of residues from normal high-order detonations. Periodic range clearances by EOD personnel reduce the likelihood of contaminant hot spots developing on land ranges.

Relatively insoluble inorganic constituents, such as lead and other metals, will tend to accumulate in surface soils, while soluble materials - such as nitrate, sulfate, and chlorate compounds - will tend to migrate vertically and horizontally. The gradual buildup of hazardous substances may eventually reach actionable concentrations (see Table 3.3-6) in "hot-spot" locations. Overall, however, the concentrations of these substances will not rise to a level of concern.

Hazardous Wastes

The anticipated amounts of hazardous wastes are well within the capacity of the Navy's hazardous waste management system. The anticipated amounts also are well within the existing capacities of hazardous waste transporters and treatment and disposal facilities.

Table 3.3-9: Estimated Expenditures of Training Materials on SCI, No Action Alternative

Activity Area	Expenditures, Annual					
	Gun Shell	Cannon / Mortar Shell	Small Arms	Flare / Smoke	Missiles / Rockets	Bomb
Amphibious Warfare	4,500	886	14,100	0	151	344
Naval Special Warfare	0	234	2,550,000	397	0	0
Strike Warfare	0	0	5,600	14	173	1,870
Space and Naval Warfare	195	0	0	0	7	0
Total (Number/year)	**4,700**	**1,120**	**2,570,000**	**411**	**331**	**2,210**
Total (weight in tons)	136	14	25	0.16	14	159
Estimated UXO (Number/yr)	235	56	NA	21	17	110
Estimated Low-Order (Number/yr)	9	2	NA	1	1	4
Note: numbers of items are estimates,. lb - pounds; yr - year.						
Source: U.S. Navy, 2007						

3.3.4.3 Alternative 1

3.3.4.3.1 SOCAL OPAREAs

Hazardous Materials

Unrecovered training materials containing hazardous constituents that would be deposited in the SOCAL OPAREAs are addressed in Section 3.4, Water Resources.

Hazardous Wastes

The amount of hazardous waste generated by SOCAL OPAREAs activities under Alternative 1 would increase in rough proportion to the increase in training activities. Used hazardous materials would be off-loaded from Navy ships upon reaching port, probably in San Diego, at which time these materials would become hazardous wastes. All hazardous wastes would continue to be managed in compliance with OPNAVISNT 5090.1C.

The anticipated increases in hazardous wastes generation would be well within the capacity of the Navy's hazardous waste management system. The anticipated increases also are well within the existing capacities of hazardous waste transporters and treatment and disposal facilities.

3.3.4.3.2 San Clemente Island

Hazardous Materials

SHOBA

Missiles, Rockets, and Aerial Targets

The missiles and aerial targets used in SHOBA consist of NSW Stinger training against Ballistic Aerial Targets (BATS). The hazardous materials found in these systems are primarily from the propellants used in the target and missile, and the warhead in the missile.

For the NSW training, BATS contain between 12 lb (5.4 kg) and 30 lb (13.6 kg) of propellant, which is expended during the launch of the target. The Stinger missile has approximately 11.4 lb (5.2 kg) of propellant and a warhead of approximately 6.6 lb (3 kg) of explosives. The propellants and explosives are used up in the exercise, creating primarily air emissions of carbon dioxide, water, and nitrogen. Under Alternative 1, 51 Stingers would be used against up to 24 BATS.

Approximately 175 rockets (25 more than under the No Action Alternative) would be used in EFEXs. In addition, as part of the EFEX, one BGM-71E TOW missile would be used under Alternative 1. The missile uses a solid propellant rocket motor for propulsion, and has a warhead containing approximately seven lb (3.1 kg) of explosives.

Artillery, Naval Gunfire, Mortar Rounds, and Cannon Rounds

Under Alternative 1, artillery and naval gun shells (about 5,100/year) and cannon and mortar rounds (about 1,840/year) would be used in training exercises on SCI. The majority of the energetic materials in these items would be converted to inorganic gaseous products and water. Less than 25 percent of the original weight of the ordnance would remain as solids and water. Less than one percent of these materials would consist of toxic metals such as lead. Total numbers of these training items are provided by warfare area in Table 3.3-11 below.

Bombs

Wholly inert and high explosive bombs are dropped primarily in Impact Area II (high explosive bombs are dropped in Impact Area IIA), the only target area where MK-80 Series bombs can be dropped. Of the approximately 2,500 bombs to be dropped (10 percent more than under the No Action Alternative), around 40 percent would be non-explosive practice bombs, 47 percent would be 500-lb (227-kg) bombs (MK-82 or equivalent), and 13 percent would be 1,000-lb (334-kg) bombs (MK-83 or equivalent). The main solid products would be aluminum oxide and carbon, and the main liquid product from detonation is water. In addition, other non-explosive practice bombs such as BDU-48, BDU-45, LGTR, and MK-76s would be dropped on the range.

Flares and Smoke Charges

A small number of flares and smoke charges (313/year versus 300/year under the No Action Alternative) would be used in Direct Action training. Flares and smoke charges also would be used in Electronic Combat (42) and Land Demolition (175). The main solid and liquid products are water and potassium. Approximately nine percent of these wastes would consist of lead oxide.

Amphibious Warfare

Amphibious warfare activities vary from small boat raids to larger events with several AAVs or LCACs. High explosive ordnance is not expended in the Over-the-Beach (OTB) portion of the amphibious assaults. No high explosive ordnance is used, so no hazardous materials are used in this exercise. The ordnance used after the landing is captured in the SHOBA analysis above.

Naval Special Warfare

These training activities involve the use of demolition explosives, both on land and underwater, small arms firing on static ranges, land navigation training, and platoon-sized activities using high explosive ordnance in authorized areas.

Under Alternative 1, about 5.1 million rounds of small arms ammunition would be used annually for NSW training, including about 1,790 grenades. Use of this ammunition would deposit approximately 29 tons (27 metric tons) of solid and liquid detonation products on SCI. Of this amount, the lead in the ammunition would be about 12 tons (11 metric tons). Other constituents include aluminum, barium, antimony, and magnesium. An estimated 90 percent of these materials are deposited on land, while an estimated 10 percent are deposited in the nearshore waters of SCI.

Under Alternative 1, approximately 105,000 lb (47,700 kg) of energetic materials would be used by NSW for explosives training. The detonation products of most of the explosives, C-4 and TNT, result in approximately 5,920 lb (2,690 kg) of water and 4,100 lb (1,860 kg) of carbon. Explosive support devices such as cable cutters, fuse cutters, time fuses, detonation cord, blasting caps, and claymore mines are included in this total.

Other Island Operations

Non-Combat Operations include EOD activities. The EOD activities involve hazardous materials during the explosive destruction of munitions, but the areas in which the activities occur are very isolated (usually on VC-3). The emission products from this limited number of events would be very small.

Activities at NALF are generally restricted to military aviation and contract flights to bring personnel to the island and return them to the mainland. The hazardous materials used and produced during airfield operations would be handled by the hazardous materials handling and processing procedures in place.

RDT&E

The components that contain munitions constituents in missile flight tests include propellants, batteries, telemetry, igniters, jet fuel, hydraulic fluid, and explosives. Under Alternative 1, five JSOWs, five LASMs, two Tomahawk missiles, five Japanese Missile tests, and one developmental Anti-Ship Missile were analyzed. The total amount of hazardous material (other than the warhead) is shown in Table 3.3-10.

Table 3.3-10: Estimated Missile Impact Constituents

Missile		Amount, lb (kg)				
Type	Number	Propellant, Residual	Batteries	Igniters, Wiring, Etc.	Explosives	Total
JSOW	5	2.9 (1.3)	NA	NA	98.1 (44.5)	101 (46)
LASM and Japanese Missile	10	1,654 (750)	13 (5.9)	0.9 (0.4)	153 (69.4)	1821 (826)
Tomahawk	2	6.2 (2.8)	NA	NA	68.6 (31.1)	79.4 (36)
Developmental Anti-Ship Missile	1	3.1 (1.4)	NA	NA	34.4 (15.6)	39.9 (18)
Source: DoN 1996, DoN 1998, DoN 2002						

<u>Hazardous Wastes</u>

Under Alternative 1, the on-island accumulation and storage, ocean transport, and ashore treatment or disposal of hazardous wastes would increase by about 50 percent from baseline conditions. Hazardous wastes would continue to be managed in compliance with OPNAVINST 5090.1C. The volume of wastes would be well within the capacity of the Navy's hazardous waste management system, and commercial waste transporters and treatment and disposal facilities.

<u>Summary</u>

Hazardous Materials

Table 3.3-11 summarizes the training materials expended on SCI under Alternative 1. Most of these materials would be deposited in SHOBA. Based on the analysis presented above, most of the constituents and degradation products of the training materials expended on SCI would be non-hazardous. Several thousand pounds of lead would be deposited on SCI ranges as a result of Navy training activities; this amount would increase by about ten percent over the No Action Alternative. The environmental fate of the training materials deposited on the land ranges would be as described under the No Action Alternative in Section 3.3.4.2.2.

Table 3.3-11: Estimated Expenditures of Training Materials on SCI, Alternative 1

Activity Area	Expenditures, Annual					
	Gun Shell	Cannon / Mortar Shell	Small Arms	Flare / Smoke	Missiles / Rockets	Bomb
Amphibious Warfare	4,990	1,590	130,000	0	277	401
Naval Special Warfare	0	245	5,050,000	488	0	0
Strike Warfare	0	0	6,270	16	194	2,100
Space and Naval Warfare	81	0	0	0	18	0
Total (Number/year)	**5,070**	**1,840**	**5,180,000**	**504**	**489**	**2,500**
Total (weight in tons)	151	15	30	0.18	18	227
Estimated UXO (Number/yr)	254	92	NA	25	24	125
Estimated Low-Order (Number/yr)	10	4	NA	1	1	5

Notes: Numbers of training items are estimates, and are rounded to three significant digits to indicate their relative imprecision. lb - pound, yr - year.

Source: DoN 2007.

Hazardous Wastes

The anticipated increases in hazardous waste generation would be well within the capacity of the Navy's hazardous waste management system. The anticipated increases also are well within the existing capacities of hazardous waste transporters and treatment and disposal facilities.

3.3.4.4 Alternative 2

3.3.4.3.3 SOCAL OPAREAs

Hazardous Materials

Expended training materials containing hazardous constituents that would be deposited in the SOCAL OPAREAs are addressed in Section 3.4, Water Resources.

Hazardous Wastes

The amount of hazardous waste generated by SOCAL OPAREAs activities under Alternative 2 would increase in rough proportion to the increase in training activities. Used hazardous materials would be off-loaded from Navy ships upon reaching port, probably in San Diego, at which time these materials would become hazardous wastes. All hazardous wastes would continue to be managed in compliance with OPNAVISNT 5090.1C.

The anticipated increases in hazardous wastes generation would be well within the capacity of the Navy's hazardous waste management system. The anticipated increases also are well within the existing capacities of hazardous waste transporters and treatment and disposal facilities.

3.3.4.3.4 San Clemente Island

Hazardous Materials

SHOBA

Missiles, Rockets, and Aerial Targets

The missiles and aerial targets used in SHOBA would consist of NSW Stinger training against BATS. BATS are described under Alternative 1. Under Alternative 2, 59 Stinger missiles would be used against BATS.

Approximately 200 rockets (versus 150 under the No Action Alternative) would be used in EFEXs. In addition, as part of the EFEX, one BGM-71E TOW missile would be used under Alternative 2. The hazardous materials found in these systems are primarily from the propellants used in the target and missile, and the warhead in the missile.

Artillery, Naval Gunfire, and Mortar Rounds

Under Alternative 2, 5,510 artillery and naval gun shells and 800 mortar rounds would be used in training exercises on SCI. The majority of the energetic materials in these items would be converted to inorganic gaseous products and water. Less than 25 percent of the original weight of the ordnance would remain as solids and water. Less than one percent of these materials would consist of toxic metals such as lead. Total numbers of these training items are provided by warfare area in Table 3.3-13 below.

Bombs

Wholly inert and high explosive bombs are dropped primarily in Impact Area II (high explosive bombs are dropped in Impact Area IIA), the only target area where MK-80 Series bombs can be dropped. Of the approximately 2,760 bombs dropped, around 40 percent would be non-explosive practice bombs, 47 percent would be 500-lb (227-kg) bombs (MK-82 or equivalent), and 13 percent would be 1,000-lb (334-kg) bombs (MK-83 or equivalent). The primary solid products would be aluminum oxide and carbon, and the primary liquid product from detonation would be water. In addition, other wholly inert bombs such as BDU-48, BDU-45, LGTR, and MK-76s would be dropped on the range.

Flares and Smoke Charges

Approximately 365 flares and smoke charges would be used in NSW Direct Action activities as signaling devices or illumination devices, compared with 300 under the No Action Alternative. In addition, 43 flares and smoke charges would be used for Electronic Combat and 189 flares and smoke charges would be used for Land Demolition. The primary solid and liquid products would be water and potassium. Approximately 9 percent of these wastes would consist of lead oxide.

Amphibious Warfare

Amphibious warfare activities vary from small boat raids to larger events with numbers of AAVs or LCACs. Marines could be airlifted onto SCI landing zones by helicopter. High explosive ordnance would not be expended in the OTB portion of the amphibious assaults. No high explosive ordnance would be used in these exercises.

Naval Special Warfare

These training activities involve the use of demolition explosives, both on land and underwater, small arms firing on static ranges, land navigation training, and SEAL platoon-sized activities using high explosive ordnance in authorized areas. On-island use of explosives is discussed in the

Explosives section of the SHOBA discussion. On-island expenditure of small arms for NSW training is captured above under Small Arms in the SHOBA analysis.

Under Alternative 2, about 6 million rounds of small arms ammunition would be used annually for NSW training, including over 900 grenades. Use of this ammunition would deposit approximately 45,800 lb (20,800 kg) of solid and liquid detonation products on the range. Of this amount, the lead in the ammunition would be over 18,300 lb (8,300 kg).

Under Alternative 2, approximately 123,000 lb (55,900 kg) of energetic materials would be used by NSW for explosives training. The products of detonation of the majority of the explosives, C-4 and TNT, resulted in approximately 6,930 lb (3,150 kg) of water and 4,810 lb (2,190 kg) of carbon. Explosive support devices such as cable cutters, fuse cutters, time fuses, detonation cord, blasting caps, and claymore mines are included in this total.

Other Island Operations

Non-Combat Operations include EOD activities. The EOD activities involve hazardous materials during the explosive destruction of munitions, but the areas in which the activities occur are very isolated (usually on VC-3). The emission products from this limited number of events would be very small, and the materials produced would be similar to the emission products discussed earlier for that type of ordnance.

Activities at NALF are generally restricted to military aviation and contract flights to bring personnel to the island and return them to the mainland. The hazardous materials used and produced during airfield operations will be handled by the hazardous materials handling and processing procedures in place.

RDT&E

The components that contain munitions constituents in missile flight tests include propellants, batteries, telemetry, igniters, jet fuel, hydraulic fluid, and explosives. Under Alternative 2, ten JSOWs, ten LASMs, two Tomahawk missiles, five Japanese Missile tests, and one developmental Anti-Ship Missile were analyzed. The total amount of hazardous material is shown in Table 3.3-12.

Hazardous Wastes

Under Alternative 2, the on-island accumulation and storage, ocean transport, and ashore treatment or disposal of hazardous wastes would increase by about 68 percent from baseline conditions. Hazardous wastes would continue to be managed in compliance with OPNAVINST 5090.1C. The volume of wastes would be well within the capacity of the Navy's hazardous waste management system, and commercial waste transporters and treatment and disposal facilities.

Summary

Hazardous Materials

Table 3.3-13 summarizes the training materials expended on SCI under Alternative 2. Most of these materials would be deposited in SHOBA. Based on the analysis presented above, most of the constituents and degradation products of the training materials expended on SCI would be non-hazardous. Several thousand pounds of lead would be deposited on SCI ranges as a result of Navy training activities; this amount would increase by about fifty percent over the No Action Alternative. The environmental fate of the training materials deposited on the land ranges would be as described under the No Action Alternative in Section 3.3.4.2.2.

Table 3.3-12: Estimated Missile Impact Constituents

Missile		Amount, lb (kg)				
Type	Number	Propellant, Residual	Batteries	Igniters, Wiring, Etc.	Explosives	Total
JSOW	10	5.7 (2.6)	NA	NA	196 (88.9)	201.7 (91.5)
LASM and Japanese Missile	15	1,203 (546)	10 (4.5)	0.7 (0.3)	111 (50.3)	1324 (601)
Tomahawk	2	30.4 (13.8)	NA	NA	343 (155.6)	79.4 (36)
Developmental Anti-Ship Missile	1	3.1 (1.4)	NA	NA	34.4 (15.6)	39.9 (18.1)
Source: DoN 1996, DoN 1998, DoN 2002						

Table 3.3-13: Estimated Expenditures of Training Materials on SCI, Alternative 2

Activity Area	Expenditures, Annual					
	Gun Shell	Cannon / Mortar Shell	Small Arms	Flares / Smokes	Missiles / Rockets	Bombs
Amphibious Warfare	5,400	2,720	244,000	0	369	459
Naval Special Warfare	0	285	6,040,000	554	0	0
Strike Warfare	0	0	6,870	16	212	2,300
Space and Naval Warfare	109	0	0	0	28	
Total (Number/year)	**5,510**	**3,010**	**6,290,000**	**570**	**609**	**2,760**
Total (weight in tons)	**164**	**22**	**44**	**0.23**	**22**	**234**
Estimated UXO (Number/yr)	**276**	**150**	**NA**	**29**	**30**	**138**
Estimated Low-Order (Number/yr)	**11**	**6**	**NA**	**1**	**1**	**6**
Notes: Numbers of training items are estimates, and are rounded to three significant digits to indicate their relative imprecision. lb - pound, yr - year.						
Source: DoN 2007.						

Hazardous Wastes

The anticipated increases in hazardous waste generation would be well within the capacity of the Navy's hazardous waste management system. The anticipated increases also are well within the existing capacities of hazardous waste transporters and treatment and disposal facilities.

3.3.5 Mitigation Measures

The Navy's process for managing hazardous waste and materials mitigates the potential for environmental impact (See sections 3.3.3.1.1 and 3.3.3.2.2).

3.3.6 Unavoidable Adverse Environmental Effects

Under the Proposed Action, hazardous constituents of expended training materials and their degradation products would accumulate in soils at a faster rate. No other unavoidable adverse effects were identified.

3.3.7 Summary of Effects by Alternative

The reasonably foreseeable activities that could add incremental impacts to the past and present impacts from hazardous waste, described in this section, have been addressed by the analyses under the No Action Alternative, Alternative 1, and Alternative 2. Table 3.3-14 presents a summary of these effects and mitigation measures.

Table 3.3-14: Summary of Effects by Alternative

Alternative	NEPA (On-Land and U.S. Territorial Waters)	*EO 12114* *(Non U.S. Territorial Waters)*
No Action Alternative	• SCI on-island use of expendable training materials will deposit tens of thousands of pounds of training materials on the land ranges. Most of the degradation products of these materials are non-hazardous inorganic materials, however, hazardous constituents and metals from ordnance are deposited into soils including lead, nickel, chromium, and copper. • The Navy's existing hazardous waste management system is sufficient for handling of wastes generated by the proposed action.	• No effect from land activities. • The Navy's existing hazardous waste management system is sufficient for handling of wastes generated by the proposed action.
Alternative 1	• Impacts on SCI would be similar to those of the No Action Alternative. Overall volume of expended training materials would increase by about 50 percent. • The Navy's existing hazardous waste management system is sufficient for handling of wastes generated by the proposed action.	• No effect from land activities. • The Navy's existing hazardous waste management system is sufficient for handling of wastes generated by the proposed action.
Alternative 2	• Impacts on SCI would be similar to those of the No Action Alternative. Overall volume of expended training materials would increase by about 68 percent. • The Navy's existing hazardous waste management system is sufficient for handling of wastes generated by the proposed action.	• No effect from land activities. • The Navy's existing hazardous waste management system is sufficient for handling of wastes generated by the proposed action.
Mitigation Measures	• The Navy's general instructions (e.g., OPNAVINST 5090.1C) and training activity planning and review processes serve to ensure that hazardous materials and hazardous wastes are stored and handled appropriately.	• The Navy's general instructions (e.g., OPNAVINST 5090.1C) and training activity planning and review processes serve to ensure that hazardous materials and hazardous wastes are stored and handled appropriately.

3.4 Water Resources

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3.4 WATER RESOURCES

Water resources include water bodies, water processes and uses, and water quality. Water quality is the chemical and physical composition of ground water and fresh and marine surface waters, as affected by natural conditions and human activities. Water bodies that could be affected by the Proposed Action are Pacific Ocean waters off southern California, and intermittent streams, impoundments, storage facilities, and ground waters on SCI.

Water resource regulations focus on the right to use water and the protection of water quality. The principal federal laws protecting water quality are the Federal Water Pollution Control Act (Clean Water Act, or "CWA"), as amended (33 United States Code [U.S.C.] § 1251 et seq.), and the Safe Drinking Water Act (SDWA) (42 U.S.C. § 300f et seq.). The principal State of California (State) law enabling water resource management is the Porter-Cologne Water Quality Control Act (WQCA; California Water Code [CWC] §§ 13000-13999.10).

3.4.1 Regulatory Requirements

3.4.1.1 Federal Regulations

The United States Environmental Protection Agency (USEPA) enforces both the CWA and the SDWA. The CWA seeks to protect surface water quality and preserve wetlands. The SDWA seeks to protect drinking water supplies. Section 403 of the CWA provides for the protection of ocean waters (waters of the territorial seas, the contiguous zone, and the high seas beyond the contiguous zone) from point-source discharges. Under Section 403(a), USEPA or an authorized state may issue a permit for an ocean discharge only if the discharge complies with CWA guidelines for protection of marine waters.

The CWA was amended in 1996 to authorize DoD and USEPA to jointly establish Uniform National Discharge Standards (UNDS) for incidental liquid discharges from Armed Forces vessels. USEPA has published final rules for Phase 1 of the UNDS program. In these rules, USEPA and the Navy identified which discharges will require control standards and a marine pollution control device (MPCD). The rules also identify the mechanism by which states can petition USEPA and DoD to review whether or not a discharge should require control by a MPCD, or to review a federal performance standard for a MPCD. Finally, the rules establish the processes USEPA and the states must follow to establish no-discharge zones, where any release of a specified discharge is prohibited.

National Oceanic and Atmospheric Administration (NOAA) also is responsible for ocean water quality. NOAA is a trustee agency for coastal and marine resources under CWA, CERCLA, the Coastal Zone Management Act, and OPA. NOAA has established programs to monitor coastal environmental quality, protect marine habitat, and restore natural resources.

3.4.1.2 State Regulations

At the State level, the WQCA established the State Water Resources Control Board (SWRCB) to exercise the adjudicatory and regulatory functions of the State in the field of water resources. Under the provisions of the CWC, the SWRCB, and nine Regional Water Quality Control Boards (RWQCBs) oversee water quality issues in nine water quality regions. The water quality regions include ground and surface waters within the three-nautical-mile (nm) State-jurisdictional limit. The RWQCBs also are responsible for implementing provisions of the CWA delegated to states, such as the National Pollutant Discharge Elimination System (NPDES), which regulates point (industrial) and non-point (storm water) sources of pollutants. For onshore military facilities, the *Defense and State Memorandum of Agreement* among the SWRCB, regional boards, and DoD defines the division of responsibilities for addressing water quality issues.

The SWRCB adopted the *Ocean Waters of California Water Quality Control Plan* (the *Ocean Plan*) (SWRCB 2005) in 1974; the *Ocean Plan* was amended in 1988, 1990, 1997, 2001, and 2005. The *Ocean Plan* establishes beneficial uses and water quality objectives for waters of the Pacific Ocean adjacent to the California coast outside of enclosed bays, estuaries, and coastal lagoons. The *Ocean Plan* also identifies Areas of Special Biological Significance (ASBS) designated or approved by the SWRCB.

The waters surrounding SCI out to a distance of 1 nm (1.9 km) or to the 300-ft (91-m) isobath, whichever is greater, have been designated by the SWRCB as an ASBS (Figure 3.4-1). Waste discharges to an ASBS are prohibited, unless the SWRCB finds that the discharge would not cause adverse impacts on beneficial uses. The *Ocean Plan* prohibits discharges of certain hazardous substances and discharges that could impact the ASBS. The SWRCB may grant an exception if it would not compromise protection of ocean waters for beneficial uses and if the public interest would be served.

3.4.2 Affected Environment

3.4.2.1 SOCAL OPAREAs

The physical oceanography of the SOCAL Range Complex can be characterized in terms of its bathymetry, or bottom topography, and its circulation. Sediment transport and deposition and bottom composition also are elements of physical oceanography. Long-term climate trends affect ocean water temperature, circulation patterns, and upwelling. Bathymetry, circulation, sediment transport and deposition, bottom topography, and climate are discussed below, along with ocean water quality.

3.4.2.1.1 Bathymetry

The shape of California’s coastline south of Point Conception creates a broad ocean embayment known as the Southern California Bight (SCB). The SCB encompasses the area from Point Conception south into Mexico, including the Channel Islands. Bottom topography in the SCB varies from broad expanses of continental shelf to deep basins. Southwest of the Channel Islands lies the Patton Escarpment, a steep ridge with contours bearing in a northwesterly direction. This ridge drops approximately 4,900 feet (ft) (1,500 meters [m]) to the deep ocean floor. Between the Patton Escarpment and the mainland lie the Santa Rosa-Cortes Ridge, deep shelf basins (e.g., Catalina, San Clemente, East Cortes, West Cortes, San Nicolas, Tanner); two important channels (Santa Barbara and San Pedro); and a series of escarpments, canyons, banks, and sea mounts (e.g., Cortes Bank, Tanner Bank, 60-Mile Bank, Farnsworth Bank, and Lausen Sea Mount), some of which are located outside of the Range Complex (Figure 3.4-2).

The ocean floor in the vicinity of SCI includes the Catalina, San Nicolas, East Cortes, and West Cortes Basins. SCI and the Tanner and Cortes Banks are the highest peaks of undersea ridges. The bathymetry surrounding SCI is irregular in shape, with Catalina Basin to the east and San Nicolas Basin to the west. A narrow island shelf extending to a depth of about 330 ft. (100 m) surrounds SCI, extending from 0.3 to three nm (0.5 to 5.5 km) from the island's coast.

Offshore relief east of SCI is extreme due to San Clemente Escarpment, leveling off at a depth of about 3,280 ft. (1,000 m) below Mean Sea Level (MSL) in Catalina Basin (CDMG 1986). Offshore relief south and west of SCI is more gradual, though depths reach a maximum of about 5,900 ft. (1,800 m) in San Nicolas Basin (CDMG 1986).

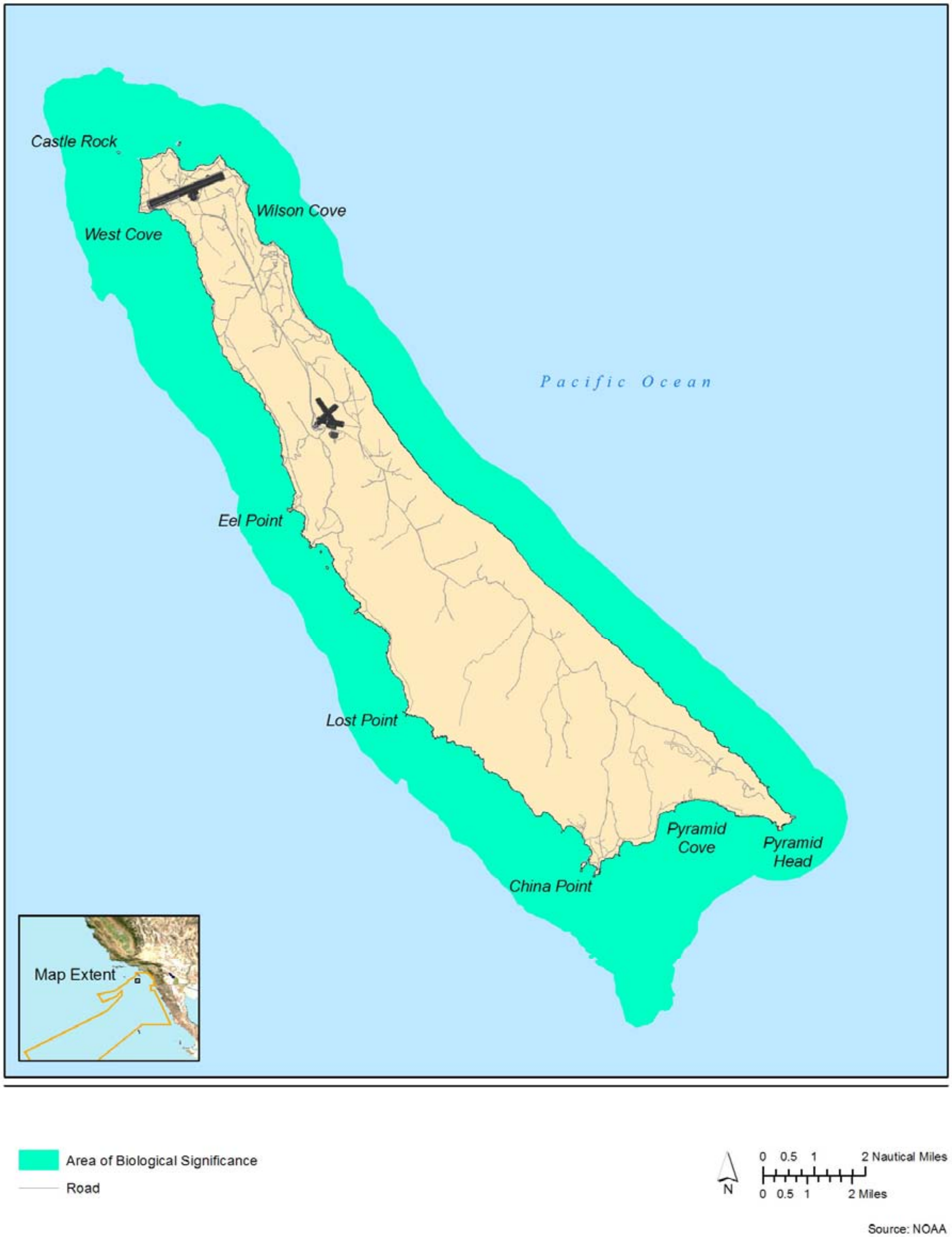

Figure 3.4-1: Area of Special Biological Significance

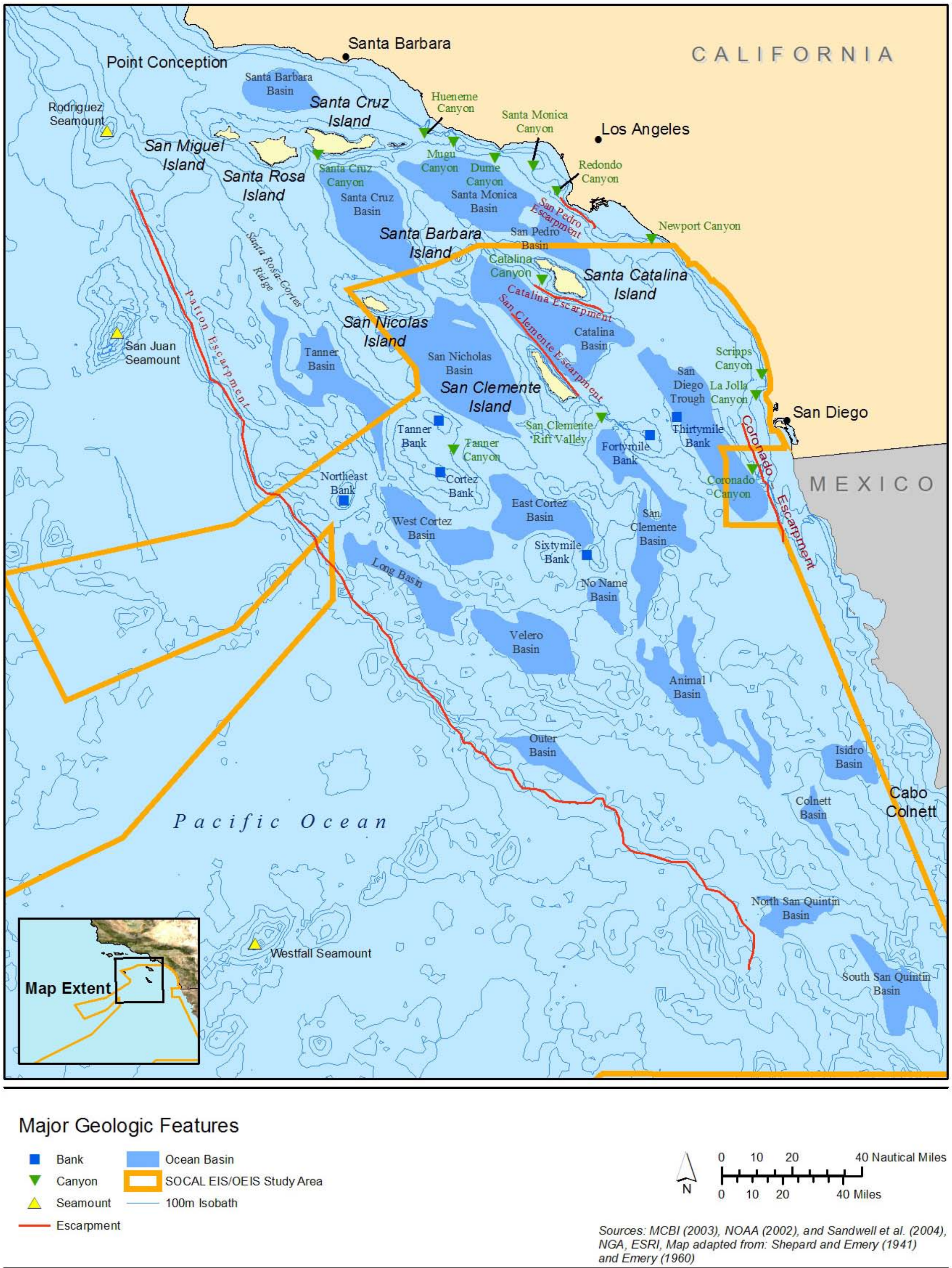

Figure 3.4-2: Major geological features of the SOCAL OPAREAs and vicinity.

Farther to the southwest, beyond Patton Escarpment, the only major bottom feature is the Westfall Seamount. To the south, along the coast of Baja California, lie several additional banks and basins, including Valero, Animal, Colnett, and North and South San Quentin Basins.

Banks and sea mounts possess unique physical characteristics that affect local biological processes. They are the focus of upwellings that attract pelagic fishes and their predators (e.g., seabirds and marine mammals) (Cross and Allen 1993). The Tanner and Cortes Banks are located approximately 97 nm (186 km) and 92 nm (179 km) due west of San Diego, California, respectively (Figure 3.4-3). These banks are subsea pinnacles on the Santa Rosa-Cortes Ridge that extend through the SCB in a southeasterly direction from near San Miguel Island to offshore of SCI. Tanner Bank's shallowest depth is approximately 66 ft (20 m); Cortes Bank rises to within 13 ft (4 m) of the ocean surface. Cortes Bank is 15 nm (28 km) south of Tanner Bank, and has approximately four times as much area above the 200-ft (60-m) depth contour. The saddle between the two banks has a depth of 820 ft (250 m), with the sides of the banks sloping at 6 percent or greater (BLM 1978).

SCI is the southernmost of the Channel Islands, and is located in the pathway of the warm, northerly flowing California Counter-Current. SCI is oblong and oriented from northwest to southeast. The leeward (mainland) side of SCI is relatively free from substantial wave and swell disturbance. However, periodic storms produce waves of sufficient magnitude to reposition many of the free rocks and therefore disturb the substrate configuration. Nearshore local currents are driven by wind and tides. Dye studies conducted from the Wilson Cove wastewater outfall indicate that the predominant water movement is generally southerly (CRM 1998).

3.4.2.1.2 Circulation

The SCB is influenced by two major oceanic currents: the southward-flowing, cold-water California Current and the northward flowing, warm-water California Counter-Current (Figure 3.4-3). These currents mix in the SCB, and strongly influence patterns of ocean water circulation, temperature, and water quality along the southern California coast and around the eight Channel Islands. The majority of the SOCAL OPAREAs, as well as SCI, lie within the SCB.

The SOCAL OPAREAs are located in the southern portion of the SCB, at the transition between two distinct biogeographic coastal provinces: the Oregonian and the Californian. The cold, temperate waters of the California Current flow from northwest to southeast to meet the warmer waters of the northwesterly flowing California Counter-Current just south of Point Conception. When the California Current reaches Point Conception, it flows away from the shoreline, creating a counter-clockwise gyre, the Southern California Eddy, in the SCB. The return flow of this gyre moves to the northeast and north through the southern Channel Islands toward the mainland, before turning toward the northwest. The mixing of cold and warm water masses affects the distribution of marine fauna and flora, leading to the presence of both cold and warm temperature species that thrive in the transition zone and overlap in their distributions.

The coastal headlands, promontories, submarine canyons, basins, ranges, and ridges of the SCB impose variations on the circulation patterns described above, primarily eddies. Northwesterly onshore winds create a southerly alongshore current near the coast, reversing the northward flow of the Southern California Eddy. The resulting circulation pattern differs substantially from other locations along the western coast of the United States. This complex circulation pattern is an important element of the coastal marine ecosystem.

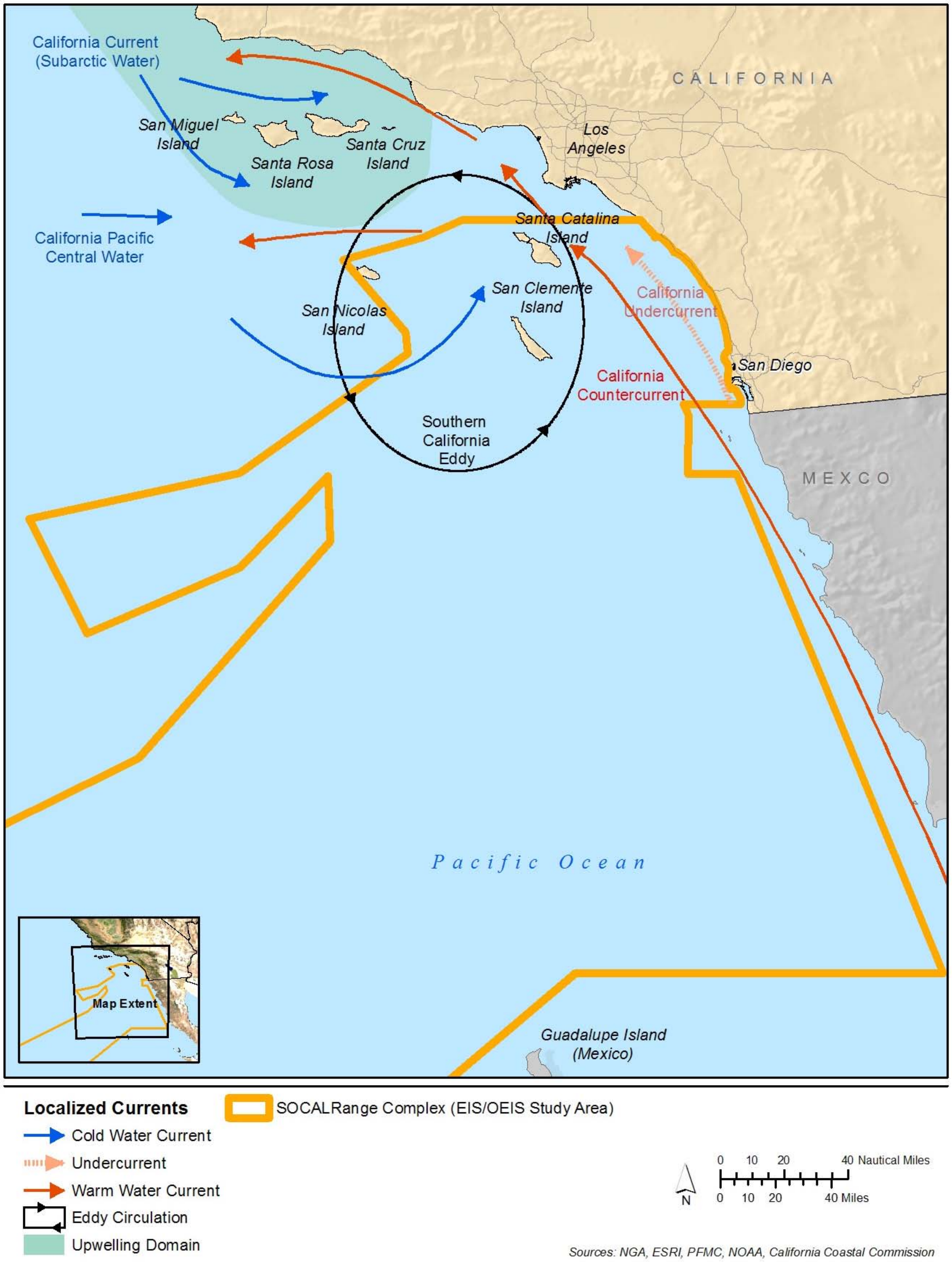

Figure 3.4-3: California Current and Counter-Current Impact on Southern California Bight

Cyclical seasonal activities also contribute to the richness of the SCB. An upwelling current (where nutrient-rich deep waters are drawn to the surface by offshore winds) in the SCB occurs from February or March through August. High nutrient levels combined with increasing day length and light intensity produce exceptionally high phytoplankton and algae production. Thorough and frequent mixing of these waters creates conditions that support a rich and varied marine flora and fauna year-round (Leatherwood et al. 1987). This increase in food supply supports even greater numbers of fish, shellfish, and other marine life.

3.4.2.1.3 Sediment Transport and Deposition

Rivers along the Pacific coast typically drain small, steep tributary basins, producing large amounts of sand discharge. This discharge is sorted by wave action at the coast into coarser particles, usually sands and gravels, which move in traction or in short-term near-bottom suspension. The coarse fraction travels along the shore within the beach and inshore zone, and offshore to the inner and central shelf at times of strong storm surge. Where submarine canyons cut into the near-shore, they intercept much of this transport.

Sandy sediments initially deposited in nearshore canyon heads are progressively transferred downslope by mass movement processes and sediment gravity flows. Fine sediments initially accumulate in canyon walls and deeper canyon floors, where they are then incorporated and carried out of the canyons to submarine fans and basin floors. Silts and clays are also transported as suspended loads, and follow water circulation during their slow fall. In general, grain size of basin sediments generally decreases with distance offshore.

The surface circulation of the SCB tends to move fine suspended sediment into Santa Barbara Basin from the California Current system to the west and through Anacapa Passage from the southeast. No detailed description of the marine sediments in this area has been developed, but they are assumed to be similar to those of other basins, which are generally composed of 35 to 85 percent fines (silts and clays) and 15 to 65 percent sand (Science Applications International Corporation and MEC 1995).

On SCI, sediment plumes are visible at the mouths of most drainages during storms. An estimated 70 percent of eroded soils eventually are transported to the ocean, amounting to 1,428 tons per year for the island (DoN 2006).

3.4.2.1.4 Bottom Composition

In the SCB, bottom substrate is heavily influenced by local sub-surface and oceanographic attributes (DoN 1999). In the SOCAL OPAREAs, soft substrates (sands, silts, and mud) dominate the benthic habitat (Cross and Allen 1993; Figure 3.4-4). Sandy substrates are found predominantly on the continental shelf, while silts (<62 microns (μm) in diameter) and mud are found in basins and on slopes (DoN 1999; DoN 2000).

Nearshore sediment distribution is consistent due to suspended sediment resuspension and mixing by the California Current. Beyond 30 km, there is an increasing percentage of organic carbon and carbonate in the sediment bed with distance from the coast (Lund et al. 1992). At the continental shelf break, offshore banks, the shelf around offshore islands (e.g. Santa Catalina and San Clemente Islands), and submarine canyons (Allen et al. 1992) rocky substrate dominates. Santa Barbara, Santa Catalina, and San Clemente Islands are typically characterized by high relief rocky habitat surrounded by soft sandy bottoms.

Figure 3.4-4: Bottom Substrate Composition in the SOCAL OPAREAs

Subtidal areas near SCI (within 100 ft. [30 m]) have sand, rock, or boulder substrates. Beyond the kelp beds (depth >100 ft. [30 m]), approximately three percent of the seafloor is rocky outcrop, rubble, and talus (Dailey et al. 1993). Near the island shelf, these rocky areas are generally interspersed with soft substrates, such as sand or gravel. Offshore, Tanner and Cortes Banks are composed primarily of base rock and rocky outcrops that may be covered with a thin layer of sediment. North and east of SCI, Catalina Basin is primarily composed of undifferentiated sediments and sedimentary rocks of Quaternary and Tertiary (Pleistocene and Miocene) age, as well as interspersed pockets of undifferentiated volcanic and sedimentary rocks of Miocene age (CDMG 1986).

3.4.2.1.5 Long-Term Climate

Long-term climatic influences in the region include El Nino, Pacific Decadal Oscillation, and global warming. The recurring El Nino-Southern Oscillation pattern is one of the strongest in the ocean-atmosphere system. El Nino is defined by relaxation of the trade winds in the central and western Pacific, which can set off a chain reaction of oceanographic changes in the eastern Pacific Ocean. Off the coast of California, El Nino events are characterized by increases in ocean temperature and sea level, enhanced onshore and northward flow, and reduced coastal upwelling of deep, cold, nutrient-rich water. During this period, plankton abundance decreases, resulting in a decrease in survivorship and reproductive success of planktivorous invertebrates and fishes. Marine mammals and seabirds, which feed on these organisms, experience widespread starvation and decreased reproductive success.

Every 20 to 30 years, the surface waters of the central and northern Pacific Ocean (20°N and poleward) shift several degrees from their mean temperature. Such shifts in mean surface water temperature, known as the Pacific Decadal Oscillation, have been detected five times during the past century, with the most recent shift having occurred in 1998. This Oscillation affects production in the eastern Pacific Ocean and, consequently, affects organism abundance and distribution throughout the food chain.

Ocean waters off the coast of California have warmed considerably over the last 40 years. It is not clear if this warming is a consequence of an interdecadal climate shift, or global warming. In response to this phenomena, along with the two discussed above, some marine species have shifted their geographic ranges northward, altering the composition of local assemblages of biota (National Centers for Coastal Ocean Science 2005).

3.4.2.1.6 Marine Water Quality

The condition of the Affected Environment (existing condition) includes impacts on water quality from past and present natural causes and man-made activities. This section describes some of these factors. Water quality in the marine environment is determined by a complex set of interactions between chemical and physical processes operating continuously in the ocean system. This dynamic equilibrium is expressed by a variety of indicators, including temperature, salinity, dissolved oxygen, and nutrient levels. Water pollutants alter the basic chemistry of sea water in various ways. The following discussion characterizes in general terms the major determinants of marine water quality in the SOCAL Range Complex.

Water quality in the SOCAL Range Complex is strongly affected by human activities in the heavily developed southern California area. In a report on the *Southern California Bight 1998 Regional Monitoring Program*, the Southern California Coastal Water Research Project identified urban runoff as "among the largest sources of contamination to Southern California's coastal ocean, containing bacterial contamination, inorganic nutrients, various organic compounds, and metals" (Southern California Coastal Water Research Project 2003). The report also stated that sediment toxicity was most severe in port and marina areas within bays, harbors, and river mouths.

The vast expanse of the offshore waters of the SOCAL Range Complex, combined with their distance from the shore and the mixing and transport effects of the currents, work together to maintain a generally high quality of water that meets or exceeds criteria set forth by the *Ocean Plan* and by National Ambient Water Quality Criteria (NAWQC) (USEPA 1986).

Temperature

Sea surface temperatures are affected by atmospheric conditions, and can show seasonal variation in association with upwelling, climatic conditions, and latitude (Tait 1980). Surface temperatures of waters along the coast of southern California range from approximately 54 degrees Fahrenheit (°F) (12 degrees Celsius [°C]) in winter to 70° F (21 °C) in summer. The coldest sea surface temperatures typically occur in February, while the warmest temperatures typically occur in September (Engle 1994).

Chemical Characteristics

The major chemical parameters of marine water quality include hydrogen ion concentration (pH), dissolved oxygen, and nutrient concentrations. The major ions present in seawater are sodium, chloride, potassium, calcium, magnesium, and sulfate.

The marine environment has a high buffering capacity (i.e., the pH of seawater is relatively stable) due to the presence of dissolved elements, particularly carbon and hydrogen. Most of the carbon in the sea is present as dissolved inorganic carbon that originates from the complex equilibrium reaction of dissolved carbon dioxide (CO_2) and water. This CO_2-carbonate equilibrium system is the major buffering system in seawater, maintaining a pH between 7.5 and 8.5.

Surface waters are usually saturated or supersaturated with dissolved oxygen as a result of photosynthetic activity and wave mixing. Dissolved oxygen levels at the surface fluctuate between 5.4 and 5.9 milliliters per liter (mL/L) (over 100 percent oxygen saturation), while levels at depths below the surface remain more constant between 0.4 and 0.6 mL/L (CALCOFI 1982). Anaerobic conditions are found at the water-sediment interface in many of the deep basins (Dailey et al. 1993).

Nutrients are chemicals or elements necessary to produce organic matter. Basic nutrients include dissolved nitrogen, phosphates, and silicates. Dissolved inorganic nitrogen occurs in ocean water as nitrates, nitrites, and ammonia, with nitrates as the dominant form. The nitrate concentration of water in the nearshore California Current varies annually from 0.1 to 10.0 micrograms per liter (µg/L). The lowest concentrations typically occur in summer. At a depth of 33 ft. (10 m) concentrations of phosphate and silicate in the California Current typically range from 0.25 to 1.25 µg/L and two to 15 µg/L, respectively (CALCOFI 1982).

Water Pollutants

Most of the marine water pollution in the SOCAL Range Complex results from municipal discharges. The oil and gas industry, however, is a source of water pollution in the northern part of the SCB. As offshore oil and gas development activity increases, the discharges of pollutants into the SCB also increases. In recent years, an increase in oil leaks, accidental spills, discharge of formation water, drill mud, sediment, debris, and sludge in the area have decreased water quality (NPS 1985).

Commercial, recreational, and institutional vessels also discharge water pollutants in the SOCAL Range Complex. Shipboard waste-handling procedures governing the discharge of non-hazardous waste streams have been established for commercial and Navy vessels. These categories of wastes include: (a) Liquids: "black water" (sewage); "grey water" (water from deck drains, showers, dishwashers, laundries, etc.); and oily wastes (oil water mixtures); and (b) Solids (garbage). Table 3.4-1 summarizes the waste stream discharge restrictions for Navy vessels at sea.

The *Ocean Plan* establishes beneficial uses and water quality objectives for waters of the Pacific Ocean adjacent to the California coast outside of enclosed bays, estuaries, and coastal lagoons. The *Ocean Plan* prescribes effluent quality requirements and management principles for waste dischargers and specific waste discharge prohibitions. It also prohibits discharges of specific hazardous substances and sludge, bypasses of untreated waste, and discharges that affect ASBS. SWRCB may grant exceptions to allow a discharge into an ASBS, however, provided that the exception will not compromise protection of ocean waters for beneficial uses and that the public interest will be served (RWQCB 1994).

Table 3.4-1: Waste Discharge Restrictions for Navy Ships

Zone (nm from shore)	Type of Waste	
	Black Water (Sewage)	Greywater
U.S. Waters (0-3 nm)	No discharge.	If vessel is equipped to collect greywater, pump out when in port. If no collection capability exists, direct discharge permitted.
U.S. Contiguous Zone (3-12 nm)	Direct discharge permitted.	Direct discharge permitted.
>12 nm from shore	Direct discharge permitted.	Direct discharge permitted.
Zone	**Oily Waste**	**Garbage (Non-plastic)**
U.S. Waters (0-3 nm)	Discharge allowed if waste has no visible sheen. If equipped with Oil Content Monitor (OCM), discharge < 15 ppm oil.	No discharge.
U.S. Contiguous Zone (3-12 nm)	Same as 0-3 nm.	Pulped garbage may be discharged.
>12 nm from shore	If equipped with OCM, discharge < 15 ppm oil. Ships with Oil/Water Separator but no OCM must process all bilge water through the oil-water separator.	Direct discharge permitted.
Zone	**Garbage (Plastic) (Non-food-contaminated)**	**Garbage (Plastic) (food-contaminated)**
U.S. Waters (0-3 nm)	No discharge.	No discharge.
U.S. Contiguous Zone (3-12 nm)	No discharge.	No discharge.
12-50 nm from shore	No discharge.	No discharge.
> 50 nm from shore	Retain last 20 days before return to port. Discharge if necessary.	Retain last three days before return to port. Discharge if necessary.
Source: DoN 2007		

Water pollutant concentrations in the open ocean portions of the SOCAL Range Complex are generally consistent with the water quality objectives of the *Ocean Plan*. Water quality in the nearshore waters of SCI, which are affected by baseline at-sea and ashore training activities, has recently been tested (DoN 2006). Based on *Ocean Plan* Table B criteria for protection of aquatic life (see Table 3.4-2), concentrations of potential water pollutants are low under baseline levels of

Navy training, and have no substantial effect on marine water quality in that portion of the SOCAL OPAREAs where training activities are most concentrated.

Table 3.4-2: Water Pollutant Concentrations in Surface Waters At SCI

CONSTITUENT	CONCENTRATION (micrograms/liter)	
	SCI Reference Sampling Site	Ocean Plan Objective
antimony	0.18	1,200[b]
arsenic	1.19	8[a]
beryllium	ND	0.033[b]
cadmium	ND	1[a]
copper	0.142	3[a]
lead	0.228	2[a]
mercury	ND	0.04[a]
nickel	0.25	5[a]
selenium	ND	15[a]
silver	ND	0.7
thallium	ND	2[b]
zinc	2.65	20[a]
polychlorinated biphenyls (PCBs)	ND	0.000019[b]
phenols	ND	30[a]
chromium, hexavalent	ND	2[a]
cyanide	ND	1[a]

Notes: (a) 6-month median value; (b) 30-day arithmetic average; ND - non-detectable concentration.

SOURCE: DoN 2006.

Sediment quality in the waters immediately surrounding SCI also was recently tested (DON 2006); the results for constituents of concern are shown in Table 3.4-3. Ten-day solid phase amphipod bioassay tests of the sediments also indicated high survival and no significant toxicity. The results indicate that baseline levels of Navy training have no effect on bottom sediment quality in that portion of the SOCAL OPAREAs where training activities are most concentrated.

Table 3.4-3: Contaminant Concentrations in Bottom Sediments At SCI

CONSTITUENT	SEDIMENT CONCENTRATION AT SCI REFERENCE SAMPLING SITE, ppm	USEPA Sediment Quality Guidelines (ERM Values), ppm
arsenic	2.87	70
cadmium	0.11	9.6
chromium	8.56	370
copper	7.48	270
lead	2.19	218
mercury	0.275	0.71
nickel	4.6	51.6
selenium	0.56	NA
silver	0.09	3.7
zinc	19.2	410
polychlorinated biphenyls (PCBs)	ND	180
phenols	ND	NA
dioxins (TEQ)	0.0 - 0.028	NA
Notes: ppm- parts per million; ERM - Effects Range Median; ND - non-detectable concentration; NA - not available; TEQ - toxicity equivalency factor.		
SOURCES: DoN 2006, NOAA 1999.		

3.4.2.1.6 Navy Activities

Water pollutants are released in the SOCAL OPAREAs by the U.S. Navy during training activities. U.S. Navy training activities require the use of a variety of solid and liquid hazardous materials. Hazardous materials required on the open ocean ranges can be broadly classified as shipboard materials - necessary for normal operations and maintenance, such as fuel and paint - and training materials. Training materials include both highly explosive and non-explosive practice munitions (considered to be hazardous materials because they contain explosives or propellants), and non-munition training materials. Baseline levels of U.S. Navy discharges to marine waters in the SOCAL OPAREAs are described under the No Action Alternative in Section 3.4.3.2.

3.4.2.1.7 Current Mitigation Measures

Navy shipboard operations and expenditures of ordnance and other training materials, such as used targets, can affect ocean water quality. Navy ships are required to conduct activities at sea in a manner that minimizes or eliminates any adverse impacts on the marine environment. Environmental compliance polices and procedures applicable to shipboard operations afloat are defined in OPNAVINST 5090.1C. DoD Instruction 5000.2-R, Executive Order (EO) 12856, and EO 13101, and OPNAVINST 5090.1C also cover pollution prevention requirements. These instructions reinforce the CWA's prohibition against discharge of harmful quantities of hazardous substances into or upon U.S. waters out to 200 nm (371 km), and mandate stringent hazardous waste discharge, storage, dumping, and pollution prevention requirements. Section 3.3.3.1 provides information on shipboard management, storage, and disposal of hazardous materials and wastes.

3.4.2.2 San Clemente Island

3.4.2.2.1 Nearshore Marine Water Quality

The description of ocean water quality in Section 3.4.2.1.6 is generally applicable to ocean areas surrounding SCI. Its distance from the mainland, the volume of the ocean, and the influences of the shelves and basins near the mainland, where pollutants settle, tends to isolate SCI from mainland influences and ensure relatively good water quality in the surrounding ocean waters. The nearshore waters of SCI are addressed separately here because they are influenced primarily by the island, in particular its surface runoff.

SCI is part of the San Pedro Channel Islands Hydrologic Unit, along with Anacapa, Santa Barbara, San Nicolas, and Santa Catalina Islands (RWQCB 1994). "Beneficial use" objectives are the bases for water quality protection under the Los Angeles Region Basin Plan (*Basin Plan*). Existing beneficial use objectives for the near-shore coastal waters of SCI include municipal and domestic water supply; groundwater recharge supply; contact water recreation; non-contact water recreation; marine habitat; wildlife habitat; habitat for rare, threatened, or endangered species; spawning habitat; and shellfish harvesting (RWQCB 1994). Once beneficial uses and water quality objectives are established, water quality standards can be identified, which are mandated for all water bodies in the State under the CWC and CWA.

The waters surrounding SCI to a distance of one nm (1.9 km) offshore or to the 300-ft. (91-m) isobath, whichever is greater, have been designated as ASBS (Figure 3.4-5).

3.4.2.2.2 Freshwater Water Quality

Surface Water

There are no perennial streams on SCI. Persistent surface water falls into two categories: naturally held water in canyons and artificially held water in constructed impoundments. Intermittent streams appear during the rainy season as water moves through steep canyons before reaching the ocean. SCI's rainy season is generally from November to April, with the annual precipitation averaging approximately seven inches (18 centimeters) (DoN 1993a). Natural water is held through the dry portion of the year in bedrock plunge pools located in the deeper portions of SCI's major canyons. The potential beneficial uses of inland surface waters on SCI include municipal and domestic water supply; groundwater recharge supply; contact water recreation; non-contact water recreation; warm freshwater habitat; wildlife habitat; and habitat for rare, threatened, or endangered species (RWQCB 1994).

Groundwater

Little information is available about groundwater resources on SCI. The island's volcanic geology is generally monolithic (i.e., like a single stone or block), limiting the potential for a drinking water aquifer (DoN 1954). Drilling efforts to date have only located brackish groundwater. If potable groundwater were present, due to the isolation of SCI, limited access, and limited island activities, there are few sources of contaminants within the watershed. Potential beneficial uses for groundwater include municipal and domestic water supply and industrial service supply (RWQCB 1994).

3.4.2.2.3 Navy Activities

<u>Discharges to Marine Waters</u>

The Los Angeles RWQCB administers the Navy's NPDES permits for SCI. The Navy is permitted to discharge an average of 25,000 gal. per day (gpd) (95,000 L per day [Lpd]) of treated domestic wastewater under NPDES Permit Number CA0110175. Since 1979, the Wilson Cove support facilities have been served by the Wilson Cove Wastewater Treatment Plant (WWTP).

The WWTP is located on the warmer and calmer northeastern side of SCI, approximately 1,000 ft. (305 m) south of Wilson Cove. The WWTP is a dual unit, extended aeration system, capable of processing up to 60,000 gpd (228,000 Lpd). Comminution, aeration, clarification, chlorination, and dechlorination processes treat domestic sewage prior to its discharge into the rocky intertidal zone. The average daily flow of WWTP ocean discharges in 2004 was 20,900 gpd. Some of the water from the WWTP is being reclaimed for dust control on the tank road.

Water monitoring required under the NPDES permit includes recording flow, temperature, and toxicity, and levels of Biological Oxygen Demand, coliform bacteria, suspended solids, oil and grease, residual chlorine, pH, settable solids, turbidity, ammonia, heavy metals (arsenic, cadmium, chromium, copper, cyanide, lead, mercury, nickel, silver, zinc), phenols, chlorinated hydrocarbons, polychlorinated biphenyls, and radioactivity. The RWQCB issued a Notice of Violation to the WWTP on December 16, 2002 for effluent limit and reporting violations (DoN 2005).

The Navy has requested authorization from RWQCB to extend the WWTP discharge pipe beyond the rocky intertidal zone and to increase the discharge rate to 48,000 gpd. (DoN 2006). Once completed, the WWTP outfall extension will allow the Navy to request a dilution factor to its permit discharge limits. That dilution factor will allow the Navy to meet its WWTP NPDES permit requirements.

Industrial storm water runoff from SCI into the ocean is regulated under the State-Wide Industrial Storm Water Permit. The Navy is complying with the requirements of that permit, including implementing relevant and appropriate Best Management Practices.

Drinking Water

There are no on-island sources of drinking water. Approximately 245,200 gal. (931,700 L) of drinking water are barged to SCI weekly. This water is pumped from the barge into a 500,000-gal. (1,900,000-L) storage tank and tested. Once laboratory analysis indicates that the water meets drinking water standards, it is pumped into distribution tanks with a capacity of two million gal. (7.6 million L) (DoN 1997).

3.4.2.2.4 Current Mitigation Measures

As noted, environmental compliance policies and procedures applicable to operations ashore are defined in OPNAVISNT 5090.1C. These include directives regarding hazardous materials and waste management, pollution prevention, and recycling. Measures about management of hazardous materials and wastes at SCI, as discussed in Section 3.3.3, provide protections for surface waters and ocean waters. In addition to these mitigation measures, implementation of the Installation Restoration Program at SCI also provides protection to these water resources from consequences of past practices. With regard to reducing or avoiding water quality degradation from the expenditure of training materials, management practices include EOD sweeps to remove unexploded ordnance and ordnance remnants from land ranges. Certain features of the training materials themselves are designed to reduce pollution, as required by Navy and DoD regulations.

3.4.3 Environmental Consequences

3.4.3.1 Approach to Analysis

3.4.3.1.1 Methodology—Marine Water Resources

This section evaluates effects of the Proposed Action on marine water quality. Because there is a close association between bottom sediment quality and water quality, and because the effects of expended training materials on bottom sediments are similar to their effects on water quality, this section also addresses bottom sediment quality. Factors considered in evaluating impacts on marine water and sediment quality include the extent or degree to which:

- Deposition of expended training materials would directly affect bottom sediment quality or indirectly affect water quality,
- Concentrations of water pollutants produced by the Proposed Action or alternatives would exceed NAWQC or Ocean Plan standards, or
- The Proposed Action or alternatives would affect existing or future beneficial uses (see Section 3.4.3.2.1).

3.4.3.1.2 Methodology—Fresh Water Resources

This section evaluates effects of the Proposed Action on surface and ground waters on SCI. Both effects on water quality and on surface hydrology are considered. Finally, the indirect effects of fresh water quality on marine water quality, via runoff from land areas, are addressed. Factors considered in evaluating impacts on hydrology and fresh water quality on SCI include the extent or degree to which:

- The Proposed Action or alternatives would affect existing or future beneficial uses (see Section 3.4.2.2.1),
- Contaminants in surface water runoff from SCI would affect nearshore marine water quality,
- The Proposed Action or alternatives would violate laws or regulations adopted to protect or manage the water resource system, or
- The concentrations in the water of potential water pollutants released into the environment by the Proposed Action would exceed water quality criteria in the *Basin Plan*. No specific water quality objectives exist for SCI; but maximum contaminant concentrations from Title 22 of the California Code of Regulations would be appropriate for this analysis.

Current and proposed activities that could affect non-marine water resources are limited to deposition of constituents of training and testing materials on surface soils on SCI. There are no known potable ground water aquifers on SCI.

3.4.3.2 No Action Alternative

3.4.3.2.1 SOCAL OPAREAs

At-sea training and test activities involve numerous combatant ships, torpedo retrieval boats, and other support craft. These vessels are manned, and do not intentionally expend any hazardous materials directly into the water. Offshore training activities also expend bombs, missiles, torpedoes, sonobuoys, targets, flares, and chaff, and accessory materials such as guide wires and hoses, from ships, submarines, or aircraft. Various types of training items are shot, launched, dropped, or placed within the SOCAL OPAREAs. Training materials entering the ocean in large quantities could affect marine water quality.

Most weapons and other devices used during at-sea training exercises are removed at the conclusion of the exercises. Some training materials, including gun ammunition and naval shells, bombs and missiles, mortars and rockets, targets and sonobuoys, and chaff and flares, however, are used on the range and not recovered. Items expended on the water, and fragments not recognizable as training materials (e.g., flare residue or candle mix), typically are not recovered. The types of expendable training materials used in each category of at-sea training are generally discussed below. Following this discussion of expended training materials by warfare area is an evaluation of each type of expendable training material, and a summary of their constituents of concern.

The ordnance used in offshore training activities includes both non-explosive practice rounds containing only spotting charges (and, as appropriate, fuels or other propellants) and high explosive rounds containing explosives or pyrotechnical materials. Explosives and propellants in high explosive rounds are mostly consumed during their operation, leaving only residues. If training items that contain explosives, pyrotechnical materials, or propellants fail to function properly, they may remain on the range as UXO, eventually releasing these materials and their degradation products to the environment. Sonobuoys and flares, smoke grenades, and other pyrotechnic training devices expended in the water may leak or leach toxic substances as they degrade and decompose. Table 3.4-4 lists constituents of concern for some ordnance components.

Table 3.4-4: Ordnance Constituents of Concern

Training Munitions	Constituent of Concern
Pyrotechnics Tracers Spotting Charges	Barium chromate Potassium perchlorate
Oxidizers	Lead oxide
Delay Elements	Barium chromate Potassium perchlorate Lead chromate
Propellants	Ammonium perchlorate
Fuses	Potassium perchlorate
Detonators	Fulminate of mercury Potassium perchlorate
Primers	Lead azide

Effects by Warfare Area

Anti-Air Warfare

Anti-Air Warfare (AAW) training is described in Section 2.3.1.1. Expended training materials for this warfare area are mostly spent projectiles, missiles, and unrecovered targets. The expenditure of about 1,420,000 small arms will deposit about 28 tons (25 metric tons) per year (TPY) of mostly non-toxic metals in bottom sediments in the SOCAL OPAREAs.

MISSILEXs use missiles and aerial targets. Typically, two NATO Seasparrow missiles and four BQM-74 aerial targets are expended in W-291 during a MISSILEX. These items contain: propellants, fuels, engine oil, hydraulic fluid, and batteries, all of which may affect water quality. The total amounts of expended training materials for this warfare area, weighing about 9 TPY, are listed below in Table 3.4-5. The aggregate effects on water quality of training materials expended on the range under the No-Action Alternative are addressed below.

Anti-Submarine Warfare (ASW)

Anti-Submarine Warfare (ASW) is described in Section 2.3.1.2. These training activities affect water and sediment quality by expending training materials that release constituents into the water column and accumulate in ocean bottom sediments over time. Air and Ship ASW exercises drop sonobuoys and targets (MK-30 and MK-39 Expendable Mobile ASW Training Targets [EMATTs]) into the ocean. The Submarine ASWs may expend MK-30 or MK-39 (EMATT) targets, although most exercises use another submarine as a target; no sonobuoys are used. No explosives are used in these exercises. Any training torpedoes used generally are recovered following each event.

Under the No Action Alternative, 268 Air ASW, 181 Ship ASW, and 48 Submarine ASW events are conducted each year, using 263 torpedoes, 1,290 targets, 321 flares and smoke canisters, and 3,550 sonobuoys. Sonobuoys sink after use. About 55 percent of the EMATTs are recovered. All of the MK-30 targets are recovered. The main sources of water quality impacts are the batteries or fuel used to propel or operate EMATTs and sonobuoys. The control wires, ballast, and other accessories from torpedo exercises mostly affect the bottom sediments. The total amounts of expended training materials for this warfare area are listed below in Table 3.4-5. The aggregate effects on water quality of training materials expended on the range under the No-Action Alternative are addressed below.

Anti-Surface Warfare

ASUW training is described in Section 2.3.1.3. GUNEXs expend projectiles against stationary and maneuverable surface targets. The A-S MISSILEXs fire AGM-114 Hellfire missiles at high-speed targets from SH-60 helicopters. In the BOMBEXs, FA-18 aircraft use MK-82 high explosive and BDU-45 non-explosive practice bombs to attack surface targets. The No Action Alternative includes one SINKEX; this exercise uses a variety of weapons platforms (e.g., aircraft, surface vessels, submarines) expending several different types of ordnance against an environmentally clean ship hulk. The total amounts of expended training materials for this warfare area are listed below in Table 3.4-5. The effects on water quality of training materials expended on the range under the No-Action Alternative are addressed below.

Amphibious Warfare

AMW training uses ships, aircraft, and amphibious vehicles, but no training materials are used in the water. Naval Surface Fire Support, Expeditionary Fires Exercise, and other AMW exercises direct the expenditure of ordnance into the land area of SHOBA. These activities are included in the discussion below of water effects from land activities.

Electronic Combat (EC)

Electronic Combat (EC) training is described in Section 2.3.1.5. Typical EC activities include firing simulated (Smokey) Surface-to-Air Missiles (SAMs). When practicing tactics against simulated SAMs, aircrews deploy chaff and defensive flares when over water. EC events will disperse training materials throughout the nearshore waters underlying the Electronic Warfare Range, located south and west of SCI. Under the No Action Alternative, 748 events are conducted. The total amounts of expended training materials for this warfare area are listed in Table 3.4-5. The effects on water quality of training materials expended on the range under the No-Action Alternative are addressed below.

Smokey SAMs, chaff, and flares are the only EC ancillary systems that can affect water quality resources. The main source of training residues is non-explosive practice S-A Missiles (referred to as Smokey SAMs), of which 12 per year will be expended under the No Action Alternative. Constituents of Smokey SAMs that end up in the ocean after use include a two-foot long biodegradable Styrofoam-like body, and unburned propellant.

The major constituents of chaff and flares are aluminum and magnesium. Some flares also contain chromium and lead. The aluminum fibers that make up chaff are generally non-toxic. Elemental aluminum in seawater tends to be converted by hydrolysis to aluminum hydroxide, which is relatively insoluble, and scavenged by particulates and transported to the bottom sediments (MBARI 2002).

Combustion products from flares are mostly non-hazardous, including magnesium oxide, sodium carbonate, carbon dioxide, and water. Small amounts of metals are used to give flares and other pyrotechic materials bright and distinctive colors. The amounts of flare residues are negligible, and the chemical constituents do not substantially affect water quality resources.

Mine Warfare

MIW includes Mine Countermeasures / Small Object Avoidance (MCMEX) and Mine Laying Exercises (MINEX) (see Section 2.3.1.6). Wholly inert mine shapes used for avoidance training are moored to the ocean bottom by cables in the Kingfisher Range. Avoidance training has no effect on water resources.

Under the No Action Alternative, 17 MINEX exercises are conducted each year. Mine training shapes are made of non-toxic materials that do not affect water quality. Most of these events involve one aircraft dropping wholly inert mine training shapes. This activity deposits 64 MK-76s, 10 MK-18A1's, and 12 MK-62's per year; some mine shapes are recovered. MINEXs are limited to physical effects on ocean bottom sediments by wholly inert mine training shapes. Due to their chemical composition and size, these mine training shapes do not substantially affect the ocean bottom. Discarded mine training shapes do not substantially affect ocean bottom sediments at their settlement locations.

MIW training does not require targets or other devices that use or contain hazardous materials. Impacts of this training on marine water quality will not be further addressed under Water Quality.

Naval Special Warfare

Naval Special Warfare training is described in Section 2.3.1.7. Underwater demolition is conducted in the nearshore areas of Basic Underwater Demolition/SEAL (BUD/S) beach or Graduation Beach, both in the Northwest Harbor area. The explosive charges vary in size from 5 to 500 lb (2.3 to 9 kilograms [kg]). Each event uses a Combat Rubber Raiding Craft (CRRC) with 55-horsepower motors to clear the areas and assist in the activity. To clear underwater obstacles, Mat Weaves use a tubular lattice mat with six 50-lb (23 kg) net explosive weight (n.e.w.) components. Depending on the manufacturer, the total n.e.w. is 480-500 lb (218-227 kg). Obstacle Loading, another underwater demolition, uses 16 charges of C4 weighing 20 lb (9 kg) each.

Possible impacts on marine water quality include contamination from hazardous materials (e.g., explosives, fuel, and oil), and turbidity. Major products from detonating high explosives are non-hazardous (e.g., CO, CO_2, H_2, H_2O, N_2, and NH_3). For example, exploding 500 lb (218 kg) of Composition 4 (C4), which is 91 percent RDX, produces about 185 lb (84 kg) of nitrogen, 125 lb (57 kg) of carbon dioxide, 82 lb (37 kg) of water, 92 lb (42 kg) of carbon monoxide, 8 lb (3.6 kg) of ethane, 1.5 lb (0.7 kg)of hydrogen, 1 lb (0.5 kg) of propane, 4.5 lb (2 kg) of ammonia, and 1 lb (0.5 kg) of methane. Underwater explosions resuspend sediments into the water column, creating a turbidity plume. These effects are not substantial because the turbidity plume eventually dissipates as particles returned to the bottom and currents dispersed the plume.

The use of explosives in nearshore areas of Basic Underwater Demolition/SEAL (BUD/S) beach or Graduation Beach can affect bottom sediments. Explosives are detonated at depths of six to 20 ft (2 to 6 meters [m]). These activities can disturb ocean-bottom sediments by creating craters, redistributing the sandy bottom and increasing turbidity. These impacts are negligible compared to wave action during a storm event, and normal ocean currents erase these temporary disturbances over time.

The total amounts of expended training materials for this warfare area are listed below in Table 3.4-5. The aggregate effects on water quality of training materials expended on the range under the No-Action Alternative are addressed below.

U.S. Coast Guard (USCG) Operations

USCG operations are described in Section 2.3.1.10. Expended materials from USCG operations are primarily small arms. Under the No Action Alternative, USCG operations use 21,000 7.62-mm and 12,000 0.50-caliber projectiles. These materials are not recovered, but are deposited on the ocean bottom. The total amounts of expended training materials for this warfare area are listed below in Table 3.4-5. The aggregate effects on water quality of training materials expended on the range under the No-Action Alternative are addressed below.

Research, Development, Test, and Evaluation

Ship Tracking and Torpedo Tests

Under the No Action Alternative, 22 Ship Tracking and Torpedo tests occur. These tests are similar to the ASW training events described above. Nominal participants for a typical test include one helicopter, one surface ship, and one submarine. MK-30 and MK-39 targets will be used for some of the tests. Only four of the tests include a torpedo firing—two running MK-54s and two non-running Recoverable Exercise Torpedoes (REXTORPs). All of the torpedoes are recovered. Residual materials left in the ocean are identical to those described under ASW.

Unmanned Underwater Vehicle (UUV) Tests

This activity involves one support ship and two Unmanned Underwater Vehicles (UUVs). UUV operations are primarily in shallow waters off NOTS pier, but also in the deep water off the eastern side of SCI, in the San Clemente Island Underwater Range (SCIUR) area, using no ordnance. If there was an accidental release of pollutants from a UUV, sheens (e.g., oil or fuel) produced from these activities will not cause any substantial long-term impact on water quality resources because most of the toxic components (e.g., aromatics) evaporate and disperse within several hours to days, and are degraded by organisms (e.g., bacteria,) (National Research Council 1985).

Sonobuoy Quality Assurance (QA)/ Quality Control (QC) Tests

All of the Navy’s Quality Assurance/Quality Control (QA/QC) testing is conducted on the eastern side of SCI, involving an aircraft dropping the sonobuoys, a surface ship, and support personnel at Naval Ordnance Test Station (NOTS) Pier. This action involves the random testing of a sample of sonobuoys from each lot received by the Navy. Impacts of sonobuoys on marine water quality are discussed below. The in-water concentrations of constituents of concern are well below the federal and State water quality criteria.

Ocean Engineering Tests

This research and development testing involves the deployment of hardware, cabling, mine and mine countermeasures equipment, underwater tools and equipment, and related components. Tests are conducted from the North Light Pier area to NOTS Pier, and are supported with research vessels, shore cranes, boats, and divers.

Long-term marine water quality can be affected by corrosion of metal components. The slow rate at which solid metals are corroded by seawater translates into slow release rates into the marine environment. Once the metal surfaces corrode, the rate at which metals are released into the environment decreases because the oxides form a relatively insoluble layer between the original material and the seawater.

Naval Undersea Warfare Center (NUWC) Acoustics Tests

NUWC Acoustics Tests impacts are similar to ASW training. These tests involve Weapon System Accuracy Trials, Sensor Accuracy Tests, At-Sea Bearing Accuracy, Acoustic Trials, and Special Tests. Torpedoes are only used during Weapon System Accuracy Trials, and all of them are recovered. No training materials are left on the range, so this activity will have no effect on water or sediment quality.

Effects by Expended Training Material

This section evaluates the effects of the unrecovered training materials from all training activities on the water quality of the SOCAL OPAREAs. Table 3.4-5 provides the annual expenditure of these materials under the No Action Alternative. Table 3.4-6 lists the recovery percentages for various types of training materials. As discussed in Section 3.3.4.1, munitions constituents from training and testing activities do not pose a risk to the marine environment.

Table 3.4-5: Estimated Number of Expended Training Materials in SOCAL OPAREAs, No Action Alternative

Activity Area	Expenditures, Annual (#/year)								
	Gun Shell	Small Arms	Missile / Rocket	Bombs	Mine Shapes	Torpedo Ballast / Hose	Flare / Chaff / Smoke	Target	Sonobuoy
Anti-Air Warfare	496	1,420,000	18	0	0		0	900	0
Anti-Submarine Warfare	0	0	0	0	0	263	321	1,290	3,550
Anti-Surface Warfare	5,950	277,000	57	397	0	0	8	800	0
Electronic Combat	0	0	0	0	0	0	146	0	0
Mine Warfare	0	0	0	0	86	0	0	0	0
Naval Special Warfare		0	0	0	95	0	0	0	0
USCG	0	33,000	0	0	0	0	0	0	0
Research, Development, Test, and Evaluation	0	0	0	0	0	10	0	35	3,178
Total	**6,450**	**1,730,000**	**75**	**397**	**181**	**273**	**475**	**3,020**	**6,730**
Estimated # of Failures (at 5%)	332	NA	4	20	NA	12	25	15	374
Estimated # of Low-Order Detonations (@ 0.2%)	13	NA	0	1	NA	NA	1	NA	NA
Total Weight (tons/year)	**174**	**72**	**21**	**21**	**6**	**15**	**0.2**	**15**	**94**

Notes: Numbers of training items are estimates, and are rounded to three significant digits to indicate their relative imprecision. Torpedoes are normally recovered, but their accessories are expended. Number (#) of failures is the number of training items that do not function properly.

Source: DoN. 2007. SOCAL Operations Data Book.

Table 3.4-6: Training Materials Recovered in Offshore Areas

Ordnance	Baseline Number	Number Recovered	Percent Recovered
MK-46 EXTORP	49	49	100
MK-46 REXTORP	129	129	100
MK-48 ADCAP EXTORP	80	80	100
MK-50 EXTORP	0	0	NA
MK-50 REXTORP	30	30	100
BQM-74 Aerial Target	6	6	100
EMATT Subsurface Target	129	71	55
MK-30 Subsurface Target	95	95	100
Sonobuoy	6,475	453	7
Note: missiles, bombs and rockets, projectiles, explosives, flares, and chaff are not recovered.			
Source: DoN 1996a, DoN 1998, DoN 2002			

Gun Shells, Small Arms, and Bombs

These training materials generally remain intact upon contact with the surface of the ocean, and sink quickly through the water column to the bottom. They thus do not affect water quality directly. Degradation and dispersal of explosive and propellant residues, and explosives and propellants from items that do not function (i.e., unexploded ordnance or UXO) will not substantially affect bottom sediments or water quality (see Section 3.3.4.1). Corrosion of metallic materials may affect the bottom sediments immediately surrounding widely scattered expended items. Corrosion of metallic materials and the leaching of toxic substances from them also may affect water quality in their vicinity, but not to a substantial degree due to the relatively insignificant amount of material, its slow rate of release into the environment, and the action of ocean currents in dispersing the materials once they enter the water column.

For example, if the 267 tons (243 metric tons) of ordnance in this category are distributed evenly over about 24,000 nm^2 (82,300 km^2) of ocean bottom, representing about 20 percent of the total bottom area within the SOCAL Range Complex, then its concentration is about 23 lb per nm^2 (3 kg/km^2) or about 0.03 lb/acre (ac) (0.03 kg/hectare [ha]). Assuming that this material remains in the top 2 inches (5 cm) of sediment and that the dry density of bottom sediments is approximately the same as that of soil, then the concentration of these materials in bottom sediments is about 40 parts per billion (ppb), which is several orders of magnitude below concentrations known to have biological effects. Most of the expended material are non-toxic metals, so the concentration of toxic materials will be substantially less than this amount. Thus, gun shells and related ordnance have no substantial effect on the bottom sediments.

Missiles and Aerial Targets

Missiles

Missiles and aerial targets used in training on the SOCAL OPAREAs contain hazardous materials as normal parts of their functional components. Missiles contain igniters, explosive bolts, batteries, warheads, and solid propellants, and aerial targets contain fuels, engine oil, hydraulic fluid, and batteries, all of which may affect water quality. Exterior surfaces may be coated with anti-corrosion compounds containing toxic metals. Most of the missiles are equipped with non-explosive warheads that contain no hazardous materials. For missiles falling in the ocean, the principal contaminant is unburned solid propellant residue and batteries. Table 3.4-7 lists typical missiles fired in the SOCAL OPAREAs, and their associated hazardous materials. Table 3.4-8 outlines the breakdown of hazardous constituents from missiles and aerial targets.

Table 3.4-7: Missiles Typically Fired in the SOCAL OPAREAs

Type	Hazardous Materials
AIM-7 Sparrow	The missile is propelled by a Hercules MK-58 dual-thrust solid propellant rocket motor. The explosive charge is an 88-lb. (40-kg) WDU-27/B blast-fragmentation warhead.
AIM-9 Sidewinder	Depending on the model, the propulsion system contains up to 44 lb. (20 kg) of solid double-base propellant. The warhead contains approximately 10 lb. (4.5 kg) of PBX-N HE.
AIM-114B Hellfire	The missile is propelled by a solid propellant rocket motor, the Thiokol TX-657 (M120E1).
AIM-120 AMRAAM	The missile is propelled by a solid propellant (ATK WPU-6B booster and sustainer) rocket motor that uses RS HTPB solid propellant fuel). The warhead is 40 lb. (18 kg) of HE.
SM-1 and SM-2 Standard Missile	Propulsion system has 1,550 lb. (703 kg) of aluminum and ammonia propellant in the booster and 386 lb. (175 kg) of propellant in the sustainer. The warhead is 75 - 80 lb. (34-36 kg), depending on the version. Potassium hydroxide battery 1.9 oz. (54 g).

Table 3.4-8: Estimated Missiles Expended, No Action Alternative

Training Item		Amount of Material or Component in Unexpended Item, lb/kg						
Type	**Number**	**Propellant**	**Batteries**	**Igniters / Wiring**	**Chaff / Flares**	**Jet Fuel,**	**Explosives**	**Total Weight**
AIM 120 AMRAAM	**4**	N/A	N/A	N/A	N/A	N/A	203 / 92	203 / 92
AIM 7 Sparrow	**7**	N/A	N/A	N/A	N/A	N/A	309 / 140	309 / 140
AIM-9 Sidewinder	**5**	17 / 8	N/A	0.4 / 0.2	2 / 1	N/A	5 / 2	24 / 11
AGM-114B	**14**	3 / 1	4 / 2	N.A	N/A	N/A	19 / 9	26 / 12
Standard Missiles	**5**	601 / 273	5 / 2	0.4 / 0.2	N/A	N/A	56 / 25	662 / 300
Note: BQM-74 not listed because 100 percent of these targets are normally recovered.								
Source: DoN 1996a, DoN 1998, DoN 2002								

Missile propellants typically contain ammonium perchlorate (NH_4ClO_4), aluminum compounds, copper, and organic lead compounds. Perchlorate is an inorganic chemical used in the manufacture of solid rocket propellants and explosives. A typical surface-to-air missile (e.g., SM-2) initially has 150 lb (68 kg) of solid propellant and uses 99-100 percent of the propellant during the exercise (i.e., <1.5 lb [0.7 kg] remaining). The remaining solid propellant fragments sink to the ocean floor and undergo physical and chemical changes in the presence of seawater. Tests show that water penetrates only 0.06 inches (in) (0.14 centimeters [cm]) into the propellant during the first 24 hours of immersion, and that fragments slowly release ammonium and perchlorate ions (Aerospace Corporation 1998). These ions rapidly disperse into the surrounding seawater such that local concentrations are extremely low.

Assuming that all of the propellant on the ocean floor was in the form of 4-in (10 cm) cubes, only 0.42 percent of it will be wetted during the first 24 hours of immersion. If all of the ammonium perchlorate leaches out of the wetted propellant, then approximately 0.01 lb (0.003 kg) will enter the surrounding seawater. The leaching rate will decrease over time as the concentration of perchlorate in the propellant declines. The aluminum in the propellant binder will eventually be oxidized by seawater to aluminum oxide. The remaining binder material and aluminum oxide will not pose a threat to the marine environment.

As noted above, most of the missiles will have non-explosive warheads that do not contain hazardous materials. Some missiles, however, could contain explosives. An estimated 99.997 percent of this material will be consumed in a high-order detonation, typically leaving less than 1.0 lb (0.5 kg) of residue. Explosives residues will degrade and disperse in a manner similar to that of propellants, and similarly will not be a substantial concern. As discussed in Section 3.3.4.1, Hazardous Materials and Hazardous Wastes, studies have concluded that munitions residues do not impact the marine environment.

Missile batteries are another source of contaminants. The batteries used for missiles are similar in type and size to those used for sonobuoys. The evaluation of the effects of expended sonobuoys (see below) concluded that they do not have a substantial effect on marine water or sediment quality.

Aerial Targets

Aerial targets are used on the SOCAL OPAREAs for testing and training. Most aerial targets contain jet fuel, oils, hydraulic fluid, batteries, and explosive cartridges. Following a training exercise, targets are generally flown (using remote control) to pre-determined recovery points. Fuel is shut off by an electronic signal, the engine stops, and the target descends. A parachute is activated and the target lands on the ocean's surface, where it is retrieved by range personnel using helicopters or range support boats. Some targets are hit by missiles, however, and fall into the ocean. Table 3.4-9 lists hazardous materials from airborne targets used on the SOCAL Range Complex.

Table 3.4-9: Hazardous Materials in Aerial Targets Typically Used in the SOCAL OPAREAs

Type	Hazardous Materials
LUU-2 Target Marker Flare	Flare materials, including magnesium and explosive bolts.
Tactical Air-Launched Decoy (TALD)	The tail section may contain a flare.
BQM-74	Oils, hydraulic fluids, a nickel-cadmium battery, and 16 gallons (48 kilograms) of JP-8 fuel.

Two types of aerial targets are used during MISSILEX: BQM-74 and the Ballistic Aerial Target System (BATS). The BQM-74 is the most common target used for this exercise. It is usually recovered after an exercise, unless it is severely damaged by a direct hit. The BATS are destroyed upon impact with the water, and are not recovered.

Hazardous materials in targets (e.g., BQM-74) include fuel and batteries. The hazardous constituents of concern for fuels, engine oil, and hydraulic fluids are hydrocarbons (compounds primarily containing carbon and hydrogen). They can be present in a wide variety of substances, such as petroleum-based fuels (diesel, JP-5, JP-4, bunker fuel, and gasoline), oils, and lubricants (Johnston et al. 1989; Grovhoug 1992; Shineldecker 1992). The most toxic components of fuel oils are aromatic hydrocarbons such as benzene, toluene, xylene, and Polycyclic Aromatic Hydrocarbons (PAHs) such as naphthalene, acenaphthene, and fluoranthene. Some PAHs are volatile and water-soluble (Curl and O'Donnell 1977). PAHs may be hazardous to wildlife, and they also can be hazardous to human health (Hoffman et al. 1995).

A BQM-74 initially has 107 lb (48.8 kg) of liquid fuel. This analysis conservatively assumes that 20 percent of the fuel (i.e., 21.5 lb [9.76 kg]) remains at the completion of each mission, and that five percent of the fuel comprises PAHs (PAHs such as acenaphthene generally make up less than four percent of fuel oil, and naphthalene is generally less than one percent [National Research Council 1985]). This analysis also assumes a worst-case scenario in which the BQM-74 is not recovered, but is destroyed on impact with the water. (Note: most targets are recovered by using an engine cut-off switch and a parachute. The target is retrieved from the water by helicopter.)

In the case of a severe malfunction and a crash, the target hits the water surface at a speed of at least 500 knots (600 miles per hour or 970 km/hr) and can realistically affect an area up to 10 times the size of the target (taking into consideration water displacement). A typical target (BQM-74) is approximately 12.9 ft (3.9 m) long, 2.3 ft (0.7 m) high, with a wingspan of approximately 5.8 ft (1.8 m). The analysis therefore assumes that a circle with a diameter of 58 ft (17.6 m) encompasses the affected area. Given the low density of the hazardous constituents (e.g., fuel, oil) relative to seawater, the analysis also assumes that only the top three ft (one m) of the water column is affected. Based on these assumptions, the affected surface area is about 10,600 ft^2 (985 square meters) and the affected volume of seawater is 2.5 x 10^5 gallons (9.7 x 10^5 L). The resulting concentration of PAHs is 503 μg/L.

Once concentrations are determined, comparisons with the NAWQC are possible for a single training event. The NAWQC provides both acute and chronic concentrations. Acute values are levels producing short-term effects (i.e., lethality), while chronic values produce long-term or sub-lethal effects. The estimated total PAHs concentration of 503 µg/L is below the threshold established in the NAWQC for individual PAHs: naphthalene (acute = 2,350 µg/L) and acenaphthene (acute = 970 µg/L; chronic = 710 µg/L). Thus, a crash of a BQM-74 in the SOCAL Range Complex has no substantial effect on water quality.

The combined concentrations from multiple exercises throughout a year cannot be compared with the NAWQC because of the assumptions upon which these criteria are based. The criteria apply to instantaneous or short-term concentrations, not to chronic or long-term effects. Even if two events were to occur simultaneously, they are not likely to affect the same volume of water. Hence, the water quality analysis considers each proposed training activity separately.

The effects of hydrocarbon releases on water quality were evaluated against the federal criteria in the NAWQC, rather than the State of California criteria in the *Ocean Plan*. The *Ocean Plan*'s water quality criteria were established to protect human health, which is not an issue where missile testing occurs on W-291. The *Ocean Plan* also does not establish criteria for individual PAHs. The *Ocean Plan*’s criterion of 0.0088 micrograms per liter for total PAHs is inappropriate as a measure of water quality impacts in this analysis, because it cannot be applied to the specific PAHs of concern (see below).

The NAWQC includes maximum permissible concentrations to protect aquatic life from water contaminants. Saltwater criteria exist for benzene, toluene, and three PAH compounds: naphthalene, acenaphthene, and fluoranthene. Benzene and toluene are both very volatile, and are unlikely to be present after a short period. Fluoranthene is generally not present, or is found at <0.1 percent) in refined petroleum (National Research Council 1985). These constituents were therefore not considered in this analysis.

Batteries are another source of contaminants from targets. The batteries used for targets are similar in type and size to those used for sonobuoys. The evaluation of the effects of expended sonobuoys (see below) concluded that they do not have a substantial effect on marine water or sediment quality.

Surface Targets

Surface targets include roboskis, bananas, trimarans, killer tomatoes, and ship hulks. In general, these targets are constructed of non-toxic materials, and have few or no hazardous constituents. Ship hulks are cleaned of hazardous materials prior to use; in the No Action Alternative, only one ship hulk per year will be expended in the SOCAL Range Complex. Expended surface targets will sink to the bottom and eventually be buried in sediment, as with other non-hazardous expended training materials left on the range.

Subsurface Targets

Subsurface targets include the MK-30 and the EMATT. In the No Action Alternative, 235 MK-30 targets will be used per year, and all will be recovered. An estimated 1,089 EMATTs per year will be used under the No Action Alternative, with 599 recovered. Thus, under the No Action Alternative, 490 EMATTs will be unrecovered each year.

The EMATT is a negatively buoyant, battery-operated device that is not recovered, and sinks to the seafloor at the conclusion of its operating life. It is powered by lithium sulfur dioxide ($LiSO_2$) batteries. Over time, the following chemical reactions occur as battery chemicals leach into the sea:

- Lithium bromide (LiBr) is an soluble salt that dissociates into bromine and lithium ions in seawater. Bromine and lithium are the seventh and 15th most abundant elements present in seawater, respectively. In addition to being found naturally in seawater, currents dilute the concentrations of these elements around the EMATT, so releases of lithium bromide will have no effect on water or sediment quality.
- The lithium metal contained in the EMATT is very reactive with water. When the lithium reacts with water it causes an exothermic (heat-liberating) reaction that generates soluble hydrogen gas and lithium hydroxide. The hydrogen gas eventually reenters the biosphere and the lithium hydroxide dissociates, forming lithium ions and hydroxide ions. The hydroxide is neutralized, ultimately forming water, so releases of lithium metal will have no effect on water or sediment quality.
- SO_2, a gas that is highly soluble in water, is a major reactive component in the battery. The SO_2 ionizes in the water, forming bisulfite (HSO_3) that is easily oxidized to sulfate in the alkaline environment of the ocean. Sulfur is present as sulfate in large quantities (i.e., 885 milligrams per liter) in the ocean, so releases of sulfur dioxide will have no effect on water or sediment quality.

Because the chemical reactions of the $LiSO_2$ batteries are local and short-lived, the concentrations of the chemicals released by the EMATT battery are greatly diffused by the ocean currents. For this reason and in light of the reactions described above, the $LiSO_2$ batteries do not substantially affect marine water quality. The effects of the lead components used in the soldering of the internal wiring and trim weights and the corrosive components of the EMATTs are the same as from the sonobuoys (i.e., limited solubilities and slow release rates; discussed below), and do not substantially affect water quality.

At the conclusion of their operating life, EMATTs scuttle themselves and sink to the seafloor to be abandoned. Expended EMATTs are unlikely to result in any physical impacts on the seafloor. Expended EMATTs sink into a soft bottom or lie on a hard bottom, where they may be covered eventually by shifting sediments. Over time, the EMATTs degrade, corrode, and become incorporated into the sediments.

The MK-30 is powered by a rechargeable silver-zinc battery system. As the MK-30 degrades, the battery components leach out into the ocean. Similar to the EMATT system, chemicals leaching from the battery system are greatly diffused by ocean currents. However, MK-30 targets are recovered after their use. With few or no MK-30s expended in the ocean each year, the amount of hazardous constituents introduced into the ocean environment from this source are negligible.

Sonobuoys

Sonobuoys are expendable devices used for a variety of ocean sensing and monitoring tasks, such as to detect underwater acoustic sources and to measure water column temperatures. Three types of sonobuoys are tested: passive, active, and bathythermograph. Lead solder, lead weights, and copper anodes are used in sonobuoys. Sonobuoys also may contain lithium sulfur dioxide, lithium, or thermal lithium batteries. Expendable Bathythermographs, or XBTs, do not use batteries and do not contain any hazardous materials. Analog Digital Converters (ADCs) have constituents similar to sonobuoys. In Fiscal Year (FY) 2004, 6,475 sonobuoys were used and seven percent were recovered.

The types of batteries used in standard range sonobuoys are classified according to the type of cathode used: lead chloride, cuprous thiocyanate, or silver chloride (DoN 1993b) with a magnesium anode. Thermal batteries have an iron disulfide cathode with a lithium alloy anode. These batteries are designed to have an active life ranging from one to eight hours, depending on the functional design of each particular sonobuoy. The chemical constituents of concern for water quality are lead, copper, and silver. A study by the Navy (DoN, 1993b) indicated no substantial effects on marine water quality from the marine deployment of sonobuoy batteries.

The maximum amount of lead released into the water during operation of the sonobuoy battery is based on a maximum battery life of 8 hours and a maximum amount of lead in the seawater cell of 0.9 lb (400 g). Metallic lead is converted to lead ion to obtain a lead concentration in water. Based on the known solubility of lead, a peak concentration of 11 µg/L (ppb) was calculated. The peak concentration of copper released from a cuprous thiocyanate seawater battery was calculated to be 0.015 µg/l (DoN 1993). Table 3.4-10 shows the estimated maximum concentrations of constituents of concern from sonobuoys, compared to the federal and State water quality criteria.

Table 3.4-10: Concentrations of Sonobuoy Battery Constituents and Criteria

Constituent	Concentration (micrograms / Liter)				
	Estimated Maximum Release[1]	State Criteria[2]		Federal Criteria[3]	
		Instantaneous	Daily Maximum	1-Hour	Daily
Lead	11.0	20.0	8.0	210.0	8.1
Copper	0.015	30.0	12.0	4.8	3.1
Silver	0.0001	7.0	2.8	1.9	N/A

[1] Concentration (µg/L) of metal released into 1 cubic meter from a single scuttled seawater battery.
[2] Sources: SWRCB 2001,USEPA 2005.

Sonobuoys contain other metal and non-metal components, such as metal housing (nickel-plated, steel-coated with polyvinyl chloride [PVC] plastics to reduce corrosion), lithium batteries, and internal wiring that, over time, can release chemical constituents into the surrounding water. The lithium battery (used only in active sonobuoys) has an exterior metal jacket (nickel-plated steel) containing SO_2, lithium metal, carbon, acetonitrile, and LiBr. During battery operation, the lithium reacts with the SO_2 and forms lithium dithionite. Since the reaction proceeds nearly to completion once the cell is activated, only residues are present when the battery life terminates. As a result, the lithium battery does not substantially degrade marine water quality.

Approximately 0.7 ounces (oz) (20 grams [g]) of lead solder are used in the internal wiring (solder) of each sonobuoy, and 15 oz (425 g) of lead are used for the hydrophone and lead shot ballast. The lead source is in the un-ionized metallic form that is insoluble in water, so the lead shot and solder are not released into the seawater. Various lead salts ($PbCl_2$, $PbCO_3$, $PbOH_2$) likely form on the exposed metal surfaces. These metal salts have limited solubilities (9.9 g/L, 0.001 g/L, and 0.14 g/L, respectively) (DoN 1993b). For these reasons, lead components of the sonobuoy do not substantially degrade marine water quality.

Most of the other sonobuoy components are either coated with plastic to reduce corrosion or are solid metal. The slow rate at which solid metal components are corroded by seawater translates into slow release rates into the marine environment. Once the metal surfaces corrode, the rate of metal released into the environment decreases. Releases of chemical constituents from all metal and non-metal sonobuoy components are further reduced by natural encrustation of exposed surfaces. Therefore, corrosive components of the sonobuoy do not substantially degrade marine water quality.

Frequent training and testing activities involving sonobuoys result in the accumulation of scuttled sonobuoys on the ocean floor. The main source of contaminants in each sonobuoy is the seawater battery. These batteries have a maximum life of eight hours, after which the chemical constituents in the battery have been consumed. Long-term releases of lead and other metal from the remaining sonobuoy components will be substantially slower than the release during seawater battery operation. Dispersion of released metals and other chemical constituents due to currents near the ocean floor will help minimize any long-term degradation of water quality in the project area. As a result, marine water quality will not be degraded by sonobuoy use during ASW activities.

Under the No Action Alternative, approximately 6,730 sonobuoys per year are used for training and Quality Assurance/Quality Control (QA/QC) testing. Approximately 3,180 sonobuoys are used for QA/QC testing east of SCI in the San Clemente Island Underwater Range (SCIUR). Of the 3,180 sonobuoys, approximately 440 are retrieved from the water to provide additional information about sonobuoy performance across a variety of conditions and sea states. The remainder of the sonobuoys are used throughout the SOCAL OPAREAs during training exercises. Using representative amounts of constituents found in sonobuoys, the total constituents deposited in the water were calculated. For the approximately 6,290 sonobuoys not recovered, approximately 18,600 lb (8,430 kg) of hazardous materials will be released into the water (see Table 3.4-11).

Table 3.4-11: Estimated Sonobuoy Constituents, No Action Alternative

CONSTITUENT	DISTRIBUTION BY WEIGHT	
	lb.	kg
Copper thiocyanate	10,000	4,550
Fluorocarbons	126	5
Copper	2,140	970
Lead	5,910	2,690
Tin/lead plated steel	377	172
Total	**18,600**	**8,430**
Notes: based on average amounts of constituents, values rounded to three significant digits.		
Source: DoN 1996a, DoN 1998, DoN 2002		

Environmental effects of the Navy's Sonobuoy Quality Assurance /Quality Control tests are assessed in *Report on Continuing Action, Standard Range Sonobuoy Quality Assurance Program, San Clemente Island, California* (DoN 1993b). The analysis in the *Report on Continuing Action* assumed a worst-case scenario of 3,500 sonobuoys scuttled annually in the sonobuoy test area, over 20-years, and assumed that these items will accumulate within 20 percent of the sonobuoy test area. This worst-case approach concludes that the density of sonobuoys on the ocean floor will be one sonobuoy for every 3,300 ft^2 (307 m^2) of ocean bottom (DoN 1993b).

These items settle to the ocean bottom, and may be covered with sand or sediment over time. This mostly non-toxic expended material does not affect soil stability on the ocean bottom, and causes minor disturbance of natural ocean processes. Under the No Action Alternative, 6,290 sonobuoys per year will be scuttled, of which 2,740 will be expended in the sonobuoy test area at a density of about one sonobuoy for every 4,200 ft^2 (390 m^2)of ocean bottom. Each sonobuoy contains about 1 lb (0.5 kg) of lead. Assuming that the lead remained in the top 2 in (5 cm) of sediment, then its concentration will increase by about 12 parts per million per year.

For the other 3,550 sonobuoys, assuming a range area of about 120,000 nm^2 (412,000 km^2) and their concentration on about 20 percent of the available range area, these sonobuoys will be deposited at a rate of about 0.15 sonobuoy / nm^2,(0.04 sonobuoy / km^2) per year, or about 1 sonobuoy per 242 million ft^2 (23 million m^2) per year. At the estimated deposition rate, these sonobuoys will not affect sediment quality.

Torpedoes

Torpedoes and torpedo targets typically contain hazardous materials, such as propellants. Other hazardous materials are used in the warheads, guidance system, and instruments. The MK-46 Recoverable Exercise Torpedo (REXTORP) and MK-50 REXTORP torpedo are non-explosive exercise torpedoes that use air charges or hydrostatic pressure to discharge ballast and float to the water's surface. They have no warheads, no propellant, and negligible amounts of hazardous materials. Table 3.4-12 describes torpedoes typically used in the SOCAL OPAREAs.

Table 3.4-12: Torpedoes Typically Used in the SOCAL OPAREAs

TORPEDO	CHARACTERISTICS
MK-46 EXTORP	Hazardous materials include explosive bolts (less than 0.035 oz. [1 g]), gas generator (130.9 lb. [59.4 kg]), and a seawater battery (4 oz. [113 g]). The monopropellant is Otto Fuel.
MK-48 ADCAP EXTORP	The hazardous materials list is classified.
MK-54 EXTORP	This EXTORP is based on the propulsion system of the MK-46 torpedo and the search and homing capabilities of the MK-50 torpedo.
Notes: in. - inch; m - meter; lb. - pound, kg - kilogram, g - gram, oz. - ounce.	
Sources: Navy EOD 60R-2-2-13: Table 1 (also known as the 60 Series weapons publications), Technical Description Documents SW515-A5-MMM-010, SW515-AG-OMP-010, SW516-AA-010; Naval Institute Guide to Ships and Aircraft of the U.S. Fleet	

In FY2004, all torpedoes were retrieved. If any are lost, then material such as grease, lubricating oils, seawater batteries, and OTTO Fuel will be released into the environment. These materials are summarized in Table 3.4-13.

Table 3.4-13: Hazardous Materials Associated with Use of the MK-46 Torpedo

MATERIAL	
Torpedo Hydraulic Fluid (MIL-H-5606E mineral oil base)	Practice Arming Rotor (Lead Azide)
Grease (Dow Corning 55M Grease)	Scuttle Valve (Lead Azide)
Lubricating and Motor Oils	Frangible Bolt (Lead Azide and Cyclonite)
Luminous Dye (Sodium Fluorescein)	Propellant (Ammonium Perchlorate)
Solder (QQ-S-571, SN60)	Gas Generator (Barium Chromate and Lead Azide)
Ethylene Glycol (two speed valve backfill fluid)	Release Mechanism (Barium Chromate and Lead Azide)
Ballast Lead Weight	Stabilizer (Barium Chromate and Lead Azide)
Explosive Bolts (Lead Azide and Cyclonite)	Cartridge Activated Cutter (Barium Chromate and Lead Azide)
Pressure Actuated Bolt (Potassium Perchlorate)	Propulsion Igniter
Practice Exploder (Lead Azide)	Exercise Head Battery
Source: DoN 1996b 4A	

Propulsion Systems

OTTO Fuel II propulsion systems are used in both the MK-46 and the MK-48 torpedoes. OTTO Fuel II may be toxic to marine organisms (DoN 1996b,c). There have been over 5,800 exercise test runs of the MK-46 torpedo worldwide between FY89 and FY96 (DoN 1996b), and approximately 30,000 exercise test runs of the MK-48 torpedo over the last 25 years (DoN 1996c). Most of these launches have been on Navy test ranges, where there have been no reports of deleterious impact on marine water quality from the effects of OTTO Fuel II or its combustion products (DoN 1996b,c). Furthermore, Navy studies conducted at torpedo test ranges that have lower flushing rates than the open sea did not detect residual OTTO Fuel II in marine environment (DoN 1996b,c). Thus, no adverse effects are anticipated from use of this fuel.

OTTO Fuel II is not released into the marine environment during normal operation. During a catastrophic failure, however, up to 59 lb (27 kg) of fuel could be released from a MK-46 (DoN 1996b). Even in the event of such a spill, no long-term adverse impacts to marine water quality will result, because:

- The water volume and depth of the SOAR dilute the spill, and
- Common marine bacteria degrade and ultimately break down OTTO Fuel (DoN 1996b,c).

Exhaust products from the combustion of OTTO Fuel II include nitrogen oxides (NO_x), carbon monoxide (CO), carbon dioxide (CO_2), hydrogen (H_2), nitrogen (N_2), methane (CH_4), ammonia (NH_3), and hydrogen cyanide (HCN) (DoN 1996b,c). These combustion products are released to the sea, where they are dissolved, disassociated, or dispersed in the water column. Except for HCN, combustion products are not a concern (DoN 1996b,c) because:

- Most OTTO Fuel II combustion products, specifically CO_2, H_2O, N_2, CH_4, and NH_3, occur naturally in seawater.
- Several of the combustion products are bioactive. N_2 is converted into nitrogen compounds through nitrogen fixation by certain cyanobacteria, providing nitrogen sources and essential micronutrients for marine phytoplankton. CO_2 and CH_4 are integral parts of the carbon cycle in the oceans and are taken up by many marine organisms.
- CO and H_2 have low solubility in seawater and excess gases bubble to the surface.
- Trace amounts of NO_x may be present, but they are usually below detectable limits. NO_x in low concentrations are not harmful to marine organisms, and are a micronutrient source of nitrogen for aquatic plant life.
- Ammonia can be toxic to marine organisms in high concentrations, but releases from OTTO fuel are quickly diluted to negligible levels.

Hydrogen cyanide (HCN) does not normally occur in seawater and, at high enough concentrations, could pose a risk to both humans and marine biota. The USEPA acute and chronic national recommendation for cyanide in marine waters is 1.0 microgram per liter (µg/L), or approximately one part per billion (ppb) (DoN 1996b,c). HCN concentrations of 280 ppb will be discharged by MK-46 torpedoes (DoN 1996b) and HCN concentrations ranging from 140 to 150 ppb will be discharged from MK-48 torpedoes (DoN 1996c). These initial concentrations are well above the USEPA recommendations for cyanide. Because it is very soluble in seawater, however, HCN will be diluted to less than one µg/L at 17.7 ft (5.4 m) from the center of the torpedo's path, and thus should pose no substantial threat to marine organisms. Even during the most intensive events, at most eight MK-48 exercise torpedoes will be used in a given day. These launches will occur over 24 hours, and are not likely to be conducted in the same portion of the SOCAL OPAREAs.

MK-50 Torpedoes. All the MK50s used on the range are Recoverable Exercise Torpedoes (REXTORPs). . Hazardous materials may be found in components of the MK-50 torpedo. During normal exercises, no hazardous materials are released to the marine environment because the torpedo is sealed. At the end of an exercise, the torpedoes are recovered.

MK-46 Torpedoes. Several hazardous materials can be found in components of the MK-46 torpedo. During normal exercises, no hazardous materials are released to the marine environment because the torpedo is sealed. At the end of an exercise, the torpedoes are recovered (DoN, 1996b).

Hazardous materials could be released on impact with a target or the seafloor. During exercises, however, the guidance system of the torpedo is programmed for target and bottom avoidance (DoN, 1996b), minimizing accidental releases. Furthermore, the contaminants will be released instantaneously, so the area exposed to acutely toxic concentrations will be minimized.

During normal venting of excess pressure or upon failure of the torpedo's buoyancy bag, gaseous CO_2, water, H_2, N_2, CO, CH_4, NH_3, hydrochloric acid (HCl), HCN, formaldehyde (CH_2O), potassium chloride (KCl), ferrous oxide (FeO), potassium hydroxide (KOH), and potassium carbonate (K_2CO_3) are discharged (DoN 1996b). Even in the event of a release, however, no long-term, adverse effects on marine water quality result, because:

- Most of the discharges are dissolved, disassociated, or dispersed in the water column.
- Most of the discharged compounds, specifically CO_2, H_2O, H_2, N_2, CH_4, and NH_3 naturally occur in seawater.
- Several of the discharged compounds are bioactive. N_2 is converted into nitrogen compounds through nitrogen fixation by certain blue green algae, providing nitrogen sources and essential micronutrients for marine phytoplankton. CO_2 and CH_4 are integral parts of the carbon cycle in the oceans, and are taken up by many marine organisms.
- HCl, KCl, KOH, and K_2CO_3 are soluble in seawater, and disassociate into ions that naturally occur in seawater.
- CO and H_2 have low solubility in seawater, and excess gases bubble to the surface.
- Although insoluble in water, FeO is nonhazardous.
- CH_2O normally does not occur in seawater. The total amount of CH_2O that is discharged from the rupture of the buoyancy bag is 3.93 µg (DoN 1996b). This quantity is diluted below 1 µg/l in less than 0.3 ft (0.1 m).

HCN can pose a risk to both humans and marine biota. The USEPA acute and chronic national recommendation for cyanide in marine waters is one µg/L, or approximately one ppb (DoN 1996b). An estimated 3.87 µg of HCN can be discharged into the marine environment if the Buoyancy Sub-system (BSS) buoyancy bag ruptures (DoN 1996b). This quantity of HCN is diluted to below the USEPA limit in less than 0.3 ft (0.1 m). During normal BSS venting, fewer exhaust products are released than during a buoyancy bag rupture, and these products are released in a greater volume of water, so BSS venting will not affect water quality.

Torpedo Accessories

Various accessories are expended during the launch, operation, and recovery of MK-46, MK-48, MK-50, and MK-54 exercise torpedoes. An assortment of air launch accessories, all of which are non-hazardous materials, will be expended into the marine environment during air launching of MK-46 and MK-50 torpedoes. Depending on the type of launch craft used, MK-46 air launch accessories may comprise a nose cap, suspension bands, air stabilizer, release wire, and propeller baffle (DoN 1996b). MK-50 air launch accessories may comprise a nose cap, suspension bands, air stabilizer, sway brace pad, arming wire, and fahnstock clip (DoN 1996b).

All of these expendable materials will sink to the ocean bottom. The materials likely will not result in any physical impacts on the sea floor because they will sink into a soft bottom, where they will be covered eventually by shifting sediments. Over time, these materials will degrade, corrode, and become incorporated into the sediments. Rates of deterioration will vary, depending on material and conditions in the immediate marine and benthic environment.

Upon completion of a MK-46 REXTORP or MK-50 REXTORP launch, six steel-jacketed lead ballast weights are released to lighten the torpedo, allowing it to rise to the surface for recovery. The 180-lb (81.7-kg) ballasts sink rapidly to the bottom and, in areas of soft bottoms, are buried into the sediments. The MK-46 Exercise Torpedoes (EXTORPs) also use ballasts, which weigh 72 lb. (32.7 kg). MK-54 and MK-48 Advanced Capabilities (ADCAP) torpedoes use buoyancy bags to lift the torpedoes to the surface after their run.

Of the 276 torpedoes estimated for the No Action Alternative, about 127 will be REXTORPs (the remaining 149 will be EXTORPs). Therefore, approximately 127 ballasts will be expended annually. The ballast materials for the MK-46 EXTORP and the REXTORPs total approximately 28,200 lb (12,900 kg) per year, and the lead in flexible hoses will total about 3,980 lb (1,800 kg) per year for the MK-48 and MK-54 EXTORPs (see Table 3.4-14).

Lead (Pb) and lead compounds are designated as priority toxic pollutants pursuant to Section 304(a) of the CWA of 1977. The USEPA saltwater quality standard for lead is 8.1 µg/L, continuous, and 210 µg/L maximum concentration (65 Federal Register 31682). Lead is a minor constituent of seawater, with a background concentration of 0.02 to 0.4 µg/L (DoN 1996b). Even if all of the expended lead ballasts and hoses from torpedo exercises were concentrated into less than one percent of the bottom area of the SOCAL Range Complex and a high rate of its dissolution into the water column were assumed, the 16 tons (15 metric tons) per year of lead will not be sufficient to exceed the water quality standard.

The metallic lead of the ballast weights likely will not dissolve into the sediment or water as lead ions (DoN 1996b). The lead is jacketed in steel, so the surface of the lead will not be in direct contact with the seawater. Also, in areas of soft bottoms, the lead weight will quickly be buried due to the velocity of its impact with the bottom and its greater density. As a result, releases of dissolved lead into bottom waters are expected to be negligible.

Table 3.4-14: Estimated Lead in Torpedo Ballasts, No Action Alternative

TORPEDO		AMOUNT OF LEAD IN BALLAST AND HOSE			
Type	Number	Per Item		Total	
		lb	kg	lb	kg
MK-46 REXTORP	109	180	82	19,600	8,940
MK-46 EXTORP	74	72	33	5,330	2,440
MK-48 EXTORP	73	53	24	3,870	1,750
MK-54 EXTORP	2	53	24	106	48
MK-50 REXTORP	18	180	82	3,240	1,480
Total	**276**			**32,100**	**14,600**
Note: Numbers rounded to three significant digits to indicate relative precision of the estimate.					
Source: DoN 1996a, DoN 1998, DoN 2002					

The MK-48 EXTORP is equipped with a single-strand control wire, which is laid behind the torpedo as it moves through the water. At the end of a torpedo run, the control wire is released from the firing vessel and the torpedo to enable recovery of the torpedo. The wire sinks rapidly and settles on the ocean floor, stretched into a long single line, as opposed to being looped or in tangles. The MK-48 torpedo also uses a flex hose to protect the control wire. The flex hose is expended into the ocean after completion of the torpedo run and, because of its weight, rapidly sinks to the bottom. Two types of flex hose are used: the Strong Flex Hose (SFH) and the Improved Flex Hose (IFH). The IFH is replacing the SFH in accordance with a phased schedule.

Exercise Torpedoes

In the No Action Alternative, about 73 MK-48 exercise torpedoes will be used, so 73 control wires and 73 flex hoses will be expended. An estimated 183 torpedoes per year will be air-launched, approximately 20 torpedoes per year will be surface-launched, and approximately 73 torpedoes per year will be launched from submarines.

Chaff and Flares

Chaff and flares are used in electronic warfare exercises. Under the No Action Alternative, about 52 packages of chaff will be released in the SOCAL OPAREAs. About 423 smoke grenades and flares will be used annually under the No Action Alternative.

Chaff is a thin polymer with a metallic (aluminum) coating used to decoy enemy radars. The chaff is shot out of launchers using a propellant charge. The fine chaff streamers act like particulates in the water, temporarily increasing the turbidity of the ocean's surface. They quickly disperse, however, and the widely spaced exercises have no discernable effect on the marine environment. The Air Force has studied chaff, and has reported no adverse impacts from chaff and said that chaff is generally nontoxic (U.S. Air Force, 1997).

Flares contain powdered or pelleted magnesium imbedded in a matrix. They are incendiary and burn at high temperatures. Two types of flares are used: those ejected from aircraft to act as a decoy for enemy missiles, and those deployed under parachutes to provide illumination in support of other activities. The combustion products from flares are not hazardous, consisting primarily of sodium carbonate, carbon dioxide, water, and magnesium oxide.

Hazardous constituents are typically present in pyrotechnic residues, but are bound up in relatively insoluble compounds. Solid flare and pyrotechnic residues may contain, depending on their purpose and color, an average weight of up to 0.85 lb (0.4 kg) of aluminum, magnesium, zinc, strontium, barium, cadmium, nickel, and perchlorates. As inert, incombustible solids with low concentrations of leachable metals, these materials typically do not meet the RCRA criteria for characteristic hazardous wastes. The perchlorate[1] compounds present in the residues are relatively soluble, albeit persistent in the environment, and probably disperse quickly.

Flares will be used occasionally but, on an annual basis, about 360 lb (163 kg) of solid flare residue will be generated. Flares will be used in various portions of the SOCAL OPAREAs, and will disperse widely in the atmosphere before settling to the ocean's surface. Assuming that the solid flare residues are all generated at the same time, distributed over 24,000 nm^2 (82,300 km^2) of the SOCAL OPAREAs (about 20 percent of the overall range area) and mixed into the top 3 feet (1 m) of ocean water, the approximately 360 lb (163 kg) of flare residue under the No Action Alternative will be dispersed in about 2.9 billion cubic feet (82 billion L) of water. Flare residue concentrations thus will be far too low to affect ocean water quality or sediment chemistry.

Mine Shapes

Mine shapes are wholly inert (i.e., containing no energetic materials) concrete and steel objects that are dropped in the mine training ranges. These ranges are used for training of air crews in offensive mine laying by delivery of wholly inert mine shapes from aircraft. There are no hazardous materials in mine shapes. Trace amounts of chromium, nickel, or other toxic metals could leach out of the steel gradually over time as it corrodes, but ocean chemistry will not be affected because of the very low rate of these emissions and their rapid dispersal in the ocean.

Unexploded Ordnance (UXO)

A small percentage of the explosive training items, generally less than five percent, may fail to function as designed. The result can be no detonation or a low-order detonation. In the first case, the item likely will settle to the ocean floor intact. In the second case, some portion of the original explosives or propellants may remain, and likely will be exposed to seawater. Given the wide range of training materials, varying failure rates and types of failures, and the wide range of explosives and propellants that may be involved, a quantitative estimate of these materials would be subject to numerous assumptions and caveats. A quantitative consideration of the effects on the marine environment of expended explosives and propellants would not change the overall conclusions of this water quality analysis because (a) these materials will be a small fraction of the quantities of explosives used for training, which in turn will be a small portion of the total amount of unrecovered training materials, (b) they will be widely dispersed within the range, and thus will be present in the environment at very low concentrations, and (c) explosives and propellants exposed to the environment typically break down into less toxic byproducts.

Summary

Water Quality

Training and testing activities will introduce several types of water pollutants to the water column. These substances include propellant and explosives residues and battery constituents from missiles and aerial targets; battery constituents from sub-surface targets and sonobuoys; torpedo fuel, metals from rusting and corroding casings and accessory materials, and chaff and flare residues. Based on the qualitative and quantitative analyses of expended training materials presented above, however, these pollutants will be released in quantities and at rates such that they will not violate any water quality standard or criteria. The No Action Alternative will have no effect on the designated beneficial uses of marine waters.

[1] Perchlorates are water-soluble inorganic compounds that are relatively persistent in the environment; exposure to which has been found to cause adverse health effects.

Bottom Sediments

The environmental fates of hazardous constituents have been addressed above for each category of expended training material. The aggregate effects of expended training materials on ocean bottom sediments in the SOCAL OPAREAs also can be assessed in terms of the number and weight of deposited items per unit area of bottom surface. A total of about 1.7 million training items, or about 418 tons (380 metric tons) per year, are expended under the No Action Alternative (see Table 3.4-5). Assuming an ocean floor area of about 120,000 nm^2 (about 412,000 km^2), and making a further conservative assumption that the training materials are concentrated within 20 percent of this area, this is about 175 items per nm^2 (about 51 items per km^2).

The deposition rate of expended training materials, by weight, is about 32 lb / nm^2 (4.1 kg/km^2) per year. If the expended training materials remained in the top 2 in (5 cm) of bottom sediments and were distributed evenly over the bottom area, then their concentration would be about 5 lb per million cubic feet (ft^3) (2.2 kg/million cubic meter [m^3]) of sediment. Depending on the density of bottom sediments, the concentration of expended training materials would be about 45 parts per billion (ppb) by weight. This concentration is several orders of magnitude below a level of concern.

Expended training materials will accumulate in ocean bottom sediments over the entire period of military training, so a short-term analysis does not capture the magnitude of the environmental effects. If the same amounts of training materials were used annually for 20 years, the aggregate density of items on the ocean floor will be about 4/ac (about 10 per ha). By weight, the density will be about 624 lb per nm^2 (83 kg/km^2), or about 0.9 ppm. At this density, expended training materials still will have no discernable effect on the quality of bottom sediments.

Expended training materials will settle to the ocean bottom and will be covered by sediment deposition over time. Most of the expended training materials are wholly inert, and thus harmless, but some of the materials are toxic metals such as lead. These items degrade and disperse very slowly, so the volume of expended training materials within the training areas, and the amounts of toxic substances being released to the environment, gradually increase over the period of military use. Concentrations of some substances in sediments surrounding the disposed items increase over time. Sediment transport via currents may eventually disperse these contaminants outside of the training areas. The density of expended training materials in ocean bottom sediments (see calculation above), however, is not high enough, however, to result in substantial sediment toxicity. Neither inert nor toxic substances at this density will measurably affect sediment quality.

3.4.3.2.2 San Clemente Island

Amphibious Warfare

Amphibious warfare land activities proposed under the No Action Alternative include NSFS, EFEX, and Amphibious Landings and Raids.

Naval Surface Fire Support Exercise

The majority of shells impact on land. Virtually all of the shells land in Impact Areas I and II, which support only limited surface water resources. The gradient of most of the land within the Impact Area is flat to gently sloping. These areas are not likely to experience increased erosion because of topography, historic use, and soil stability.

Surface waters are generally found in long, deep canyons draining to the ocean. Erosion may result from indirect impacts within canyons. Increased soil erosion from ordnance impacts within the SHOBA Impact Areas is addressed in Section 3.1, Geology and Soils.

Only about 1.5 percent of the shells fall short and enter the water. The only possible impact on marine water quality is from hazardous constituents, and the products from detonation of high explosives are generally non-hazardous (e.g., CO, CO_2, H_2, H_2O, N_2, and NH_3). Projectile bodies are made of steel or metal alloys that are also mostly non-hazardous.[1] The steel and metal alloys are relatively insoluble, but seawater will eventually oxidize the expended training material into benign by-products (e.g., iron and aluminum).

Expeditionary Firing Exercise (EFEX)

Artillery activities on SCI damage surface hydrology (i.e., disturb canyons or other areas supporting surface water) and introduce hazardous materials associated with artillery activities. Few areas on SCI support surface water, however, and these areas probably are not affected by artillery or other Navy activities. Impacts of EFEXs on the quality of SCI's surface waters are limited to increased turbidity from sediment transport and the effects of hazardous materials. EFEXs occur within designated areas with limited surface water resources. Hazardous materials emissions from cannon and mortar rounds are similar to those from five-inch shells (discussed above). No substantial effects are anticipated.

Amphibious Landings and Raids

These activities include landings of Marines in Northwest Harbor or on the western terraces at night. Movement from the shore is typically to VC-3. No high explosive ordnance is used. Impacts of individuals on foot, and restricted to the shoreline and existing roads, are minimal. Pursuant to the conditions and stipulations of this activity, Marines avoid canyons and other areas where water concentrates to minimize erosion. Because these activities are small in scale and dispersed over large areas, and no training materials are expended, their effect on surface water quality and, indirectly, on marine water quality will be negligible.

One possible impact on marine water quality of amphibious landings is resuspension of sediments into the water column (i.e., turbidity), resulting in re-mobilization of any contaminants in the sediments, resulting in short-term, local impacts on marine water quality. The sediment plume from these activities is eventually dispersed by wind and water motion. Analysis of nearshore bottom sediments around SCI, however, indicates that the concentrations of contaminants are too low to have an effect (see Table 3.4-3).

Naval Special Warfare

Land Demolitions

Land demolitions occur in the Demolition Range, a bermed rectangular area located in North Head. Three basic types of explosive materials are used: C4, TNT, and HBX. These charges vary in size from 1.5- to 500-lb (0.7 - 227 kg) n.e.w., with an average of 50 lb (23 kg) per event. Products from the detonation of high explosives are non-hazardous (e.g., CO, CO_2, H_2, H_2O, N_2, and NH_3) and, pursuant to the conditions and stipulations of this activity, impacts outside of the designated operational area do not occur. Effects on water quality are negligible because these activities occur in a designated area devoid of water resources.

Small Arms

Small arms qualification firing occurs at the rifle range. Small arms rounds embed in an earthen berm. No effects on marine water resources are expected because these activities occur on land. The Surface Danger Zone extends over the water, but few rounds escape the bermed area. Lead does not enter the marine environment in surface runoff from the site because the most common

[1] Steel may contain boron, chromium, cobalt, molybdenum, nickel, selenium, titanium, tungsten, or vanadium to improve its strength or corrosion resistance.

inorganic forms of lead in surface soils are relatively insoluble in water and runoff is contained within the berm.

Impacts on other water resources could include contamination from hazardous materials (e.g., lead) exceeding *Basin Plan* criteria. The shells are fired in dirt/sand bunkers where they accumulate. There are no groundwater resources in the North Head area. Surface runoff carrying lead shot to the ocean is considered unlikely because of topography and existing conditions of the area. Furthermore, pursuant to the conditions and stipulations of this activity, effects outside of the designated area, other than wildfires, do not occur.

Small arms projectiles contain steel, lead, antimony, copper, tungsten, and other metals. Lead is a contaminant of concern for small arms, and can be toxic if eaten or inhaled. However, the lead used in small arms rounds is relatively insoluble and, at SCI, is not exposed to conditions that favor dissolution (i.e., high precipitation and acidic conditions). Soluble lead may be present in the soil and, during the rainy season, may percolate through the sandy soil and eventually run-off into the ocean. Seasonal rainfall amounts are low, however, and there are few surface and no groundwater resources in the vicinity of the Impact Areas. Steel, antimony, tungsten, and copper are also used in military-grade ammunition for small arms.

Land Navigation

No aspect of land navigation directly affects marine water quality. Pursuant to the conditions and stipulations of this activity, effects outside of the designated area do not occur, avoiding any direct effects on surface hydrology. Foot traffic within designated areas can affect erosion rates which, in turn, could affect sediment transport into on-island drainage features and nearshore waters. The discussion presented in Section 3.1, Geology and Soils, however, demonstrates that this is an inconsequential concern.

Unmanned Aerial Vehicle (UAV) Training

Unmanned Aerial Vehicle (UAV) training involves minimal ordnance, smoke, and lasers, and has no effects on water resources.

NSW Group ONE (NSWG-1) SEAL Platoon Operations

Naval Special Warfare (NSW) Group ONE (NSWG-1) training may introduce trace amounts of pollutants that originate in vehicles, boats, lubricants, compressed air tanks, weapons, and lithium batteries. Demolitions use C-4 and RDX/PETN. Products from the detonation of C-4 and RDX/PETN high explosives are non-hazardous (e.g., CO, CO_2, H_2, H_2O, N_2, and NH_3). Therefore, impacts of explosives on marine water quality are negligible.

Impacts on other water resources can include contamination from hazardous materials (e.g., lead bullets) exceeding *Basin Plan* criteria. This activity occurs within a designated existing training area. Lead from projectiles may leach into the soils over a long period. No surface or groundwater resources are present at this location, however, and runoff potential is minimal due to topography and existing conditions. In addition, effects outside of the designated training areas do not occur.

Direct Action

Hazardous materials from explosives and small arms rounds expended during Direct Actions are similar to those of other training activities. Both small arms and demolition training have been addressed above, and those evaluations have concluded that no substantial effects on hydrology or surface water quality will result from these activities.

Strike Warfare

Under the No Action Alternative, 176 Air Strikes are conducted. Principal weapons to be dropped during Air Strike training in the land area of SHOBA are the 25-lb (11-kg), non-explosive practice MK-76; the MK-82, a 500-lb (227-kg) bomb; or the MK-83, 1,000-lb (454-kg) bomb. Under the No Action Alternative, about 1,870 bombs weighing an estimated 158 tons (144 metric tons) will be dropped, primarily in SHOBA. Virtually all of the shells land in Impact Areas I and II, which support only limited surface water resources. The gradient of most of the land within the Impact Area is flat to gently sloping. These areas are not likely to experience increased erosion because of their topography, long-term use, and soil stability.

Impacts of Air Strikes on the surface water resources of SCI are limited to the effects of hazardous materials on surface water quality from activities exceeding *Basin Plan* standards. Residues of explosives and propellants will degrade and disperse. Accumulations of metals in surface soils will constitute a minor component of the soil and have no substantial effect on water quality. Activities occur within designated land areas and do not affect the hydrology outside of the designated boundaries.

Non-Combat Operations

Explosive Ordnance Disposal

Explosive Ordnance Disposal (EOD) activities could affect surface water resources of SCI through contamination by hazardous materials. Explosives products and residues will be similar to those of other activities, and will include only trace amounts of toxic materials. No effects on marine water resources are expected from these trace quantities of toxic materials deposited in upland range areas.

Naval Auxiliary Landing Field (NALF) SCI Airfield Operations

Naval Auxiliary Landing Field (NALF) provides opportunities for aviation training and aircraft access to SCI. Activities include Fleet Carrier Landing Practice (FCLP), visual and instrument approaches and departures, aircraft equipment calibration, survey and photo missions, range support, exercise training, R&D test support, medical evacuation, and supply and personnel flights. Under the No Action Alternative, NALF experiences about 25,120 landing-takeoff operations per year.

There are no surface or groundwater resources near the airfield that could be affected by storm water runoff, so NALF activities do not affect surface water quality. Marine water quality can be affected by fuel and oil residues in storm water runoff from NALF activities. Annual rainfall on SCI is low, however, so the amount of storm water runoff is low. The Navy has procedures to prevent and contain any accidental spills, which minimizes their incidence and the amounts of fuel and oil residues present.

Research, Development, Test, and Evaluation

Missile Flight Tests

The Joint Standoff Weapon (JSOW) missile testing program at SCI was the subject of an EA in 1996 which resulted in a FONSI (Department of the Navy [DoN], 1996a). An EA was also completed for Tomahawk missile testing at SCI (DoN, 1998). There are three main target areas, the Missile Impact Range (MIR), offshore ships, and SHOBA. These activities use both high explosive and non-explosive practice warheads originating from aircraft, ships, or submarines. Targets are located in the ocean, as well as on land, so these activities can affect marine water quality. Missile residues will include small amounts of residual fuel and explosives (see Table 3.4-15). Expended missile materials were evaluated for training (see above), and this evaluation demonstrated that no substantial effects on water quality will result.

Table 3.4-15: Estimated Missile Impact Constituents, No-Action Alternative

MISSILE		CONSTITUENTS, LB/KG							
		Residual Fuel		Battery		Igniter		Explosives	
Type	No.	lb	kg	lb	kg	lb	kg	lb	kg
Joint Standoff Weapon	3	2	1	NA	NA	NA	NA	59	27
Land-Attack Standard Missile	5	751	341	6	3	0.5	0.2	70	32
Note: NA - not available.									

3.4.4.3 Alternative 1

3.4.4.3.1 SOCAL OPAREAs

Effects by Warfare Area

Anti-Air Warfare

Under Alternative 1, the number of air-to-air MISSILEXs would remain unchanged at 13 operations per year, Surface-to-Air Missile Exercises would increase from 1 under the No Action Alternative to 4 per year, and Surface-to-Air Gunnery Exercises would increase by about 34 percent (262 to 350). The number of missiles (24 versus 18 under No Action Alt.) and targets (about 1,080 versus about 900 under No Action Alt.) deployed would increase in rough proportion to this increase in training activities. Under Alternative 1, the number of naval gun shells expended would increase from 496 under No Action Alt. to 663 per year. Small arms expenditures would increase from about 1.4 million to about 1.9 million items per year. Levels of other training materials expended would increase in rough proportion to the increase in training activities.

These increases, ranging from 20 percent for targets to 34 percent for naval gun shells, would not translate into discernable changes in water or sediment quality because, based upon the evaluation of the No Action scenario, the scale of these discharges still would be insignificant relative to the volume of water into which they would be released and the surface area of the bottom sediments over which they would be dispersed. Effects of ASW operations on marine water quality and sediment quality thus would be similar to those under the No Action Alternative. AAW training materials expended in the SOCAL OPAREAs under Alternative 1 are summarized in Table 3.4-16, and their aggregate effects on ocean water quality and sediment quality are addressed below.

Anti-Submarine Warfare (ASW)

Under Alternative 1, the number of Air ASW training activities would increase by about 11 percent. More torpedoes (330 versus 263 under the No Action Alt.), targets (an estimated 2,090 versus 1,290 under the No Action Alt.), and sonobuoys (about 9,070 versus about 3,550) would be deployed. The main source of water quality effects would be the batteries or fuel used to propel or operate the units. Expenditures of training materials would be episodic and spatially separated within the range.

Ship ASW events would increase by about ten percent under Alternative 1, and surface ships may be added to IAC training events. The number of sonobuoys (about 1,250 versus about 790 under the No Action Alt.) and other expendable training items used would change accordingly. The density of sonobuoys in ocean bottom sediments would be lower under Alternative 1 than under the No Action Alternative, however, because they would be distributed over a larger area.

Under Alternative 1, the number of Submarine ASWs would increase from 45 under the No Action Alternative to 53. This training would be dispersed over the area encompassed by the

SWTR. Events in SOAR would decrease, and events would occur in both the SWTR Near-shore area and SWTR Offshore area. The numbers of torpedoes and targets (49 versus 41 under the No Action Alt.) deployed would increase proportionately. Effects of Sub ASWs on marine water quality would be similar to those described under the No Action Alternative.

The number of targets used for training would increase by more than 60 percent. The number of EMATTs would increase, mostly due to the Navy's plan that EMATTs would constitute 80 percent of the underwater targets in the future. The number of torpedoes used for training also would increase by about 11 percent over the No Action Alternative.

ASW training materials expended in the SOCAL OPAREAs under Alternative 1 are summarized in Table 3.4-15, and their aggregate effects on ocean water quality and sediment quality are addressed below.

Anti-Surface Warfare

VBSS would occur 78 times per year compared to 56 times under the No Action Alternative. The intensity of these training events and the number of participants would increase. Despite these increases, the impacts on water quality would be similar to those described under the No Action Alternative because VBSSs have few components that could impact marine water quality.

The number of Air-to-Surface Bombing and Gunnery Exercises would increase from 79 under the No Action Alternative to 85 per year. Surface ships and targets could affect marine resources. Effects on water quality resources would be similar to those described under the No Action Alternative.

Under Alternative 1, 350 Surface-to-Surface Gunnery exercises (S-S GUNEXs) would be conducted annually, compared to 315 under the No Action Alternative. S-S GUNEX training would increase by about 11 percent. Discarded training materials used in this exercise would increase by a similar percentage. This activity involves the use of high explosive and non explosive practice ordnance against towed or self-propelled targets. The 11-percent increase would not substantially increase effects on water quality. The effects under Alternative 1 would be similar to those described under the No Action Alternative. ASUW training materials expended in the SOCAL OPAREAs under Alternative 1 are summarized in Table 3.4-16, and their aggregate effects on ocean water quality and sediment quality are addressed below.

Electronic Warfare

Typical Electronic Combat (EC) training activities and the types of training materials expended during these activities are described above under the No Action Alternative. Under Alternative 1, the number of ECs would increase from 748 under the No Action Alternative to 755 per year, an increase of about one percent. Deployment of Smokey SAMs, chaff, and flares are the only ancillary activities that could affect water quality, and the one-percent increase in activities would not increase the impacts on water quality. Effects of ECs on marine water quality would be similar to those described under the No Action Alternative. EC training materials expended in the SOCAL OPAREAs under Alternative 1 are summarized in Table 3.4-16, and their aggregate effects on ocean water quality and sediment quality are addressed below.

Mine Warfare

The total number of MCMEX activities would increase from 44 to 46 per year under Alternative 1. This activity does not require targets or other devices that use or contain hazardous materials. Therefore, MCMEX training would not affect marine water quality.

Alternative 1 would include a new activity, Mine Neutralization training. In this activity, mine detection systems would be deployed and retrieved. The Navy would conduct 732 such training events annually under Alternative 1. Because this activity does not require targets or the expenditure of other devices that use or contain hazardous materials, it would not affect marine water quality or other water resources.

Under Alternative 1, the number of MINEXs would remain the same as under the No Action Alternative (17 events per year). Mining training would occur both near SCI and in the SWTR-OS area. Approximately two mining events would be conducted in SWTR-OS annually. Mining training in the SWTR-OS area typically would be Mine Readiness Certification Inspections (MRCIs) involving either three P-3s in a Patrol Wing or up to 170 FA-18 aircraft in an Air Wing. In the case of Air Wing MRCIs, the aircraft take off from an aircraft carrier, drop their shapes in a pre-determined pattern, and return to the carrier. The drops would be centered on 300-ft (91-m) depth lines, typically in the waters located between Tanner and Cortes Banks. The mines are wholly inert, do not contain hazardous materials, and are typically recovered.

Mine Warfare training materials expended in the SOCAL OPAREAs under Alternative 1 are summarized in Table 3.4-16, and their aggregate effects on ocean water quality and sediment quality are addressed below.

Naval Special Warfare

Typical NSW training activities and the types of training materials expended during these activities are described above under the No Action Alternative. Under Alternative 1, underwater demolition training activities would increase by about 20 percent over the No Action Alternative. Although the shallow-water detonations could create temporary craters in the bottom habitat or otherwise disturb sediments, these would be temporary effects. As discussed in Section 3.3.4.1 in Hazardous Materials and Hazardous Wastes, the residues of underwater detonations would not substantially affect ocean water quality. This activity would have no aggregate effect because explosives residues from one training event would be widely dispersed before the next training event occurred. Overall, the impact of Alternative 1 on ocean bottom sediments would be about the same as under the No Action Alternative.

U.S. Coast Guard (USCG) Operations

USCG operations are described in Section 2. Expended materials from USCG operations are primarily small arms. Under Alternative 1, USCG operations would use 21,000 7.62-mm and 12,000 0.50-caliber projectiles. These materials would not be recovered, but would be deposited on the ocean bottom.

Research, Development, Test, and Evaluation

Research, Development, Test, and Evaluation (RDT&E) training materials expended in the SOCAL OPAREAs under Alternative 1 are summarized in Table 3.4-16, and their aggregate effects on ocean water quality and sediment quality are addressed there. The following text provides additional details for individual RDT&E activities. Under Alternative 1, the annual number of events for some of the RDT&E activities (Ocean Engineering, Sonobuoy Tests, and UUV Tests) would be the same as under the No Action Alternative.

Ship Tracking and Torpedo Tests

Only 15 Ship Tracking and Torpedo tests are proposed under Alternative 1, a decrease of seven. Only four of the tests would include a torpedo firing, two running MK-54s, and two non-running REXTORPs. All of the torpedoes would be recovered. Residual materials left in the ocean would be identical to those described under Air ASW. Overall, the SPAWAR activities would have lesser effects on ocean bottom sediments under Alternative 1 than under the No Action Alternative.

Unmanned Underwater Vehicle (UUV) Tests

Typical UUV training activities and the types of training materials expended during these activities are described above under the No Action Alternative. This activity would be performed the same number of times as the baseline year (ten per year). Effects on water quality resources from UUV tests would be identical to those described above under the No Action Alternative.

Sonobuoy Quality Assurance (QA)/ Quality Control (QC) Tests

This activity is described under the No Action Alternative. The number of Sonobuoy QA/QC Control tests would be the same under Alternative 1 as under the No Action Alternative. Under Alternative 1, this element of the Proposed Action would have no impact on marine water quality because it would be indistinguishable from baseline conditions.

Ocean Engineering Tests

Typical UUV training activities and the types of training materials expended during these activities are described above under the No Action Alternative. The number of Ocean Engineering tests would remain the same as under the No Action Alternative. Under Alternative 1, this element of the Proposed Action would have no impact on marine water quality because it would be indistinguishable from baseline conditions.

Effects by Training Material

This section evaluates the effects of the unrecovered training materials from all training activities on the water quality of the SOCAL OPAREAs. Table 3.4-16 below provides the annual expenditure of these materials under Alternative 1.

Table 3.4-16: Estimated Expended Training Materials in SOCAL OPAREAs, Alternative 1

Activity Area	Expenditures, Annual (#/year)								
	Gun Shell	Small Arms	Torpedo Ballast/Hose	Missile / Rocket	Bomb	Mine Shape	Flare / Chaff / Smoke	Target	Sonobuoy
Anti-Air Warfare	663	1,890,000	0	24	0	0	0	1,080	0
Anti-Submarine Warfare	0	0	330	0	0	0	651	2,090	9,070
Anti-Surface Warfare	7,230	307,000	0	71	443	0	8	956	0
Electronic Warfare	0	0	0	0	0	0	146	0	0
Mine Warfare	0	0	0	0	0	86	0	0	0
Naval Special Warfare	0	0	0	0	0	122	0	0	0
USCG		33,000							
Space and Naval Warfare	0	0	10	0	0	0	0	24	3,180
Total	7,890	2,230,000	340	95	443	208	805	4,150	12,200
Baseline	6,440	1,730,000	273	75	397	181	475	3,020	6,730
Difference	1,450	506,000	67	20	46	27	330	1,130	5,470
Total Weight (tons/year)	212	53	17	32	27	37-	0.4	NA	172

Notes: Numbers of training items are estimates, and are rounded to three significant digits to indicate their relative imprecision. NSW activities not included because expended training materials would be negligible.

Source: SOCAL Operations Data Book. 2007. DoN.

Gun Shells, Small Arms, and Bombs

As shown in Table 3.4-16, these items account for the overwhelming majority of expended training materials, about 2.2 million items per year weighing about 292 tons (265 metric tons).

Under Alternative 1, the number of such items would increase about 30 percent over the No Action Alternative. Based on the analysis presented for the No Action Alternative, the total weight of these materials would, if dispersed evenly over about 20 percent of the range, have a concentration of about 0.03 lb/ac (0.03 kg/ha).

Over a 20-year period, assuming that none of the material was lost, the concentration would be about 0.6 lb/ac (0.7 kg/ha). Most of the expended material are non-toxic metals, so the concentration of toxic materials would be substantially less than this amount. Thus, gun shells and related ordnance have no substantial effect on the bottom sediments.

Missiles and Aerial Targets

Missiles and aerial targets used in training on the SOCAL OPAREAs contain hazardous materials as normal parts of their functional components, as discussed under the No Action Alternative. Under Alternative 1, AIM-120 AMRAAMs, AIM-7 Sparrows, AIM-9 Sidewinder missiles, NATO Sea Sparrows, and Standard Missiles would be fired at BQM-74 targets. Missiles may be configured with telemetry or warheads. Table 3.4-17 lists the constituents of these training materials. Under Alternative 1, the number of such items would increase about 9 percent over the No Action Alternative. Based on the analyses of missile and aerial target components presented under the No Action Alternative, this element of the Proposed Action would not affect ocean water quality.

Surface Targets

Under Alternative 1, the estimated number of surface targets to be used would increase incrementally. The most substantial increase would be from one ship hulk to two ship hulks for the SINKEXs. The nature of expended training materials from these activities and their environmental fates, however, would be as described under the No Action Alternative. No substantial effects on water resources are anticipated.

Table 3.4-17: Estimated Missile Constituents under Alternative 1, lb (kg)

Training Item		Amount, lb (kg)						
Type	Number	Missile Propellant Remaining	Batteries	Igniters, Wiring, Etc.	Flares	Jet Fuel	Explosive	Total
AIM-120 AMRAAM	4	NA	NA	NA	NA	NA	203 (92)	203 (92)
AIM-7 Sparrow	7	NA	NA	NA	NA	NA	309 (140)	309 (140)
AIM-9 Sidewinder	5	17 (8)	NA	2 (1)	0.4 (0.2)	NA	5 (2)	24 (11)
AGM-114B	16	4 (2)	6 (3)	NA	NA	NA	22 (10)	32 (15)
Standard Missiles	7	1,050 (478)	8 (4)	1 (1)	NA	NA	78 (35)	1,140 (518)
Note: All BQM-74s are recovered, so aerial targets are not included in this table.								
Source: DoN 1996a, DoN 1998, DoN 2002								

Subsurface Targets

The potentially hazardous constituents of subsurface targets and their predicted environmental fate are discussed above under the No Action Alternative. An estimated 1,510 EMATTs per year would be used under Alternative 1, with 831 recovered. An estimated 601 MK-30 targets would be used, and all would be recovered. Thus under Alternative 1, the number of unrecovered EMATTs would increase from 490 to 679, an approximately 39 percent increase. Based on the considerations addressed under the No Action Alternative, these EMATTs would not have a substantial effect on water or sediment quality.

Exercise Torpedoes

The potentially hazardous constituents of exercise torpedos and their predicted environmental fate are discussed above under the No Action Alternative. The potential effects of torpedo fuel, torpedo ballast, and torpedo hose on ocean water quality and sediments were evaluated, and determined not to be substantial. Under Alternative 1, the number of torpedoes used per year would increase by about 24 percent. Approximately 40,100 lb (18,300 kg) of lead ballast and hose from MK-46 REXTORP, MK-46 EXTORP, MK-48, and MK-54 torpedoes would be deposited annually, as shown in Table 3.3-18. This amount is a 25 percent increase over the amount of lead deposited in the ocean during torpedo exercises under the No Action Alternative. Based on the analysis presented for the No Action Alternative, and taking into consideration the estimated percentage increases, the effects of expended training materials associated with torpedo exercises would not substantially affect marine water quality or sediment quality.

Sonobuoys and Sensing Devices

The potentially hazardous constituents of sonobuoys and their predicted environmental fate are discussed above under the No Action Alternative. Under Alternative 1, approximately 12,200 sonobuoys per year would be expended at sea. Approximately 3,180 sonobuoys would be used for QA/QC testing east of SCI in SCUIR or off NOTS pier. Of the 3,200 sonobuoys, approximately 440 would be retrieved from the water. The remainder of approximately 9,070 sonobuoys would be used throughout the SOCAL OPAREAs during training exercises. Using representative amounts of constituents found in sonobuoys, total hazardous constituents deposited in the ocean were calculated. For the approximately 11,800 sonobuoys expended and not retrieved, approximately 34,800 lb (15,800 kg) of materials would be released into the water. Table 3.4-19 provides a breakdown of these materials.

Table 3.3-18: Estimated Lead in Torpedo Ballasts, Alternative 1

TORPEDO		AMOUNT OF LEAD IN BALLAST AND HOSE			
		Per Item		Total	
Type	Number	lb	kg	lb	kg
MK-46 REXTORP	138	180	82	24,800	11,300
MK-46 EXTORP	94	72	33	6,770	3,100
MK-48 & MK-54	89	53	24	4,720	2,140
MK-50 REXTORP	21	180	82	3,780	1,720
Total	**342**			**40,100**	**18,300**
No-Action Alternative	276			32,100	14,600
Difference	66			8,000	3,700
Note: Numbers rounded to three significant digits to indicate relative precision of the estimate.					
Source: DoN 1996a, DoN 1998, DoN 2002					

Under Alternative 1, 11,800 sonobuoys per year would be scuttled. The analysis of sonobuoy battery constituents presented under the No Action Alternative demonstrates that these constituents, released during the operation of the sonobuoy, would not affect water quality. The density of the 2,740 sonobuoys scuttled in the sonobuoy test area would be as described under the No Action Alternative. The density of the other 9,070 sonobuoys scuttled in the SOCAL OPAREAs would be about 0.5 sonobuoy per nm^2, based on the assumptions made for the No

Action Alternative. At the estimated densities, these sonobuoys would not affect sediment quality.

Table 3.4-19: Sonobuoy Hazardous Constituents, Alternative 1

Material	Amount	
	lb.	kg
Copper thiocyanate	18,800	8,530
Fluorocarbons	236	107
Copper	4,010	1,830
Lead	11,100	5,050
Tin/lead plated steel	708	322
Total	**34,800**	**15,800**
No-Action Alternative	18,600	8,430
Difference	16,200	7,370
Notes: Numbers rounded to three significant digits to indicate relative precision of the estimate. Estimate based on average amounts of constituents/sonobuoy.		
Source: DoN 1996a, DoN 1998, DoN 2002		

Chaff and Flares

The potentially hazardous constituents of chaff and flares, and their predicted environmental fates are discussed above under the No Action Alternative. The same number of chaff packages (52) would be used under Alternative 1 as under the No Action Alternative, so Alternative 1 would have no impact from the use of chaff.

The number of flares expended in the SOCAL OPAREAs would increase from 423 to 753 under Alternative 1. Based on the quantitative evaluation presented under the No Action Alternative, this 78 percent increase in expended flare materials under Alternative 1 would have no effect on ocean water or sediment quality.

Summary

Water Quality

Training and testing activities would introduce several types of water pollutants to the water column. These substances would include propellant and explosives residues and battery constituents from missiles and aerial targets; battery constituents from sub-surface targets and sonobuoys; torpedo fuel, metals from rusting and corroding casings and accessory materials, and chaff and flare residues. Based on the analyses of expended training materials presented above, however, these pollutants would be released in quantities and at rates such that they would not violate any water quality standard or criteria. Alternative 1 would have no effect on the designated beneficial uses of marine waters.

Bottom Sediments

The environmental fates of hazardous constituents were addressed above for each category of expended training material. The aggregate effects of expended training materials on ocean bottom sediments in the SOCAL OPAREAs also can be assessed in terms of the number and weight of deposited items per unit area of bottom surface. A total of about 2.26 million training items, or about 550 tons (500 metric tons) per year, would be expended under Alternative 1 (see Table 3.4-16). Assuming an ocean floor area of about 120,000 nm^2 (about 412,000 km^2), and making a further conservative assumption that the training materials are concentrated within 20 percent of this area, this is about 91 items per nm^2 (about 26 items per km^2).

The deposition rate of expended training materials, by weight, is about 46 lb/nm^2 (6.1 kg/km^2) per year. If the expended training materials remained in the top 2 in (5 cm) of bottom sediments and were distributed evenly over the bottom area, then their concentration would be about 8 lb per million cubic feet (ft^3) (119 kg per million cubic meters [m^3])of sediment. Depending on the density of bottom sediments, the concentration of expended training materials would be about 69 parts per billion (ppb) by weight.

Expended training materials would accumulate in ocean bottom sediments over the entire period of military training, so a short-term analysis does not capture the magnitude of the environmental effects. In a worst-case scenario, assuming the same amounts of training materials would be used annually for 20 years, the density of expended training materials on the ocean floor would increase to about 1,800 items per nm^2 (about 977 items per km^2). By weight, the density would be about 0.3 ton/nm^2 (0.3 kg/km^2), or about 0.8 ppm. At this density, expended training materials would have no discernable effect on the quality of bottom sediments.

Expended training materials would settle to the ocean bottom and would be covered by sediment deposition over time. Most of the training materials would be wholly inert, and thus harmless, but some of it would be toxic metals such as lead. These items would degrade very slowly, so the volume of training materials within the training areas, and the amounts of toxic substances being released to the environment, would gradually increase over the period of military use. Concentrations of some substances in sediments surrounding the disposed items would increase over time. Sediment transport via currents could eventually disperse these contaminants outside of the training areas. The density of expended training materials in ocean bottom sediments (see calculation above) generally would not be high enough, however, to result in substantial sediment toxicity. Neither inert nor toxic substances at this density would measurably affect sediment quality.

3.4.4.3.2 San Clemente Island

Navy training activities on SCI would affect water resources through: (a) deposition of explosive and propellant residues on training ranges, which would be carried in surface runoff into adjacent marine waters; (b) deposition of metallic ordnance remnants containing heavy metals and other hazardous constituents, which would initially accumulate in surface soils and could eventually be transported into adjacent waters; and (c) disturbance of surface soils by foot and vehicle traffic and ordnance impacts, resulting in increased erosion and discharges of sediment into adjacent waters. Surface water quality would not be substantially affected because few natural surface water features exist on SCI. Ground water quality is not considered to be an issue because ground waters on SCI are non-potable.

<u>Amphibious Warfare</u>

Naval Surface Fire Support

The annual number of NSFS operations would increase from 47 under the No Action Alternative to 50 under Alternative 1, a 6 percent increase. The amounts of training materials expended, such as ordnance, would increase by a similar percentage. The additional naval shell impacts would incrementally increase the area of surface soil disturbance in SHOBA. The effects of NSFS operations on marine water quality would be similar, but greater in quantity than those described under the No Action Alternative.

Expeditionary Firing Exercise (EFEX)

The annual number of EFEX operations would increase from 6 under the No Action Alternative to 7 under Alternative 1, a 17 percent increase. The amounts of expended bombs, artillery shells, and gun shells would also increase, and personnel and ground vehicles would increase by a similar percentage. Effects would occur primarily on the sandy beaches used for the landings and in the ordnance impact areas. The impact of the EFEXs on marine water quality would be similar in nature to, but lesser in degree, to those of a BL (see above).

Battalion Landing

Under Alternative 1, the Navy would conduct one amphibious battalion landing (no Battalion Landings will occur under the No Action Alternative). The only potential impact on water quality resources from this operation would be from the amphibious landings. Amphibious landings would increase turbidity within the nearshore environment; however, because it is mostly sandy in the nearshore, sediment would likely quickly settle to the bottom. Additionally, most areas of SCI are routinely affected by continuous wave action, which inherently increases turbidity along beaches. This impact would be temporary, and sediment would quickly settle back out of the water column.

USMC Stinger Firings

Under Alternative 1, three USMC Stinger Firings operations would occur each year (no Stinger Firings will occur under the No Action Alternative). The USMC Stinger firings are conducted from positions onshore in SHOBA. The current positions are on China Point and to the west toward Impact Area II near the shoreline. The stingers are fired toward the ocean, not over land. Stinger Missiles could miss Ballistic Aerial Targets (BATS) or Remotely Piloted Vehicles (RPVs), and continue flying out to sea. If this occurred, the missile would expend all its fuel, leaving only the missile casing and non-explosive warhead at impact. The effects of this operation on water quality would be similar to Air ASW.

Amphibious Landings and Raids

The annual number of small boat raids would increase from 7 under the No Action Alternative to 34 under Alternative 1. These operations would include landings of Marines, which would occur in Northwest Harbor or on the western terraces at night. Movement from the shore would typically be to VC-3. No high explosive ordnance would be used. However, because Marines would be on foot and would be restricted to the shoreline and existing roads, effects of small boat raids on marine water quality would remain negligible.

Amphibious operations would involve beach landings at West Cove of ten USMC Amphibious Assault Vehicles (AAVs), carrying 120 Marines, who would then transit to VC-3 to complete the assault mission. Similar to other amphibious operations, AAV operations would be subject to conditions and stipulations requiring avoidance of canyons and other sources of surface water, minimizing the potential for erosion.

Expeditionary Fighting Vehicle (EFV) Company Assault

Expeditionary Fighting Vehicle (EFV) Company Assault training would be introduced to SCI under Alternative 1 with one proposed operation. There would be no live-fire, but blanks and smoke charges would be expended. The EFVs would proceed to SHOBA and conduct live-fire on land with their 30-mm gun, 7.62-mm machine gun, and small arms. Live-fire from sea to land would be accomplished in the SHOBA nearshore waters into Impact Areas I and II. Sea-to-sea live-fire would be conducted in the offshore waters of Laser Training Ranges 1 and 2 (3 nm [6 km] west of SCI) and Fleet Training Area Hot (FLETA HOT) 15 nm (28 km) south of SCI. Following completion, the EFVs would traverse back to embarkation beaches via the AVMR and AVMR-SHOBA.

The impacts on water quality associated with this operation are similar to those described above for the AAV, and are also addressed in a separate Environmental Impact Statement (EIS) (DoN, 2003).

Assault Amphibian (AA) School Battalion Operations

The AA School Battalion Operation would be introduced to SCI under Alternative 1 with ten proposed operations. In the AA School Battalion Operation, two Landing Craft Air Cushion (LCACs) would carry five to six EFVs with approximately 50 Marine students and instructors embarked to arrive offshore near West Cove or Horse Beach Cove. The EFVs may be dropped off about 2 nm (4 km) from shore for student open-water driving training. The vehicles would also enter the nearshore waters and practice firing from ship to shore. EFV operations are addressed in a separate EIS (DoN, 2003).

Naval Special Warfare

Land Demolition

The annual number of Land Demolition operations would increase from 354 under the No Action Alternative to 674 under Alternative 1, a 90 percent increase. Because any impacts on marine water quality would be indirect, however, effects on marine water quality would be similar to impacts under the No Action Alternative (see Section 3.4.3.2).

Small Arms

The annual number of Small Arms Training operations would increase from 171 under the No Action Alternative to 205 under Alternative 1, a 20 percent increase. Because any impacts on marine water quality would be indirect, however, impacts would be similar to impacts under the No Action Alternative (see Section 3.4.3.2).

Land Navigation

The annual number of Land Navigation operations would increase from 99 under the No Action Alternative to 118 under Alternative 1, a 20 percent increase compared to the No Action Alternative. Because any impacts on marine water quality would be indirect, however, impacts would be similar to impacts under the No Action Alternative (see Section 3.4.3.2).

Unmanned Aerial Vehicle (UAV) Training

The annual number of classes would increase from 5 under the No Action Alternative to 51 under Alternative 1. Although the number of classes and corresponding flights would increase, the impacts would be similar to those described above under the No Action Alternative because this activity does not disturb surface soils or release any hazardous materials that could migrate into surface waters.

NSW Group ONE (NSWG-1) SEAL Platoon Operations

Under Alternative 1, 16 new TARs north of SHOBA and 3 new TARs in SHOBA would be created. The annual number of NSWG-1 operations could increase from 340 under the No Action Alternative to a maximum of 512 under Alternative 1, a 51 percent increase, if every TAR were approved, designated, equipped, and operated to its limit.

NSWG-1 SEAL Platoon Operations under Alternative 1 would use the offshore, nearshore, and onshore components of TARs 1, 2, 3, 4, 5, 10, 13, 17, 20, 21, and 22. The exercises typically involve ingress to SCI by a special boat, SDV or reinforced inflatable boat, travel on foot to the target or objective area, execution of the mission (intelligence, Combat Search and Rescue [CSAR], direct assault, or other), and egress from the target areas and SCI by boat.

The increase in activity under Alternative 1 would involve minimal disturbance on a portion of the sandy shoreline of SCI. These impacts would be similar to those described in EFEX. No impacts on water quality resources would be expected from operations on TARs 6, 9, 11, 12, 14, 15, 18, and 19 because the TARs would be located on designated land areas on SCI.

TARs 7 and 8 are exclusively located in open Territorial Waters and would be used for parachute drop zones under this operation. No training materials would be expended during drops, so water resources would not be affected by this activity.

Direct Action

The annual number of Direct Action activities would increase from 156 under the No Action Alternative to 163 under Alternative 1, a four percent increase, but they would be organized into the three Training Areas and Ranges (TARs) of 20, 21, and 22. The types of operations would not change. Impacts of Direct Actions on marine water quality would be similar to those described under the No Action Alternative. The Sea, Air, Land (SEAL) teams do not deposit batteries or other hazardous materials in the operations areas, and fuel leaks on their boats are rare. Repeated foot traffic in the TARs is not likely to affect water quality or water resources.

Strike Warfare

The annual number of bombing exercises would increase from 176 under the No Action Alternative to 197 under Alternatifve 1, a 12 percent increase. As discussed under the No Action Alternative, however, operations would only occur within designated land impact areas of SHOBA, where effects on water quality would be negligible.

Under Alternative 1, the number of CSAR operations would increase from seven to eight, a 14 percent increase. Because these operations have a small footprint on the ground and any impacts on marine water quality (e.g., erosion) would be indirect, however, effects from CSAR operations would be similar to impacts under the No Action Alternative.

Non-Combat Operations

Explosive Ordnance Disposal

The annual number of EOD operations would increase from four under the No Action Alternative to five under Alternative 1. Only minor effects on marine water resources would occur because operations occur within designated areas on VC-3 on SCI where no water resources exist.

Naval Auxiliary Landing Field (NALF) SCI Airfield Operations

Under Alternative 1, approximately 26,400 NALF operations would occur, a five percent increase over the No Action Alternative. NALF activities would affect marine water quality indirectly via increased quantities of water pollutants contained in runoff from the airfield. Effects of NALF operations on marine water quality would be similar to those described under the No Action Alternative.

U.S. Coast Guard (USCG) Operations

USCG operations are described in Section 2.3.1.10. Expended materials from USCG operations are primarily small arms. Under Alternative 1, USCG operations would use 21,000 7.62-mm and 12,000 0.50-caliber projectiles. These materials would not be recovered, but would be deposited on the ocean bottom.

Research, Development, Test, and Evaluation

Missile Flight Tests

Missile Flight Tests would occur 15 times per year under Alternative 1. SPAWAR conducts multiple missile tests. Targets are located in the ocean, so marine water quality could be affected. Missile impacts were evaluated for training operations, and that evaluation concluded that there would be no substantial effect. The same conclusion is appropriate for this test activity.

Summary

Training operations would deposit various types of expended training materials on the surface of SCI. These materials would accumulate over time, and hazardous constituents contained in this material could contaminate surface soils in intensely used portions of the land ranges. These pollutants would not be transported into near-shore waters in sufficient quantities to affect marine water quality, or migrate into groundwater in sufficient concentrations to affect groundwater quality. No known groundwater aquifers capable of being developed for potable water use are known to exist on SCI, so these activities would not affect groundwater quality.

3.4.4.4 Alternative 2

Navy training activities in the open ocean would have no effect on water resources other than water and sediment quality. Training effects on marine water quality and sediment quality are addressed below.

3.4.4.4.1 SOCAL OPAREAs

Effects by Warfare Area

Anti-Air Warfare

Under Alternative 2, the number of Air-to-Air MISSILEXs would remain the same as under the No Action Alternative at 13 operations per year. Surface-to-Air MISSILEXs would increase from 1 under the No Action Alternative to 6 per year. Under Alternative 2, Surface-to-Air Gunnery Exercises would increase by about 34 percent. The total number of missiles (28 versus 18) and targets (1,110 versus 900) deployed also would increase. Under Alternative 2, the number of naval gun shells expended would increase by about 34 percent to about 663 per year, and the number of small arms expended would increase from about 1.4 to about 1.9 million items per year. Levels of other training materials expended would increase in rough proportion to the increase in training activities.

These increases, ranging from 23 percent for targets to 34 percent for naval gun shells, would not translate into discernable changes in water or sediment quality because, based upon the evaluation of the No Action scenario, the scale of these discharges would still be insignificant relative to the volume of water into which they would be released and the surface area of the bottom sediments over which they would be dispersed. Effects of ASW operations on marine water quality and sediment quality thus would be similar to those under the No Action Alternative. AAW training materials expended in the SOCAL OPAREAs under Alternative 2 are summarized below in Table 3.4-20, and their aggregate effects on ocean water quality and sediment quality are addressed below.

Anti-Submarine Warfare

Under Alternative 2, the number of Air ASW activities would increase from 131 to 144 per year, or by about 11 percent. The number of Ship ASW operations would increase from 136 to 150 per year, or about seven percent. The number of Submarine ASW operations would increase from 48 to 53 per year, or by about 10 percent. This training would be dispersed over the area of the SWTR. The number of expendable training items used would change accordingly. The number of sonobuoys used under Alternative 2 would increase from about 3,550 to about 9,100, or by about 156 percent.

The number of targets used for training would increase by more than 50 percent due to the increase in training activity. EMATTs would be a larger portion of the targets used, mostly due to the Navy plan that EMATTs would constitute 80 percent of the underwater targets in the future. The number of torpedoes used for training also would increase in rough proportion to the increase in training levels.

Alternative 2 would result in an approximately 10 percent increase in the annual amounts of training materials expended. This increase would not translate into discernable changes in water or sediment quality because the scale of these discharges still would be insignificant relative to the volume of water into which they would be released and the surface area of the bottom sediments over which they would be dispersed. Effects of ASW operations on marine water quality and sediment quality thus would be similar to those that will occur under the No Action Alternative. ASW training materials expended in the SOCAL OPAREAs under Alternative 2 are summarized in Table 3.4-20, and their aggregate effects on ocean water quality and sediment quality are addressed below.

Anti-Surface Warfare

VBSS would occur 90 times per year under Alternative 2 compared to 56 times under the No Action Alternative, an increase of 61 percent. The increase in the number of operations would result in a negligible increase in impacts because the operation expends only about 64 pounds of ordnance, and thus has a negligible effect on water quality. As a surface activity, it has no effect on bottom sediments.

The annual number of Air-to-Surface Missile Exercises would increase from 47 under the No Action Alternative to 50 per year under Alternative 2, a 6 percent increase. BOMBEXs and A-S GUNEXs would increase from 79 to 100 per year, a 27 percent increase. Under Alternative 2, 350 Surface-to-Surface Gunnery Exercises would be conducted, 35 more than under baseline conditions and an increase of about 11 percent. Unrecovered training materials used in these exercises would increase by similar percentages. Effects on water quality and sediment quality would increase in rough proportion to the increased level of activity.

Overall, Alternative 2 would result in an approximately 13 percent increase in the annual amounts of training materials expended. This increase would not translate into discernable changes in water or sediment quality because the scale of these discharges would be insignificant relative to the volume of water into which they would be released and the surface area of the bottom sediments over which they would be dispersed. Effects of ASUW operations on marine water quality thus would be similar to those that will occur under the No Action Alternative. ASUW training materials expended in the SOCAL OPAREAs under Alternative 2 are summarized in Table 3.4-20, and their aggregate effects on ocean water quality and sediment quality are addressed below.

Electronic Warfare

Typical Electronic Combat (EC) training activities and the types of training materials expended during these activities are described above under the No Action Alternative. The number of EC operations would increase from 748 to 775 per year, an increase of about 4 percent. The number of Smokey SAMs (12 per year) would not change, the number of chaff packages would increase from 52 per year to 54, and the number of flares would remain the same at 30 per year. These increases in unrecovered training materials, an estimated 2 additional training items per year, would have no discernable effects on marine water quality or sediment quality. EC training materials expended in the SOCAL OPAREAs under Alternative 2 are summarized in Table 3.4-21, and their aggregate effects on ocean water quality and sediment quality are addressed below.

Mine Warfare

The number of MCMEX activities would increase from 44 to 48 per year under Alternative 2. This activity does not require targets or other devices that use or contain hazardous materials. Therefore, MCMEX training would not affect marine water quality.

Under Alternative 2, the Navy would install 15 bottom-laid mine shapes to establish a new Shallow Water Minefield at Tanner Bank (see Section 2.5.2.2). Installing the mines would temporarily disturb ocean bottom sediments, but would have no long-term effect on marine water quality.

Alternative 2 would include a new activity, Mine Neutralization training. In this activity, mine detection systems would be deployed and retrieved. The Navy would conduct 732 such training events annually under Alternative 2. Because this activity does not require targets or the expenditure of other devices that use or contain hazardous materials, it would not affect marine water quality or other water resources.

Under Alternative 2, the number of MINEXs would increase from 17 under the No Action Alternative to 18 per year. About 90 percent of MINEXs would take place on SCI's nearshore mining ranges. Approximately nine MINEXs would take place annually in SWTR-OS. Because these activities do not require targets or other devices that use or contain hazardous materials, effects of this training on marine water quality and sediment quality would be negligible.

Under Alternative 2, two extensions of SOAR would be instrumented with transducer nodes and fiber optic cables to create a Shallow Water Training Range (SWTR). All equipment to be used for installation would be properly maintained and monitored for leakage of fuel, oil, or other hazardous materials. Vessels and equipment used for cable deployment and installation would comply with regulatory requirements and best management practices for minimizing the inadvertent discharge of potential marine contaminants. Any effects on water quality would be temporary.

Installation of the nodes and cables would result in minor, temporary increases in turbidity from disturbances of bottom sediments. Disturbed sediments would rapidly disperse and settle back to the seabed. Cables would eventually become buried in bottom sediments. Cable materials (e.g., glass, plastic, nylon) would not leach contaminants into the water or sediments, but would - based on observations of existing cable arrays - become encrusted with benthic organisms. The nodes would have a total footprint of about 0.6 ac (0.24 ha) and the cable array would have a total footprint of about 11 ac (4.ha); their combined footprint would cover about 0.003 percent of the 500 nm^2 (926 km^2) SWTR. No substantial short-term or long-term effects on water quality would result from the installation of these new facilities.

Naval Special Warfare

Typical NSW training activities and the types of training materials expended during these activities are described above under the No Action Alternative. NSW training materials expended in the SOCAL OPAREAs under Alternative 2 are summarized in Table 3.4-21, and their aggregate effects on ocean water quality and sediment quality are addressed below.

NSW Center Underwater Demolitions

The annual number of Underwater Demolitions would increase from 72 under the No Action Alternative to 85 under Alternative 2, about a 20 percent increase. Although the shallow-water detonations could create temporary craters in the bottom habitat or otherwise disturb sediments, these effects would be temporary. As discussed in Section 3.3.4.1 in Hazardous Materials and Hazardous Wastes, the residues of underwater detonations would not substantially affect ocean water quality. This activity would have no aggregate effect because explosives residues from one training event would be widely dispersed before the next training event occurred. The long-term effects on ocean bottom sediments of 13 more detonations per year under Alternative 2 thus would be indistinguishable from those under the No Action Alternative.

U.S. Coast Guard (USCG) Operations

USCG operations are described in Section 2. Expended materials from USCG operations are primarily small arms. Under Alternative 2, USCG operations would use 21,000 7.62-mm and 12,000 0.50-caliber projectiles. These materials would not be recovered, but would be deposited on the ocean bottom.

Research, Development, Test, and Evaluation

Research, Development, Test, and Evaluation (RDT&E) training materials expended in the SOCAL OPAREAs under Alternative 2 are summarized in Table 3.4-21, and their aggregate effects on ocean water quality and sediment quality are addressed there. The following text provides additional details for individual RDT&E activities.

Ship Tracking and Torpedo Tests

The number of Ship Tracking and Torpedo Tests would decrease from 22 under the No Action Alternative to 20 per year. This decreased level of activity relative to the No Action Alternative would clearly have no environmental effect.

Unmanned Underwater Vehicle (UUV) Tests

This activity is described under the No Action Alternative. Unmanned Underwater Vehicle (UUV) Tests would increase from 10 per year under the No Action Alternative to 15 per year under Alternative 2, a 50 percent increase. UUVs normally release no water pollutants during their operation and 15 tests per year is a very low level of activity. Accordingly, this activity would have no effect on water quality.

Sonobuoy Quality Assurance (QA)/ Quality Control (QC) Tests

This activity is described under the No Action Alternative. The number of Sonobuoy QA/QC Operations would increase from 117 under the No Action Alternative to 120 per year. The number of expended sonobuoys would increase by about 3 percent. The effects of expended sonobuoys on water resources were analyzed for training activities, and no substantial effects were identified. Based on these considerations, this element of Alternative 2 would have no effect on water resources.

Ocean Engineering Tests

Typical UUV training activities and the types of training materials expended during these activities are described above under the No Action Alternative. The number of Ocean Engineering operations would remain the same as under the No Action Alternative, at 242 per year. Therefore, the effects of Ocean Engineering operations on marine water quality and sediment quality would be the same as those described under the No Action Alternative.

Effects by Training Material

This section evaluates the effects of the unrecovered training materials from all training activities on the water quality of the SOCAL OPAREAs. Table 3.4-20 below provides the annual expenditure of these materials under Alternative 2.

Table 3.4-20: Estimated Expended Training Materials in SOCAL OPAREAs, Alternative 2

Activity Area	Expended Training Items (#/year)								
	Gun Shell	Small Arms	Torpedo Ballast/Hose	Missile / Rocket	Bomb	Mine Shape	Chaff/ Flares / Smoke	Target	Sonobuoy
Anti-Air Warfare	663	1,890,000	0	28	0	0	0	1,110	0
Anti-Submarine Warfare	0	0	331	0	0	0	653	2,090	9,100
Anti-Surface Warfare	7,230	311,000	0	71	487	0	10	1,020	0
Electronic Warfare	0	0	0	0	0	0	151	0	0
Mine Warfare	0	0	0	0	0	92	0	0	0
Naval Special Warfare	0	0	0	0	0	153	0	0	0
U.S. Coast Guard		33,000							
Space and Naval Warfare	109	0	12		0	0	0	35	3,260
Total	**7,890**	**2,240,000**	**343**	**99**	**487**	**245**	**814**	**4,250**	**12,400**
Baseline	6,440	1,730,000	273	75	397	181	475	3,020	6,730
Difference	1,450	476,000	70	24	90	64	339	1,230	5,640
Total Weight (TPY)	212	55	19	39	28	45	0.4	NA	173

Notes: Numbers of training items are estimates, and are rounded to three significant digits to indicate their relative imprecision.

Source: SOCAL Operations Data Book. 2007. DoN.

Gun Shells, Small Arms, and Bombs

As shown in Table 3.4-21, these items account for the overwhelming majority of expended training materials, about 2.26 million items per year weighing about 295 tons (268 metric tons). Under Alternative 2, the number of such items would increase about 30 percent over the No Action Alternative. Based on the analysis presented for the No Action Alternative, the total weight of these materials (295 tons [268 metric tons] per year) would, if dispersed evenly over about 20 percent of the range, have a concentration of about 0.03 lb/ac (0.03 kg/ha) per year.

Over a 20-year period, assuming that none of the material was lost, the concentration would be about 0.6 lb/ac (0.6 kg/ha). Most of the expended material would be non-toxic metals, so the concentration of toxic materials would be substantially less than this amount. Thus, gun shells and related ordnance have no substantial effect on the bottom sediments.

Missiles and Aerial Targets

Missiles and aerial targets used in training on the SOCAL OPAREAs contain hazardous materials as normal parts of their functional components, as discussed under the No Action Alternative. Under Alternative 2, AIM-120 AMRAAMs, AIM-7 Sparrows, AIM-9 Sidewinder missiles, AGM-114B Hellfires, and Standard Missiles would be fired at BQM-74 targets. Missiles may be configured with telemetry or warheads. Table 3.4-21 lists the constituents of these training materials. Under Alternative 2, the number of such items would increase about 9 percent over the No Action Alternative. Based on the analyses of missile and aerial target components presented under the No Action Alternative, this element of the Proposed Action would not affect ocean water quality because the scale of these discharges still would be insignificant relative to the volume of water into which they would be released and the surface area of the bottom sediments over which they would be dispersed.

Table 3.4-21: Estimated Missile Constituents under Alternative 2

Training Item		Amount, lb (kg)						
Type	**Number**	**Residual Propellant**	**Batteries**	**Igniters / Wiring**	**Flares**	**Jet Fuel**	**Explosive**	**Total**
AIM-120 AMRAAM	4	NA	NA	NA	NA	NA	203 (92)	203 (92)
AIM-7 Sparrow	7	NA	NA	NA	NA	NA	309 (140)	307 (139)
AIM-9 Sidewinder	5	17 (8)	NA	2 (1)	0.4 (0.2)	NA	5 (2)	24 (11)
AGM-114B	16	4 (2)	6 (3)	NA	NA	NA	22 (10)	31 (15)
Standard Missiles	7	1,050 (478)	8 (4)	1 (1)	NA	NA	78 (35)	1,140 (518)
Note: All BQM-74s are recovered.								

Note: estimates rounded to three significant digits to indicate the relative precision of the estimates.

Source: DoN 1996a, DoN 1998, DoN 2002

Surface Targets

Under Alternative 2, the estimated number of surface targets to be used would increase incrementally. The most substantial increase would be from one ship hulk to two ship hulks for the SINKEXs. The nature of expended training materials from these activities and their environmental fates, however, would be as described under the No Action Alternative. No substantial effects on water resources are anticipated.

Subsurface Targets

The potentially hazardous constituents of subsurface targets and their predicted environmental fate are discussed above under the No Action Alternative. An estimated 1,500 EMATTs per year would be used under Alternative 2, with 825 recovered. An estimated 600 MK-30 targets would be used, and all would be recovered. Thus under Alternative 2, the number of unrecovered EMATTs would increase from 490 under the No Action Alternative to 675, an approximately 38 percent increase. Based on their small number and the considerations addressed under the No Action Alternative, these EMATTs would not have a substantial effect on water or sediment quality.

Exercise Torpedoes

The potentially hazardous constituents of exercise torpedoes and their predicted environmental fate are discussed above under the No Action Alternative. The potential effects of torpedo fuel, torpedo ballast, and torpedo hose on ocean water quality and sediments were evaluated, and determined not to be substantial. Under Alternative 2, the number of torpedoes used per year would increase by about 24 percent. Approximately 40,300 lb (18,400 kg) of lead ballast and hose from MK-46 REXTORP, MK-46 EXTORP, MK-48, and MK-54 torpedoes would be deposited annually, as shown in Table 3.4-22. This amount is a 25 percent increase over the amount of lead deposited in the ocean during torpedo exercises under the No Action Alternative. Based on the analysis presented for the No Action Alternative, and taking into consideration the estimated percentage increases, the effects of expended training materials associated with torpedo exercises would not substantially affect marine water quality or sediment quality.

Table 3.4-22: Estimated Lead in Torpedo Ballasts and Hoses, Alternative 2

TORPEDO		LEAD IN BALLAST AND HOSE (lb/kg)			
		Per Item		Total	
Type	Number	lb	kg	lb	kg
MK-46 REXTORP	138	180	82	24,800	11,300
MK-46 EXTORP	94	72	33	6,770	3,100
MK-48 & MK-54	89	53	24	4,720	2,140
MK-50	22	180	82	3,960	1,800
Total	**343**			**40,300**	**18,400**
No Action Alternative	**276**			32,200	14,700
Difference	**67**			8,100	3,700
Note: Numbers rounded to three significant digits to indicate relative precision of the estimate.					
Source: DoN 1996a, DoN 1998, DoN 2002					

Sonobuoys and Sensing Devices

The potentially hazardous constituents of sonobuoys and their predicted environmental fate are discussed above under the No Action Alternative. Under Alternative 2, approximately 12,400 sonobuoys per year would be expended at sea. Approximately 3,260 sonobuoys per year would be used for QA/QC testing east of SCI in SCUIR or off NOTS pier. Of these sonobuoys, approximately 440 per year would be recovered. The remaining 9,100 (12,400 - 3,260) sonobuoys would be used throughout the SOCAL OPAREAs for training. Using representative amounts of sonobuoy constituents, total hazardous constituents deposited in the ocean were calculated. For the estimated 12,000 sonobuoys to be expended and not retrieved (12,400-440), approximately 35,200 lb (16,100 kg) of hazardous constituents would be released in the water (see Table 3.4-23).

Table 3.4-23: Sonobuoy Hazardous Constituents

Material	Amount	
	lb.	kg
Copper thiocyanate	19,000	8,620
Fluorocarbons	238	108
Copper	4,050	1,840
Lead	11,200	5,100
Tin/lead plated steel	715	325
Total	**35,200**	**16,000**
No-Action Alternative	18,600	8,430
Difference	16,600	7,560
Source: DoN 1996a, DoN 1998, DoN 2002		

Under Alternative 2, approximately 12,000 sonobuoys per year would be scuttled. The analysis of sonobuoy battery constituents presented under the No Action Alternative demonstrates that these constituents, released during the operation of the sonobuoy, would not affect water quality. The density of the 2,820 sonobuoys scuttled in the sonobuoy test area would be as described under the No Action Alternative. The density of the other 9,100 sonobuoys scuttled in the SOCAL OPAREAs would be about $0.5/nm^2$ ($0.14/km^2$), based on the assumptions made for the No Action Alternative. At the estimated densities, these sonobuoys would not affect sediment quality.

Chaff and Flares

The potentially hazardous constituents of chaff and flares, and their predicted environmental fates are discussed above under the No Action Alternative. The number of chaff packages would increase from 52 to 54 under Alternative 2 compared to the No Action Alternative. This small increase would have no effect on marine water quality.

The number of flares expended in the SOCAL OPAREAs would increase from 423 under the No Action Alternative to 760 under Alternative 2. Based on the quantitative evaluation presented under the No Action Alternative, this 80 percent increase in expended flare materials under Alternative 2 would have no effect on ocean water or sediment quality.

Summary

Water Quality

Training activities would introduce water pollutants to the water column. Based on the analysis presented above, however, these pollutants would be released in quantities and at rates that would not result in a violation of any water quality standard or criteria. Alternative 2 would have no effect on the designated beneficial uses of marine waters.

Sediment Quality

The environmental fates of hazardous constituents were addressed above for each category of expended training material. The aggregate effects of expended training materials on ocean bottom sediments in the SOCAL OPAREAs also can be roughly assessed in terms of the number and weight of deposited items per unit area of bottom surface. A total of about 2.26 million training items, or about 572 tons (520 metric tons) per year, would be expended per year under Alternative 2 (see Table 3.4-20). Assuming an ocean floor area of about 120,000 nm^2 (about 412,000 km^2), and making a further conservative assumption that the training materials are concentrated within 20 percent of this area, this is about 90 items per nm^2 (about 26 items per km^2).

The deposition rate of expended training materials, by weight, is about 48 lb/nm^2 (6.3 kg/km^2) per year. If the expended training materials remained in the top 2 in (5 cm) of bottom sediments and were distributed evenly over the bottom area, then their concentration would be about 8 lb of expended training material per million cubic feet (ft^3) (81 kg per million cubic meters) of sediment. Depending on the density of bottom sediments, the concentration of expended training materials would be about 70 parts per billion (ppb) by weight.

Training materials would accumulate in ocean bottom sediments over the entire period of military training, so a short-term analysis does not capture the magnitude of the environmental effects. In a worst-case scenario, assuming the same amounts of training materials would be used annually for 20 years, their density on the ocean floor would increase to about 1,790 items per nm^2 (about 974 items per km^2). By weight, the density would be about 0.4 ton/nm^2 (106 kg/km^2), or about 1.3 ppm. At this density, training residues would have no discernable effect on bottom sediments. Expended training materials would settle to the ocean bottom and would be covered by sediment deposition over time. Most of the training material would be wholly inert, and thus harmless, but some of it would be toxic metals such as lead. Neither inert nor toxic substances at this density would measurably affect sediment quality.

3.4.4.4.2 San Clemente Island

Navy training activities on SCI would affect water resources through: (a) deposition of explosive and propellant residues on training ranges, which would be carried in surface runoff into adjacent marine waters; (b) deposition of metallic ordnance remnants containing heavy metals and other hazardous constituents, which would initially accumulate in surface soils and could eventually be transported into adjacent waters; and (c) disturbance of surface soils by foot and vehicle traffic and ordnance impacts, resulting in increased erosion and discharges of sediment into adjacent waters. Surface water quality would not be substantially affected because few natural surface water features exist on SCI. Ground water quality is not considered to be an issue because ground waters on SCI are non-potable.

Amphibious Warfare

Naval Surface Fire Support Exercise

The annual number of NSFS operations would increase from 47 under the No Action Alternative to 52 under Alternative 2, a 9 percent increase. The amounts of training materials expended, such as ordnance, would increase by a similar percentage. The additional naval shell impacts per year would incrementally increase the area of surface soil disturbance in SHOBA. The effects of NSFS operations on marine water quality would be similar, but greater in quantity than those described under the No Action Alternative.

Expeditionary Firing Exercise (EFEX)

The annual number of EFEXs would increase from 6 under the No Action Alternative to 8 under Alternative 2, a 33 percent increase. The amounts of expended bombs, artillery shells, and gun shells would also increase by a similar percentage, and personnel and ground vehicles would increase by a similar percentage. Effects would occur primarily on the sandy beaches used for the landings and in the ordnance impact areas. The impact of the EFEXs on marine water quality would be similar in nature to, but lesser in degree, to those of a BL (see above).

Battalion Landing

The Navy would conduct two amphibious landings per year under Alternative 2. This would be a new activity; no Battalion Landings (BL) occur under the No Action Alternative. The BL would involve up to 70 amphibious vehicles, up to 104 ground vehicles, and up to 3,000 personnel. An event of this size and intensity would result in some surface soil disturbance regardless of the care with which it was undertaken. Effects would occur primarily on the sandy beaches used for the landings and in the ordnance impact areas.

The effects of this activity on erosion and sedimentation would depend in part on the weather. A substantial rain event during or shortly after a BL could accelerate erosion and transport substantial amounts of sediment into marine waters. Conversely, dry weather or light rains after a BL would allow areas of disturbed soil to recover.

USMC Stinger Firings

Under Alternative 2, four USMC Stinger Firing operations would occur each year, compared to no Stinger Firings under the No Action Alternative. Up to 4 vehicles and 5 platoons of personnel would participate in each event. The USMC Stinger firings are conducted from positions onshore in SHOBA. The current positions are on China Point and to the west toward Impact Area II near the shoreline. The stingers are fired toward the ocean. Stinger Missiles could miss Ballistic Aerial Targets (BATS) or Remotely Piloted Vehicles (RPVs), and continue flying out to sea. If this occurred, the missile would expend all its fuel, leaving only the missile casing and non-explosive warhead at impact. Effects of this operation on water quality resources would be similar to those described under Alternative 1.

Amphibious Landings and Raids

The annual number of amphibious landings and small boat raids would increase about seven-fold (from 7 under the No Action Alternative to 49 under Alternative 2). The number of amphibious vehicles involved would increase about five-fold, from 40 per year to 196 per year. The number of ground vehicles would increase about 10-fold, from 8 per year under the No Action Alternative to 80 per year. About 20,500 rounds of various types of ordnance would be expended per year. Areas affected would be primarily the sandy beaches used for amphibious landings, rocky shore areas used for small boat raids, and ordnance impact areas. Effects of these operations on marine water quality would be similar to those described under Alternative 1.

Expeditionary Fighting Vehicle (EFV) Company Assault training would be introduced to SCI under Alternative 2. The types of impacts associated with this operation are similar to those described under Alternative 1, but could be greater due to the greater number of yearly operations (2 rather than 1). Most of the activities would occur on land, however, where surface water resources are limited and direct effects on these resources would be unlikely.

Naval Special Warfare

Land Demolitions

The annual number of Land Demolitions would increase from 354 under the No Action Alternative to 674 under Alternative 2, a 90 percent increase. Any impacts on marine water quality would be indirect and would be similar to impacts under the No Action Alternative (see Section 3.4.3.2).

Small Arms

The annual number of Small Arms Training activities would increase from 171 under the No Action Alternative to 205 under Alternative 2, an increase of 20 percent. Any impacts on marine water quality would be indirect and would be similar to impacts under the No Action Alternative (see Section 3.4.3.2).

Land Navigation

The annual number of Land Navigation activities would increase from 99 under the No Action Alternative to 118 under Alternative 2, an increase of 19 percent. Any impacts on marine water quality would be indirect and would be similar to impacts under the No Action Alternative (see Section 3.4.3.2).

Unmanned Aerial Vehicle (UAV) Training

The annual number of these training activities would increase from 5 under the No Action Alternative to 27 under Alternative 2, a 440 percent increase. Although the number of classes and corresponding flights would greatly increase, the impacts would be similar to those described above under the No Action Alternative because this activity does not disturb surface soils or release any hazardous materials that could migrate into surface waters.

NSW Group ONE (NSWG-1) SEAL Platoon Operations

The annual number of NSWG-1 activities would increase from 340 under the No Action Alternative to 668 under Alternative 2, a 96 percent increase.

NSWG-1 SEAL Platoon Operations under Alternative 2 would use the offshore, nearshore, and onshore components of TARs 1, 2, 3, 4, 5, 10, 13, 17, 20, 21, and 22. The exercises typically involve ingress to SCI by a special boat, SDV or reinforced inflatable boat, travel on foot to the target or objective area, execution of the mission (intelligence, Combat Search and Rescue [CSAR], direct assault, or other), and egress from the target areas and SCI by boat.

The increase in activity under Alternative 2 would involve minimal disturbance on a portion of the sandy shoreline of SCI. These impacts would be similar to those described in EFEX. No impacts on water quality resources would be expected from operations on TARs 6, 9, 11, 12, 14, 15, 18, and 19 because the TARs would be located on designated land areas on SCI.

TARs 7 and 8 are exclusively located in open Territorial Waters and would be used for parachute drop zones under this operation. No training materials would be expended during drops, so water resources would not be affected by this activity.

Direct Action

The annual number of Direct Action operations would increase from 156 under the No Action Alternative to 190 under Alternative 2, a 22 percent increase, and the Navy would add the same three TARs in SHOBA as described in the discussion of Alternative 1. Small arms, explosives, and smoke/flare expenditures would increase by about the same percentage. Effects of Direct Actions on marine water quality would be similar to those described under the No Action Alternative.

Strike Warfare

The annual number of bombing exercises would increase from 176 under the No Action Alternative to 215 under Alternative 2, a 22 percent increase. As discussed under the No Action Alternative, however, effects on marine water quality would be negligible because operations would only occur within designated land impact areas of SHOBA.

The annual number of CSAR training operations would increase from 7 under the No Action Alternative to 8 under Alternative 2, a 14 percent increase. These operations involve very little ground disturbance and little or no expenditure of ordnance, so their effects on surface soils - and indirectly on marine water quality - are negligible.

Non-Combat Operations

Explosive Ordnance Disposal (EOD)

The annual number of EOD operations would increase from 4 under the No Action Alternative to 10 under Alternative 2, a 150 percent increase. Total personnel involved would remain at 10 per event. Total detonations would increase from 32 to 80, and the quantities of explosives consumed would increase from 640 to 1,600 pounds per year. The major detonation products would be non-hazardous substances (see Table 3.3.4) and operations would occur in designated areas of VC-3, where no water resources exist, so this activity would have no effect on water quality. Effects of these EOD operations on marine water quality would be similar to those described under the No Action Alternative.

Naval Auxiliary Landing Field (NALF) SCI Airfield Operations

Under Alternative 2, about 27,400 air operations would occur compared with about 25,120 under the No Action Alternative, a 9 percent increase. NALF activities would affect marine water quality indirectly via increased quantities of water pollutants contained in runoff from the airfield. Effects of NALF operations on marine water quality would be similar to those described under the No Action Alternative.

U.S. Coast Guard (USCG) Operations

USCG operations are described in Section 2.3.1.10. Expended materials from USCG operations are primarily small arms. Under Alternative 2, USCG operations use 21,000 7.62-mm and 12,000 0.50-caliber projectiles. These materials are not recovered, but are deposited on the ocean bottom.

Research, Development, Test, and Evaluation

Missile Flight Tests

The annual number of Missile Flight Tests would increase from 5 under the No Action Alternative to 20 under Alternative 2, a four-fold increase. The number of missiles expended would increase proportionately, while the number targets would increase by only 120 percent, from 5 to 11. Missile impacts were evaluated for training operations, and that evaluation concluded that there would be no substantial effect. The same conclusion is appropriate for this test activity.

3.4.4 Mitigation Measures

Current mitigation measures are identified in Section 3.4.2.1.7. No additional mitigation measures are needed because there were no substantial effects on water quality were identified.

3.4.5 Unavoidable Adverse Environmental Effects

No unavoidable environmental consequences to water quality in the SOCAL OPAREAs or on SCI were identified.

3.4.6 Summary of Effects by Alternative

Table 3.4-24 summarizes the water quality effects of the No Action Alternative, Alternative 1, and Alternative 2. For purposes of analyzing such effects under both NEPA and EO 12114, the Table allocates effects on a jurisdictional basis (*i.e.*, under NEPA for actions or effects within U.S. Territory, and under EO 12114 for actions or effects outside U.S. Territory).

Table 3.4-24: Summary of Water Quality Effects

Alternative	NEPA (On-Land and US. Territorial Waters)	EO 12114 (Non-U.S. Territorial Waters)
No Action Alternative	• Releases of munitions constituents from explosives, ordnance, and small arms rounds used during training exercises have no substantial impacts. • No long-term degradation of marine, surface, or ground water quality.	• Munitions constituents and other materials (batteries, fuel, and propellant) from training devices have minimal effect; are below standards; or result in local, short-term impacts. • No long-term degradation of marine water quality.
Alternative 1	• Munitions constituents (explosives, ordnance, small arms rounds) from training devices and training exercises would have little effect or result in short-term impacts. • No long-term degradation of marine, surface, or ground water quality.	• Munitions constituents and materials (batteries, fuel, and propellant) from training devices would have minimal effect; would be below standards; or would result in local, short-term impacts. • No long-term degradation of marine water quality.
Alternative 2 (Preferred Alternative)	• Impacts to Alternative 2 would be substantially the same as Alternative 1.	• Impacts to Alternative 2 would be substantially the same as Alternative 1.
Mitigation Measures	• Navy ships are required to conduct activities at sea in a manner that minimizes or eliminates any adverse impacts on the marine environment. • Environmental compliance polices and procedures applicable to shipboard operations afloat are defined in OPNAVINST 5090.1C. DoD Instruction 5000.2-R, Executive Order (EO) 12856, and EO 13101, and OPNAVINST 5090.1C also cover pollution prevention requirements. These instructions reinforce the CWA's prohibition against discharge of harmful quantities of hazardous substances into or upon U.S. waters out to 200 nm (371 km), and mandate stringent hazardous waste discharge, storage, dumping, and pollution prevention requirements.	• Navy ships are required to conduct activities at sea in a manner that minimizes or eliminates any adverse impacts on the marine environment. • Environmental compliance polices and procedures applicable to shipboard operations afloat are defined in OPNAVINST 5090.1C. DoD Instruction 5000.2-R, Executive Order (EO) 12856, and EO 13101, and OPNAVINST 5090.1C also cover pollution prevention requirements. These instructions reinforce the CWA's prohibition against discharge of harmful quantities of hazardous substances into or upon U.S. waters out to 200 nm (371 km), and mandate stringent hazardous waste discharge, storage, dumping, and pollution prevention requirements.

Alternative	NEPA (On-Land and US. Territorial Waters)	EO 12114 (Non-U.S. Territorial Waters)
	• With regard to reducing or avoiding water quality degradation from the expenditure of training materials, management practices include EOD sweeps to remove unexploded ordnance and ordnance remnants from land ranges. • Certain features of the training materials themselves are designed to reduce pollution, as required by Navy and DoD regulations.	

3.5 Acoustic Environment

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3.5 ACOUSTIC ENVIRONMENT (AIRBORNE)

3.5.1 Affected Environment

3.5.1.1 Existing Conditions

3.5.1.1.1 Sound Sources

Sound from Explosive Sources and Ordnance

Sound attributable to land explosions on SCI results from demolition practice, explosive ordnance disposal (EOD) activities, bombing practice, offshore bombardment, and onshore artillery. The types and quantities of ordnance expended, and thus the sound levels generated, depend on the training objectives and the range used. Table A-1 in the Appendix depicts sound levels for representative ordnance types used in military training on SCI. The majority of land explosion sounds occur in the Shore Bombardment Area (SHOBA), with smaller amounts on the land Demolition Range near Northwest Harbor. Table 3.5-1 identifies typical average 24-hour noise contour levels and the associated affected area in the vicinity of Northwest Harbor.

Table 3.5-1: Total Area within Ordnance Noise Contour near Northwest Harbor

Noise Level (dBA, L_{dn})	Affected Area (mi^2)
85	0.24
80	0.45
75	0.83
70	1.49
65	2.96

Note: mi^2 - square miles.

Typical sound sources in SHOBA include naval gun projectiles, artillery, inert and live aerial bombs, mortars, aircraft cannon, machine guns, other small arms, and land-based demolitions. There are two Impact Areas in SHOBA. Impact Area I lies to the east, and is available for most ordnance, except explosive bombs over 250 pounds (lb.) (114 kilograms [kg]). All 500- and 1,000-lb. bombs are restricted to Impact Area II, which is located nearest the shoreline in the southwestern section of SHOBA.

Aircraft Overflight

The majority of aircraft activities at SCI occur at the Naval Auxiliary Landing Field (NALF) airfield. The landing runway hosts a variety of aircraft activities, including simulated carrier landings, touch-and-go's, helicopter activities, cargo delivery, and personnel transport. Air activities conducted at NALF are generated almost exclusively by Navy and Marine Corps aircraft.

The Department of Defense (DoD) NOISEMAP program was used to generate noise level contours for existing NALF operations. Model input consisted of a digitized representation of the landing field, departure and arrival flight tracks, and air operational data. Using these data, both sideline and takeoff noise emissions levels are selected for each class of aircraft, applied to the flight track model, and summed over the total yearly number of operations.

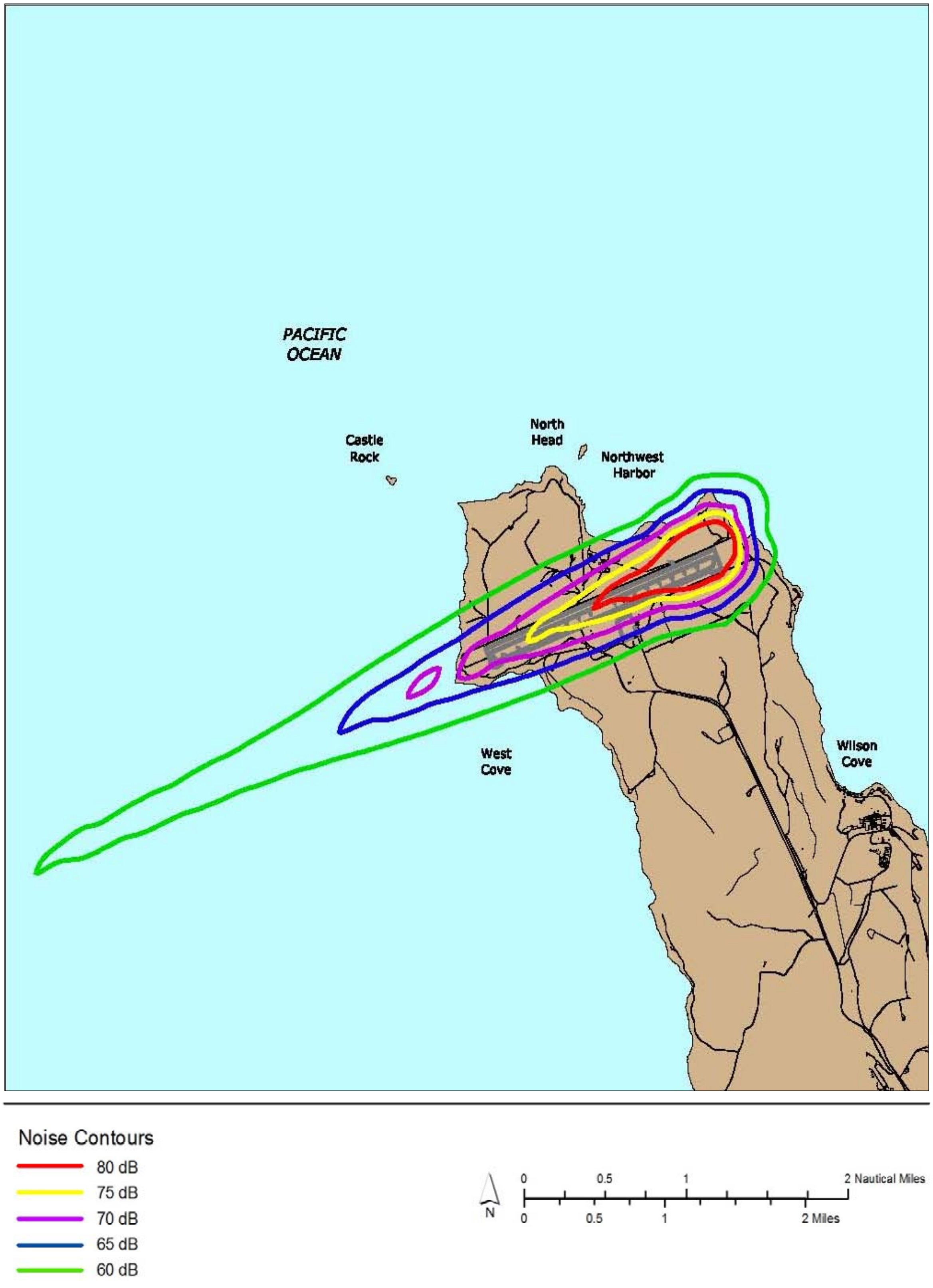

Figure 3.5-1: Noise Contours at NALF SCI

The lands surrounding the NALF that lie within the 65 through 85 dBA L_{dn} aircraft noise contours are shown in Table 3.5-2. The noise contours are shown in Figure 3.5-1. Based upon these values, most of the area affected by NALF aircraft operations lies offshore of SCI. The only land area substantially affected by NALF operations is the Naval Special Warfare (NSW) Sea, Air, and Land (SEAL) training area at Basic Underwater Demolitions/SEALS (BUD/S) Camp and Maritime Operations (MAROPS), which are located beneath the 75 dBA, L_{dn} noise contour.

Table 3.5-2: Total Area under Noise Contour at NALF SCI

Noise Contour Level (dBA, L_{dn})	Affected Area (mi^2)
85	10.8
80	19.9
75	37.3
70	70.8
65	136.6
Note: mi^2 - square mile	

Target Launches

Airborne targets are launched from the western end of NALF Runway 23. The BQM-74, the typical target, is launched from a rail by a solid rocket booster and sustained by a small conventional jet engine. Although no data are available on the BQM-74, sound measurements were collected from the launch of a BQM-34S at Naval Air Station (NAS) Point Mugu in 1997. The BQM-34 is almost twice as large as the BQM-74; Burgess and Greene (1998) found that for this launch, the JATO booster bottles on the BQM-34 generate an A-weighted SPL 145 dB at the source at launch. Sound levels decrease to 92 dB at 1,200 ft. (370 m) (DoN 2002).

SCI was surveyed in 1999 to quantify and catalog existing sound sources. The results of the 24-hour sound level monitoring are summarized in Table 3.5-3, with statistical noise descriptors (e.g., L_{max}, L_{min}) provided for each monitoring location.

Table 3.5-3: 24-Hour Average Ambient Sound Levels on San Clemente Island

Site	24-Hour Average Noise Level Descriptors (dBA)						
	Description	L_{eq}	L_{max}	L_{min}	L_{10}	L_{90}	L_{dn}
ML 1	NALF airfield operations area	59.6	77.4	36.0	56.6	38.4	63.5
ML 2	Old Airfield VC-3	45.5	62.6	38.1	46.0	39.3	50.0
ML 3	Near Mt. Thirst	48.0	66.3	33.7	49.9	37.7	52.8
ML 4	southwestern end of island – Near SHOBA	56.4	67.3	45.4	52.0	49.3	62.0
ML 5	Near Eel Point, TAR 17	61.5	73.4	55.0	63.6	57.9	66.2

Source: Investigative Science and Engineering (ISE) (1999).

3.5.1.1.2 Sensitive Receptors

Within the SOCAL Range Complex, the only structures are on SCI, and there are no public communities. All personnel on SCI are naval personnel, Navy contractors, or Navy-invited visitors. Military personnel are not considered to be sensitive receptors of airborne noise for purposes of environmental impact analysis. While persons on recreational or fishing vessels within the SOCAL Range Complex might be exposed to sound generated by military activities, the likelihood of such exposure is quite low, due to extensive SOPs employed by the Navy to ensure civilian persons do not interfere and are not inadvertently affected by military activities.

3.5.1.2 Current Mitigation Measures

For SCI, as elsewhere in the SOCAL Range Complex, advance notice of scheduled operations is made available to the public and the commercial fishing community via the worldwide web, NOTMARs and NOTAMs. These provide notice to commercial fishermen, recreational boaters, and other area users that military activities, including aircraft operations and ordnance use, will occur in the vicinity of SCI. SCI is off-limits to all persons except for military personnel and escorted official visitors.

3.5.2 Environmental Consequences

3.5.2.1 Approach to Analysis

The analysis presented in this section is limited to impacts of airborne sound on humans. Impacts of military-generated sound on natural resources, including underwater sound, are addressed in Sections 3.6 (Marine Plants and Invertebrates), 3.7 (Fish), 3.8 (Sea Turtles), and 3.9 (Marine Mammals). Impacts on terrestrial biological resources are addressed in Section 3.12.

Potential airborne sound-generating events associated with the Proposed Action were identified, and the potential airborne sound levels that could result from these activities were estimated on the basis of published data on military sound sources. These estimated sound levels were reviewed to determine whether they would (a) represent a substantial increase in the average ambient sound level, (b) have an adverse effect on a substantial population of sensitive receptors, or (c) be inconsistent with any relevant and applicable standards.

3.5.2.2 No Action Alternative

Military activities in the SOCAL OPAREAs and on SCI, especially live firing of weapons and aircraft operations, are sources of intrusive noise. SCI is off-limits to non-military personnel other than infrequent official visitors who are escorted to the island. Military personnel who might be exposed to noise from these activities are required to take precautions, such as the wearing of protective equipment, to reduce or eliminate potential harmful effects of such exposure (military personnel are not considered sensitive receptors for purposes of impact analysis). With regard to potential exposure of non-military personnel in ocean areas (such as fishermen in the vicinity of SCI) precautions are taken pursuant to SOPs to prevent such exposure (see Appendix D). Because sound-generating events are intermittent, occur in remote or off-limit areas, and do not expose a substantial number of human receptors to high noise levels, no sensitive receptors are likely to be exposed to sound from such military activities.

3.5.2.3 Alternative 1

Under Alternative 1, the number of noise-generating training activities would increase. This increase in operations would not result in general increases in levels of the ambient airborne sound. Due to the logarithmic nature of noise, increases in the number of flight operations at NALF SCI (about 6 percent) would not substantially alter existing noise contours. As noted, extensive precautions are taken to eliminate exposure of non-military personnel to unwanted sound from military activities. As with the No Action Alternative, sound-generating events under Alternative 1 are intermittent, occur in remote or off-limit areas, and do not expose a substantial number of human receptors to high noise levels. No sensitive receptors are likely to be exposed to sound from such military activities.

Alternative 1 would include force structure changes, including the introduction of the EA-18G, the P-8A, the MV-22, and the SH-60R/S aircraft.

The EA-18G is based on the F/A-18E/F aircraft, which is slightly louder (about 7 dB louder on approach and 3 dB louder on departure at a reference altitude of 1,000 feet) than the EA-6B aircraft now used extensively for training in the SOCAL Range Complex. However, noise studies prepared by the Navy for a transition to the EA-18G at Whidbey Island (DoN 2005) determined that noise contours would be reduced because of the better performance of the new aircraft at lower power settings and a steeper climb-out profile. Thus, the introduction of this aircraft in the SOCAL Range Complex would not substantially increase aviation noise.

The P-8A would replace the P-3C in 2009 or 2010. The P-3C accounts for about one percent of flight operations for training in the SOCAL Range Complex. Its use would be intermittent and minor, compared to other aircraft. The P-8A is marginally louder (1 - 2 dB) than the P-3C during straight-in approaches and departures, and it is substantially louder (7 - 8 dB) than the P-3C during touch-and-go operations (Wyle 2008). Because the differences between the two aircraft in overall noise profiles are minor and because these aircraft represent a small fraction of the aircraft operations in support of training in the SOCAL Range Complex, the introduction of the P-8A would have a negligible effect on the acoustical environment of the Range Complex.

The MV-22 is generally considered to be very noisy during its transition from vertical to horizontal flight, but quieter than the aircraft it's replacing (CH-46) during horizontal flight. Because the aircraft generally would make its transition from vertical to horizontal flight while over SCI, and generally be in horizontal flight while over areas accessible to the public, the introduction of this aircraft would result in a net reduction in noise levels from the CH-46.

The noise footprint of the SH-60R/S would be about the same as the aircraft it would replace, resulting in no change in anticipated noise contours.

On-island and surface activities associated with construction of the SWTR would not be substantial sources of airborne noise, and would not affect long-term ambient noise levels in these areas. Airborne noise associated with operation of the SWTR would be limited to occasional helicopter flights at low altitudes and speeds, and occasional vessel transits, which would not be substantial sources of noise in off-range areas.

3.5.2.4 Alternative 2

The types of effects on humans of sound generated by military activities under Alternative 2 would be identical to those under Alternative 1. As with the No Action Alternative and Alternative 1, sound-generating events under Alternative 2 are intermittent, occur in remote or off-limit areas, and do not expose a substantial number of human receptors to high noise levels. Due to the logarithmic nature of noise, increases in the number of flight operations at NALF SCI (about 14 percent) would not substantially alter existing noise contours. No sensitive receptors are likely to be exposed to sound from such military activities.

The noise effects of anticipated force structure changes and construction of the SWTR would be as described for Alternative 1.

3.5.3 Mitigation Measures

Current mitigation measures are described in Section 3.5.1.2. No airborne noise impacts due to the Proposed Action or the alternatives were identified. Therefore, no additional mitigation is required.

3.5.4 Unavoidable Adverse Environmental Effects

The Proposed Action would have no unavoidable adverse effects on the acoustic environment.

3.5.5 Summary of Effects by Alternative

Airborne noise generated by the Proposed Action under the No Action Alternative, Alternative 1, or Alternative 2 would have no substantial environmental effects because:

- Noise from training activities in the SOCAL Range Complex would be dispersed and intermittent, so it would not contribute to long-term noise levels;
- Training areas on SCI are remote and isolated from the general public, so no sensitive receptors (non-participants) would be exposed to these noise events;
- No new public areas would be exposed to noise from training and testing activities.
- Land-based ordnance detonations occur mostly in SHOBA, a designated restricted area, which has been used for live-fire activities since at least 1937; and
- The incremental increases in the numbers of range events would not considerably increase long-term average noise levels; hourly average equivalent noise levels are and would remain relatively low.

Table 3.5-4 summarizes noise effects and mitigation measures for the No Action, Alternative 1, and Alternative 2.

Table 3.5-4: Summary of Effects by Alternative

Alternative	NEPA (On-Land and U.S. Territorial Waters)	EO 12114 (Non-U.S. Territorial Waters)
No Action Alternative	• Sound-generating events are intermittent, occur in remote or off-limits areas, and do not expose a substantial number of human receptors to high noise levels. No sensitive receptors are likely to be exposed to sound for such military activities.	• Sound-generating events are intermittent, occur in remote areas, and do not expose a substantial number of human receptors to high noise levels. No sensitive receptors are likely to be exposed to sound for such military activities.
Alternative 1	• Increases in training activities generally are not of a magnitude that would result in a perceptible increase in the ambient noise level. Therefore, impacts would be the same as under the No Action Alternative.	• Increases in training activities generally are not of a magnitude that would result in a perceptible increase in the ambient noise level. Therefore, impacts would be the same as under the No Action Alternative.
Alternative 2 (Preferred Alternative)	• Increases in training activities generally are not of a magnitude that would result in a perceptible increase in the ambient noise level. Therefore, impacts would be the same as under the No Action Alternative.	• Increases in training activities generally are not of a magnitude that would result in a perceptible increase in the ambient noise level. Therefore, impacts would be the same as under the No Action Alternative.
Mitigation Measures	• Advance notice of scheduled operations is made available to the public	• Advance notice of scheduled operations is made available to the public

3.6 Marine Plants and Invertebrates

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3.6 MARINE PLANTS AND INVERTEBRATES

For the purposes of this Draft Environmental Impact Statement (EIS)/Overseas Environmental Impact Statement (OEIS) marine biological resources are defined as marine flora and fauna and the habitats they occupy within the SOCAL Range Complex, which encompasses the surface and subsurface ocean OPAREAs, over-ocean military airspace, and San Clemente Island. This section specifically addresses marine invertebrates and flora. The marine plants and invertebrates are addressed in Section 3.6; fish are addressed in Section 3.7, sea turtles in Section 3.8, marine mammals in Section 3.9, and seabirds in Section 3.10. Threatened and endangered species, as defined by the U.S. Fish and Wildlife Service (USFWS) and the National Marine Fisheries Service (NMFS), are also addressed in each of these sections. A Federally listed endangered species is defined as any species, including subspecies, which is "in danger of extinction throughout all or a significant portion of its range." A Federally listed threatened species is defined as any species "likely to become an endangered species within the foreseeable future throughout all or a significant portion of its range." "Proposed" endangered or threatened species are those species for which a proposed regulation has been published in the Federal Register, but a final rule has not yet been issued.

3.6.1 Affected Environment

3.6.1.1 SOCAL OPAREAs

3.6.1.1.1 Existing Conditions

<u>Offshore Environment</u>

Marine Flora

Most of the marine flora in the offshore environment of the complex is composed of phytoplankton. Phytoplankton are microscopic plants that have a patchy abundance throughout the euphotic zone. The distribution of plankton is dependent upon many factors, including light intensity, salinity, temperature, currents, nutrients, reproductive cycles, and predators (Smith 1977). Over 280 species of phytoplankton have been reported in the SOCAL OPAREAs and vicinity (Abbott and Hollenberg 1976). In the SCB, waters from both the north and the south mix and promote increased phytoplankton abundance and diversity (DoN 1999). The phytoplankton community (ranging in size from a few microns to hundreds of microns) is comprised of diatoms and dinoflagellates typically found in both colder northern waters and warmer southern waters (Walsh et al. 1977; Estrada and Blasco 1979; Hardy 1993). Phytoplankton carry out photosynthesis and form the basis of the aquatic food chain. They are a food source for larger zooplankton (microscopic animals) that in turn are preyed upon by invertebrates, fishes, and other large marine species such as baleen whales.

Zooplankton an*d *Cephalopods

The SCB is a transition zone between subarctic, central, and equatorial zooplankton species, and as a result biomass fluctuations are accompanied by changes in species composition (CDFG 2002, DoN 2005). In the northern region (located north of latitude 33°N), the zooplankton community is dominated by subarctic zooplankton species associated with the California current, while the southern region (south of latitude 33°N) contains a higher diversity of organisms dominated by more central Pacific and subtropical species (Bernal and McGowan 1981). As described in Section 3.4, oceanographic features and bottom topography south of Point Conception produce localized turbulence, mixing, and increased surface nutrients which in turn support aggregations of primary and secondary production such as krill (Euphausiids) (Fiedler et al. 1998). Off the California coast, zooplankton biomass tends to reach its maximum abundance in the summer months. Main prey species for marine mammals found within the SCB include

Euphausia pacifica and *Thysanoessa spinifera* both of which are relatively cold water species, produced locally along the southern California coast (Brinton 1976, Brinton 1981). Swarms of *E. pacifica* are most abundant off Channel Island shelf edges between 150-200 m during daylight, with vertical migration to the surface at night (Fiedler et al. 1998). *T. spinifera* is a more coastal species, highly favored by blue whales (*Balaenoptera musculus*), and found during daylight from 50-150 m particularly on shelf areas northwest of San Miguel Island, and north of Santa Rosa Island (Fiedler et al. 1998).

The California market squid (*Loligo opalescens*) is the major commercially important pelagic squid species within the SCB and a CPS species (CDFG 2005, Zieberg et al., 2006). During daylight, the pelagic market squid occurs at depth between 500-800 m (2,625 ft) (PFMC 1998) and moves to the surface to feed at night. While spawning can occur from May-October for one to three-year-old squid, there is some variability, and coastal and at sea spawning can occur at other times (Leet et al. 2001). Typically, market squid within the SCB has a bimodal maximum abundance with peaks between January to April and November to early December, and lowest abundance during summer and fall (CSU 1990, Ziedberg et al. 2006). Other potentially occurring SCB squid species include Humboldt or Jumbo Squid (*Dosidicus gigas*), Clubhook squid (*Moroteuthis robusta*), Boreal clubhook squid (*Onychoteuthis borealijaponica*) and Flowervase jewel squid (*Histioteuthis hoylei* (Young 1972, Roper et al. 1984, CSU 1990).

Benthic Marine Invertebrates

Soft bottom benthic marine invertebrates live in or on the bottom sediments. Many species known as infauna are sedentary and live buried in the sediments for their entire life. Mobile species typically move freely on the surface of the sediments (epifauna) but usually bury themselves in the sediment to feed or to conceal themselves. Populations of deep benthic assemblages are randomly dispersed due to physical conditions that are fairly homogeneous and natural disturbances (e.g., predation) that are either of very low intensity or occur randomly in space and time. In general, the abundance and distribution of deep benthic assemblages appear to be persistent and stable in the SCB (Dailey et al. 1993), although assemblages in the offshore environment are generally impoverished due to sediment type, the absence of hard-bottom reefs, and sediment transport caused by cross-shelf movement of material seaward from shallower to deeper regions (SAIC and MEC 1995).

In general, the marine invertebrate assemblages inhabiting deep-water regions (greater than 100 ft [30 m]) can be characterized by depth (Figure 3.6-1). Species composition and abundance change with increasing water depth and changes in the presence of rock substrate. Beyond the depth of kelp beds (>100 ft [30m]), approximately 3% of the seafloor is rocky outcrops, rubble, and talus inhabited by marine invertebrate assemblages. Species most common to each of the major deep benthic assemblages, as well as information on abundance and diversity, are briefly summarized below (as cited in Dailey et al. 1993).

Outer Mainland Shelf

Macrofauna on the outer mainland shelf (water depth of 100 to 495 ft [30 to 150 m]) have been studied extensively, and most muddy areas are inhabited by the red ophiuroid *Amphiodia urtica*, which is usually numerically dominant. In areas of high sand content, macrobenthic assemblages are different, as *A. urtica* is less abundant or absent, and other species occur instead, such as the pelecypod *Tellina modesta*, the gastropod *Caecum crebricinctum*, and the ophiuroid *Amphipholis hexacanthus*. Most macrobenthic populations on the mainland shelf are randomly dispersed on the seafloor, although numbers of species, individuals, and species diversity generally decreases with depth.

Figure 3.6-1. Benthic Assemblages in the Vicinity of San Clemente Island

Offshore Upper Slope, Shelves, Ridges, and Banks

The Channel Island shelves, Santa Rosa-Cortes Ridge, and Tanner and Cortes Banks provide a unique habitat and exhibit the most diverse macrobenthic assemblages of the deep-water regions in the complex. The high species diversity is attributed mainly to the persistent upwelling (which affects the productivity of the area) and the wide range of sediment types. Assemblages that inhabit these areas extend to about 1,640 ft (500 m) and are much more spatially heterogeneous than on the mainland shelf. Dominant assemblages include polychaete worms (*Chloeia pinnata*, *Lumbrineris* spp.), ophiuroids (*Amphipholis squamata*, *Amphiodia urtica*), pelecypods (*Parvilucina tenuisculpta*), ostracods (*Euphilomedes* spp.), and amphipods (*Photis californica*).

Offshore Lower Slope

Offshore lower slope regions, with water depths of 1,640 to 4,921 ft (500 to 1,500 m), are relatively low in species abundance and diversity. Slope assemblages consist mostly of randomly dispersed populations. Dominant assemblages include amphipods (*Byblis* spp.), polychaetes (*Lumbrineris* spp., *Tharyx* spp., Paraonidae, *Phyllochaetopterus limicolus*), and ophiuroids (*Amphipholis squamata*, *Ophiura leptoctenia*).

Basins

Deep sea basins exhibit the lowest macrofaunal species abundance and diversity of any other benthic habitat in the offshore region. This impoverishment could be due to anaerobic conditions and high sedimentation rates typical of these areas. Assemblages in most of the basins studied are composed of randomly dispersed populations occurring at depths between 2,057 and 3,077 ft (627 and 938 m) in nearshore basins and between 4,452 and 8,435 ft (1,357 and 2,571 m) in offshore basins. The benthic assemblages of different basins (e.g., Catalina Basin, San Nicolas Basin) have been found to differ slightly from one another, most likely due to differences in proximity to land and sources of sediment, sedimentation rate, and productivity of overlying water. Dominant assemblages include polychaete worms (*Lumbrineris* spp., *Tharyx* spp., *Phyllochaetopterus limicolus*, Paraonidae), ophiuroids (*Ophiura leptoctenia*), gastropods (*Mitrella permodesta*), and mollusks (Aplacophora).

Offshore Banks

The offshore banks include the Tanner and Cortes Banks, which are described in Section 3.4. At Tanner Bank, 156 taxa (41 macrophytes and 115 macroinvertebrates) were recorded at a depth of 85 ft (26 m) along the edge of a plateau. The biological community contained a mixture of shallow and deep elements. On exposed ridges the sea palm (*Eisenia arborea*) occurred in dense patches with an understory of smaller brown and red algae such as *Lithophyllum proboscideum*, *Rhodymenia pacifica*, *R. californica*, and *Dictyota flabellata*. Large heads of the purple hydrocoral (*Stylaster californicus* [=*Allopora californica*]) were present near cliff edges and on the exposed ridges in the middle of *Eisenia* patches. Other dominant invertebrates were the colonial strawberry anemone (*Corynactis californica*) and various sponges. At slightly greater depths, *Eisenia* and *Stylaster* did not occur, while encrustations of *Lithophyllum proboscideum* alternated with patches of *Codium hubbsii* and *Corynactis californica*, and suspension feeding invertebrates (sponges, hydroids, and bryozoans) were common. The red sea urchin (*Strongylocentrotus franciscanus*) and the blood star (*Henricia leviuscula*) were also common (BLM 1978).

At Cortes Bank, 163 taxa (52 macrophytes and 111 macroinvertebrates) were recorded at a depth of 66 ft (20 m) in an area of rock outcrops mixed with coarse sand. The sea palm (*Eisenia arborea*) was dense on the rock outcrops and low ridges, but the geniculate coralline alga *Calliarthron tuberculosum* attained high density where *Eisenia* was not dominant (BLM 1978).

The encrusting coralline alga *Lithophyllum proboscideum* was common on low-lying rocks. By percent cover, frequency, and number of individuals per unit area, suspension feeding invertebrates such as anemones, hydroids, bryozoans, and sponges were dominant. Larger motile invertebrates such as the red sea urchin (*Strongylocentrotus franciscanus*), seastars (*Asterina miniata*, *Pisaster giganteus*), and the smooth turban snail (*Norrisia norrisii*) were frequently observed (BLM 1978).

Nearshore Environment

The nearshore environment within SOCAL Range Complex encompasses all areas where water depths are less than 120 ft (36 m) up to the mean high tide mark, and includes a variety of different habitats such as coastal salt marsh, mudflats, beaches, rocky intertidal, seagrass, and kelp forest habitat. A brief description of each of these habitats is provided below.

Intertidal habitats of the SOCAL Range Complex are semi-diurnal (i.e., two high and two low tides each day, with variation in the height of successive high or low tides) and span the region between the highest high and the lowest low tide mark. The SOCAL Range Complex contains several intertidal habitats including coastal salt marshes, mudflats, coastal beach, and rocky shores. Intertidal environments serve as essential habitats for many fish (e.g., juvenile California halibut), birds (e.g., western snowy plover) and invertebrates (e.g., mussels, anemones, seastars, and crabs) (Thompson et al. 1993). The intertidal zone normally lacks flowering plant vegetation but can support significant algal cover.

Coastal Beach

In the SOCAL Range Complex and vicinity, exposed sandy beaches make up over 75% of the shoreline and approximately 23% of the Channel Islands coastlines (Dugan et al. 2000). Sandy beaches have a steep gradient, topographically, because they are exposed to significant wave action; therefore, the sediments are coarse in size, aerobic, experience rapid and differential drying, and are more strongly zoned than mudflats (Dugan et al. 2000). These habitats support extensive invertebrate communities that are an important food resource for shorebirds. A number of plants and animals have become adapted to this stressful habitat; the most common invertebrates found are the common sand crab (*Emerita analoga*), isopods (e.g., *Excirolana chiltoni*), talitrid amphipods (e.g., *Megalorchestia* spp.), polychaetes (e.g., *Euzonus mucronata*), the Pismo clam (*Tivela stultorum*), the bean clam (*Donax gouldii*), and the purple olive snail (*Olivella bipiicata*) (Dugan et al. 2000).

Rocky Intertidal

Less than one-quarter of the mainland shoreline in the SOCAL Range Complex is considered rocky intertidal habitat (MMS 2001); however, bedrock intertidal reefs comprise 14% of the San Diego County coastline and the remaining 86% consists of sand, gravel, or cobble beaches (Engle and Adams 2003). Most rocky intertidal shores in the county occur on the Point Loma and La Jolla peninsulas (Engle and Adams 2003). In 22 out of 61 monitored rocky intertidal habitats in the SOCAL Range Complex, over 224 species of macroflora and 315 species of macrofauna were recorded (Littler 1980). This emphasizes the importance and diversity of rocky shore environments along the southern California coast (Littler 1980). In a rocky intertidal study of San Diego County, a total of 35 key species were monitored for a six year period between 1997 and 2003. The objective of this study was to identify the dynamics of species abundance among seasons, years, and sites throughout central and southern California (Engle and Adams 2003).

The biological assemblages common to rocky intertidal habitats are defined by extreme physical factors including exposure to air and potential desiccation, strong wave and surf exposure, rocky substrate, competition for living space, and the need to find food and shelter while avoiding predators. Cracks, crevices, and overhangs create microhabitats for organisms to hide from predators, minimize wave shock, and avoid desiccation. These characteristics create a strong pattern of vertical zonation in which the distribution of an organism is determined by its physiological tolerance to desiccation and competitive and predatory interactions with other species (MMS 2001).

Splash zone

The splash zone is the uppermost intertidal band; it is only occasionally wetted by waves. Lichens, blue-green algae, green algae (e.g., *Enteromorpha* spp.), and brown encrusting algae (e.g., *Ralfsia* spp.) dominate the macroflora of this zone. The nearly terrestrial isopod, *Ligia occidentalis*, is abundant in the highest areas followed by littorines (*Littorina planaxis*) and limpets (*Lottia* spp.) that aggregate in cracks and depressions and by sparse populations of barnacles (*Chthamalus* spp.) (Thompson et al. 1993).

High intertidal zone

The high intertidal zone is located below the splash zone and is exposed to air regularly; therefore, the organisms common in this zone have adapted to temperature fluctuations and desiccation. This zone is also known as the barnacle zone because of their dense populations (*Chthamalus* spp. and *Balanus glandula*). In addition, this zone has a high abundance and diversity of macrophytes; however, macrophyte populations are kept in check by the resident grazers including periwinkle snails, limpets, chitons, turban shells, and crabs (*Pachygrapsus crassipes*) (Thompson et al. 1993).

Middle intertidal zone

The middle intertidal zone is covered with water at higher low tides; thus, the organisms in this zone are offered some protection from desiccation. California mussels (*Mytilus californianus*) dominate on exposed rocky substrates and bay mussels (*Mytilus edulis*) dominate in more protected areas but they share space with the gooseneck barnacle (*Pollicipes polymerus*). This zone generally has high algal cover and the cloning anemone (*Anthopleura elegantissima*) may blanket large areas of rock with interspersed populations of barnacles, snails, and black abalone (*Haliotis cracherodii*). *Octopus* spp. and sea stars (*Pisaster ochraceous*) are important predators in this zone.

Low intertidal zone

The low intertidal zone is located at the lowest low tide level and is almost always submerged. Organisms in this zone are very fragile when exposed to air but are the most diverse and abundant of all the zones. Algae (e.g., *Egregia menziesii*) are the most conspicuous element; however, surfgrass (*Phyllospadix* spp.) beds can dominate in some areas. Sand-tube worms (*Phragmatopoma californica*), sea hares (*Aplysia californica*), purple sea urchins (*Stongylocentrotus purpuratus*), nudibranchs, tunicates, sculpins, brittle stars, and sea cucumbers are some of the organisms that can be found associated with this zone (Thompson et al. 1993).

Subtidal Habitat

Subtidal habitats are located below the low tide mark and are permanently flooded by tidal water. In southern California, rocky, sandy, and muddy substrates occur in the coastal subtidal environment. The SOCAL Range Complex contains several subtidal habitats including seagrasses, unvegetated shallows, and rocky subtidal which includes the benthic macroflora (kelp beds) and macrofauna (invertebrate assemblages). In southern California, rocky, sandy, and muddy substrates occur in the coastal subtidal environment. However, the shallow subtidal rocky habitats in southern California are conspicuously dominated by large brown algae commonly referred to as kelps (Dayton 1985).

Seagrasses

Seagrasses are submerged aquatic vegetation that form extensive underwater meadows (or beds) and create important marine wetland habitats. They are a group of about 60 species and are found in shallow-water depths and various temperature and salinity ranges throughout many parts of the world (Phillips and Meñez 1988). Most seagrasses have flattened leaves that help them adjust to light restrictions and slow rates of gas diffusion in the water column (Thayer et al. 1984). Their extensive rhizome (root) system forms dense and tough belowground mats that function in anchorage and the absorption of nutrients. The leaves are capable of transporting oxygen to the rhizomes allowing seagrasses to grow in anoxic sediments (Thayer et al. 1984).

Seagrass ecosystems promote biodiversity by providing a variety of unique niches and have been found to parallel that of adjacent high diversity ecosystems (e.g., coral reefs, mangroves, salt marshes, and bivalve reefs) (Green and Short 2003). Seagrasses grow up to 0.4 inches (10 millimeters) per day; this high rate of growth sustains the feeding pathways of many herbivores and detrital-feeders.

Geographic distributions of seagrasses are based upon individual species tolerances to hydrological and atmospheric conditions (i.e., water temperature, salinity, irradiance, depth, substrate, and exposure) (Phillips and Meñez 1988). In southern California, eelgrass (*Zostera marina*) and surfgrass (*Phyllospadix* spp.) are the dominant native seagrasses (CalEPPC 1999). Eelgrass grows in shallow, subtidal, or intertidal unconsolidated sediments and surfgrass grows on wave-beaten rocky shores (den Hartog 1970). There is insufficient seagrass bed data for the SOCAL OPAREAs. A few locations of seagrass beds are known for eelgrass (*Zostera marina*) and surfgrass (*Phyllospadix* spp.); however, the areas where seagrasses may be expected to occur (i.e., in protected areas of suitable depth) within the SOCAL OPAREAs and vicinity are designated as potential seagrass range (Figure 3.6-2).

Eelgrass

Eelgrass (*Z. marina*) is the dominant seagrass species in terms of biomass on the Pacific coast of North America. It grows in brackish to marine waters and can tolerate a wide range of temperatures and depths (up to 10 m below mean low tide) (NOAA 2001). The depth of growth is primarily controlled by the clarity of water and transmission of light to the seagrass bed. Primary production by *Z. marina* beds can reach 84 to 480 gC/m^2/yr, making it one of the most productive habitats in the ocean (Zimmerman 2003). In San Diego Bay, eelgrass covers approximately 440 ha and provides important habitat for migrating waterfowl, resident forage fish, invertebrates, and wading birds (DoN 2004a). The Southern California Eelgrass Mitigation Policy of 1991 currently protects the eelgrass beds in southern California (Leet et al. 2001).

Surfgrass

Surfgrass (*Phyllospadix* spp.) is the dominant species in the rocky subtidal and intertidal zones of southern California where it has adapted to life in high wave exposure environments by clinging to rocky surfaces. Infaunal polycheates are known to live in the rhizome mats of surfgrass stands (populations) and the primary production rate can reach 8,000 gC/m^2/yr, making it the highest reported for seagrasses (Ramirez-Garcia et al. 2002). Of three species of surfgrass, two (*P. scouleri* and *P. torreyi*) are found in the SOCAL OPAREAs and vicinity.

Figure 3.6-2. Known seagrass distributions, potential seagrass range (based on depth), and the potential eelgrass range located in the SOCAL OPAREAs and vicinity

Phyllospadix scouleri inhabits the lower intertidal and shallow subtidal zones while *P. torreyi* grows at greater depths and is more abundant on the exposed parts of the coast. *Phyllospadix torreyi* provides important habitat for spiny lobsters (*Panulirus interruptus*) during their larval pelagic stage (Green and Short 2003) and for deep-sea benthic fauna where it has been found in the macrophyte detritus layers of submarine canyons in southern and central California (Ramirez-Garcia et al. 2002).

Asian eelgrass

Asian eelgrass (*Zostera asiatica*) has been a recent discovery in three subtidal regions along the southern and central California coasts. They are known to form underwater forests up to 10 ft (3 m) in height. Asian eelgrass is currently not listed as an invasive species (CalEPPC 1999). Little is known about its current status and additional work is necessary to unveil the habitat value of this species in this region (Green and Short 2003).

Unvegetated Shallows

Unvegetated subtidal habitats are an important microhabitat found in the southern California area; they can range from the more shallow areas of the subtidal to the intertidal zone. They harbor extensive algal mats, generally the dense red alga *Gracilaria verrucosa*, interspersed with areas of exposed sediment (Adams et al. 2004). The algal mats also include other red algae species including *Hypnea valentiae* and *Griffithsia pacifica* (DoN 2000). These mats drift just above the sediments or are loosely anchored to the sediments and can get up to 1.0 to 2.0 ft (0.3 to 0.6 m) thick during warmer months. These mats provide refuge from predators and forage areas for many species of motile invertebrates and fishes (Adams et al. 2004). In addition, they provide food for fish (e.g., California killifish), invertebrates (e.g., crabs, isopods, and mollusks), and some aquatic birds (Leet et al. 2001). An important commercial and recreational fish, the juvenile California halibut, is restricted primarily to these unvegetated shallow subtidal environments (Adams et al. 2004).

Live/Hardbottom

Rocky substrate can provide support to extensive communities of marine plants and animals that require attachment for survival. Subtidal rocky substrates provide habitat for a diverse ecosystem of fish and invertebrates including seaweeds, sponges, octopus, feather stars, and the commercially valuable spiny lobster and abalone (Chess and Hobson 1997). This habitat generally refers to kelp forest communities and the associated invertebrate assemblages.

Live bottoms, as defined by the BLM, are areas “containing biological assemblages consisting of such sessile invertebrates as sea fans, sea whips, hydroids, anemones, ascidians, sponges, bryozoans, and hard corals living upon and attached to naturally occurring hard or rocky formations with rough, broken, or smooth topography; and whose lithotope favors accumulation of turtles, pelagic and demersal fish.” In the SOCAL OPAREAs, the marine benthic invertebrate assemblages are extremely diverse and include representatives of nearly all phyla. There are limited live/hardbottom community data for the SOCAL OPAREAs. A few locations of deep-sea corals are known; however, live/hardbottom assemblages can be expected to occur on deep rocky substrate located within the OPAREAs (Figure 3.6-3).

Benthic Macrophytes

Southern California’s benthic macrophytes are represented by over 700 varieties of seaweeds, corallines, brown algae, green algae, and seagrasses (Leet et al. 2001). In the SOCAL OPAREAs, benthic macrophytes are designated to specific ecological groups based upon substrate type (Murray and Bray 1993). Benthic macrophytes are intensely zone specific and individual species dominate a specific substrate at a specific depth profile. The most common macrophytes found on sandy substrates at all depths are the turf algae; the most common turf algae include rhodophytes (e.g., *Tiffaniella snyderae*, *Polysiphonia pacifica*, *Hypnea valentiae*) and a common chlorophyte, *Chaetomorpha linum*. In the SOCAL OPAREAs, the chlorophyte *Enteromorpha* spp. is the most common species found in the intertidal zone; it is found in both muddy and salt panne habitats and is a tolerant species resistant to desiccation and hypersaline environments. Rocky substrate at shallow subtidal and intertidal depths harbors the most abundant and diverse species of all the zones. This zone contains rhodophytes (e.g., *Mazzaella* spp., *Endocladia muricata*), chlorophytes (e.g., *Ulva* spp. and *Cladophora* spp.), phaeophytes (e.g., *Dictyota flabellata* and *Colpomenia sinuosa*), and many epiphytic species (e.g., *Polysiphonia* spp., and *Ceramium eatonianum*). The most conspicuous benthic macrophyte is a phaeophyte commonly known as kelp. Kelp attaches to rocky substrates at subtidal depths and form the distinctive “kelp forests” familiar to southern California. They extend from seafloor to surface and form a vertically structured habitat that is the fundamental element to many important ecosystems in southern California (Rodriguez et al. 2001).

Kelp

Kelp attaches to rocky substrate and can grow up to 50 m in length in nearshore areas of 2 to 30 m depth. Several species of kelp occur throughout southern California; the most notable species is the giant kelp (*Macrocystis pyrifera*). Giant kelp forms large beds or forests that can extend up to one mile in width and several miles in length (Foster and Schiel 1985). The stems and blades of kelp can form overlying canopies on the water’s surface and provide unique habitat for plant and animal communities.

Several species of kelp may form canopies (e.g., *M. pyrifera*, *Pelagophycus porra*, *Egregia menziesii*, *Cystoseira osmundacea*), and south of Point Conception, *E. menziesii* is the dominant kelp in the inshore waters, *M. pyrifera* dominates the intermediate waters, and south of Point La Jolla, *P. porra* dominates the offshore waters. The kelp beds along the U.S. Pacific coast and Channel Islands are the most extensive and elaborate submarine forests in the world (Rodriguez et al. 2001), and provide refuge, forage, and nursery areas for nearly 800 animal and plant species in southern California including sea urchins, squid, abalone, spiny lobster, California halibut, Pacific mackerel, rockfish, and crab (Leet et al. 2001). In addition, kelp forests provide large quantities of drift kelp (detached kelp) to adjacent habitats; drift kelp provides an important resource to soft and rocky benthos, deep channel basins, sandy beaches, rocky shores, and coastal lagoons (Rodriguez 2003).

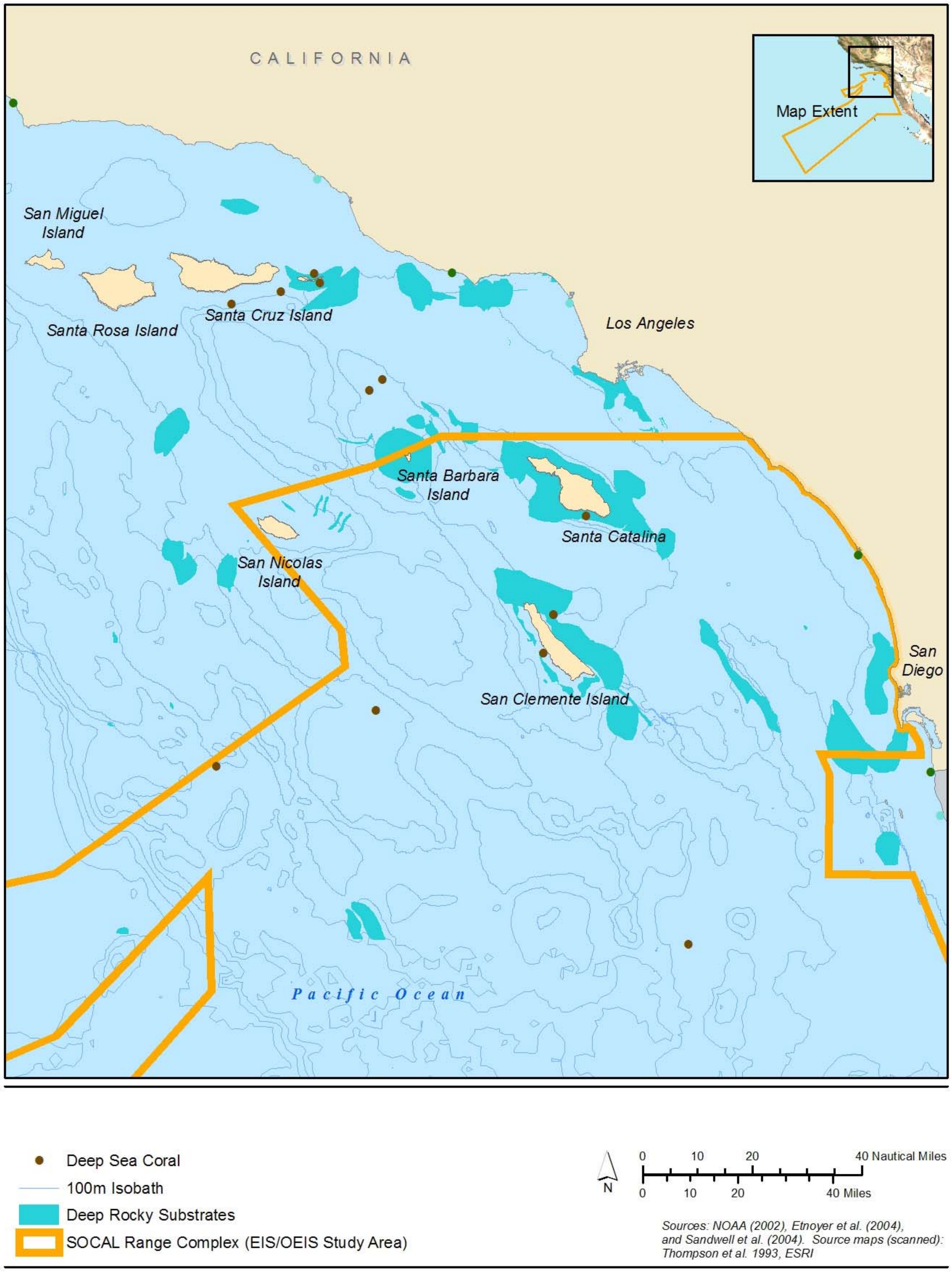

Figure 3.6-3. Live hardbottom community locations

Temperature, light, sedimentation, substrate, relief, wave exposure, and biological factors (i.e., grazing, competition with other species) determine the distribution and abundance of kelp. The most persistent beds occur on solid rock substrate with moderately low relief and moderate sand coverage; very low relief and abundant sand has less persistent kelp (Deysher et al. 2002). Wave exposure and interspecific competition affect both the temporal and spatial variability of giant kelp (Foster and Schiel 1985, Graham 1997). Kelp are sensitive to light irradiance; because of this, they are restricted from waters less than 2 m in depth even along protected shorelines of central California (Graham 1997).

The coastlines along the SOCAL Range Complex, and islands within the OPAREAs (San Clemente, Santa Barbara, Santa Catalina, and San Nicolas) have extensive stands of kelp forests (Figure 3.6-4). San Clemente Island has a steep bottom profile that restricts kelp forests to a narrow band adjacent to the shore (DoN 2002). Santa Catalina, San Nicolas,and Santa Barbara Islands have broader and shallower rocky extensions with wider kelp beds. The structure of kelp forests between and around the islands can also depend on their exposure to oceanic swells, with the more protected waters providing for larger and more stable forests. The kelp habitat around Santa Catalina Island is protected by several reserves and the California SWRCB has also designated stretches of the island's coastline as ASBS. The kelp habitat associated with San Clemente Island is subject to both recreational and commercial harvest and is managed by the CDFG. The kelp associated with Santa Barbara Island is federally protected under the Channel Islands National Marine Sanctuary Act (McArdle 1997). San Nicolas Island provides a large percentage (14 percent) of the total kelp canopy of the entire SCB (Dailey et al. 1993), and about 30 percent of the giant kelp found in the Channel Islands (Engle 1994).

Significant declines of southern California kelp beds have occurred over the last half-decade, likely due to both natural and human-induced causes. In the 1950s and 1960s, the kelp forests off Point Loma and La Jolla (Figure 3.6-4) began to deteriorate (Foster and Schiel 1985). Since 1957, southern California kelp beds have undergone a two-thirds reduction in standing biomass (Steneck et al. 2002). El Niño events and increasing Sea Surface Temperatures (SST) have been linked with this decline (Dayton et al. 1992, Tegner et al. 1996). Surveys conducted in 1967, 1989, and 1999 showed that kelp canopy in the SOCAL OPAREAs declined from 34,495 to 11,198 to 7,297 acres (13,960 to 4,532 to 2,953 ha), respectively (Leet et al. 2001). In the SOCAL OPAREAs, kelp habitats of concern includes San Onofre, south Carlsbad, and Point Loma along the mainland coast and Santa Catalina and San Clemente Islands (Leet et al. 2001).

Algal Assemblages Associated with Kelp Forests

There are abundant algal assemblages associated with the understory of kelp forests. The stipitate kelps form some important subsurface canopies; in southern California these are *Pterygophora californica* (stalked kelp), *Eisenia arborea* (southern sea palm), and several species of *Laminaria* (broadleaf kelp). These understory kelps are more characteristic of exposed areas (Edwards and Foster 1996). *E. arborea* is a particularly important species found in low intertidal to subtidal (10 m) depths from Vancouver Island, British Columbia to Bahia Magdalena, Mexico (Abbott and Hollenberg 1976). It forms extensive subsurface canopies, 3.3 to 6.6 ft (1 to 2 m) above the bottom and can become the dominant alga in the absence of *M. pyrifera* (Edwards and Hernández-Carmona 2005). It has been suggested that *E. arborea* stores sufficient nitrogen in its tissues to survive extended periods of nutrient limitation such as those conditions experienced during El Niños (Hernández-Carmona et al. 2001). As a consequence, *E. arborea* exhibits greater survival and recruitment during and following an El Niño and it is possible for it to gain a competitive advantage over and temporarily exclude *M. pyrifera* (Edwards and Hernández-Carmona 2005).

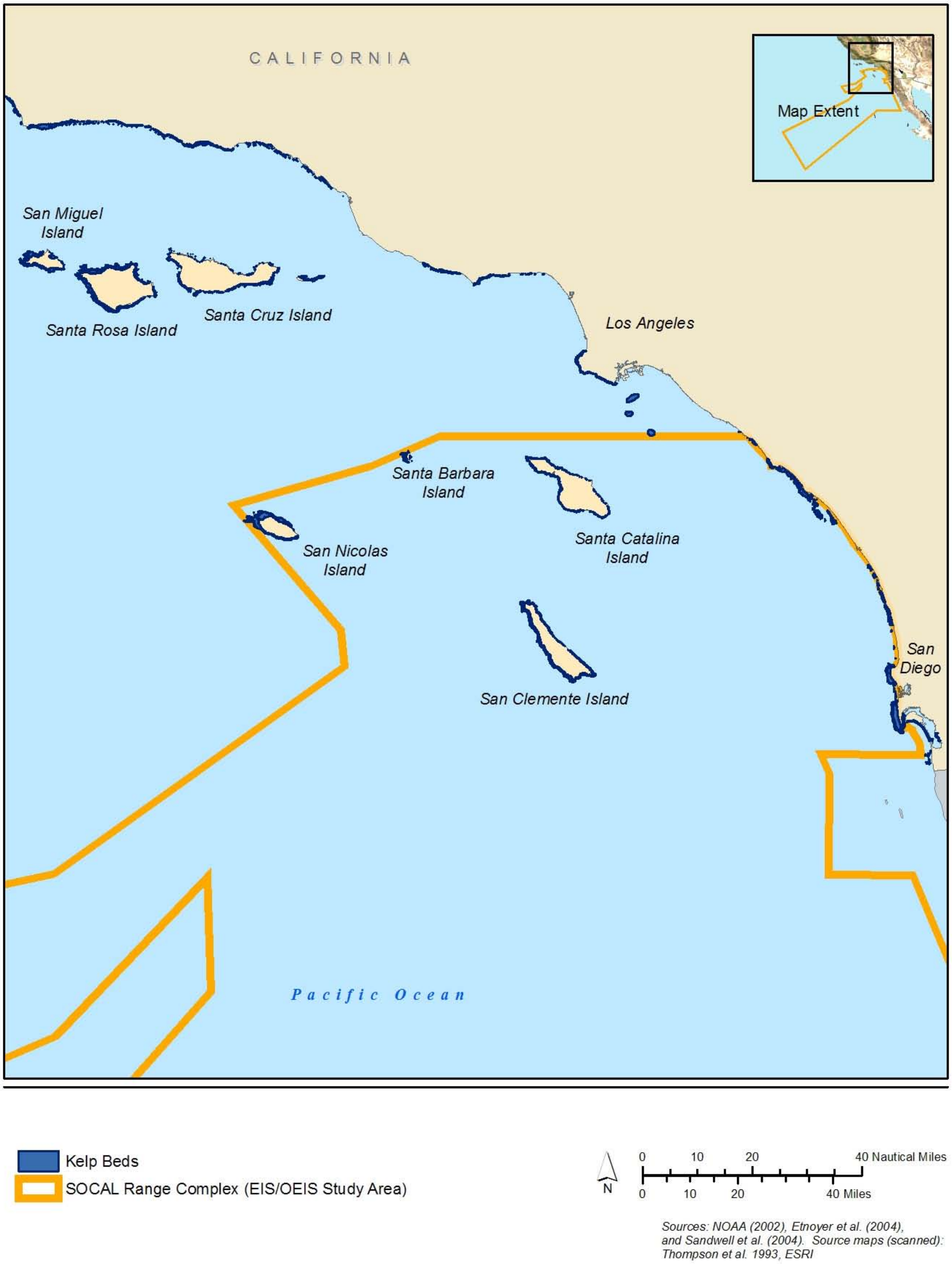

Figure 3.6-4. Kelp beds located in the SOCAL OPAREAs and vicinity

Benthic Macrofauna

The benthic macrofauna associated with rocky subtidal habitats in southern California are located synonymously with kelp and other benthic macrophytes. This habitat is characterized by continuous bottom surge produced by passing swells. Strong vertical zonation is present and rivals that of rocky intertidal habitats (Rodriguez 2001). Over 260 species of sponges, hydroids, sea fans, mollusks, echinoderms, and ascidians have been identified in the nearshore subtidal rocky substrates of southern California (Chess and Hobson 1997). In general, the biomass and abundance of epifauna decreased from the top of a rocky outcropping to the base. Rock oysters (*Chama pellucida*), mussels (*Mytilus edulis* and *M. californianus*), and green and pink abalone (*Haliotis fulgens* and *H. corrugata*) dominated the tops. Deeper, the substrate is covered by patches of calcareous bryozoans, gorgonians, stony corals, purple sea urchins (*Strongylocentratus purpuratus*), rock scallops, and red and white abalone (*H. rufescens* and *H. sorensoni*). The white abalone is classified as a federal endangered species; it usually occurs at depths from 66 to 197 ft (20 to 60 m) although some have been found in water as shallow as 16 ft (5 m) (Hobday et al. 2001). Near the bottom, there are relatively few species found and populations are sparse. The most conspicuous organisms are stony corals, gorgonians, sponges, barnacles, and red urchins (*S. franciscanus*) (Chess and Hobson 1997). According to Thompson et al. (1993), at Santa Catalina Island, red, purple, and diadematid urchins (*Centrostephanus coronatus*) are common but abundance varies with depth. Purple urchins are most common in depths less than 5 m, red urchins dominate at intermediate depths, and diadematid urchins are the most numerous species below 10 m.

Corals

Within the SOCAL OPAREAs and vicinity, corals are located in shallow-water areas on hardbottom habitats of the inner continental shelf as well as in deeper waters along the continental shelf edge, island shelves and slopes, the continental slope, submerged banks, submarine canyons, and seamounts (Bythell 1986; Lissner 1988; Thompson et al. 1993; Chess and Hobson 1997; Etnoyer and Morgan 2003, 2005; Roberts and Hirshfield 2004; Figure 3.6-3). Corals of the SOCAL OPAREAs include anthozoans and hydrozoans (or hydrocorals); anthozoans include hexacorals and octocorals. Hexacorals are represented by scleractinians (stony corals), antipatharians (black corals), and corallimorpharians (coral-like organisms lacking a calcium carbonate skeleton); octocorals include soft corals and gorgonians (e.g., sea fans). The following discussion will emphasize stony corals and deep-sea corals of the SOCAL OPAREAs (deep-sea corals occur in water depths exceeding 656 ft (200 m) (Etnoyer and Morgan 2005). Most of the habitat-forming deep-sea corals are anthozoans and hydrozoans (Etnoyer and Morgan 2003, 2005).

Executive Order (E.O.) 13089 on Coral Reef Protection (63 FR 32701) was issued in 1998 “to preserve and protect the biodiversity, health, heritage, and social and economic value of U.S. coral reef ecosystems and the marine environment.” It is DOD policy to protect the U.S. and International coral reefs and to avoid impacting coral reefs to the maximum extent possible. No concise definition of coral reefs has been promulgated, with regard to regulatory compliance of E.O. 13089. In general, coral reefs shall consist of tropical reef building Scleractinian and Hydrozoan corals, as well as calcified Octocorals in the families Tubiporidae and Helioporidae, non-calcified Octocorals (soft corals) and Gorgonian corals, all growing in the 0 to 300 foot depth range. Deep water (300 to 3,000 foot depth range) precious corals and other deep water coral communities will only be considered in the case of a SINKEX, where the vessel might ultimately land on a deep water coral community.

Stony Corals

Stony corals of the SOCAL OPAREAs and vicinity are typically ahermatypic (non-reef building species) and azooxanthellate (the animal tissue of the corals does not host algal symbionts also known as zooxanthellae) (Bythell 1986; Cairns 1994). Reef building stony corals are characteristic of tropical western margins of the Pacific, Atlantic and Indian Oceans (Veron 2000); true coral reefs closest to the SOCAL OPAREAs are located approximately 100 km north of Isla Cedros, Mexico (28°22'N; 115°15'W) on the Pacific side of the Baja California peninsula and at the northern and southern ends of the Gulf of California (Spalding et al. 2001). While there are no true coral reefs in the SOCAL OPAREAs, stony corals that can host zooxanthellae occur in shallow water regions of the SOCAL OPAREAs (e.g., *Dendrophyllia* spp.; Etnoyer and Morgan 2005). The majority of stony corals of the SOCAL OPAREAs are, however, azooxanthellate and obtain energy from detritus, zooplankton, and nekton they capture from the surrounding water (Cairns 1994; Roberts and Hirshfield 2004). Since azooxanthellate corals do not depend on sunlight and a symbiotic existence with zooxanthellae, they can be found in water depths exceeding 19,685 ft (6,000 m) (Lissner 1988; Cairns 1994; Roberts and Hirshfield 2004; Etnoyer and Morgan 2005). Despite the fact that corals of the SOCAL OPAREAs are classified as non-reef building, recent surveys of deep-water areas of the Atlantic and Pacific Oceans revealed that deep-ocean corals can form large reefs (Roberts and Hirshfield 2004).

A common stony coral in the shallow subtidal and sublittoral zones of the SOCAL OPAREAs and vicinity is the orange cup coral (*Balanophyllia elegans*) (McConnaughey and McConnaughey 1985; Bythell 1986; Kushner et al. 1999). Although most stony coral species of the SOCAL OPAREAs are found in water depths greater than 148 ft (45 m) (Bythell 1986; Table 2-2), orange cup corals are found from the intertidal zone to depths of 1,640 ft (500 m) (McConnaughey and McConnaughey 1985; Hellberg and Taylor 2002). Common stony corals of the shallow rocky insular shelf of Santa Catalina Island and Channel Islands are *Paracyanthus stearnsii*, *Balanophyllia elegans*, and *Astrangia lajollensis* (Chess and Hobson 1997; Kushner et al. 1999).

Many of the stony corals found in the SOCAL OPAREAs form solitary polyps the skeleton of which is approximately 0.4 to 0.8 inches (1 to 2 cm) in height and diameter (Bythell 1986). Individual branching colonies of stony corals found in the SOCAL OPAREAs are relatively small and consist of tens of polyps. Yet, clusters of these coral colonies can produce extensive live cover on hard substrates (e.g., the Channel Islands) (Bythell 1986). Further, *Lophelia pertusa* which occurs in the SOCAL OPAREAs can build enormous yet delicate reef structures supporting diverse communities of organisms including benthic organisms and fish (Rogers 1999). Deep-water *Lophelia* reefs found in the Atlantic Ocean range from 50 m to 4 km across and 115 to 541 ft (35 to 165 m) in height. The growth rate of *L. pertusa* is slow and ranges from 0.2 to 1.0 inches/yr (4 to 25 mm/yr). Hence, large reefs made of *Lophelia* can be several thousand years old (Rogers 1999). Recent observations of fish aggregation on such deep-water reefs suggest that *Lophelia* reefs may function as breeding and feeding areas (Roberts and Hirshfield 2004).

Octocorals

Soft corals that are common in shallow waters (16 to 59 ft [5 to 18 m] water depth) along the mainland SCB, off Santa Catalina Island and the Channel Islands are *Muricea californica*, *M. fruticosa*, and *Lophogorgia chiliensis* (red gorgonian) (Chess and Hobson 1997; Kushner et al. 1999).

Hydrocorals

A common hydrocoral of the SCB and SOCAL OPAREAs on rocky reefs and banks is *Stylaster californicus* (California hydrocoral, formerly *Allopora californica*), which is generally found in water depths ranging from 49 to 295 ft (15 to 90 m) (Richards et al. 1990, Grossman and GEC 1998, Cairns 1999). The California hydrocoral is characterized by extensive and delicate branches. The deepest record of *S. californicus* is 2,700 t (823 m) (Etnoyer and Morgan 2005).

Invertebrate Hearing Overview

Very little is known about sound detection and use of sound by invertebrates (see Budelmann 1992a, b, Popper et al. 2001 for reviews). The limited data shows that some crabs are able to detect sound, and there has been the suggestion that some other groups of invertebrates are also able to detect sounds. In addition, cephalopods (octopus and squid) and decapods (lobster, shrimp, and crab) are thought to sense low-frequency sound (Budelmann 1992b). Packard et al. (1990) reported sensitivity to sound vibrations between 1-100 Hz for three species of cephalopods. Wilson et al. (2007) documents a lack of physical or behavioral response for squid exposed to experiments using high intensity sounds designed to mimic killer whale echolocation signals. In contrast, McCauley et al. (2000) reported that caged squid would show behavioral responses when exposed to sounds from a seismic airgun.

There has also been the suggestion that invertebrates do not detect pressure since few, if any, have air cavities that would function like the fish swim bladder in responding to pressure. It is important to note that some invertebrates, and particularly cephalopods, have specialized end organs, called statocysts, for determination of body and head motions that are similar in many ways to the otolithic end organs of fish. The similarity includes these invertebrates having sensory cells which have some morphological and physiological similarities to the vertebrate sensory hair cell, and the "hairs" from the invertebrate sensory cells are in contact with a structure that may bear some resemblance to vertebrate otolithic material (reviewed in Budelmann 1992a, b). As a consequence of having statocysts, it is possible that these species could be sensitive to particle displacement (Popper et al. 2001).

It is also important to note that invertebrates may have other organs that potentially detect the particle motion of sound, the best known of which are special water motion receptors known as chordotonal organs (e.g., Budelmann 1992a). These organs facilitate the detection of potential predators and prey and provide environmental information such as the movement of tides and currents. Indeed, fiddler crab (*Uca* sp.) and spiny lobster (*Panulirus* sp.) have both been shown to use chordotonal organs to respond to nearby predators and prey.

Like fish, some invertebrate species produce sound, with the possibility that it is used for communication. Sound is used in territorial behavior, to deter predators, to find a mate, and to pursue courtship (Popper et al. 2001). Well known sound producers include lobsters (*Panulirus* sp.) (Latha et al. 2005) and snapping shrimp (*Alpheus heterochaelis*) (Heberholz and Schmitz 2001). Of all marine invertebrates, perhaps the one best known to produce sound are the snapping shrimp (Heberholz and Schmitz 2001). Snapping shrimp are found in oceans all over the world and make up a significant portion of the ambient noise budget in many locales (Au and Banks 1998).

Effects of Sound on Invertebrates

McCauley et al. (2000) found evidence that squid exposed to seismic airguns show a behavioral response including inking. However, these were caged animals, and it is not clear how unconfined animals may have responded to the same signal and at the same distances used. In another study, Wilson et al. (2007) played back echolocation clicks of killer whales to two groups of squid (*Loligo pealeii*) in a tank. The investigators observed no apparent behavioral effects or any acoustic debilitation from playback of signals up to 199 to 226 dB re 1 µPa. It should be noted, however, that the lack of behavioral response by the squid may have been because the animals were in a tank rather than being in the wild.

In another report on squid, Guerra et al. (2004) claimed that dead giant squid turned up around the time of seismic airgun operations off of Spain. The authors suggested, based on analysis of carcasses, that the damage to the squid was unusual when compared to other dead squid found at other times. However, the report presents conclusions based on a correlation to the time of finding of the carcasses and seismic testing, but the evidence in support of an effect of airgun activity was totally circumstantial. Moreover, the data presented showing damage to tissue is highly questionable since there was no way to differentiate between damage due to some external cause (e.g., the seismic airgun) and normal tissue degradation that takes place after death, or due to poor fixation and preparation of tissue. To date, this work has not been published in peer-reviewed literature, and detailed images of the reportedly damaged tissue are also not available.

There has been a recent and unpublished study in Canada that examined the effects of seismic airguns on snow crabs (DFO 2004). However, the results of the study were not at all definitive, and it is not clear whether there was an effect on physiology and reproduction of the animals.

There is also some evidence that an increased background noise (for up to three months) may affect at least some invertebrate species. Lagardère (1982) demonstrated that sand shrimp (*Crangon crangon*) exposed in a sound proof room to noise that was about 30 dB above ambient for three months demonstrated decreases in both growth rate and reproductive rate. In addition, Lagardère and Régnault (1980) showed changes in the physiology of the same species with increased noise, and that these changes continued for up to a month following the termination of the signal.

Finally, there was a recently published statistical analysis that attempted to correlate catch rate of rock lobster in Australia over a period of many years with seismic airgun activity (Parry and Gason 2006). The results, while not examining any aspects of rock lobster behavior or doing any experimental study, suggested that there was no effect on catch rate from seismic activity.

3.6.1.2 San Clemente Island

3.6.1.2.1 Existing Conditions

Nearshore Environment

SCI is the southernmost of the Channel Islands and is located in the pathway of the warm, northerly flowing California Countercurrent. The island is oblong and oriented from northwest to southeast. The leeward (mainland) side of the island is relatively free from substantial wave and swell disturbance. However, periodic storms produce waves of sufficient magnitude to reposition many of the free rocks and therefore disturb the substrate configuration. Nearshore local currents are wind and tidal driven. Dye studies conducted from the Wilson Cove wastewater outfall indicate that the predominant water movement is generally southerly (CRM 1998).

The nearshore marine environment can be divided into intertidal and subtidal habitats, which can be further separated by substrate type (e.g., rocky or sandy). Each substrate type supports distinct biological assemblages and is subject to varying physical factors. Because rocky habitats are ideal for attachment of marine flora and sessile (non-motile) invertebrates and are generally more stable, they support more species than sandy habitats. Biogeographically, the macrophytes and macroinvertebrates at SCI display a high percentage of southern species as a result of the warm, northward-flowing California Countercurrent (Murray et al. 1980, Murray and Littler 1981).

Rocky Intertidal Zone

Much of the intertidal area at SCI is a rocky shore environment consisting of bedrock and boulders. Therefore, the substrate is relatively stable and provides organisms with areas for attachment and for refuge. Intertidal surveys conducted on rocky substrata near the Wilson Cove outfall recorded a total of 129 taxa, of which 65 were macrophytes and 64 were macroinvertebrates (CRM 1998). Table 3.6-1 lists the intertidal and subtidal species observed in the vicinity of Wilson Cove. Blue-green algae provided the greatest macrophyte percent cover (26.8 percent), followed by feather boa kelp (*Egregia menziesii*) (13.4 percent) and the red algae *Corallina officinalis* var. *chiliensis* (8.0 percent), *Gigartina canaliculata* (7.5 percent), and *Pterocladia capillacea* (7.3 percent). The barnacles *Chthamalus fissus*/*dalli* (3.6 percent) and *Tetraclita squamosa rubescens* (1.2 percent) accounted for nearly three-fourths of the total macroinvertebrate cover based on annual percentages. The site exhibited little seasonality, but there was a slight tendency for higher macrophyte cover in December and June, with a small reduction of invertebrate cover in June. Compared with mainland sites, the absence of large mobile invertebrates on the leeward side of SCI was noted.

Sandy Beaches

Organisms occupying sandy beaches are subject to a similar array of physical factors as described above, but the relative importance of these factors in structuring the community and their effect on the substrate differ. Perhaps the most important physical factor governing life on exposed sand beaches is wave action and its effect on sand particle size. The importance of sand particle size to organism distribution and abundance is its effect on water retention and an organism's ability to burrow. Fine sand tends to hold water above the tide level due to capillary action, while coarse sand and gravel allow water to drain away quickly as the tide retreats. Wave-induced substrate movement is another important factor in sandy beach areas. As waves pass over the particles they are picked up, churned in the water, and redeposited. Therefore, particles are continually moved and sorted creating a very dynamic, unstable environment.

Several sandy beaches are present on SCI. On the north end of the island, sandy beaches are present at Northwest Harbor, Graduation Beach, and West Cove. Three other sandy beaches are present at the southern end of the island at China Cove, Horse Beach Cove, and Pyramid Cove. The sandy beaches are relatively small (approximately 330 to 990 ft [100 to 300 m] long), except for the beaches at China and Pyramid coves, which range from approximately 1,650 to 3,300 ft (500 to 1,000 m) in length.

No studies have documented the fauna or flora on the sandy beaches at SCI; however, it is presumed that the common organisms present on sandy beaches in Southern California would also occur at SCI. Species typical of Southern California sandy beaches include invertebrates such as polychaete worms (*Nephtys californiensis*), sand crabs (*Emerita analoga*), and clams (*Donax gouldii*) (DoN 1995). Macroscopic plants or sessile invertebrates do not occur on sandy beaches because no stable substrate is present for them to attach and maintain themselves.

Microscopic flora such as benthic diatoms, dinoflagellates, and blue-green algae may be present on the sand grains (Nybakken 1988). In addition, it is not known if any of these beaches are utilized by grunion (*Leuresthes tenuis*) for spawning habitat. Grunion are known to spawn on sandy beaches on other Channel Islands (Engle and Miller 2005).

Table 3.6-1: List of Intertidal and Subtidal Organisms, San Clemente Island Marine Resources Inventory

	Scientific Name	Common Name
Plants	**Cyanophyta**	
	Blue Green Algae	blue green algae
	Chlorophyta	
	Chaetomorpha spiralis	green algae
	Cladophora graminea	green algae
	Codium fragile	green algae
	Codium setchellii	green algae
	Ulva californica	green algae
	Phaeophyta	
	Brown Turf Algae	
	Filamentous brown algae	brown algae
	Colpomenia sinuosa	brown algae
	Dictyopteris undulata	brown algae
	Dictyota flabellata	brown algae
	Dictyota binghamiae	brown algae
	Ectopcarpus sp.	brown algae
	Hydroclathus clathratus	brown algae
	Leathesia difformis	brown algae
	Pachydictyon coriaceum	brown algae
	Pelvetia fastigata	brown algae
	Pseudolithoderma nigra	brown algae
	Pterospongium rugosum	brown algae
	Ralfsia sp.	brown algae
	Scytosiphon dotyi	brown algae
	Scytosiphon lomentaria	brown algae
	Zonaria farlowii	brown algae
	Leafy Brown Algae	
	Endarachne binghamiae	brown algae
	Larger Seaweeds	
	Cystoseira sp.	brown algae
	Egregia menziesii	feather boa kelp
	Eisenia arborea	sea palm
	Halidrys sp.	brown algae
	Macrocystis pyrifera	giant kelp
	Sargassum agardhianum	brown algae
	Sargassum palmeri	brown algae
	Rhodophyta	
	Coralline Turf	
	Amphiroa beavoisii	red algae
	Corallina offcianalis var. *chiliensis*	red algae
	Haliptilon gracile	red algae

	Scientific Name	Common Name
	Jania sp.	red algae
	Crustose Corallines	
	Lithothamnion sp.	red algae
	Lithophyllum sp.	red algae
	Red Turf Algae	
	Acrosorium venulosum	red algae
	Asparagopsis taxiformis	red algae
	Gelidium nudifrons	red algae
	Gigartina canaliculata	red algae
	Gymnogongrus leptophyllus	red algae
	Hypnea valentiae var. *valentiae*	red algae
	Laurencia pacifica	red algae
	Liagora californica	red algae
	Microcladia coulteri	red algae
	Odonthalia sp.	red algae
	Plocamium cartilageneum	red algae
	Pterocladia capillacea	red algae
	Prionitis linearis	red algae
	Rhodoglossum affine	red algae
	Rhodymenia californica	red algae
	Spermatophyta	
	Phyllospadix torreyi	surfgrass
Animals	**Cnidaria**	
	Aglaophenia struthionoides	hydroid
	Anthopleura elegantissima	aggregate anemone
	Balanophyliia elegans	hydroid
	Hydroids, unid.	
	Lophogorgia chiliensis	red gorgonian
	Muricea californica	California golden gorgonian
	Paracyathus stearnsi	brown cup coral
	Annelida	
	Chaetopterus variopedatus	parchment tube worm
	Diopoatra ornata	ornate tube worm
	Pista sp.	terrebellid tube worm
	Serpulidae, unid.	polychaete worm
	Spiochaetopterus costarum	spionid worm
	Spirobidae, unid.	polychaete worm
	Arthropoda	
	Balanus glandula	barnacle
	Balanus pacificus	barnacle
	Chthamalus fissus	barnacle
	Chthamalus dalli	barnacle
	Ligia occidentalis	rock louse

	Scientific Name	Common Name
	Pachygrapsus crassipes	lined shore crab
	Panulirus interruptus	California lobster
	Tetraclita squamosa rubescens	thatched barnacle
	Mollusca - Gastropoda	
	Lottia (=*Collisella*) limatula	file limpet
	Lottia (=*Collisella*) *scabra*	rough limpet
	Lottia (=*Collisella*) spp. (juv.)	juvenile limpet
	Lottia (=*Collisella*) strigatella	strigated limpet
	Conus californica	California cone snail
	Haliotis fulgens	green abalone
	Haliotis corrugata	pink abalone
	Kelletia kelletii	Kellet's whelk
	Lithopoma undosum	wavy turban snail
	Littorina scutulata	banded littorine
	Lottia gigantea	owl limpet
	Norrisia norrisi	Norris's top snail
	Serpulorbis squamigerus	calcareous tube snail
	Tegula eiseni	Eisen's turban snail
	Tegula funebralis	black turban snail
	Mollusca - Pelecypoda	
	Mytilus californianus	California mussel
	Pododesmus c.f. *cepio*	abalone jingle
	Echinodermata	
	Linkia columbiae	fragile star
	Parastichopus californicus	sea cucumber
	Strongylocentrotus franciscanus	red urchin
	Strongylocentrotus purpuratus	purple urchin
	Ectoprocta	
	Bugula californica	bryozoan
	Diaperoecia californica	lacy bryozoan
	Mucronella major	colonial bryozoan
	Urochordata	
	Aplidium c.f. *productum*	colonial tunicate
	Clavulina huntsmanni	light bulb tunicate
	Didendum c.f. *carnulentum*	colonial tunicate
	Euherdmania claviformis	sand tunicate
	Metandropcarpa taylori	colonial tunicate
	Tunicate, unid.	
Source: CRM 1998		

Rocky Subtidal

As in the intertidal zone, the rocky substrate provides areas for attachment and refuge for marine flora and fauna. Offshore of the Wilson Cove outfall, a boulder reef rises from 1.5 ft (0.5 m) to over 10 ft (3 m) above the seafloor. This reef habitat extends continuously along the shoreline to depths of 50 ft (15 m). Sandy bottom habitat is intermittently present and consists of coarse sand, shell hash, and gravel. Beyond the 50-ft (15-m) depth contour, the reef transitions into a sloping sand bottom with occasional boulder outcrops (CRM 1998). Subtidal surveys conducted near the Wilson Cove outfall recorded a total of 81 taxa, of which 30 were macrophytes and 25 were macroinvertebrates (refer to Table 3.6-1) (CRM 1998). Organisms primarily associated with the 10-ft (3-m) isobath included surfgrass (*Phyllospadix torreyi*), sea palm (*Eisenia arborea*), feather boa kelp (*Egregia menziesii*), red sea urchins (*Strongylocentrotus franciscanus*), and the gastropods *Lithopoma undosa* and *Tegula eiseni*. In comparison to the 10-ft (3-m) isobath, the 40-ft (12-m) isobath is characterized by dense giant kelp (*Macrocystis pyrifera*) forest, a greater diversity of taxa, reduced cover of turf algae, higher cover of coralline turf and crustose red algae (*Lithophyllum*/ *Lithothamnion*), and higher cover of sessile and colonial organisms.

SCI has historically been an important area for commercial kelp harvesting, and large kelp beds are present around much of the island (Figure 3.6-5). During the 1950s and into the mid-1960s, SCI was the leading producer of kelp among all of the Channel Islands. More recently, the kelp beds at SCI have fluctuated in size along their borders, although relatively little change in the total abundance has occurred (CINP 2005, BLM 1977). The distribution and abundance of giant kelp vary greatly on opposing sides of the island, presumably due to differences in depth, nutrients, water movement, and light penetration (water transparency). On the northeast side, water depth drops off rapidly to more than 660 ft (200 m), while steep cliffs up to 330 ft (100 m) high back the shoreline. Giant kelp forms long, narrow fringing beds at appropriate depths that do not exceed 330 ft (100 m) in width. On the southwest (windward) side of SCI, a broad apron of shallow water is present where wind and waves induce steady circulation. Upwelling is common on this side of the island, and very large giant kelp beds occur along the entire length of the island. The maximum depth where giant kelp occurs around the island is approximately 130 ft (40 m) near Seal Cove. More commonly, the beds are within the 80-ft (24-m) contour. Because of the evenness of the outer edge, the beds appear to be limited by depth. The shallow limit of giant kelp on the exposed coast is usually 15 ft (5 m), while in protected coves such as Eel Point, kelp is present just below the low tide mark in water depths of 7 to 15 ft (2 to 5 m) (CINP 2005, BLM 1977).

The total extent of kelp beds around SCI was measured from digitized sensitivity index maps produced in 1980 (NOS 1980). The extent of kelp beds may be about 9.3 mi^2, or about half the nearshore zone within the 20-fathom contour. However, the abundance of kelp in suitable habitat is quite variable over time (Murray and Bray 1993, Bushing 1995). Results of surveys conducted between 1975 and 1977 produced an estimate of 3.5 mi^2 of kelp canopy coverage (Murray and Bray 1993).

Figure 3.6-5. Giant kelp beds adjacent to San Clemente Island (DoN 2007)

Sandy Subtidal

Sand bottom habitats at depths between 50 and 66 ft (15 and 20 m) include large associations of phoronid worms (*Phoronopsis californica*), ornate tube worms (*Diopatra ornata*), and sea cucumbers (*Parastichopus californiensis*) (CRM 1998). Other species typical of southern California subtidal sandy bottom habitats may also be present at SCI and include polychaete worms (*Diopatra splendidissima*, *Pista pacifica*, *Loimia medusa*), echinoderms (*Dendraster excentricus*, *Astropectin armatus*, ophiuroids), crabs (*Pagurus* spp., *Paguristes* spp., *Randallia ornata*, *Blepharipoda occidentalis*), clams (*Ensis* sp.), cnidarians (*Harenactis attenuata*, *Zaolutus actius*, *Renilla kollileri*, *Stylatula elongatus*), and snails (*Olivella biplicata*, *Polinices* sp.) (DoN 1995). Eelgrass beds (*Zostera marina*) have been observed on sandy subtidal substrate along the less exposed and relatively calm eastern side of SCI (Engle and Miller 2005).

3.6.1.2.2 Current Mitigation Measures

In order to reduce or eliminate potential effects of Navy activities on marine plants and invertebrates, buffer zones have been designated for training events using both explosive and non-explosive ordnance. Lookouts are posted to visually survey for floating kelp, plants, or algal mats. In training using explosive ordnance, the intended impact area shall not be within 600 yds (585 m) of known or observed live hard-bottom communities, kelp beds, floating plants, or algal mats. For training events using non-explosive ordnance, intended impact area shall not be within 200 yds (183 m) of known or observed live hard-bottom communities, kelp beds, floating plants, or algal mats. For air-to-surface missile exercises, the buffer zone is extended to 1800 yds (1646 m) around hard bottom communities, kelp forests, floating plants, and algal mats, for both explosive and non-explosive ordnance.

3.6.1.3 Marine Protected Areas and Marine Managed Areas

3.6.1.3.1 Marine Protected Areas

Marine Protected Areas (MPAs), as defined in EO 13158, are "any area of the marine environment that has been reserved by federal, state, territorial, tribal, or local laws or regulations to provide lasting protection for part or all of the natural and cultural resources therein. “Section 5 of EO 13158 stipulates, "each Federal agency whose actions affect the natural or cultural resources that are protected by MPAs shall identify such actions. To the extent permitted by law and to the maximum extent practicable, each Federal agency, in taking such actions, shall avoid harm to the natural and cultural resources that are protected by an MPA."

Many areas of U.S. marine waters receive some level of managed protection. NOAA and the Department of the Interior (DoI) are documenting all marine sites, and the National MPA Center is compiling a comprehensive inventory of all federal, state, tribal, and local sites that meet certain criteria of either a Marine Managed Area (MMA) or an MPA. MMAs are similar to MPAs in that they have a conservation or management purpose, defined boundaries, and some legal authority to protect resources. MMAs encompass a wider range of management intents, which include areas of protection for geological, cultural, or recreational resources that might not be included under the definition provided in EO 13158 for MPAs. MMAs may also include areas that are managed for reasons other than conservation (e.g., security zones, shellfish closures, sewage discharge areas, and pipeline and cable corridors). Of the current 251 federal sites in the MMA Inventory, numerous are located within the boundaries of the SOCAL Range Complex (NOAA 2004a).

3.6.1.3.2 National Marine Sanctuaries

The boundaries of the Channel Islands National Marine Sanctuary (CINMS) extend from mean high tide to 6 nm offshore, with California state waters extending 3 nm from the shores off San Miguel, Santa Rosa, Santa Cruz, Anacapa, and Santa Barbara Islands (NOAA 2003). NOAA designated this NMS in 1980 and set aside 1,252 square nautical miles (nm^2) of protected area in this sanctuary (NOAA 2003). Santa Barbara Island is the only island that is located within the boundaries of the SOCAL Range Complex. Within these boundaries there are several regulatory agencies (i.e., federal, state, and local), which have overlapping jurisdiction. For example, the CDFG is responsible for managing living marine resources from high tide to 3 nm offshore.

Per CINMS regulations (15 CFR §922.71(a)), national defense activities in existence at the time of designation are not subject to CINMS regulatory prohibitions, provided they meet the terms and conditions of the designation document. Article 5, Section 2 of the designation document requires existing national defense activities "to be consistent with the [CINMS] regulations to the maximum extent practicable." Further, CINMS regulations (15 CFR §922.71(b)) require that the exemption of additional activities having significant impact shall be determined in consultation between the National Marine Sanctuary Program (NMSP) Director and the Department of Defense. Further information about these regulations is available from the CINMS website (NOAA 2004c).

3.6.1.3.3 National Parks and National Monuments

There are two national monuments found in the SOCAL Range Complex. The Cabrillo National Monument includes a lighthouse and is comprised of 160 acres of the southern-most point of the Point Loma peninsula (NPS 2004a) in San Diego, California. Cabrillo National Monument was dedicated in 1913 to commemorate Juan Rodríguez Cabrillo, who was the first European to set foot on the west coast of the U.S., landing at San Diego Bay in 1542. A variety of marine bird species utilize this park, and its rocky coastline provides habitat for a variety of marine plants and invertebrates. Additionally, many marine mammal species can be seen migrating along the coast from this monument. The California Coastal National Monument was created by Presidential Proclamation on January 11, 2000 and designates all non-major U.S. owned lands (rocks, islands, etc.) along the coast of California from mean high tide out to a distance of 12 nautical miles (22 kilometers) as national monuments. The Channel Islands, including SCI are located outside this designation.

The Channel Islands National Park consists of a chain of five islands (San Miguel, Santa Rosa, Santa Cruz, Anacapa, and Santa Barbara) near Los Angeles covering 249,353 acres (1,009 km^2), half of which are underwater (NPS 2004b). The park boundaries extend 1 nm from each of the island's shorelines, which is within California state waters. Over 145 species of plants and animals are endemic to this island chain (NPS 2004b). None of the five islands are within the boundaries of the SOCAL Range Complex. Santa Barbara Island is the smallest in the chain with only 639 ac (2.6 km^2) (NPS 2004b). Its cliff habitat is a breeding ground for numerous bird species. The Channel Islands National Park is not within the SOCAL Range Complex.

3.6.1.3.4 Critical/Protected Habitats

NMFS responsibilities include rebuilding and maintaining sustainable fisheries, promoting the recovery of protected species, and protecting and maintaining the health of coastal marine habitats. To satisfy these responsibilities, the NMFS uses protected areas as one of several tools to conserve and manage marine resources. There are no Critical or Protected Habitats designated in the SOCAL OPAREAs (NOAA 2004a).

3.6.1.3.5 National Wildlife Refuges

The San Diego Wildlife Refuge Complex, which is composed of a series of small National Wildlife Refuges (NWRs): San Diego NWR (9,478 ac), Seal Beach NWR (911 ac), Tijuana Slough NWR (1,051 ac), and Sweetwater Marsh NWR (316 ac) lies at several locations along the coast of Southern California; some of these locations are in the vicinity of the SOCAL Range Complex. This complex was established in 1972 to preserve and protect rare bird and plant species of southern California's coastal ecosystem (i.e., salt marshes, mudflats, eel grass beds) (USFWS n.d.).

3.6.1.3.6 National Estuarine Research Reserves

The National Estuarine Research Reserve System (NERRS) is a partnership between NOAA and the coastal states. The system is a network of 26 reserves, consisting of relatively pristine estuarine areas that contain key habitat and are protected from significant ecological change or developmental impacts (NERRS 2004a). The reserves also provide reference sites for research, monitoring, and educational programs that focus on functional estuarine ecosystems. NERRSs include a variety of rare, endangered, and threatened species.

One NERR is located in the vicinity, but not in the SOCAL OPAREAs, and includes the Tijuana River National Estuarine Research Reserve which is located in San Diego County on the U.S./Mexico border. The 2,500 acre reserve contains a variety of habitats, including saltmarshes, mudflats, beaches, dunes, riparian zones, and coastal sage environments and is home to several federal endangered and threatened shorebirds and saltmarsh vegetation (NERRS 2004b).

3.6.1.4 State Marine Managed Areas

The Marine Life Protection Act (MLPA - Assembly Bill 993) was introduced in February 1999 and is included in Chapter 10.5 of the California Fish and Game Code, Sections 2850 to 2863. "The purpose of the MLPA was to improve the array of MPAs existing in California waters through the adoption of a Marine Life Protection Program and a comprehensive master plan" (CDFG 2003). The MLPA states that "marine life reserves" (defined as no-take areas) are essential elements of an MPA system because they "protect habitat and ecosystems, conserve biological diversity, provide a sanctuary for fish and other sea life, enhance recreational and educational opportunities, provide a reference point against which scientists can measure changes elsewhere in the marine environment, and may help rebuild depleted fisheries." The CDFG is the lead agency responsible for implementing the provisions of the MLPA (CDFG 2003).

NOAA and the DoI are working with states to collect data on sites managed by their state agencies for inclusion in the national MMA Inventory. A State Advisory Group was established with regional representatives to guide the development of the state data collection process. Data collection has been initiated for most states and is in various stages of completion. For California, informational and GIS data has been received for the preliminary 135 proposed sites and are currently in review (NOAA 2004a). There are currently no new locations proposed for southern California.

3.6.1.4.1 Ecological Reserves

State Ecological Reserves have a boundary that extends seaward out to 1 nm (1.9 km). Many of these reserves allow no commercial or recreation takes of various invertebrate or aquatic plant species, while some prohibit the take of any marine life. Enforcement on these reserves is the responsibility of the CDFG (see CDFG 2002 for more details).

Within or in the vicinity of the SOCAL Range Complex are the following five California State Ecological Reserves:

- Farnsworth Bank Ecological Reserve - This 0.06 nm^2 (0.21 km^2) reserve has habitats of high relief and rock pinnacles. The purpose of this reserve is to protect a population of hydrocoral, *Allopora californica*, which inhabit the rock pinnacles on the reserve.
- San Diego-La Jolla Ecological Reserve - This 0.58 nm^2 (1.9 km^2) reserve consists of rocky reef habitats and 1.41 nm (2.6 km) of shoreline. The purpose of this reserve is to provide nearshore habitat to support research activities associated with Scripps Institute of Oceanography.
- Heisler Park Ecological Reserve - This 0.4 nm^2 (1.4 km^2) reserve, with 0.39 nm (0.7 km) of shoreline, consists of rocky platforms and sandy beaches. Commercial and recreational takes of any kind are prohibited. The purpose of this reserve is to protect the local nearshore kelp bed habitat.
- Point Loma Reserve - This 0.01 nm^2 (0.3 km^2) reserve has 0.54 nm (1.0 km) of shoreline and consists of various intertidal and subtidal habitats. Its purpose is to protect the marine populations within the Cabrillo National Monument.
- Lover's Cove Reserve - This 0.08 nm^2 (0.27 km^2) reserve is 80% hardbottom habitat. This reserve is frequently used as a tourist destination in the summer months.

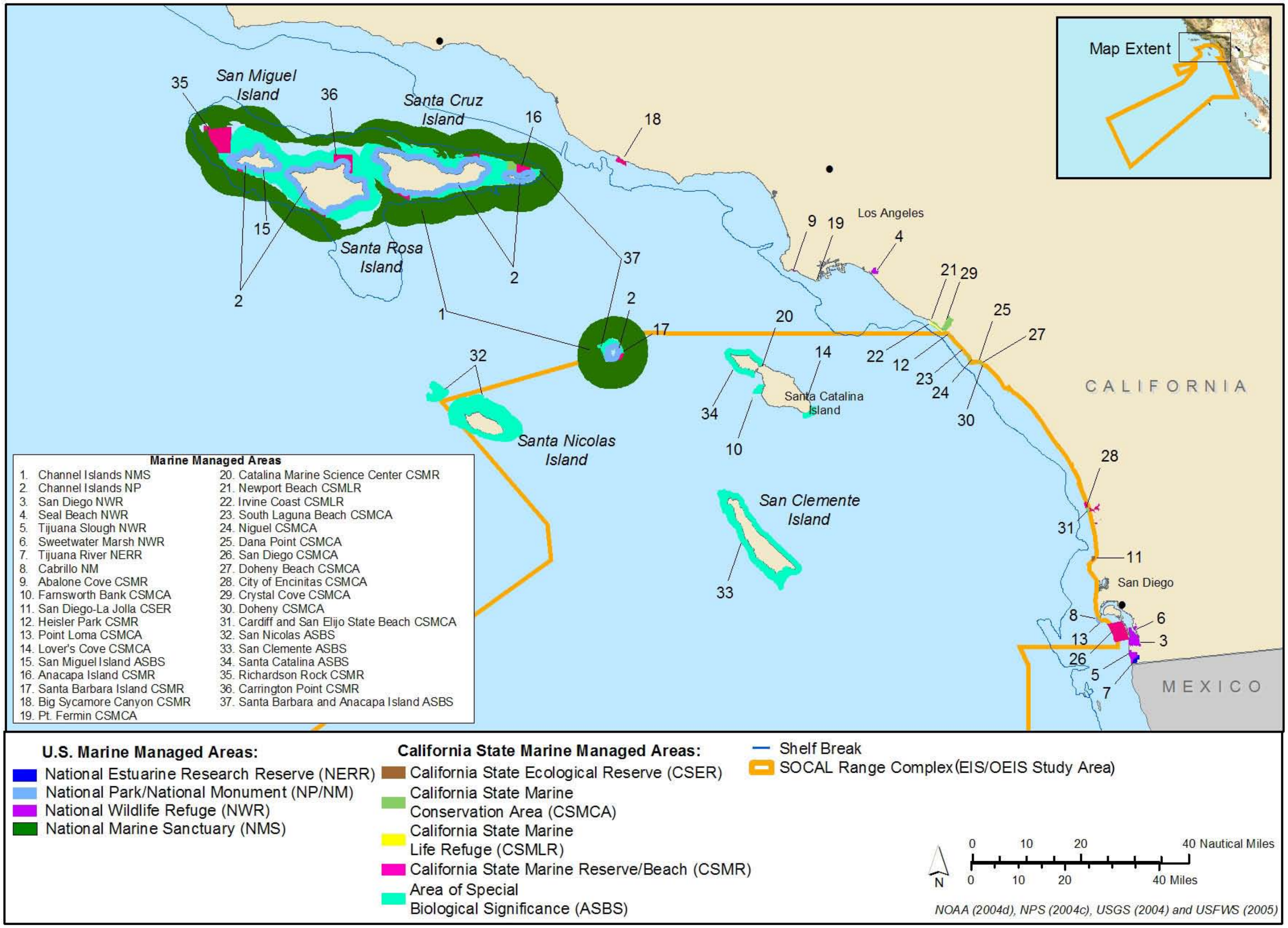

Figure 3.6-6. Locations of U.S. Federal Marine Managed Areas (MMA) and California State MMAs in the SOCAL OPAREAs and vicinity

3.6.1.4.2 State Marine Life Refuges

Many of these refuges allow no commercial or recreation takes of various invertebrate or aquatic plant species, while some prohibit the take of any marine life. Enforcement on these refuges is the responsibility of the CDFG (see CDFG 2002 for more details).

- Catalina Marine Science Center Marine Life Refuge - The benthic substrate of this 0.6 nm^2 (2.1 km^2) refuge consists of 50% hardbottom and 50% softbottom habitats, with 1.1 nm (2.0 km) of shoreline. The purpose of this refuge is to provide an area for research activities in association with the adjacent science center.
- Dana Point Marine Life Refuge - The 0.16 nm^2 (0.55 km^2) refuge has 0.56 nm (1.0 km) of shoreline and consists of 90% hardbottom and 10% softbottom habitats. This refuge's purpose is to offer complete protection from take in the intertidal zone and provide research opportunities for the nearby Orange County Ocean Institute.
- San Diego Marine Life Refuge - The 0.11 nm^2 (0.37 km^2) refuge has 0.54 nm (1.0 km) of shoreline and consists of various intertidal and subtidal habitats.
- Doheny Beach Marine Life Refuge - This 0.11 nm^2 (0.37 km^2) refuge consists mostly of sandy habitat and has 1.09 nm (2.0 km) of shoreline. Its purpose is to protect intertidal organisms.
- City of Encinitas Marine Life Refuge - This 0.09 nm^2 (0.31 km^2) refuge has 0.78 nm (1.4 km) of shoreline and consists primarily of soft and sandy benthic habitats.

3.6.1.4.3 State Parks

Enforcement on these parks is the responsibility of the CDFG (see CDFG 2002 for more details).

- Crystal Cove State Park - This 0.16 nm^2 (0.55 km^2) park has 2.85 nm (5.3 km) of shoreline with sandy beaches and rocky habitats.
- Doheny State Beach (overlays Doheny Marine Life Refuge) - The purpose of this 0.16 nm^2 (0.55 km^2) beach is to provide additional protection to marine life within the state beach boundaries.
- Cardiff and San Elijo State Beach - This 1.29 nm^2 (4.4 km^2) each consists of various intertidal habitats and has 2.28 nm (4.2 km) of shoreline. The purpose of this beach is to provide scenic and recreational resources to the public.

3.6.1.5 Threatened and Endangered Species

3.6.1.5.1 White Abalone

The white abalone (*Haliotis sorenseni*) is the only Federally listed, marine invertebrate animal that may occur within the SOCAL Range Complex. The white abalone, historically found from Punta Abreojos, Baja California, Mexico, to Point Conception, California, is a prosobranch gastropod mollusk that occurs on hard substrate, reportedly in water depths of 65 to 196 ft (20 to 60 m) (NMFS 2001, 2006). They prefer a specific type of habitat, consisting of open, low relief rock or boulder habitat surrounded by sand. Sand may be important in forming channels for the movement and concentration of algal drift. They also appear to be restricted to depths where algae will still grow, a function of light and substrate availability (Hobday and Tegner, 2000). White abalone are relatively sedentary and do not form large aggregations. They have separate sexes (i.e., males and females) and reproduce by broadcast spawning, reaching sexual maturity at age 4 to 6 years at a size of 3 to 5 inches (9 to 13 cm). Newly settled individuals feed on benthic diatoms, bacterial films, and single-celled algae found on coralline algal substrates. As they grow larger, white abalone feed on drift and attached algae, including deeper water brown taxa *Laminaria farlowii* and *Agarum fimbriatum*. Adult white abalone can reach a shell length of up to approximately 9 in (21 cm).

The white abalone was commercially harvested throughout its range until the mid-1970s, when stocks declined precipitously. It was Federally listed as an endangered species on May 29, 2001 (NMFS 2001, 2006).

In October 1999, surveys were conducted in potential white abalone habitat areas on SCI (Figure 3.6-7). This survey was limited to the north, west, and south sides of the island. Most of the individuals observed were found offshore of the center of the island on the west side. The east side of the island was not surveyed. Individuals and groups of two or more were most abundant offshore from Seal Cove and Seal Point, the latter being the southwestern most point of SCI. A total of 24 white abalone were found, ranging from 1 to 6 individuals per site, at 10 of the 26 sites surveyed. Abalone were found in 98 to 197 ft (30 to 60 m) of water, with most in approximately 157 ft (48 m). White abalone surveys at Tanner and Cortes banks in 1999 (Lafferty et al. 2004) found the mean depth for this species to be 154 ft (47 m) at Tanner Bank and 157 ft (48 m) at Cortes Bank.

Surveys conducted by Haaker et al. (2001) at five California islands and three offshore banks resulted in counting a total of 157 white abalone within 141 acres (0.5 hectares) of habitat. The mean density calculated from these data was 6.7 white abalone per acre (range 0 to 24.2 per acre) with densities at Tanner and Cortes Banks being the highest.

More recent (2002-2004) habitat mapping and surveys for white abalone at SCI and Tanner and Cortes Banks have resulted in a much greater estimate of suitable habitat and population sizes (Butler et al., unpublished). In August of 2004, the Navy participated with NOAA Fisheries Southwest Fisheries Science Center and California State University Monterey in identifying and surveying potential white abalone habitat off the west shore of SCI from Castle Rock south to China Point. The surveys were conducted over a ten day period and consisted of multibeam and sidescan sonar mapping to identify potential substrate and habitat from the seaward edge of the kelp beds at 82 ft (25 m) out to approximately 248 ft (75 m) along the western side of SCI. Extensive ROV surveys were conducted where suitable habitat was identified. These survey results were analyzed along with previous surveys of SCI and Tanner and Cortes Banks (Butler et al., unpublished). In all surveys, white abalone were found almost exclusively at depths of 100 to 200 ft (30 to 60 m). Abalones were found on substrate consisting of rocky reef or sand/rock interface; white abalones were not found in areas of only sandy bottom (Butler et al., unpublished). The resulting estimate of suitable habitat is 2,220 acres (889 ha) on SCI, partially based on the increased percentage of rocky substrate in the continental shelf when compared with previous habitat evaluations (Butler et al., unpublished). The SCI population is estimated as 1,938 +/-1,598 individuals (Butler et al., unpublished).

3.6.1.5.2 Black Abalone

The black abalone (*Haliotis cracherodii*) was added to NMFS' Candidate Species list on June 23, 1999 (64 FR 33466), transferred to NMFS' Species of Concern list on April 15, 2004 (69 FR 19975), and has since been proposed for listing on the List of Endangered and Threatened Species under the ESA. Black abalone ranged historically from Crescent City (Del Norte County, California) to Cabo San Lucas (Southern Baja California), but it is believed that the current range of black abalone extends from Point Arena (Mendocino County, California) to Northern Baja California, but are rare north of San Francisco (Morris et al. 1980). Of the seven species of abalone found in California, black abalone is a relatively shallow water species and is most abundant in rocky intertidal habitat (Morris et al., 1980), although they do occur from the high intertidal zone to 6 m depth. Average black abalone shell length is approximately 115 mm, however, maximum shell length may exceed 200 mm (Morris et al., 1980). Larval black abalone tend to settle into areas characterized by bare rock and coralline red algae (Douros 1985, Miner et al. 2006). Once settled onto rocky substrata, black abalone juveniles consume rock-encrusting coralline algae and diatom and bacterial films (Haaker et al. 1986). Adult black abalone feed primarily on pieces of algae drifting with the surge or current, such as giant kelp, bull kelp, and feather boa kelp (Haaker et al., 1986). Growth rates can vary depending on food availability, water temperature, and other environmental factors (CDFG 2005). Abalone are long-lived (30+ years) and it takes approximately 20 years for black abalone to reach their maximum length (Blecha et al. 1992). Black abalone are preyed upon by a wide variety of marine predators including sea stars, fishes, octopus, the southern sea otter, and striped shore crab.

Historically, sea otter predation and hunting by Native Americans were two primary sources of mortality for large black abalone. Chinese immigrants began harvesting abalone from dense intertidal beds in central and southern California and Baja California in the mid-1800s, and annual harvest reached a peak of 1,814 metric tons (mt) in 1879 (Howorth 1978, Rogers-Bennett et al. 2002). Commercial harvest was banned in the early 1900s, during which time black abalone populations expanded slightly. However, in 1968 commercial harvest of black abalone resumed. The commercial harvest was greatest around the islands off southern California, particularly San Miguel, San Clemente, and San Nicolas Islands (CDFG, unpublished data). By the mid-1980s overharvesting, as evidenced by declining trends in fishery-dependent data and eventual closure of the commercial fishery reduced southern California coastal populations of black abalone considerably. In the mid- and late-1980s, black abalone on the Channel Islands suffered massive local die-offs (generally >90 percent losses) from a disease known as Withering Syndrome (WS) (Haaker et al. 1992, Richards and Davis 1993, Lafferty and Kuris 1993). The cause of WS is unknown, but has been attributed to a Rickettsiales-like pathogen (Friedman et al. 2000). The principal cause of black abalone population decline in southern and central California has been attributed to over-harvesting (Karpov et al. 2000) and/or the onset of WS in southern California in the 1980s (Lafferty and Kuris 1993) and the disease's northward progression. Black abalone populations have declined by over 99 percent in southern California (except for San Nicolas and San Miguel Islands). No black abalone were observed during rocky intertidal surveys conducted at 11 locations around SCI in 2006 (DoN 2007).

A recent, intensive survey aimed at recording black abalone distribution at SCI was conducted in January 2008 (DoN 2008 in prep). The survey was performed between Northwest Harbor and Pyramid Head along the west shore within primary abalone habitat. Ten abalone were recorded, with most occurring at locations previously documented to support abundant populations (e.g., West Cove, Eel Point, Mail Point). All abalone were greater than 100 mm with no signs of recruitment (fresh shells), and most were observed on exposed headlands where Navy operations have little potential for interaction. Based on the area surveyed, the approximate black abalone at SCI is one abalone per 2.3 acres (9,150 m^2).

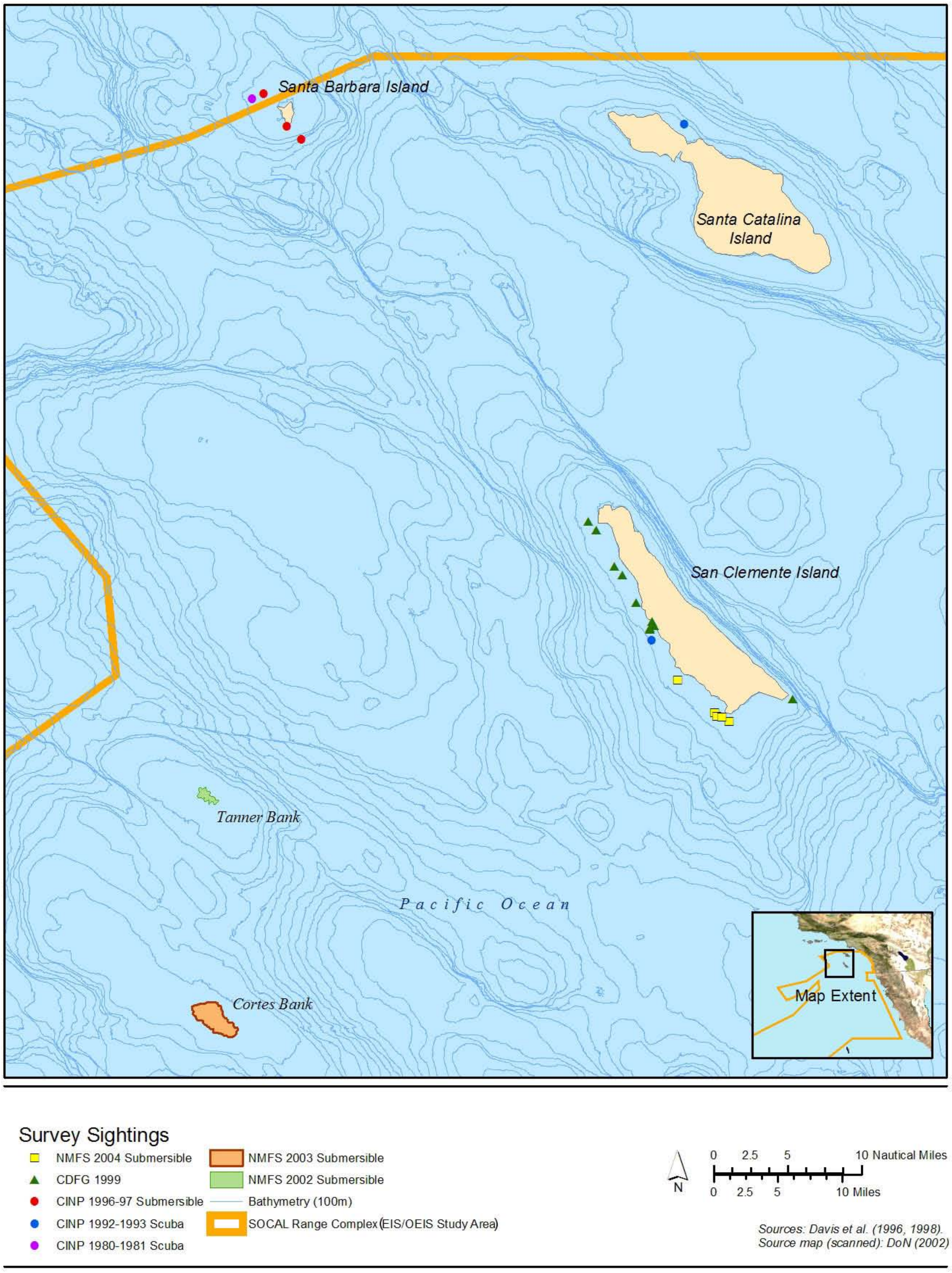

Figure 3.6-7. Locations of white abalone in the SOCAL OPAREAs and vicinity

3.6.2 Environmental Consequences

3.6.2.1 Approach to Analysis

This section addresses the impacts of project alternatives on marine plants and invertebrates, and their habitats. Impacts on fish are addressed in Section 3.7; sea turtles in Section 3.8; marine mammals in Section 3.9; and seabirds in Section 3.10. The significance of impacts depends on context and intensity, specifically on the magnitude of the impacts, and the degree to which sensitive species or habitats, i.e., those that are legally protected or otherwise have unique ecological, commercial, recreational, or scientific importance, are affected.

Impacts on marine plants and invertebrates have the potential to result from the following:

- Physical destruction or adverse modification of benthic habitats resulting from the deposition of debris, the installation and use of facilities, and training activities
- Debris and discharge alteration of water quality
- Debris and discharge alteration of sediment quality

The significance of these types of impacts in turn depends on the following:

- Magnitude of loss or adverse modification of sensitive habitats, e.g., kelp beds, rocky reefs, endangered species' habitat
- Exceedence of National Ambient Water Quality Criteria (NAWQC) or Ocean Plan standards for water quality (see Section 3.4)
- Exceedence of criteria from the National Oceanic and Atmospheric Administration (NOAA) Effects Range-Low (ER-L) values for biological effects of contaminant concentrations in sediments (Long and Morgan 1991, Long et al. 1995)

The impact analysis relies strongly on other sections of the document where these types of effects on the marine environment are quantified. Key sections for this analysis include Section 3.1, Geology; Section 3.3, Hazardous Materials; and Section 3.4, Water Resources.

3.6.2.2 No Action Alternative

3.6.2.2.1 SOCAL Range Complex

Anti-Air Warfare (AAW) Training

Air Combat Maneuvers (ACM): No ordnance is released during this exercise, and the operation does not require targets or other devices that use or contain potentially hazardous materials. No impacts to marine biological resources are anticipated since there are no sensitive marine resources in the vicinity of the operation.

Air Defense Exercise (ADEX): The operation does not require targets or other devices that use or contain potentially hazardous materials. No impacts to marine biological resources are anticipated since there are no sensitive marine resources in the vicinity of the operation.

Missile Firing Exercises (MISSILEX). MISSILEX operations involve the use of missiles and targets, which contain missile propellants, target fuels, engine oil, hydraulic fluid, and batteries, all of which may affect marine water quality and biota. Operations occur in the open ocean (W-291) where there are no sensitive marine resources. The relatively small quantities of materials expended, dispersed as they are over a very large area, and would have no physical effects on marine biological resources. The detailed analysis of Section 3.4, Water Quality, indicates that the concentration of potential contaminants associated with targets and missiles is below water quality criteria established for the protection of aquatic life.

Surface-to-Air Gunnery Exercise (GUNEX S-A). Like ASW Operations, GUNEX S-A operations occur in the open ocean (W-291) where there are no sensitive marine biological resources, and since devices used do not contain potentially hazardous materials, no impacts on marine biological resources are anticipated from GUNEX S-A operations.

Anti-Submarine Warfare (ASW) Training

Most weapons and devices used during ASW Training exercises would be recovered at the conclusion of the exercises; however, some targets (e.g., MK-39 Expendable Mobile Training Target [EMATT]) and sonobuoys would be discarded at sea.

Potential impacts of ASW Training on marine plants and invertebrates would primarily be associated with the expenditure of ordnance and incidental release of other materials in exercises that would be conducted in W-291 and all ocean operating areas of the SOCAL Range Complex. The resulting debris and/or discharges may affect the physical and chemical properties of benthic habitats and the quality of surrounding marine waters, in turn affecting populations of marine plants and invertebrates.

The analysis of water quality effects associated with targets and sonobuoys is provided in Section 3.4, Water Quality. That analysis draws upon research conducted by the Navy for the Sonobuoy Quality Assurance Program at SCI (DoN 1993). As discussed in Section 3.4.2, the evaluation of water quality effects versus published criteria is properly applied to single event values. Loading effects or cumulative effects on water quality in SOAR would not be anticipated because the chemical by-products of training would be widely dispersed in space and time both as a result of the wide distribution of training exercises and of oceanic circulation.

Sonobuoys

Under the No Action Alternative a total of 91,179 pounds (lbs) (41,199 kilograms [kg]) of sonobuoy debris would accumulate on the ocean bottom within the SOCAL OPAREAs annually (see Section 3.2, Geology). The area of SOAR is 670 square miles (mi^2). From Section 3.3.3, the density of sonobuoys accumulating on the seafloor over a 20-year period would amount to approximately one per 80,089 square feet (ft^2) (7,441 square meters [m^2]), assuming an even distribution over 20 percent of the SOCAL OPAREAs and that all sink to the bottom. These amounts would be minimal in terms of physical modification of the habitat.

No adverse effects on benthic marine plants are anticipated because the depth of water in which these operations would occur averages 3,600-5,400 ft (1,097–1,646 m). Sensitive ocean bottom marine resources are not known for these portions of the SOCAL OPAREAs, which exceeds the depth where benthic plants grow. Planktonic marine plants would be temporarily disturbed at the locations where sonobuoys enter and pass through surface water within the photic zone. Debris would settle on soft-bottom habitat that has low species diversity relative to hard-bottom or nearshore habitats and would eventually corrode, become encrusted by organisms, or be buried by sediment. Soft-bottom habitats are not considered sensitive and, in such areas, the adverse effects of debris would be minimal because the density of organisms and debris is low and debris may serve as a potential refuge for invertebrates and fishes.

Impacts from other hazardous materials, primarily batteries, may affect water or sediment quality in the vicinity of the debris (see Section 3.4.2 for battery constituents). The release of metal ions (Pb^{+2}, Cu^{+2}, and Ag^{+}) during operation of the seawater batteries or as a result of corrosion of sonobuoy or target components represents a source of potential environmental degradation for marine invertebrates. In general, the toxicological impact of exposure to high concentrations of heavy metals can result in either immediate mortality of exposed organisms (acute effect) or accumulation of heavy metal residues by these same species. Benthic communities exposed to high concentrations of heavy metals (specifically copper and zinc) are characterized by reduced species richness (number of species), reduced abundance (number of organisms), and a shift in community composition from sensitive to more tolerant taxa.

As discussed in Section 3.4, the dissolution of lead, copper, and silver compounds from sonobuoy batteries have a less than significant effect on water quality because the expected concentrations of these metals in the water column would be well within State and Federal criteria. This conclusion is based on the detailed investigations conducted by the Navy (DoN 1993), and because of the conservative assumptions used, would not likely be affected by differences in chemical speciation or solubility at depth. Each of the three metals of concern behaves differently in that regard. Lead from the batteries would be a mixture of lead ions (Pb^{+2}), lead chloride ($PbCl^{2}$,), and lead carbonate ($PbCO_3$), and would tend to be scavenged from the water column by sediments and transported to the bottom (DoN 1993). Other sonobuoy constituents, primarily lead ballast weights and lead solder, would sink to the bottom and would not be expected to affect water quality because of their very low solubility. The formation of lead oxide (PbO) and other salts on exposed metal surfaces would limit the further dissolution of metals in the sediments. Ballast weights and solder would be unlikely to be ingested by deposit feeding benthic invertebrates due to their size.

Copper ions in seawater near the surface are strongly bound by organic molecules, but these bonds would be released as the molecules sink, resulting in greater concentrations of copper in solution with increasing depth (DoN 1993). The residence time of copper in the ocean is estimated as 5,000 years (DoN 1993). Silver is dissolved in seawater primarily as silver chloride ion ($AgCl_2^-$). Like copper, silver concentrations tend to increase with depth. The residence time of silver in the ocean is estimated as 350 years (DoN 1993). The relatively small inputs of copper and silver associated with ASW training would remain in solution for long periods of time and would likely be dispersed out of the SOCAL OPAREAs by currents. Concentrations, however, would be orders of magnitude below those that would have the potential to cause biological effects (see Figure 3.4-1).

Following the calculations of Section 3.3.3 and 3.4.4, assuming that 117,700 sonobuoys would be scuttled in the SOCAL OPAREAs over a 20-year period, the total deposition of lead on the seafloor from solder and ballast weights would amount to 115,228 lb (52,376 kg). If, as in Section 3.3.3, this material were dispersed within 20 percent of the area of SOAR, the total accumulation of lead in the upper 4 inches (in) (10 centimeters [cm]) of ocean sediments (assuming a dry weight mass of 800 kg/m^3) would amount to an average concentration of 1.89 mg/kg. This concentration is 4 percent of the ER-L for lead in sediments, which equals 46.7 parts per million (mg/kg). The ER-L for lead is considered a reasonable threshold for biological effects (Long and Morgan 1991; Long et al. 1995). Actual concentrations to which organisms would be exposed would be much smaller because most of the lead would remain intact in large fragments that are encrusted and essentially inert.

Targets

Target activities can potentially result in temporary, localized impacts on water quality. However, these would occur in the open ocean away from sensitive marine resources. In addition, many of the hazardous constituents of concern (i.e., fuel, oil) are less dense than seawater and would remain near the surface and therefore would not affect the benthic community. Sheens (e.g., oil or fuel) produced from these activities have a less than significant long-term effect on marine biological resources because a majority of the toxic components (e.g., aromatics) would evaporate within several hours to days or be degraded by biogenic organisms (e.g., bacteria, phytoplankton, zooplankton) (National Research Council 1985). This process may occur at a faster rate depending on sea conditions (e.g., wind and waves). Ocean currents at the surface and within the water column would also rapidly dilute any metal ions or other chemical constituents released by the sonobuoy or target.

The chemical breakdown of lithium sulfide ($LiSO_2$) from EMATT batteries would have a minimal effect on water quality or marine biology because the products of the reaction are abundant in seawater and will diffuse to surrounding concentrations within a short distance from the point of release (Section 3.4.2).

Torpedoes

Potential effects of torpedoes on marine biological resources are associated with propulsion systems, chemical releases, or expended accessories. Effects of these components on marine biology are less than significant for the following reasons: a worst-case spill of fuel from a torpedo would have no significant effects on water quality or on marine biological resources due to the dilution of the spill in the open ocean, the small area affected, and the eventual degradation of the dispersed fuel by marine bacteria (Section 3.4.2).

- Most of the expended exhaust products would be non-toxic, with the exception of cyanide, which, based on a USEPA criterion of 1 part per billion, could have short-term toxic effects within 17.7 ft (5.4 m) (Section 3.4.2) in the immediate wake of the torpedo
- A breach of the lithium boiler system is extremely unlikely and would have very small-scale, temporary effects on water quality and marine organisms
- Compounds released during venting or failure of the buoyancy bag on the MK-50 torpedo are mostly non-toxic, the only exceptions being hydrogen cyanide (HCN), and formaldehyde (CH_2O), which would have the potential for toxic effects only within 1 ft (0.3 m) of the release
- Steel-jacketed lead weights released from torpedoes would fall directly to the bottom and become buried and encrusted, without anticipated effects on water or sediment quality or benthic organisms other than the very small direct impact of each weight as it hits the bottom

In conclusion, since the density and diversity of benthic marine organisms at the depths where operations would occur are very limited, and since the metals are relatively insoluble, impacts on benthic marine organisms and sediment quality from hazardous constituents during ASW operations would be minimal.

Anti-Surface Warfare Training

Visit Board Search and Seizure (VBSS). Visit Board Search and Seizure would occur 56 times per year and requires one SH-60L aircraft and one Torpedo Weapons Retrieval (TWR) support boat to perform the operation. The impacts of the support ships and aircraft would be similar to those discussed above under ASW but would occur less frequently and would not involve any live or inert ordnance.

Anti-Surface Missile (MISSILEX A-S). Helicopters and fighter/attack aircraft expend precision-guided munitions against maneuverable, high-speed, surface targets. The air-to-surface missiles used in this operation are the Laser-Guided Training Round (LGTR), the AGM-114 (Hellfire), and Glide Bomb Units (GBUs) 12, 16 and 32i, with primary operations in the Laser Training Ranges (LTRs) 1 and 2. Under the No Action Alternative, this operation is conducted 94 times per year. The effects of the aircraft and deployed missiles are similar to those discussed above under ASW and add a small amount to those impacts.

Air-to-Surface Bombing. This event involves conducting attacks on surface vessels from naval aircraft. It involves pairs of FA-18, SH-60, or P-3 aircraft delivering ordnance against towed targets. The surface ships and targets have the potential to impact marine resources in a manner similar to that discussed above under ASW, but impacts occur less frequently.

Air-to-Surface Gunnery (GUNEX A-S). Helicopter crews successfully complete day aerial gunnery operations with the GAU-16 (0.50 cal) or M-60 (7.62 mm) machine gun. This requires approximately 200 rounds of ammunition per event. The effects of the targets are similar to those discussed above under ASW.

Gunnery Exercises. A GUNEX takes place in the open ocean to provide gunnery practice for ship crews utilizing shipboard gun systems. Exercises involve a variety of surface targets, both stationary and maneuverable. The types of ordnance used are the 5-inch 54 or 52 cal deck gun on CGs and DDGs and 25 mm cannon on amphibious ships, or 0.50 cal machine guns. Operations involving the use of maneuverable targets contain fuel, engine oil, hydraulic fluid, and batteries, all of which may affect marine water quality and biota. The relatively small quantities of materials expended, dispersed as they are over a very large area, would have similar impacts as described for ASW. Operations involving stationary targets have no potentially hazardous materials, and the ordnance has little potentially hazardous materials. No impacts to marine biological resources are anticipated since there are no sensitive marine resources in the vicinity of the operation.

Sinking Exercise (SINKEX). A SINKEX is conducted only occasionally, typically during a Joint Task Force Exercise (JTFEX), and is conducted under a permit from the USEPA. Operations involve the use of missiles, bombs, and torpedoes, which contain missile propellants, fuel, engine oil, hydraulic fluid, and batteries, all of which may affect marine water quality and biota. The relatively small quantities of materials expended, dispersed as they are over a very large area, would have no significant physical effects on marine biological resources. The detailed analysis of Section 3.4, Water Quality, indicates that the concentration of potential contaminants associated with bombs and missiles is below water quality criteria established for the protection of aquatic life. In addition, SINKEX operations occur in the open ocean (at least 1,000 fathoms [6,000 feet] deep) in W-291 where there are no sensitive marine resources and where the sunken vessel would not destroy or adversely effect sensitive benthic habitats, such as deep-water coral habitat. However, the sunken vessel may alter soft-bottom habitats, but may provide a beneficial use by providing habitat in the deep water environment. Given these reasons, impacts from SINKEX are anticipated to be minimal.

Amphibious Warfare

Naval Surface Fire Support (NSFS). NSFS operations involve surface ships firing at surface targets in fire support areas in SHOBA. Potential impacts from NSFS operations include damage to sensitive marine resources (i.e., rocky intertidal and subtidal habitat). Fire Support Area I (FSA I) is located in Pyramid Cove, which is predominantly sandy beach. Therefore, if shells detonate in the nearshore area of FSA I, no impacts would occur to sensitive marine habitats or organisms (see Section 3.6.1 for discussion of sandy beach habitat).

FSA II is located in the China Cove area and has some rocky nearshore habitat (e.g., China Point) interspersed between sandy habitats. Based on Section 3.3, 1.5 percent of the 4,270 shells (64) fell short and entered the water during the baseline year. An unknown number of these may have detonated in the vicinity of rocky habitats and resulted in the destruction of the substrate and associated organisms (e.g., surfgrass, algae, and invertebrates). No data are available on the extent of impacts, but they are predicted to affect areas on the order of 10s to 100s of square feet, denuding the substrate, or breaking existing rocks to create new unoccupied surfaces. The rate of recolonization and recovery is likely to be highly site specific, depending on the timing, extent and severity of disturbance, the constituent species of the affected community, and variable processes of larval recruitment from the plankton and the immigration of motile species from adjacent areas (Sousa 1984, 2001). Recovery of California rocky shore communities affected in this manner to pre-disturbance conditions would be likely to require several years (e.g., Walder and Foster 2000). Whether recurrent disturbances affect the same area repeatedly or different (but nearby within FSA II) areas is unknown.

Most disturbances would occur in very shallow to intertidal waters and hence would not affect the endangered white abalone, which occurs in the nearshore waters around SCI (Haaker et al. 2001) and is typically found at 65 to 200 ft (20 to 60 m) (Hobday and Tegner 2000, NMFS 2001). The probability of a shell falling short at FSA II and sinking to the bottom on or immediately adjacent to a white abalone is very remote due to the sparse distribution of white abalone and the low likelihood that the shells would fall short of the target area. Black abalone are believed to occur in the intertidal zone on SCI, and although populations have dramatically declined due to disease and overfishing, there is a probability the black abalone may be present in FSA II. However, given the localized nature of the impact in FSA II in relation to abundant rocky shore habitats along the SCI coastline and the narrow distribution of black abalone in the intertidal zone, the effect of FIREX operations on marine biological resources is considered to be minimal.

Expeditionary Firing Exercise (EFEX). Effects on marine biological resources from EFEX include potential fuel or oil spills from landing craft, which would have short-term, localized but no long-term impacts on marine biological resources near SHOBA, and ingress and egress locations. Disturbances along the shore during landings would primarily affect the sandy beach area, which is not considered sensitive. Effects of gunnery are similar but occur less frequently than those discussed for ASW and NSFS, and are anticipated to be minimal. Effects on marine biological resources from hazardous materials are discussed in Section 3.4 and from amphibious landings under GUNEX, and are anticipated to be minimal.

Expeditionary Assault Battalion Landing. The amphibious forces would land by helicopter (primarily CH-46s) and amphibious landings by utilizing rubber boats, Landing Craft Air Cushion (LCAC), Amphibious Assault Vehicles (AAV) (after 2007 the Expeditionary Fighting Vehicle [EFV]), and Landing Craft, Utility (LCU). These expeditionary forces would land at Northwest Harbor, Wilson Cove, West Cove, and Horse Beach in the Shore Bombardment Area (SHOBA). This operation does not occur under the No Action Alternative; therefore, no impacts are occurring.

Stinger Air-Defense Missile Firing. The Stinger is a small shoulder-fired or vehicle mounted anti-aircraft missile utilized by Marine and NSW forces. Training is conducted from positions onshore in SHOBA, or by NSW units firing the missiles from boats in the nearshore area. This operation does not occur in the baseline operations and therefore does not occur under the No Action Alternative. Therefore, no effects on marine biological resources result from this operation.

Amphibious Landings and Raids (on SCI). Potential impacts on marine biological resources from Amphibious Landings and Raids would be due to the beach landings associated with bringing personnel ashore. Landings typically would occur on sandy beaches at West Cove, Horse Beach Cove, or Northwest Harbor, which are very dynamic habitats that are biologically less diverse than rocky intertidal habitats. In addition, organisms inhabiting sandy beach areas have adapted to surviving in a variable environment that is subject to regular wave disturbance and cycles of erosion and deposition. In this environment, amphibious landings do not have lasting effects as the sandy bottom is rapidly reworked by waves and tides, and organisms that are displaced are able to rapidly recolonize by immigration and larval recruitment. Amphibious landings may also introduce hazardous materials (i.e., fuel and oil) that may affect marine organisms; however, impacts on marine resources from hazardous materials are expected to be minimal because of the low likelihood and low volumes of spills, and their dispersion and degradation in the marine environment.

Amphibious Operations – CPAAA. This covers a wide range of amphibious operations, which occur in the ocean area known as the Camp Pendleton Amphibious Assault Area (CPAAA). No live or inert ordnance is authorized. The CPAAA is predominantly bordered by sandy beach, which are very dynamic habitats and are biologically less diverse than rocky intertidal areas. Localized impacts to benthic infauna would be expected, although recolonization would also be expected relatively soon after the disturbance.

Electronic Warfare

Electronic Combat (EC) Operations. EC Operations are conducted in offshore areas and on the Electronic Warfare (EW) Range at the SCI. Offshore events generally consist of electronic threat simulation and jamming services that are provided to surface ships. Typical EW activities include threat avoidance training, signals analysis, use of airborne and surface electronic jamming devices to defeat tracking radar systems, and the firing of very small simulated surface-to-air missiles (called Smokey SAMs).

In FY04, operations were conducted using 12 Smokey SAMs, 52 packets of chaff, and 30 flares. Deployment of Smokey SAMs and chaff and flares are the only ancillary operations systems that could potentially affect marine biological resources.

Constituents of Smokey SAMs that end up in the ocean after use include the 2-ft (0.6 m) long biodegradable Styrofoam-like body and small amounts of unburned propellant (see Section 3.4.2 for discussion). The major constituents of chaff and flares are aluminum and magnesium, respectively, with some flares also containing small amounts of chromium and lead. The aluminum fibers that make up chaff are generally non-toxic. Elemental aluminum in seawater would tend to be converted by hydrolysis to aluminum hydroxide, which is relatively insoluble, and is scavenged by particulates and transported to the bottom sediments (Kleinberg 2003). Combustion products from flares are non-hazardous, consisting of magnesium oxide (64.2 percent), sodium carbonate (23.6 percent), carbon dioxide (9.0 percent), and water (2.9 percent) (Section 3.4). The amounts of debris are negligible, and the chemical constituents do not affect water quality or, by extension, marine biological resources.

Mine Warfare

Mine Interdiction Warfare (MIW) training includes Small Object Avoidance (SOA), Mine Countermeasures (MCM) Exercises and Mine Laying Exercises (MINEX). SOA training is conducted at the Kingfisher Range and Shallow Water Training Range (SWTR), while MCM training is currently conducted on the Kingfisher Range and offshore areas in the Tanner and Cortez Banks. MCM training engages ships' crews in the use of sonar for mine detection and avoidance, and minefield navigation and reporting. MINEX events are conducted on the MINEX Training Ranges in the Castle Rock, Eel Point, China Point, and Pyramid Head areas offshore of SCI.

SOA and MCM operations involving ships transiting through a field of tethered mine shapes. There are no sensitive marine resources in the vicinity of the operation, and these operations do not require targets or other devices that use or contain potentially hazardous materials.

In the single aircraft MINEX, the aircraft makes multiple passes dropping one or more inert training shapes (e.g., MK-76, MK18A1) in the various mine ranges near SCI. A normal operation usually consists of dropping four inert mine shapes. The shapes are scored for accuracy as they enter the water and would not be recovered. In the multiple aircraft exercise, mines shapes are dropped in a coordinated deployment pattern. The final location of each mine would be scored and the shapes would be recovered, some by marine mammals. In FY04, operations were conducted using 86 inert mine shapes (64 not recovered). The probability of a mine shape sinking to the bottom on or immediately adjacent to a white abalone is very remote due to the narrow distribution and low abundance of white abalone. As there are no other sensitive marine resources in the vicinity of the operation, and the operation does not require targets or other devices that use or contain potentially hazardous materials, effects of mining training on marine biological resources are not anticipated.

Naval Special Warfare (NSW) Training

NSW Center Land Demolitions. Effects to marine biological resources are not anticipated because Land Demolitions occur within designated land areas on SCI.

NSW Center Underwater Demolitions. NSW Center Underwater Demolitions are conducted in the nearshore areas of BUD/S beach or Graduation Beach, both in the Northwest Harbor area.

Underwater Demolitions take place on an area of sandy bottom, shallow subtidal habitat, which is not a sensitive habitat, nor are sensitive species present in this habitat. (see Section 3.6.1). Shallow sandy subtidal habitats support a community of widespread, common species that include tubeworms, burrowing anemones, bivalves, crabs, and sand dollars. No kelp beds, surfgrass, or eelgrass beds are present. Demolition operations would cause the disturbance of surficial sediments and the mortality of organisms living on and in the substrate, and in the overlying water column. Mobile species are expected to rapidly move back into the area following detonations, whereas sedentary species would be eliminated and may or may not recover to previous abundances depending on the spatial overlap and time interval between detonations. Turbidity increases following explosions would be brief, i.e., lasting a few minutes to a few hours, and not expected to extend a substantial distance away from the area of the detonations because the sediments are coarse and would rapidly fall out of suspension or be dispersed by waves and currents. Effects on sediment-dwelling organisms, which are regularly exposed to high turbidity as a result of waves and currents, would be minimal. Detonation products are non-hazardous and would not affect water quality (see Section 3.4.2). Impacts on fish are discussed in Section 3.7.

NSW Center Small Arms. While small arms training events typically occur on designated ranges ashore on SCI, training of personnel also is conducted aboard surface ships at sea firing into the sea. No impacts on marine biological resources are expected as operations do not affect marine habitats that support sensitive species.

NSW Center Land Navigation. No impacts on marine biological resources are expected because Land Navigation Operations would occur within designated land areas on SCI.

UAV/UAS Training. This operation was performed five times during the baseline year (2004). It involves several unmanned aircraft, three Pointer ships, and several support boats to conduct photo imaging and capture the onshore, nearshore, and offshore environments. Although fuel and oil could potentially be spilled from compromised aircrafts or support vessels that may affect marine organisms, any releases would be very small. No other aspects of this operation effects marine biological resource, therefore, impacts are anticipated to be minimal.

Insertion/Extraction. NSW personnel conduct insertion/extraction operations including parachute training of personnel, rubber boats, and equipment, within the Leon Water Drop Zone and in transit to San Clemente Island. Potential impacts on marine biological resources from insertion/extraction operations would be due to the beach landings associated with bringing personnel ashore. Combat Rubber Raiding Craft (CRRC) landings typically would occur on sandy beaches, which are very dynamic habitats that are biologically less diverse than rocky intertidal habitats. The landing of small CRRCs themselves causes minimal disturbance to the shoreline, and though fuel and oil could potentially be spilled from the CRRCs' engines that may affect marine organisms, any releases would be very small. The effect to marine biological resources from insertion/extraction operations is therefore anticipated to be minimal.

NSW Boat Operations. Special Boat Team 12 conducts boat training throughout the SOCAL OPAREAs. Boat operations occur in the open ocean between Naval Amphibious Base Coronado, SCI, Seal Beach, Port Hueneme, Camp Pendleton, and SSTC. Although fuel and oil could potentially be spilled from vessels that may affect marine organisms, any releases would be very small and not significant. No other aspects of this operation effects marine biological resource, therefore, impacts are anticipated to be minimal.

SEAL Platoon Operations. SEAL activities vary widely and include operations that would be performed in the offshore, nearshore, and onshore Training Areas and Ranges (TARs) of SCI. Potential effects on marine biological resources from SEAL operations are similar to other small boat operations and are anticipated to be minimal.

TAR 1—Demolition Range Northeast Point. TAR 1 is an existing component and exists to provide basic demolition and Over-the-Beach (OTB) tactical training. It is 1 acre (ac) in size, and 23 operations per year occur under the No Action Alternative. Effects to marine biological resources are limited to platoon-sized ingress and egress via CRRCs over sandy substrate, which, as described for insertion/extraction operations is not considered a sensitive habitat and does not support threatened or endangered species. Therefore, effects on marine biological resources are expected to be minimal from operations on TAR 1.

TAR 4—Whale Point/Castle Rock. TAR 4 was previously used as a demolition range and is 27.4 ac in size. A total of 212 operations per year would occur under the No Action Alternative. Operations include land demolition training, OTB, strategic reconnaissance, direct action tactical training, immediate action drills, small arms live-fire, Military Operations in Urban Terrain (MOUT) operations, helicopter landings, UAV operations, and convoy/mounted operations. Effects on marine biological resources would be limited to nearshore and onshore ingress and egress which, as described for insertion/extraction operations does not occur on sensitive habitat and does not affect threatened or endangered species. Therefore, effects on marine biological resources are expected to be minimal from operations on TAR 4.

NSW Direct Action. NSW Direct Action is primarily a ground operation involving an amphibious landing, ground maneuver, live-fire and demolition training by a Marine Corps special operations or NSW units. This category also includes boat-to-shore and boat-to-boat gunnery. Demolition training can be either on land or underwater. A typical Gunnery Exercise is a NSW mission conducted against an objective in SHOBA, usually at night, using small arms live-fire and demolitions charges.

Most live-fire occurs either onshore or from boats with firing directed onshore, so no impacts on marine biological resources would be expected to occur from ordnance entering the water. One exception would be when SEAL units conduct air defense missile firing training in SHOBA. These involve small, shoulder-fired Stinger missiles fired at BATS, which would be launched from the back of a truck parked on the southern edge of SHOBA. BATS are small, solid rocket propelled targets, containing 12-30 lb (5.4-13.6 kg) of propellant that would be expended on launch, leaving no significant hazardous components. Stinger missiles have approximately 11.4 lb (5.2 kg) of propellant (also expended on launch) and a 0.85 lb (0.4 kg) explosive warhead. While the targets would be launched from the shore, the Stingers would be fired from two locations. When Special Boat Units (SBUs) fire their Stingers from boats in the nearshore ocean area, and the expended Stinger missiles would land in the water or when firing from land the stingers would land in Impact Area IIA.

Only eight air defense missile firing operations are conducted under this alternative. Some missile and/or target debris would enter the water, and as described under ASW operations, impacts would be minimal.. Therefore, only those NSW Direct Action operations involving an amphibious landing have the potential to impact marine biological resources. One typical Direct Action Exercise would be a Naval Special Warfare Full Mission Profile conducted against an objective in SHOBA. Participants include a SEAL platoon of 14 men, a Special Operations Craft, and a support element. The Special Operations Craft with the SEAL platoon transits over the open ocean to within 2 mi of SCI. The SEAL platoon transitions to CRRCs and proceeds toward the beach. The SEALs then either swim the remaining distance or land the CRRC on the beach. After the attack, the SEALs relaunch or swim back to the boat. CRRC landings typically would occur on sandy beaches, which are very dynamic habitats that support relatively fewer organisms than rocky intertidal habitats. The landing of small rubber CRRCs themselves would cause minimal disturbance to the shoreline, and though fuel and oil could potentially be spilled from the CRRCs' engines that may affect marine organisms, any releases would be very small and not significant. The effect on marine biological resources from Direct Action and demolitions are anticipated to be minimal.

Research, Development, Test and Evaluation (RDT&E)

Ship Tracking and Torpedo Tests. There were 22 Ship Tracking and Torpedo tests conducted under the No Action Alternative. Nominal participants for a typical test were one helicopter, one surface ship, and one submarine. Potential impacts of Ship Tracking and Torpedo Tests on marine plants and invertebrates would primarily be associated with the incidental release of materials from surface ships, submarines, or the release of a torpedo. The resulting debris and/or discharges may affect the physical and chemical properties of benthic habitats and the quality of surrounding marine waters, in turn affecting populations of marine plants and invertebrates. However, only four of the tests included a torpedo firing, two running MK-54s and two non-running Recoverable Exercise Torpedoes (REXTORPs), and all of the torpedoes were recovered. Disturbance of deep ocean dwelling organisms would be expected from this operation but would be of short duration. Hazardous constituents of concern possibly emitted from the surface ship or submarine (i.e., fuel, oil) are less dense than seawater and would remain near the surface and therefore would not affect the benthic community. Sheens (e.g., oil or fuel) produced from these activities are not expected to cause any long-term impact on marine biological resources because a majority of the toxic components (e.g., aromatics) will evaporate within several hours to days and/or be degraded by biogenic organisms (e.g., bacteria, phytoplankton, zooplankton) (National Research Council 1985). Effects on marine biological resources from Ship Tracking and Torpedo Tests are anticipated to be minimal.

Unmanned Underwater Vehicle (UUV) Tests. This operation was performed ten times during the baseline year (2004). It involves one support ship and two unmanned underwater vehicles. Unmanned UUV operations occur primarily in shallow water up to shoreline in the NOTS pier area utilizing no ordnance. During a worst-case scenario, in which the UUV is compromised, many of the hazardous constituents of concern that may be emitted from the UUVs (i.e., fuel, oil) are less dense than seawater and remain near the surface and therefore do not affect the benthic community. Sheens (e.g., oil or fuel) produced from these activities are not expected to cause any long-term impact on marine biological resources because a majority of the toxic components (e.g., aromatics) will evaporate within several hours to days and/or be degraded by biogenic organisms (e.g., bacteria, phytoplankton, zooplankton) (National Research Council 1985). Effects on marine biological resources from UUV operations are anticipated to be minimal.

Sonobuoy Quality Assurance (QA)/Quality Control (QC) Tests. Sonobuoys are expendable devices used for the detection of underwater acoustic sources and for conducting vertical water column temperature measurements. This program has been previously evaluated and found to have less than significant impacts on marine biology and other resources (DoN 1993). In FY04, 117 operations were conducted and 3,098 sonobuoys were deployed, with 2,674 not recovered. This program would be conducted on the east side of the island and does not overlap the ASW activities, discussed above under ASW. Potential impacts from sonobuoys on marine biological resources in SOAR are discussed under ASW. In both locations, these impacts are anticipated to be minimal. As discussed under ASW, sonobuoy emissions do not accumulate or result in additive effects on water quality as would occur within an enclosed body of water. The constituents of sonobuoys are widely dispersed in space and time throughout training areas, and water quality effects are appropriately analyzed in terms of the single event release that occurs from individual sonobuoys. Lead has the potential to accumulate in bottom sediments, but the potential concentrations would be well below sediment quality criteria based on thresholds for negative biological effects. By far the greatest amount of material is likely to be deposited in relatively inert form, as the lead ballast weights that become encrusted with lead oxide and other salts and would be covered by the bottom sediments.

The wide separation between the Sonobuoy Quality Assurance Program and the activities conducted in SOAR ensures that there would be no potential for cumulative effects of the combined total of 7,683 sonobuoys. Impacts on marine biological resources from sonobuoy QA/QC tests are anticipated to be minimal.

Ocean Engineering Tests. Ocean Engineering is primarily Long-Term Environmental Testing and has been conducted from the early 1980s to present. This research and development testing involves the ocean deployment of hardware, cabling, mine, and MCM equipment (including live ordnance testing), underwater tools and equipment, and related components. The test items would be placed in appropriate locations in the water and/or on the seafloor to measure the long-term effect of exposure to the marine environment. Tests run from days to decades, and monitoring would be periodically and consistently performed with SCUBA divers or with RPVs piloted from the pier or boat. Periodic removal of excessive marine growth from the devices is often required. Tests would be conducted from the North Light Pier area to NOTS pier, and would be supported with research vessels, shore cranes, small boats, and divers. In FY04, 242 operations were conducted and utilized six small vessels. Effects to marine biological resources are anticipated to be minimal because Ocean Engineering operations would occur in sandy subtidal habitats where very limited resources occur.

Marine Mammal Mine Shape Location and Research. SPAWAR trains and deploys marine mammals to SCI operational areas in support of Navy operations. The primary task of the marine mammals is to perform underwater surveillance for object detection, location, marking, and recovery. None of the training exercises involves explosives or other intrusive activities; therefore, effects from Marine Mammal Mine Shape Location and Research operations are anticipated to be minimal.

Unmanned Aerial Vehicles (UAV) Training. This operation was performed 12 times during the baseline year (2004). It involves one aircraft per operation to conduct photo imaging and capture the onshore, nearshore, and offshore environments. UAV tests involve no ordnance. Therefore, it is unlikely that there would be any impacts on marine resources due to this operation.

Missile Flight Tests. This operation is proposed to be conducted 5 times in the No Action Alternative. The Joint Standoff Weapon (JSOW) missile testing program at SCI was the subject of an EA (NAWCWPNS, 1994) which resulted in a FONSI. An EA was also completed for Tomahawk missile testing at SCI (NAWCWPNS, 1998). There are three primary target areas: the Missile Impact Range (MIR), offshore ships, and SHOBA. As targets are located in the ocean, there exists a potential for effects to marine biological resources; however, these effects are similar to those described in ASW and are anticipated to be minimal.

Naval Undersea Warfare Center (NUWC) Acoustics Tests. The San Diego Division of NUWC is a Naval Sea Systems Command (NAVSEA) organization supporting the Pacific Fleet. NUWC operates and maintains the SCI Underwater Range (SCIUR). NUWC conducts tests, analysis, and evaluation of submarine USW exercises and test programs. It also provides engineering and technical support for Undersea Warfare (USW) programs and exercises design cognizance of underwater weapons acoustic and tracking ranges and associated range equipment. It also provides proof testing and evaluation for underwater weapons, weapons systems, and components.

Under the No Action Alternative, NUWC operations are proposed to be conducted a total of 46 times per year. These tests involve Weapon System Accuracy Trials (WSATs), Sensor Accuracy Tests (SATs), At-Sea Bearing Accuracy, Acoustic Trials, and Special Tests. Torpedoes would be utilized during WSATs only and these would be recovered. Sonar would be utilized in WSATs, SATs, and Special Test operations. No sonar is used under the other tests. The operations are all conducted in the SCIUR area within 12 nm (22 km) of the shoreline. A total of eight torpedoes would be expended per year, and potential impacts of NUWC Acoustic Tests on marine plants and invertebrates are primarily associated with the incidental release of materials from surface ships or a torpedo. The resulting debris and/or discharges may affect the physical and chemical properties of benthic habitats and the quality of surrounding marine waters, in turn affecting populations of marine plants and invertebrates. However, a small number of tests include torpedo firings and the potential for surface ships to release fuel and/or oil is small. Additionally, NUWC Acoustics Tests are similar in effect to Sonobuoy QA/QC Tests; therefore, effects on marine biological resources associated with NUWC Acoustics Tests are anticipated to be minimal.

3.6.2.3 Marine Protected Areas and Marine Managed Areas

The No Action Alternative does not propose new Navy activities in the CINMS, nor activities that are different from those currently conducted in the CINMS. Therefore, proposed activities under the No Action Alternative are consistent with those activities currently conducted in the CINMS, are consistent with those described in the designation document, and are not being changed or modified in a way that would require consultation.

3.6.2.3.1 Threatened and Endangered Species

White Abalone

Most training activities in the SOCAL OPAREAs are not likely to affect white abalone because those activities would occur outside the habitat of this species. A few of the training activities, however, have the potential to affect the species because they occur in or immediately adjacent to white abalone habitat and result in objects entering or being placed within that habitat. These include sonobuoy testing and use, chaff and flare fallout to the water and mine training exercises.

Sonobuoys. Sonobuoy testing occurs in SCIUR on the northeast side of SCI. This area is located immediately adjacent to the island and extends 5 nm (9 km) offshore. Within this area, sonobuoy testing occurs seaward of the 3,000-ft (914-m) depth contour (approximately 1.5 mi [2.4 km] offshore). Only the sonobuoys that fail to function properly are recovered (approximately 5 percent). The remainder are scuttled and sink to the bottom. Based on the current directions and operational procedure of scuttling the test sonobuoys while they are still over deep water, none of the sonobuoys are expected to sink in white abalone habitat at the northern end of the island.

The probability of a sonobuoy sinking to the bottom on or immediately adjacent to a white abalone is very remote due to the sparse distribution of white abalone and the likelihood that the sonobuoys would be scuttled far from abalone habitat. Modeling and laboratory testing have shown that the concentration of potentially toxic chemical components (lead, copper, and silver) of the seawater batteries used in sonobuoys released during operation of the batteries and during scuttling is below the maximum levels allowed in the California Ocean Plan. These chemicals are further diluted by oceanic currents. The other components of the sonobuoys sink to the bottom in depths where white abalone do not occur. The slow release of chemicals during the corrosion of the sonobuoy debris is also well below toxic levels. Bioaccumulation of these metals by the attached algae used as food by white abalone is not likely to occur because the metals are released away from the nearshore areas where these algae grow and dilution by oceanic currents would keep concentrations too low for accumulation to levels that could be toxic to white abalone.

Chaff and Flares. Both chaff and flares are used during aircraft training exercises. Chaff is an aluminum-coated glass fiber used as a defensive mechanism to reflect radar. These fibers are generally 25.4 microns in diameter (including the aluminum coating) and are cut into dipoles 0.3 to 2.0 in (0.7 to 5 cm) long. The fibers are coated with Neofat 18 (90 percent stearic acid and 10 percent palmitic acid) to minimize clumping of the fibers when ejected. The chemical components of chaff are shown in Table 3.6-2. All of the components of the aluminum coating are present in seawater in trace amounts, except magnesium, which is present at 0.1 percent. The stearic acid coating is biodegradable and nontoxic. The potential for chaff to accumulate in white abalone habitat and then for an individual abalone to come in contact with the chaff is very unlikely. Chemicals leached from the chaff would also be diluted by the surrounding seawater, thus reducing the potential for concentrations to build up to levels that could have effects on organisms. Such low use over a large area (hundreds of square nautical miles) would have no effects on white abalone.

Flares are used over water during training. They are composed of a magnesium pellet that burns quickly at a very high temperature leaving ash and end caps and pistons. Laboratory leaching tests of flare pellets and residual ash using synthetic seawater found barium in the pellet tests while boron and chromium were found in the ash tests. The pH of the test water was raised in both tests. Ash from flares would be dispersed over the water surface and then settle out. Most of the flares are used in the SHOBA and a few (less than 100) are used in the EC Range. Only a small portion (less than 2 percent) of the SHOBA contains white abalone habitat. Dispersed flare ash is not expected to alter water chemistry in the vicinity of white abalone because only a small amount would be expected to fall within their habitat. Chemical leaching would occur throughout the settling period through the water column and any leaching after the particles reach the bottom would be dispersed by currents. As a result, flare ash is expected to have no effect on white abalone. Dud flares that fall into the ocean could land in white abalone habitat, but the number would be very low given the large area over which flares are used, the small amount of white abalone habitat within that area, and the low expected frequency of duds within the total number used.

Table 3.6-2. Chaff Chemical Composition

Component	Percent by Weight
Glass Fibers	
Silicon dioxide (SiO_2)	52-56
Alumina (Al_2O_3)	12-16
Calcium oxide (CaO) & Magnesium oxide (MgO)	15-25
Boron oxide (B_2O_3)	8-13
Sodium oxide (Na_2O) & Potassium oxide (K_2O)	1-4
Iron oxide (Fe_2O_3)	1 or less
Aluminum Coating	
Aluminum (Al)	99.45 min
Silicon (Si) + Iron (Fe)	0.55 max
Copper (Cu)	0.05 max
Manganese (Mn)	0.05 max
Magnesium (Mg)	0.05 max
Zinc (Zn)	0.05 max
Vanadium (V)	0.05 max
Titanium (Ti)	0.03 max
Others	0.03 max
Sources: Military Specification R-6034b; Aluminum Association, Inc.	

Mine Training. During mine training exercises, inert mine shapes are dropped from aircraft into specific MTRs along the west and south sides of SCI. The baseline use of mine shapes is 86 per year, and that would remain identical per year for Alternative 1 and increase to 91 for Alternative 2. However, some of the mine shapes are recovered (22 for the baseline and Alternative 1 and 24 for Alternative 2). The unrecovered shapes are inert material that sink to the bottom. The four MTRs overlap white abalone habitat where they are over water less than 197 ft (60 m) in depth. This includes the north and east sides of MTR1, the east side of MTR2, the China Point area for the China Point range, and the northwest corner (near China Point) of the Pyramid Head range. The number of mine shapes that could be dropped within white abalone habitat within each training range is shown in Table 3.6-3. The density of white abalone is very low at SCI, estimated to be one per hectare by the National Marine Fisheries Service (NMFS) in their FY01 Annual Report (nine abalone per 1 million ft^2). Adult white abalone live on rock surfaces that are at various angles, and they may be within crevices or on the sides of rocks where they would be less likely to be hit by falling objects. The mine shapes are of inert materials and would have no effect on water quality or direct toxic effects if abalone were to come in contact with the mine shapes.

Table 3.6-3. Mine Shapes per Year in White Abalone Habitat

Location	Baseline	Alternative 1	Alternative 2
MTR1	43	43	46
MTR2	17	17	18
China Point + Pyramid Head	18	18	18
Notes: Calculated based on 50% deployed to MTR1, 20% to MTR2, and 10% each to China Point and Pyramid Head			

Black Abalone

Most training activities in the SOCAL OPAREAs would not affect black abalone because those activities would occur outside the habitat of this species. A few of the training activities, however, have the potential to affect the species because they occur in black abalone habitat and result in potentially damaging habitat. These include Naval Surface Fire Support (NSFS) and Insertion/Extraction.

NSFS operations involve surface ships firing at surface targets in fire support areas in SHOBA. Potential impacts from NSFS operations include damage to rocky intertidal and subtidal habitat. Fire Support Area II is located in the China Cove area and has some rocky nearshore habitat (e.g., China Point) interspersed between sandy habitats. Based on Section 3.3, 1.5 percent of the 4,270 shells (64) fell short and entered the water during the baseline year. An unknown number of these may have detonated in the vicinity of rocky habitats and resulted in the destruction of the substrate and associated organisms (e.g., surfgrass, algae, and invertebrates). No data are available on the extent of impacts, but they are predicted to affect areas on the order of 10s to 100s of square feet, denuding the substrate, or breaking existing rocks to create new unoccupied surfaces. It is not known if black abalone are present in the vicinity of FSA II, but given the dramatic decline in black abalone populations due to WS, and results from island-wide intertidal surveys that documented 10 abalone around SCI (DoN 2007, 2008), black abalone are presumed to be rare or absent at FSA II.

The landing of small CRRCs themselves causes minimal disturbance to the shoreline, and though fuel and oil could potentially be spilled from the CRRCs' engines that may affect black abalone, any releases would be very small. Given the low probability that black abalone would be present at the exercise location, and if a spill were to occur, the impact to black abalone from insertion/extraction operations are not likely.

3.6.2.4 Alternative 1

Alternative 1 is a proposal designed to meet Navy and DoD current and near-term operational training requirements. If Alternative 1 were to be selected, in addition to accommodating training operations currently conducted, the SOCAL Range Complex would support an increase in training operations including Major Range Events and force structure changes associated with introduction of new weapons systems, vessels, and aircraft into the Fleet. Under Alternative 1, baseline-training operations would be increased. In addition, training and operations associated with force structure changes would be implemented for the LCS, MV-22 Osprey,P8A Poseidon, EA-18G Growler, and SH-60R/S Seahawk Multi-Mission Helicopter, the Landing Platform-Dock [LPD] 17 amphibious assault ship, and the DDG 1000 [Zumwalt Class] destroyer. Force structure changes associated with new weapons systems would include Offensive Mine Counter Measure (OMCM) systems.

3.6.2.4.1 SOCAL Range Complex

Anti-Air Warfare (AAW) Training

AAW Operations are conducted more often in Alternative 1 than in the No Action Alternative (See Table 2-7). The total number of operations increases from 4,386 to 4,857 from the No Action Alternative to Alternative 1, an increase of 10.7 percent.

Impacts to marine biological resources are not anticipated from AAW operations, as described previously for the No Action Alternative (see Section 3.6.2.2.1), and the small change in the number of exercises would not change those predictions.

Anti-Submarine Warfare (ASW) Training

ASW Operations are conducted more often in Alternative 1 than in the No Action Alternative (See Table 2-7). The total number of operations increases from 1,693 to 2,969 from the No Action Alternative to Alternative 1, an increase of 75 percent.

As described in Section 3.6.2.2.1, all of the ASW operations are not expected to have impacts on marine biological resources, and the change in the number of exercises would not change those predictions.

Anti-Surface Warfare Training

Anti-Surface Warfare Operations are conducted more often in Alternative 1 than in the No Action Alternative (Table 2-7). The total number of operations increases from 498 to 565 from the No Action Alternative to Alternative 1, an increase of 13.5 percent.

Impacts to marine biological resources are anticipated to be minimal, as described previously for the No Action Alternative (see Section 3.6.2.2.1), and the small change in the number of exercises would not change those predictions.

Amphibious Warfare

Amphibious Warfare Operations are conducted more often in Alternative 1 than in the No Action Alternative (Table 2-7). The total number of operations increases from approximately 2,265 to approximately 2,366 from the No Action Alternative to Alternative 1, an increase of 4.5 percent.

Impacts to marine biological resources are anticipated to be minimal, as described previously for the No Action Alternative (see Section 3.6.2.2.1), and the small change in the number of exercises would not change those predictions. For other Amphibious Warfare operations, the analysis is provided below.

Expeditionary Assault Battalion Landing. The Navy proposes to conduct one amphibious battalion landing under Alternative 1. The amphibious forces would land by helicopter (primarily CH-46s) and amphibious landings by utilizing rubber boats, Landing Craft Air Cushion (LCAC), Amphibious Assault Vehicles (AAV) (after 2007 the Expeditionary Fighting Vehicle [EFV]), and Landing Craft, Utility (LCU). These expeditionary forces would land at Northwest Harbor, Wilson Cove, West Cove, and Horse Beach in the Shore Bombardment Area (SHOBA). The potential for amphibious battalion landings to have a direct impact on sensitive habitats (i.e., rocky intertidal and subtidal habitats) would be reduced by measures that are taken to avoid potentially sensitive habitats. Amphibious battalion landings would occur only on the sandy portions of West Cove, Horse Beach Cove, or Northwest Harbor. Sandy beach habitats are very dynamic and are biologically less diverse than rocky intertidal habitats. In addition, organisms inhabiting sandy beach areas have adapted to surviving in a variable environment. There is also the low likelihood of fuel or oil spills from vessels participating in the exercises. However, impacts to marine plants and invertebrates are anticipated to be minimal.

Amphibious Operations – CPAAA. Under Alternative 1, the number of CPAAA amphibious operations would increase from 2,205 for the No Action Alternative to 2,271 operations per year. Despite the increase in the number of operations, effects from amphibious operations to marine biological resources would be similar to those described under the No Action Alternative and are anticipated to be minimal.

Stinger Air-Defense Missile Firing. Under Alternative 1, three USMC Stinger Firings operations would occur each year. The current firing positions are on China Point and to the west toward Impact Area II near the shoreline. The stingers are fired toward the ocean. A potential exists for Stinger Missiles to miss BATS or RPVs thus allowing missiles to continue flying out to sea. If this should occur, the missiles would be devoid of fuel, thereby consisting of only the missile casing and warhead. Impacts on marine biological resources from this operation would be similar to Air ASW and anticipated to be minimal.

Amphibious Landings and Raids (on SCI). Under Alternative 1, the number of amphibious landings and raids on SCI would increase from 7 for the No Action Alternative to 34 operations per year. Despite the increase in the number of operations, effects from amphibious landings and raids on SCI to marine biological resources would be similar to those described under the No Action Alternative and are anticipated to be minimal.

Electronic Warfare

The number of EC operations would increase from 748 to 755 operations per year. There would be the same number of SAMs (12), and an increased number of chaff (55 versus 52) and flares (31 versus 30) deployed. Deployment of chaff and flares are the only ancillary operations systems that could potentially affect marine biological resources, and the small increase would not increase the impacts on marine biological resources. Effects from EC operations to marine biological resources would be similar to those described under the No Action Alternative and are anticipated to be minimal.

Mine Warfare

The number of mine countermeasures (MCM) operations would increase from 44 to 46 operations per year. As this operation does not require targets or other devices that use or contain potentially hazardous materials, effects from MCM operations to marine biological resources would be similar to those described under the No Action Alternative and are not anticipated.

Mine neutralization operations involve helicopters towing surface sleds and submerged equipment through simulated threat minefields with the goal of clearing a safe channel through the minefield for the passage of friendly ships. Using a variety of external Organic Airborne Mine Countermeasures (OAMCM) systems, the MH- 60S crew searches for mines and mine-like shapes, detects and identifies them, then neutralizes them. These systems include the AN/AQS-20A Advance MCM Sonar, the AN/ALQ-220 Organic Airborne and Surface Influence Sweep (OASIS) mine sweeping system, the Airborne Laser Mine Detection System (ALMDS), the Airborne Mine Neutralization System (AMNS), and the Rapid Airborne Mine Clearance System (RAMCIS). Live fire operations would be conducted at SCI in one of the MTRs. Non-firing operations would be conducted at SCI or in a new Shallow Water Minefield (SWM). AMNS use would result in the firing of the MH4 Neutralizer, either live or inert. The RAMICS would use a modified MK44 Bushmaster canon to fire a 30mm supercavitating projectile.

The number of mine neutralization operations would increase from 0 to 732 operations per year, and the potential impacts of OAMCM systems on marine plants and invertebrates would primarily be associated with the expenditure of ordnance and incidental release of other materials in exercises that would be conducted in SWAT 1 (offshore), Pyramid Cove, MTR-1, MTR-2, and Northwest Harbor. The resulting debris and/or discharges may affect the physical and chemical properties of benthic habitats and the quality of surrounding marine waters, in turn affecting populations of marine plants and invertebrates. The analysis of water quality effects associated with OAMCM systems is provided in Section 3.4, Water Quality, and indicates that effects from mine neutralization operations to water quality are anticipated to be minimal.

The number of MINEX operations would be the same as the No Action Alternative (i.e., 17 operations per year). There would also be no change in the number of mines dropped (640). However, under this Alternative, mining training would occur both near SCI and at the Advance Research Project Agency (ARPA) Training Minefield . As there are no sensitive marine resources in the vicinity of the operation, and the operation does not require targets or other devices that use or contain potentially hazardous materials, impacts from MINEX operations to marine biological resources would be similar to those described under the No Action Alternative and are anticipated to be minimal.

Mining readiness certification training would typically involve either 3 P-3s in a Patrol Wing or up to 17 FA-18 aircraft in an Air Wing. In the case of an Air Wing, the aircraft take off from an aircraft carrier, drop their shapes in a pre-determined pattern, and return to the carrier. Activities of a Patrol Wing would be similar except the flights would originate on land. The drops would be centered on 300-ft (91-m) depth contours, typically in the waters located between Tanner and Cortes Banks. White abalone are known to occur at the Tanner and Cortes Banks; however, they are generally found in water depths less than 200 ft (61 m). Mine shapes are recovered to assist in final scoring for accuracy of mine shape placement. As the mines are inert and do not contain hazardous materials, are recovered, and are dropped in areas that are not known to host sensitive marine resources, impacts are anticipated to be minimal.

Naval Special Warfare (NSW) Training

NSW Center Land Demolitions. No impacts on marine biological resources are expected because Land Demolitions would occur within designated land areas on SCI.

NSW Center Underwater Demolitions. Under Alternative 1, the number of Underwater Demolition operations would increase from 86 to 101 operations per year. Impacts from Underwater Demolition operations to marine biological resources would be similar to those described under the No Action Alternative and are anticipated to be minimal.

NSW Center Small Arms. This operation was performed 171 times during the baseline year and would increase to 205 operations under Alternative 1. Even with the increase in number of operations, the impacts on marine biological resources from small arms operations would be similar to those described above under the No Action Alternative, and no impact anticipated.

NSW Center Land Navigation. No impacts on marine biological resources are expected because Land Navigation Operations would occur within designated land areas on SCI.

UAV/UAS Training. This operation was performed five times during the baseline year and would increase to 15 operations under Alternative 1. Even with the increase in number of operations, the impacts on marine biological resources from UAV/UAS training would be similar to those described above under the No Action Alternative, and anticipated to be minimal.

Insertion/Extraction. This operation was performed five times during the baseline year and would increase to 10 operations under Alternative 1. Even with the increase in number of operations, the impacts to marine biological resources would be similar to those described above under the No Action Alternative, and anticipated to be minimal.

NSW Boat Operations. This operation was performed 287 times during the baseline year and would increase to 320 operations under Alternative 1. Even with the increase in number of operations, the impacts to marine biological resources would be similar to those described above under the No Action Alternative, and anticipated to be minimal.

SEAL Platoon Operations. Under Alternative 1, the number of SEAL Platoon operations would increase from 340 to 512 operations per year, and would utilize the offshore, nearshore, and onshore components of the following TARs: 1, 2, 3, 4, 5, 10, 13, 17, 20, 21, and 22. The exercises typically involve ingress to the island by a special boat, SEAL Delivery Vehicles (SDVs) or reinforced inflatable boat, travel on foot to the target or objective area, execution of the mission (intelligence, Combat Search and Rescue [CSAR], direct assault, or other), and egress from the target areas and the island by boat.

The increase in operations would add incrementally to shoreline disturbance, but the impact on marine plants and invertebrates would be expected to involve very limited disturbance within a small fraction of the limited sandy shoreline of SCI, and would therefore are anticipated to be minimal. No impacts on marine biological resources would be expected from operations on TARs 6, 9, 11, 12, 14, 15, 16, 18, and 19 because the TARs would be located in designated land areas on SCI.

TARs 7 and 8 are exclusively located in open waters and would be utilized for parachute drop zones under this operation. The impacts on marine biological resources would be similar to those described under Small Boat Raid and are anticipated to be minimal.

NSW Direct Action. This operation was performed 156 times during the baseline year and would increase to 163 operations under Alternative 1. Even with the increase in number of operations, the impacts to marine biological resources would be similar to those described above under the No Action Alternative, and anticipated to be minimal.

Research, Development, Test and Evaluation (RDT&E)

Ship Tracking and Torpedo Tests. There are 15 Ship Tracking and Torpedo tests proposed under Alternative 1, a decrease of 7. Additional tests are proposed to occur in Alternatives 1 and 2 that did not occur in FY04. These tests include evaluations of a defensive torpedo against an incoming offensive torpedo threat. The 9-15 hour tests would be run in the SOAR with a submarine, aircraft carrier and SH-60B Light Airborne Multi-purpose System (LAMPS)-equipped helicopter. The SH-60B would employ sonobuoys, which will be the only items not recovered. Although Alternative 1 includes additional action under the operation, they would not add an impact to the marine biological resources, especially because of the decrease in number of operations. The impacts would be less but similar to those described above under the No Action Alternative. Therefore, impacts on marine biological resources from Ship Tracking and Torpedo Tests are anticipated to be minimal.

Unmanned Underwater Vehicle (UUV) Tests. This operation would be performed the same number of times as the baseline year (ten per year). Impacts on marine biological resources from UUV operations would be identical to those described above under the No Action Alternative and are anticipated to be minimal.

Sonobuoy Quality Assurance (QA)/Quality Control (QC) Tests. The number of sonobuoy testing operations would stay the same as baseline at 117 per year. Impacts from sonobuoy testing operations to marine biological resources would remain similar to those described under the No Action Alternative and are anticipated to be minimal

Ocean Engineering Tests. The number of Ocean Engineering operations would remain the same as the No Action Alternative (i.e., 242 per year). Impacts from Ocean Engineering operations to marine biological resources would be similar to those described under the No Action Alternative and are anticipated to be minimal.

Marine Mammal Mine Shape Location and Research. The number of Marine Mammal Mine Shape Location operations would increase from 5 to 20 per year. Despite the increase in operations, the operation does not involve explosives or other intrusive activities, therefore, impacts from Marine Mammal Mine Shape Location operations to marine biological resources would be similar to those described under the No Action Alternative and are anticipated to be minimal.

Missile Flight Tests. Missile Flight Tests are proposed to occur 15 times per year under Alternative 1. SPAWAR conducts multiple missile tests. As targets are located in the ocean, there exists a potential for effects to marine biological resources; however, effects are similar to those described in ASW and are anticipated to be minimal.

Naval Undersea Warfare Center (NUWC) Acoustics Tests. Under Alternative 1 this operation is proposed to increase from 44 to 83 times per year compared to the No Action Alternative. These tests involve WSATs, SATs, At-Sea Bearing Accuracy, Acoustic Trials, and Special Tests. Torpedoes would be utilized during WSATs only. Although this operation would almost double in number, the impacts to marine biological organisms would be incrementally minimal because the potential for releases of materials from surface ships or torpedoes are so small and NUWC Acoustics Tests are similar in impact to Sonobuoy QA/QC Tests; therefore, impacts on marine biological resources associated with NUWC Acoustics Tests are anticipated to be minimal.

Naval Auxiliary Landing Field (NALF) SCI Airfield Activities

Under Alternative 1, the number of NALF operations would increase from the No Action Alternative (25,120 to 26,400), and since operations occur within designated land areas on SCI, impacts to marine biological resources are not anticipated.

New Platforms/Vehicles

The introduction of the future platforms such as the LCS, MV-22, P8A Poseidon, EA-18G Growler, and MH-60R Seahawk Multi-Mission Helicopter, assuming that use and usage areas will remain similar to platforms that they are replacing will not have any impact to marine biological resources.

3.6.2.4.2 Marine Protected Areas and Marine Managed Areas

Alternative 1 does not propose new Navy activities in the CINMS, nor activities that are different from those currently conducted in the CINMS. Therefore, proposed activities under the Alternative 1 are consistent with those activities currently conducted in the CINMS, are consistent with those described in the designation document, and are not being changed or modified in a way that would require consultation.

3.6.2.4.3 Threatened and Endangered Species

Impacts to white and black abalone are not expected as described previously for the No Action Alternative (see Section 3.6.3.2.2), and the change in the number of exercises would not change those predictions. However, consultation with the resource agencies will ensure no impact to abalone species.

3.6.2.5 Alternative 2

Implementation of Alternative 2 would include all elements of Alternative 1 (accommodating training operations currently conducted, increasing training operations [including Major Range Events], and accommodating force structure changes). In addition, under Alternative 2:

- In order to optimize training throughput and meet the FRTP, training operations of the types currently conducted would be increased over levels identified in Alternative 1 (see Table 2-8);
- Range enhancements would be implemented, to include an increase in Commercial Air Services, establishment of a shallow water minefield; and establishment of the SWTR in the SOAR extensions, as described in Section 2.5.2.

Alternative 2 is the preferred alternative.

3.6.2.5.1 SOCAL Range Complex

Anti-Air Warfare (AAW) Training

AAW Operations are conducted more often in Alternative 2 than in the No Action Alternative (Table 2-8). The total number of operations increases from 4,386 to 4,889 from the No Action Alternative to Alternative 2, an increase of 11.5 percent.

Impacts to marine biological resources are not expected as described previously for the No Action Alternative (see Section 3.6.2.2.1), and the small change in the number of exercises would not change those predictions.

Anti-Submarine Warfare (ASW) Training

ASW Operations are conducted more often in Alternative 2 than in the No Action Alternative (Table 2-8). The total number of operations increases from 1,693 to 2,971 from the No Action Alternative to Alternative 2, an increase of 75.5 percent.

Impacts to marine biological resources are not expected as described previously for the No Action Alternative (see Section 3.6.2.2.1), and the change in the number of exercises would not change those predictions.

Anti-Surface Warfare Training

Anti-Surface Warfare Operations are conducted more often in Alternative 2 than in the No Action Alternative (Table 2-8). The total number of operations increases from 498 to 592 from the No Action Alternative to Alternative 1, an increase of 18.9 percent.

Impacts to marine biological resources are not expected as described previously for the No Action Alternative (see Section 3.6.2.2.1), and the change in the number of exercises would not change those predictions.

Amphibious Warfare

Amphibious Warfare Operations are conducted more often in Alternative 2 than in the No Action Alternative (See Table 2-8). The total number of operations increases from approximately 2,265 to approximately 2,408 from the No Action Alternative to Alternative 2, an increase of 6.3 percent.

Impacts to marine biological resources are anticipated to be minimal, as described previously for the No Action Alternative (see Section 3.6.2.2.1), and the small change in the number of exercises would not change those predictions. For other Amphibious Warfare operations, the analysis is provided below.

Expeditionary Assault Battalion Landing. The Navy proposes to conduct two amphibious battalion landing under Alternative 2. The amphibious forces would land by helicopter (primarily CH-46s) and amphibious landings by utilizing rubber boats, Landing Craft Air Cushion (LCAC), Amphibious Assault Vehicles (AAV) (after 2007 the Expeditionary Fighting Vehicle [EFV]), and Landing Craft, Utility (LCU). These expeditionary forces would land at Northwest Harbor, Wilson Cove, West Cove, and Horse Beach in the Shore Bombardment Area (SHOBA). The potential for amphibious battalion landings to have a direct impact on sensitive habitats (i.e., rocky intertidal and subtidal habitats) would be reduced by measures that are taken to avoid potentially sensitive habitats. Amphibious battalion landings would occur only on the sandy portions of West Cove and Northwest Harbor. Sandy beach habitats are very dynamic and are biologically less diverse than rocky intertidal habitats. In addition, organisms inhabiting sandy beach areas have adapted to surviving in a variable environment. There is also the low likelihood of fuel or oil spills from vessels participating in the exercises. However, impacts to marine plants and invertebrates are anticipated to be minimal.

Stinger Air-Defense Missile Firing. Under Alternative 2, four USMC Stinger Firings operations would occur each year. Effects on marine biological resources from this operation would be similar to those described under Alternative 1 and are anticipated to be minimal.

Amphibious Operations – CPAAA. Under Alternative 2, the number of CPAAA amphibious operations would increase from 2,205 for the No Action Alternative to 2,276 operations per year. Despite the increase in the number of operations, effects from amphibious operations to marine biological resources would be similar to those described under the No Action Alternative and are anticipated to be minimal.

Amphibious Landings and Raids (on SCI). Under Alternative 2, the number of amphibious landings and raids on SCI would increase from 7 for the No Action Alternative to 66 operations per year. Despite the increase in the number of operations, effects from amphibious landings and raids on SCI to marine biological resources would be similar to those described under the No Action Alternative and are anticipated to be minimal.

Electronic Warfare

The number of EC operations would increase from 748 to 775 operations per year. Impacts from EC operations to marine biological resources would be similar to those described under the No Action Alternative and are anticipated to be minimal.

Mine Warfare

The number of MCM operations would increase from 44 to 48 operations per year. As this operation does not require targets or other devices that use or contain potentially hazardous materials, effects from these operations to marine biological resources are similar to those described under the No Action Alternative and are not anticipated.

In addition, 12 additional MCM operations would be conducted in SWTR area. As this operation does not require targets or other devices that use or contain potentially hazardous materials, impacts from these operations to marine biological resources would be similar to those described under the No Action Alternative and are anticipated to be minimal.

The number of mine neutralization operations would increase from 0 in the No-Action Alternative to 732 operations per year. Impacts from mine neutralization operations to marine biological resources would be similar to those described under Alternative 1 and anticipated to be minimal.

The number of Mining Training operations would increase from 17 to 18 operations per year. There would also be a slight increase in the number of mines dropped (640 versus 679). Under this Alternative, mining training would occur both near SCI and in the SWTR area. As there are no sensitive marine resources in the vicinity of the operation, and the operation does not require targets or other devices that use or contain potentially hazardous materials, impacts from Mining Training operations to marine biological resources would be similar to those described under the No Action Alternative and anticipated to be minimal. Mining Training in the SWTR area would be similar to that described under Alternative 1, and marine biological resource impacts are anticipated to be minimal.

Naval Special Warfare (NSW) Training

NSW Center Land Demolitions. No impacts on marine biological resources are expected because Land Demolitions would occur within designated land areas on SCI.

NSW Center Underwater Demolitions. Under Alternative 2, the number of Underwater Demolition operations would increase from 72 to 85 operations per year. Impacts from Underwater Demolition operations to marine biological resources would be similar to those described under the No Action Alternative and are anticipated to be minimal.

NSW Center Small Arms. This operation was performed 171 times during the baseline year and would increase to 205 operations under Alternative 2. Even with the increase in number of operations, the impacts on marine biological resources from small arms operations would be similar to those described above under the No Action Alternative, and no impact anticipated.

NSW Center Land Navigation. No impacts on marine biological resources are expected because Land Navigation Operations would occur within designated land areas on SCI.

UAV/UAS Training. This operation would be increased from five to 27 operations per year compared to baseline. Although operations would increase slightly, impacts on marine biological resources are limited and would be similar to those described above under the No Action Alternative. Therefore, impacts on marine biological resources from UAV/UAS training would are anticipated to be minimal.

UAV/UAS Training. This operation was performed five times during the baseline year and would increase to 27 operations under Alternative 2. Even with the increase in number of operations, the impacts on marine biological resources from UAV/UAS training would be similar to those described above under the No Action Alternative, and anticipated to be minimal.

Insertion/Extraction. This operation was performed five times during the baseline year and would increase to 15 operations under Alternative 2. Even with the increase in number of operations, the impacts to marine biological resources would be similar to those described above under the No Action Alternative, and anticipated to be minimal.

NSW Boat Operations. This operation was performed 287 times during the baseline year and would increase to 320 operations under Alternative 2. Even with the increase in number of operations, the impacts to marine biological resources would be similar to those described above under the No Action Alternative, and anticipated to be minimal.

SEAL Platoon Operations. The number of SEAL Platoon operations, under Alternative 2, would increase from 340 to 668 operations per year - a 96 percent increase. Impacts on marine biological resources on TARs that have a marine component (TARs 1, 2, 3, 4, 5, 7, 8, 10, 13, 17, 20, 21, and 22) from these operations, including the use of stinger missiles in shallow water, and relatively slight disturbance of intertidal substrates during landings, would occur more frequently but would be anticipated to be minimal as discussed under Alternative 1. Additionally, no impacts on marine biological resources are expected from operations on TARs 6, 9, 11, 12, 14, 15, 16, 18, and 19 because the TARs would be located in designated land areas on SCI.

NSW Direct Action. This operation was performed 156 times during the baseline year and would increase to 190 operations under Alternative 2. Even with the increase in number of operations, the impacts to marine biological resources would be similar to those described above under the No Action Alternative, and anticipated to be minimal.

Strike

Bombing Exercise (Land). Effects to marine biological resources are less than significant because Bombing Exercise (Land) occur within designated land areas on SCI.

Combat Search and Rescue (CSAR). Under Alternative 2, the number of CSAR operations would increase from 7 in the No Action Alternative to 8 operations per year; however, no impacts on marine biological resources are expected because CSAR Operations would occur within designated land areas on SCI.

Non-Combatant Operations

Explosive Ordnance Disposal (EOD). Under Alternative 2, the number of EOD operations would increase from 4 in the No Action Alternative to 10 operations per year; however, no impacts on marine biological resources are expected because EOD Operations would occur within designated land areas on SCI.

Research, Development, Test and Evaluation (RDT&E)

Ship Tracking and Torpedo Tests. The number of Ship Torpedo Defense Operations would decrease to 20 per year from 22 under the No Action Alternative. With the decrease in number of operations, the impacts would be less but similar to those described above under the No Action Alternative and under Alternative 1. Therefore, impacts on marine biological resources from Ship Tracking and Torpedo Tests are anticipated to be minimal.

Unmanned Underwater Vehicle (UUV) Tests. This operation was performed ten times during the baseline year (2004) and would increase to 15 times under Alternative 2. Although operations would increase under Alternative 2, the impacts on marine biological resources from UUV operations would be similar to those described under the No Action Alternative and are anticipated to be minimal.

Sonobuoy Quality Assurance (QA)/Quality Control (QC) Tests. The number of sonobuoy testing operations would increase from 117 to 120 per year. Impacts on marine biological resources from these operations would remain similar to those described under the No Action Alternative and are anticipated to be minimal.

Ocean Engineering Tests. The number of Ocean Engineering operations would remain the same as under the No Action Alternative (i.e., 242 per year). Therefore, impacts on marine biological resources from Ocean Engineering operations would be similar to those described under the No Action Alternative and are anticipated to be minimal.

Marine Mammal Mine Shape Location and Research. The number of Marine Mammal Mine Shape Location operations would increase from 5 to 30 per year. Despite the increase in operations, the operation does not involve explosives or other intrusive activities, therefore, impacts from Marine Mammal Mine Shape Location operations to marine biological resources would be similar to those described under the No Action Alternative and are anticipated to be minimal.

Missile Flight Tests. Missile Flight Tests are proposed to occur 20 times per year under Alternative 2. SPAWAR conducts multiple missile tests. As targets are located in the ocean, there exists a potential for effects to marine biological resources; however, effects are similar to those described in ASW and are anticipated to be minimal.

Naval Undersea Warfare Center (NUWC) Acoustics Tests. Under Alternative 2, this operation is proposed to increase to 139 times per year compared to 44 under the No Action Alternative. These tests involve WSATs, SATs, At-Sea Bearing Accuracy, Acoustic Trials, and Special Tests. Torpedoes would be utilized during Weapon System Accuracy Trials only. Impacts on marine biological resources associated with the increase in operations are similar to those described in the No Action Alternative and are anticipated to be minimal.

Naval Auxiliary Landing Field (NALF) SCI Airfield Activities

Under Alternative 2, the number of NALF operations would increase from the No Action Alternative (25,120 to 27,400), and since operations occur within designated land areas on SCI, impacts to marine biological resources are not anticipated.

New Platforms/Vehicles

The introduction of the future platforms such as the LCS, MV-22, P8A Poseidon, EA-18G Growler, and MH-60R Seahawk Multi-Mission Helicopter will not have any impact to marine biological resources provided that use and usage areas will remain similar to platforms that they are replacing.

SOCAL Range Complex Enhancements

Commercial Air Services Increase. Under the Proposed Action, an increase in Commercial Air Services would be implemented. No aspect of this operation effects marine biological resources, and therefore impacts are not expected.

Shallow Water Minefield. The Navy proposes to construct a shallow water minefield in the SOCAL Range Complex. Multiple site options off Tanner Bank, Cortes Bank, La Jolla, and Point Loma have been identified with consideration being given to bathymetry and required capabilities. Shallow water minefield support of submarine MCM training requires a depth of 250-420 ft (76-128 m), and a sandy bottom and flat contour in an area relatively free from high swells and waves. The size of the area should be a minimum of 2x2 nm (3.7x3.7 km) and optimally 3x3 nm (5.6x5.6 km). Mine shapes would be approximately 600 yards (549 m) apart and 30-35 inches (0.8-0.9 m) in size, and would consist of a mix of recoverable/replaceable bottom shapes (~10 cylinders weighed down with cement) and moored shapes (~15 shapes, no bottom drilling required for mooring). Small, localized impacts to epibenthic and benthic fauna in the vicinity of the mine shapes would occur; however, based on the project criteria, no sensitive habitat or species will be affected by the installation of the shallow water minefield (see Threatened and Endangered Section regarding white abalone), and therefore, impacts from installation of a shallow water minefield would be anticipated to be minimal.

SWTR Extension. This component of Alternative 2 is to instrument and use two extensions of the current SOAR, one 250-nm^2 (463-km^2) area to the west in the area of the Tanner/Cortes Banks, and one 250-nm^2 (463-km^2) area between SOAR and the southern section of SCI. The SWTR instrumentation is a system of underwater acoustic transducer devices, called nodes, connected by cable to each other and to a land-based facility where the collected range data are used to evaluate the performance of participants in shallow water training exercises.

Since the exact cable route has not been decided, it is not possible to determine if sensitive habitat will be affected by the SWTR Extension. The marine biological resource that could be most affected is the white abalone, and anywhere the cable crosses between 65 to 196 ft (20 to 60 m) and there is rocky substrate, there is the possibility of affecting white abalone or disrupting abalone habitat. Assuming that rocky substrate is avoided throughout the cable corridor, the activities that could affect marine biological resources are associated with the construction of the SWTR Extension. Direct impact and mortality of marine invertebrates at each node and from burial of the trunk cable would occur. Assuming that 300 transducer nodes will be used, approximately 65,400 ft^2 (6,075 m^2) of soft bottom habitat would be affected, and also assuming that 14 nm (25.9 km) of the trunk cable will be buried (assuming a width of 7.8 inches [20 cm], which is twice the wide of the trench to account for sidecasted material), approximately 55,757 ft^2 (5,180 m^2) of soft bottom habitat would be affected. Soft bottom habitats are not considered sensitive habitats and generally support lower biological diversity than hard substrate habitats. Soft bottom organisms are also generally opportunistic and would be expected to rapidly re-colonize the disturbed areas. Localized turbidity during installation may also temporarily impact suspension feeding invertebrates in the vicinity of the cable corridor and nodes. Therefore, assuming that rocky substrate is avoided, impacts to marine biological resources from the SWTR Extension are anticipated to be minimal.

3.6.2.5.2 Marine Protected Areas and Marine Managed Areas

Alternative 2 does not propose new Navy activities in the CINMS, nor activities that are different from those currently conducted in the CINMS. Therefore, proposed activities under the Alternative 2 are consistent with those activities currently conducted in the CINMS, are consistent with those described in the designation document, and are not being changed or modified in a way that would require consultation.

3.6.2.5.3 Threatened and Endangered Species

Impacts to white and black abalone are not expected as described previously for the No Action Alternative (see Section 3.6.3.2.2), and the change in the number of exercises and range enhancements would not change those predictions. However, consultation with the resource agencies will ensure no impact to abalone species.

3.6.3 Mitigation Measures

Current mitigation measures are identified in Section 3.6.1.2.2. With regard to training activities, no adverse impacts on the marine environment (as discussed in this section) were identified; therefore no additional mitigation measures are identified in this section. However, Sections 3.7 (fish); 3.8 (sea turtles); 3.9 (marine mammals); 3.10 (seabirds) identify specific impacts and mitigation measures for other marine resources that could also benefit marine plants and invertebrates.

To prevent environmental impacts associated with construction of the SWTR, no cable would be laid on top of abalone.

3.6.4 Unavoidable Adverse Environmental Effects

No unavoidable environmental effects were identified.

3.6.5 Summary of Effects by Alternative

Table 3.6-4 presents a summary of effects and mitigation measures for the No Action, Alternative 1, and Alternative 2.

Table 3.6-4. Summary of Marine Biology Effects

Alternative	NEPA (On-Land and U.S. Territorial Waters)	EO 12114 (Non-U.S. Territorial Waters)
No Action Alternative	• Hazardous materials from training devices (e.g., ordnance, batteries, small arms rounds) and training exercises have no effect or result in short-term, localized impacts. Potential loss of rocky intertidal habitat from NSFS may produce localized, short-term impacts. Disturbance of sandy bottom habitat and increased turbidity from amphibious landings and underwater demolition. No long-term changes to species abundance or diversity. No loss or degradation of sensitive habitats. No impacts to threatened and endangered species.	• Hazardous materials from training devices (e.g., ordnance, batteries, small arms rounds) and training exercises have no effect or result in short-term, localized impacts. No long-term changes to species abundance or diversity. No loss or degradation of sensitive habitats. No impacts to threatened and endangered species.
Alternative 1	• Impacts as described in the No Action Alternative plus the following: • Impacts to marine biological resources from Major Range Events would be similar to those described for ASU, AAW, ASUW, NSW, and AMW operations and would be minimal. • New Platforms and Vehicles will have similar effects as the platforms that they are replacing, and will have minimal impacts to marine biological resources. • Small increases in the number of Offshore Operations, SHOBA Operations, Underwater Demolitions exercises, and RDT&E tests would result in minimal impacts to marine biological resources. • No impacts to threatened and endangered species.	• Impacts as described in the No Action Alternative plus the following: • Impacts to marine biological resources from Major Range Events would be similar to those described for ASU, AAW, ASUW, NSW, and AMW operations and would be minimal. • New Platforms and Vehicles will have similar effects as the platforms that they are replacing, and will have minimal impacts to marine biological resources. • Small increases in the number of Offshore Operations, SHOBA Operations, Underwater Demolitions exercises, and RDT&E tests would result in minimal impacts to marine biological resources. • No impacts to threatened and endangered species.
Alternative 2 (Preferred Alternative)	• Impacts same as described for No Action Alternative and Alternative 1, plus the following. • Construction of a shallow water minefield and SWTR Extension would result in localized impacts to marine biological resources during installation; however, based on the project criteria, no sensitive habitat or species will be affected, and therefore, impacts would be minimal. • No impacts to threatened and endangered species.	• Impacts same as described for No Action Alternative and Alternative 1, plus the following. • Construction of a shallow water minefield and SWTR Extension would result in localized impacts to marine biological resources during installation; however, based on the project criteria, no sensitive habitat or species will be affected, and therefore, impacts would be minimal. • No impacts to threatened and endangered species.
Mitigation Measures	• Mitigation measures for underwater detonations, implemented for marine mammals and sea turtles, offer protections to other marine habitats and resources	• Mitigation measures for underwater detonations, implemented for marine mammals and sea turtles, offer protections to other marine resources.

3.7 Fish

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3.7 FISH

This section describes the marine fish and their associated habitats within the ocean areas of the SOCAL Range Complex.

3.7.1 Affected Environment

The southern portion of the Southern California Bight (SCB) is a transitional zone between subarctic and subtropical water masses. The California Current system is rich in microscopic organisms (i.e., diatoms, tintinnids, and dinoflagellates), which form the base of the food chain in the SOCAL Range Complex. Small coastal pelagic fishes and squid depend on this planktonic food supply and in turn are fed upon by larger species (e.g., highly migratory species [HMS]). About 481 species of fish inhabit the SCB (Cross and Allen 1993).The great diversity of species in the area occurs for several reasons: (1) the ranges of many temperate and tropical species extend into, and terminate in, the SCB; (2) the area has complex bottom topography and a complex physical oceanographic regime that includes several water masses and a changeable marine climate (Horn and Allen 1978; Cross and Allen 1993); and (3) the islands and nearshore areas provide a diversity of habitats that include softbottom; rock reefs; extensive kelp beds; and estuaries, bays, and lagoons.

3.7.1.1 SOCAL OPAREAs

3.7.1.1.1 Existing Conditions

Of the 519 recognized California marine fish species, there are at least 481 species within the greater SCB, south of Point Conception (Horn 1980, Cross and Allen 1993, Horn et al. 2006). Geographical variation of both larval and adult fish distribution within the SCB is strongly related to depth preference, warm or cold-water affinities of each particular fish species, and water mass influences associated with ocean circulation patterns described in Section 3.4 (Cross and Allen 1993, Horn et al. 2006). Occasional climatic level shifts in ocean mass resulting from El Nino, and La Nino events can directly influence the either warm or cold-water species composition during any given year.

Fish can be categorized as pelagic (living in the water column), benthic (living on the ocean bottom), or demersal (associated with the ocean bottom, but are often found feeding in the water column). The pelagic habitat can be subdivided into the epipelagic, mesopelagic, and bathypelagic zones. Epipelagic habitats in the SCB extend to depths of 328 feet (ft) (100 meters [m]) and are inhabited by nearly 200 species of fish. The mesopelagic zone and the deep (greater than 1,640 ft [500 m]) bathypelagic zone, taken together, are inhabited by 124 species and coastal areas by 79 species (Cross and Allen 1993). Water depths in large areas of the SOCAL OPAREAs are greater than 1,640 ft (500 m).

The epipelagic zone is illuminated and subject to fluctuations in temperature. It is inhabited by large, active, fast-growing, and long-lived epipelagic fishes, by mesopelagic species that rise in the water column to feed at night, and by those demersal and benthic species that feed in the water column (Cross and Allen 1993). Epipelagic fish include small schooling herbivores such as northern anchovy, Pacific sardine, and Pacific mackerel; schooling predators such as tunas; and large solitary predators such as sharks and swordfish (Cross and Allen 1993). During their life cycles and over the period of a day, fish may occupy more than one habitat. At night, some benthic and midwater species rise to the surface, and other species that dwell in kelp forests may become pelagic (i.e., mid-water) or move out over soft or rock substrates (i.e., ocean bottom habitats).

Epipelagic species account for approximately 40% of the total fish species reported and 50% of the families (Cross and Allen 1993, Horn et al. 2006). Mesopelagic and bathypelagic (>550 m) fish fauna are comprised of over more than 120 species (Cross and Allen 1993). Based on studies in the Santa Catalina Basin, Rainwater (1975) noted that SCB midwater fish assemblages could be further categorized by depth of occurrence into an upper mesopelagic region (200-350 m), a lower mesopelagic region (350-500 m), and a bathypelagic region (>550 m). Rainwater (1975) also noted that water around 200 m depth was relatively depauperate of deep-water fish species during daylight. This is due to limited horizontal food availability at depth and results in vertical nighttime migration of mesopelagic fish species (Cross and Allen 1993).

The nearshore zone includes a great diversity of habitats; different fish communities occupy soft and rocky bottoms and kelp forests (see Section 3.6 for more detailed information regarding habitats). Rocky reefs also add to habitat diversity. The diversity and abundance of fish that occupy the nearshore zone are directly related to the diversity of available habitats.

In the SOCAL Range Complex, groundfishes (e.g., flatfishes, skates/sharks/chimeras, rockfishes, etc.) are important recreational and commercial species. The shelf and slope demersal rockfishes are the most specious genus of fishes off the western coast of North America. These fishes are typically the dominant species documented in many ichthyological surveys, in terms of abundance and diversity, especially between the 20 to 200 m isobaths (Mearns et al. 1980). HMS (e.g., tuna, billfishes, sharks, dolphinfish [*Coryphaena hippurus*], and swordfish [*Xiphias gladius*]) and coastal pelagic species (CPS) such as anchovies, mackerels, sardines, and squids support extensive fisheries in the area. The harvest of CPS is one of the largest fisheries in the SOCAL Range Complexin terms of landed biomass and volume, as well as revenue (California Department of Fish and Game [CDFG] 2007).

Given the open ocean area of the many U.S. Navy operations, fish species in the epipelagic (<100 m) and mesopelagic zones (100-500 m) are the most likely to be potentially affected. DoN (2005a) summarizes life histories of key pelagic and groundfish, and this information is included here by reference. Key species, especially commercially important pelagic species, likely present within the SCB are presented in Appendix D – EFH Assessment.

The CDFG maintains commercial catch block data for waters in the northern part of the range (Figure 3.7-1), and all statements referring to catch are for that part of the range for which data are available. For the period 2002 to 2005, the most commonly harvested commercial species in the SOCAL OPAREAs were squid, mackerel (Pacific, jack), tuna (albacore, yellowfin, bluefin, skipjack, and other), and Pacific sardine (Table 3.7-1). During 2002, the northern portion of the SOCAL OPAREAs accounted for 24.8 percent of California fish landings and 29.3 percent of invertebrate landings (Table 3.7-1). In 2003, 2004, and 2005, the figures were 15.0 percent and 7.0 percent, 11.1 percent and 10.5 percent, and 16.6 percent and 43.7 percent, respectively.

Descriptions contained in this section are based on literature surveys of the fish fauna of similar locations in the SCB, commercial fisheries data provided by CDFG, interviews with persons knowledgeable of area fisheries, and the limited information on fish collected in the vicinity of SCI. Common and scientific names of species mentioned in the text are located at the end of this section in Table 3.7-11. Marine flora and benthic organisms are discussed in Section 3.6, and marine mammals are discussed in Section 3.9.

Figure 3.7-1: CDFG Catch Blocks for the SOCAL Range Complex

Table 3.7-1: Commercial Catch Totals (pounds) for the SOCAL OPAREAs and California from 2002–2005

	Pounds Landed					
	2002			2003		
Species	**SOCAL OPAREAs**	**California**	**SOCAL %**	**SOCAL OPAREAs**	**California**	**SOCAL %**
All Tuna	1,070,943	6,621,794	13.9	828,415	4,911,466	14.4
Pacific/Jack Mackerel	8,451,587	1,191,568	87.6	8,344,365	815,706	91.1
Pacific Sardine	60,811,734	67,833,609	47.3	39,120,029	37,449,894	51.1
All Other Fish	3,506,580	51,867,435	6.3	1,019,624	37,317,825	2.7
Total Fish Landings	**73,840,845**	**127,514,405**	**36.7**	**49,312,433**	**80,494,890**	**38.0**
Squid	59,715,687	100,958,918	37.165604	7,437,305	91,902,096	7.5
All Other Invertebrates	4,508,756	25,867,385	14.843082	3,198,996	36,941,056	8.0
Total Invertebrate Landings	**64,224,443**	**126,826,304**	**33.6**	**10,636,301**	**128,843,152**	**7.6**
Total Landings	**138,065,287**	**254,340,709**	**35.2**	**59,948,734**	**209,338,043**	**22.3**
	2004			**2005**		
Species	**SOCAL OPAREAs**	**California**	**SOCAL %**	**SOCAL OPAREAs**	**California**	**SOCAL %**
All Tuna	771,474	4,016,533	16.1	1,466,890	1,850,068	44.2
Pacific/Jack Mackerel	8,545,744	1,588,296	84.3	6,955,643	635,410	91.6
Pacific Sardine	29,236,960	68,412,162	29.9	28,059,117	48,114,100	36.8
All Other Fish	1,948,852	51,538,715	3.6	2,151,683	54,694,975	3.8
Total Fish Landings	**40,503,031**	**125,555,705**	**24.4**	**38,633,333**	**105,294,553**	**26.8**
Squid	15,425,229	72,910,931	17.5	66,672,527	56,216,029	54.3
All Other Invertebrates	3,458,166	40,894,390	7.8	3,025,650	24,743,147	10.9
Total Invertebrate Landings	**18,883,395**	**113,805,321**	**14.2**	**69,698,177**	**80,959,176**	**46.3**
Total Landings	**59,386,426**	**239,361,026**	**19.9**	**108,331,509**	**186,253,729**	**36.8**
Source: CDFG 2007						

Non-Commercial Fish Species

Non-commercial fish species include prey for commercial species; species that are unpalatable, rare, and/or not easily captured; and deep water species. Many of the species mentioned in this section and those that follow are harvested by commercial and recreational fisheries. However, the focus of these sections is a description of the fish communities and their associations with common habitat types.

The fish fauna of the islands within the SCB changes from a typically southern assemblage in the nearshore waters of SCI and Santa Catalina Island in the south, to a typically northern assemblage in nearshore waters of San Miguel Island at the western end of the Channel Islands (Cross and Allen 1993). Engle (1993) rated the geographical affinities of the rocky subtidal fish fauna of the islands in the SCB as follows:

Warm	Santa Catalina, San Clemente
Warm intermediate	Anacapa, Santa Cruz, Santa Barbara
Cold intermediate	Santa Rosa, San Nicolas
Cold	San Miguel

The fish faunas of Santa Catalina and San Clemente islands are similar (Engle 1993). Information on the abundance and distribution of non-commercial species of SCI can be found in CDFG 1970, Engle 1993, and Kushner and Rich 2004. These data are augmented with information from similar habitats and situations for Santa Catalina Island.

Nearshore Habitats Nearshore fish habitats include soft and hard bottoms, rock reefs, and kelp beds. Sixty species of fish have been collected from rocky and sand substrates with and without kelp cover in the islands of the SCB by Engle (1993). However, this number under-represents the actual number observed by about 50 percent. Sand dwellers, rare and cryptic species, and some species that were hard to identify in the field are not included in his estimate. In all, about 125 species of fish inhabit kelp beds and rocky nearshore habitats (Ebeling et al. 1979). The relative abundance of fish observed by divers at ten locations in the nearshore waters of SCI by CDFG (1970) and at 17 locations by Engle (1993) are shown in Table 3.7-2.

Kelp Habitats. The most conspicuous feature of the nearshore zone is the presence of extensive kelp beds. Giant kelp prefer depths of less than 131 ft (40 m) (Bushing 1995). In general, there is a large positive relationship between density of kelp and the density of fish on cobble and rock bottoms (DeMartini and Roberts 1990). A minimum density of giant kelp is necessary for populations of some species to occur on a rock reef (Holbrook et al. 1990). These species are strongly associated with kelp at some or all of their life stages. Removal of kelp can cause a decline of over 50 percent in fish biomass. Most of the decline is caused by the disappearance of midwater species that associate with the kelp canopy (Bodkin 1988).

In general, the abundance of fish on rock reefs is related to abundance of kelp as well as vertical relief of the bottom (Cross and Allen 1993). In the nearshore waters of San Nicolas Island, Cowen and Bodkin (1993) found that within the kelp forests, areas with the greatest vertical relief supported the greatest numbers and diversity of fish, while those with sandy bottoms supported the fewest. They did not find that coverage by kelp affected the abundance of fish. However, most of their rocky sampling sites had enough kelp cover to accommodate fish that associate with kelp. In the presence of kelp, the abundance of some species assemblages does not depend on the presence of high relief rock (Larson and DeMartini 1984).

Mass mortality of kelp forest fishes may occur during an El Niño event (Bodkin et al. 1987). This mortality is caused by warming of the water and large swells generated during storms associated with an El Niño event. Rockfishes associated with kelp forests are particularly susceptible to mortality during these events.

Table 3.7-2: Relative Abundance of Fish in Nearshore Waters of SCI

Species	Engle 1993	CDFG 1970	Species	Engle 1993	CDFG 1970
Pacific angel shark	P		Garibaldi	A	C
Blue shark		P	Senorita	A	A
Swell shark	P	P	California clingfish		P
Horn shark	C	P	California sheephead	A	C
Bat ray	C	C	Rock wrasse	A	C
Chimera		P	Kelpfish	C	
California moray	C	C	Giant kelpfish	C	C
Smelt	C		Island kelpfish	A	A
Topsmelt	A	A	Blackeye goby	A	A
(Calico) kelp bass	P	C	Blueband goby	A	A
Barred sand bass			Zebra goby	C	C
Giant sea bass			Kelp rockfish	C	P
Guadalupe cardinalfish		C	Treefish	C	P
Spotted cusk-eel		P	Blue rockfish	P	
Purple brotula		P	Black-and-yellow rockfish	P	
Sargo	P		Olive rockfish		P
Salema	P		Gopher rockfish	P	
Halfmoon	A	C	Grass rockfish	P	
Opaleye	A	C	Bocaccio rockfish	P	P
Zebra surfperch	P		Honeycomb rockfish		P
Black surfperch	A		California scorpionfish	C	P
Rubberlip surfperch	P		Rainbow scorpionfish		P
Phanerodon	P		Painted greenling	C	C
Striped surfperch	P		Snubnose sculpin	P	
Pile surfperch	P	C	Coralline sculpin	P	
Kelp surfperch	A	A	Cabezon	P	
Rainbow surfperch	P		Lavender sculpin	P	
Shiner surfperch	C		Ocean whitefish	P	
Zebra surfperch		C	Jack mackerel	P	P
Black surfperch		C	Turbot	P	
Blacksmith	A	A	Yellowtail		C
Sources: CDFG 1970; Engle 1993.					
A-abundant; C-common; P-present.					

The abundance of fishes in kelp forests has been estimated for various areas (Table 3.7-3). However, most surveys only estimate the abundance of conspicuous fishes. The abundance of cryptic forms can be four times higher than that of conspicuous species; however, biomass of cryptic species is equivalent to only about 10 percent of that of conspicuous species (Allen et al. 1992).

Table 3.7-3: Fish per Acre within Kelp Beds in the Southern California Bight

Location	Kind of Fish	Number	No. Samples	Reference
San Nicolas Island	Conspicuous Fish	320	295	Cowen and Bodkin 1993
Santa Catalina	Conspicuous Fish	2,771	360	Allen et al. 1992
Santa Catalina	Cryptic Fish	10,456	360	Allen et al. 1992
Santa Catalina	All Fish	13,227	360	Allen et al. 1992
San Onofre	All Fish	2,506	407	Larson and DeMartini 1984
Location	**Kind of Fish**	**Pounds**	**No. Samples**	**Reference**
Santa Catalina	All Fish	46	360	Allen et al. 1992
San Onofre	All Fish	298	107	Larson and DeMartini 1984

Coastal Resources Management (1998) counted conspicuous fish at depths of 10 and 39 ft (3 and 12 m) off Wilson Cove, SCI, in August 1997. They collected 29 fish in their sampling areas, which totaled 478 square yards (yd^2). Mean abundance of fish was 231 per acre at 10 ft (3 m) and 608 per acre at 39 ft (12 m) (Table 3.7-4). Giant kelp were virtually absent at 10 ft (3 m) and were abundant at 39 ft (12 m).

Table 3.7-4: Fish per Acre at Two Depths in Wilson Cove, SCI

	Depth	
Species	**10 ft (3 m)**	**39 ft (12 m)**
Blackeye goby	0	86.8
Black surfperch	28.9	0
California moray	0	28.9
Kelpfish	28.9	86.8
Garibaldi	57.9	0
Blue banded goby	0	202.6
Halfmoon	0	28.9
Senorita	28.9	0
Kelp bass	86.9	57.9
Rockfish spp.	0	57.9
California sheephead	0	57.9
Total	**231.4**	**607.7**

Fish species within a kelp forest show some vertical zonation. Kelp perch, giant kelpfish, and halfmoon are associated with the kelp canopy (Larson and DeMartini 1984). California sheephead and various surfperches are associated with the bottom. Kelp bass, white surfperch, and señorita are found throughout the water column in the kelp forest. Garibaldi, blacksmith, and several rockfish species are abundant only in areas with high bottom relief and are absent from cobble substrates (Larson and DeMartini 1984).

Rocky Habitats. Density of fish is much lower on rocky bottoms that have little or no kelp coverage than within kelp forests. Density of fish on a cobble bottom without kelp at San Onofre, which is on the mainland at the same latitude as SCI, was 324 fish per acre compared to 2,506 fish per acre within kelp forests on cobble bottoms (Larson and DeMartini 1984). Barred sand bass, white sea perch, California sheephead, and kelp bass were the most common species on the cobble bottom without kelp.

The removal of kelp from a high relief rocky bottom in central California reduced the abundance of midwater fish from 3,189 per acre to 816 per acre, and bottom fish from 1,650 per acre to 804 per acre (Bodkin 1988). Total (midwater and bottom fish) biomass was reduced from 1,426 lb per acre to 585 lb per acre. There was no change in biomass at a control site where kelp was not removed. The most notable decline was in the abundance of rockfish.

Allen (1985) characterized the fish fauna of nearshore habitats in the southern part of the SCB, which included Santa Catalina Island, but not SCI. Among the habitat types in his classifications were shallow water rock reefs close to shore at depths of 6.6–39 ft (2–12 m) and deeper rock reefs at depths >65 ft (20 m). Fish assemblages in shallow reef habitats were similar to those in kelp forests but lacked the kelp associated species, especially those associated with the kelp canopy. Species characteristic of shallow and deeper reef habitats are shown in Table 3.7-5. Also shown in Table 3.7-5 are species found in all rock habitats at SCI. Most of the species characteristic of rock habitats in the SCB are found at SCI.

Nearshore and Offshore Soft Substrates

Nearshore and offshore soft substrate habitats are common in the SOCAL OPAREAs (see Figure 3.6-4). Species characteristic of nearshore and offshore soft substrate habitats in the SCB and those found at SCI are shown in Table 3.7-6. In comparison to fish species characteristic of rocky substrates, fewer species characteristic of soft substrates are found at SCI (Tables 3.7-5 and 3.7-6). Nearshore and inner shelf, soft-substrate species include smelt, turbot, northern anchovy, queenfish, shiner surfperch, walleye surfperch, and white surfperch (Cross and Allen 1993). Fishes of the outer shelf include calico and stripetail rockfish, curlfin turbot, English sole, northern anchovy, and Pacific sanddab (Table 3.7-6) (Allen 1985; Cross and Allen 1993).

Love et al. (1986) sampled soft substrates at three stations at each of three sites along the coast of the SCB. Queenfish and white croaker were the dominant species in trawls taken at depths of 20, 40, and 60 ft (6, 12, and 18 m) at northern sites off the city of Santa Barbara. Northern anchovy, California halibut, and speckled sanddab were caught in significant quantities at all depths. At three sampling sites near Los Angeles, the dominant species and their corresponding depths were queenfish, white croaker, and California halibut at 20 ft (6 m); speckled sanddab, white croaker, California halibut, and queenfish at 40 ft (12 m); and speckled sanddab and California halibut at 60 ft (18 m). Queenfish and white croaker were the most commonly taken species in trawls taken at 20 and 40 ft (6 and 12 m) off San Onofre. White croaker and northern anchovy were dominant at the 60-ft (18-m) depth at this site. White croaker and queen fish, which are common all along the coast, were not recorded in samples collected off SCI (Table 3.7-2). At northern sites (near Santa Barbara), fish abundance was constant at all three depths, whereas off Los Angeles and San Onofre, abundance decreased with increasing depth. There were considerable seasonal and annual fluctuations in the abundance of fish. At depths of 20 ft (6 m), fish abundance was low during December, increased in April, and peaked in late summer and early fall. Fish may have moved offshore during winter. During the study, from 1982 to 1984, an El Niño event (1982/1983) was associated with a decline in the abundance of many fish species in nearshore waters. The fish may have moved out of warmer, nearshore waters to areas of cooler water.

Mean standing crop of fish recorded in beam trawls taken at depths of 20–43 ft (6–13 m) on softbottoms between Hermosa Beach and Carlsbad was 9,778 pounds (lb) (4,438 kg) per square nautical mile (nm^2) (Allen and Herbinson 1991). Catch along coasts more exposed to the open sea was slightly lower at 8,328 lb (3,780 kg) per nm^2.

Mean standing crop of fish on soft substrates of the outer shelf and slope of the SCB may be about 1,622 lb (736 kg) per nm^2 (Cross and Allen 1993). Flatfish, sculpins, and rockfish are commonly associated with offshore soft substrates (Table 3.7-6).

Table 3.7-5: Species Characteristic of Shallow and Deep Rock Reef Habitats without Kelp in the SCB and Species Found in All Rock Habitats at SCI

Species	Shallow	Deep	SCI	Species	Shallow	Deep	SCI
Horn shark			B	White sea bass			B
Swell shark			B	Black croaker	A	A	B
California moray			B	White croaker	A		
Northern anchovy	A			Queenfish	A		
Topsmelt	A		B	Opaleye	A	A	B
Jacksmelt	A			Halfmoon	A	A	B
California scorpionfish		A	B	Kelp surfperch	A	A	
Spotted scorpionfish			B	Shiner surfperch	A		B
Kelp rockfish	A			Pile surfperch	A	A	B
Brown rockfish	A			Black surfperch	A	A	B
Gopher rockfish	A			Walleye surfperch	A		B
Black and yellow rockfish		A	B	Rainbow surfperch	A	A	
Blue rockfish	A		B	Dwarf surfperch	A		
Brown rockfish		A	B	White surfperch	A	A	
Bocaccio rockfish				Rubberlip surfperch	A	A	B
Gopher rockfish	A		B	Blacksmith	A	A	B
Grass rockfish				Garibaldi	A		B
Kelp rockfish	A	A	B	California barracuda	A		
Olive rockfish			B	Rock wrasse	A		
Squarespot rockfish			B	Señorita	A	A	B
Yellowtail rockfish			B	California sheephead	A	A	B
Treefish			B	Kelpfish			B
Painted greenling	A			Spotted kelpfish	A	A	
Cabezon	A	A	B	Giant kelpfish	A		
(Calico) kelp bass	A	A	B	Lingcod			B
Barred sand bass	A	A	B	Ocean whitefish			B
Giant sea bass			B	Blackeye goby		A	
Jack mackerel		A		Yellowtail			B
Sargo	A		B	Pacific bonito		A	
Salema	A			Turbot		A	
Source: A-Allen 1985; B-Blunt 1980.							

Table 3.7-6: Species Characteristic of Sandy Beach Open Coast, Nearshore, and Offshore Soft Substrates in the SCB and those found at SCI

Species	Open Coast	Nearshore	Offshore	Species	Open Coast	Nearshore	Offshore
Gray smoothhound shark	X	X		White croaker	X	X	X
Shovelnose guitarfish		X	X	Spotfin croaker	X		
Spiny dogfish			X	Queenfish	X	X	X
Round stingray	X	X		California corbina	X		
Northern anchovy	X	X	X	Yellowfin croker	X		
Deepbody anchovy	X	X		Barred surfperch	X		
Slough anchovy	X	X		Shiner surfperch	X	X	X
California lizardfish		X	X	Pile surfperch	X	X	X
Pacific hake		X	X	Black surfperch	X	X	X
Spotted cusk-eel		X	X	Walleye surfperch	X	X	X
Basketweave cusk-eel		X	X	Dwarf surfperch	X	X	
Blackbelly eelpout			X	White surfperch	X	X	X
Specklefin midshipman		X	X	Pink surfperch		X	X
Plainfin midshipman		X	X	California barracuda	X	X	
California killifish		X		Giant kelpfish	X	X	
Topsmelt	X	X	X	Arrow goby		X	
Jacksmelt	X	X		Blackeye goby		X	X
California grunion	X			Bay goby		X	X
Kelp pipefish		X	X	Pacific butterfish		X	
California scorpionfish		X	X	Pacific sanddab		X	X
Calico rockfish		X	X	Speckled sanddab		X	X
Splitnose rockfish			X	Longfin sanddab			X
Vermilion rockfish		X	X	Bigmouth sole			X
Bocaccio rockfish		X	X	California halibut		X	X
Stripetail rockfish			X	Fantail sole		X	X
Halfbanded rockfish			X	Rex sole			X
Shortspine combfish			X	Diamond turbot		X	
Longspine combfish			X	Slender sole			X
Roughback sculpin			X	Dover sole		X	X
Yellowchin sculpin		X	X	English sole			X
Pacific staghorn sculpin		X		Hornyhead turbot			X
Pygmy poacher			X	Turbot		X	X
Blacktip poacher			X	Curlfin turbot		X	X
Barred sand bass	X	X	X	White sea bass		X	X

Sources: Allen 1985; Blunt 1980.

Midwater Fish

Midwater or mesopelagic fish are pelagic and inhabit depths of 164–1,969 ft (50–600 m). As shown in Figure 3.6-2, most SOCAL OPAREAs waters are of these depths or greater. Many midwater fish are strong swimmers; migrate to surface waters each night and return to deep water during the day; have well developed eyes, swim bladders, and photophores (light-producing organs); and are shaded dark on the dorsal (upper) surface and light on the ventral (lower) surface. In contrast, bathypelagic fish, which inhabit the deepest waters, are generally weak swimmers; have either no or poorly developed eyes, swim bladders, and photophores; and are black or brown in color (Brown 1974).

There are about 120 species of midwater fishes in the SCB. Only a small percentage of these are important commercially. Northern species are associated with the lower mesopelagic zone, where Pacific subarctic water is the dominant water mass and are most common in winter and spring when intrusions of this northern water mass are greatest. Southern species are most common during summer and fall when water of southern origin intrudes. Central Pacific species are represented by only a few species (Cross and Allen 1993).

To the north of SCI, sampling within three deep water areas revealed that three to nine species accounted for 90 percent of the individuals taken in each of the Santa Barbara Basin, the Santa Cruz Basin, and the Rodriguez Dome area (Brown 1974). The depth ranges of some epipelagic and demersal species or their juvenile or larval stages extend into the mesopelagic zone. These include Pacific hake, Pacific mackerel, swordfish, and sablefish.

Commercially Important Fish Species

Commercial landings were obtained for CDFG statistical blocks within the SOCAL OPAREAs (Figure 3.7-1). CDFG maintains commercial landings statistics for statistical blocks that are 5 degrees latitude by 5 degrees longitude in area (about 81 nm^2) for nearshore areas and larger for offshore waters. CDFG provided landings data by month and species for each of the requested statistical blocks for the years 2002 to 2005, inclusive, for all fish and invertebrates (Robertson 2007). In 1993, landings data represented approximately 50 percent of the actual catch (Kobylinsky 1998), and landings in other years have represented approximately 80 percent or more of the actual catch.

Eighty statistical blocks fell wholly or partially within the SOCAL OPAREAs. The SOCAL OPAREAs extends farther south than the area for which CDFG collects data; thus, these data are lacking for the southern portion of the SOCAL OPAREAs. The ArcInfo Geographic Information Systems (GIS) program was used to apportion fish within blocks to the SOCAL OPAREAs.

The annual catch of fish and invertebrates in the SOCAL OPAREAs from 2002 to 2005 are shown in Table 3.7-7. Catch is variable among years, ranging from 104 million pounds (lbs) (47,173 metric tons) in 2002 to 29.4 million lbs in 2002. The highest total catches were in 2002 and 2005. A high catch of Pacific sardine (37.2 million lbs [16,873 metric tons]) and squid (53.5 million lbs [24,267 metric tons]) in 2002, and a high catch of squid (63.4 million lbs [28,757metric tons]) in 2005 contributed strongly to those years' high catches (Table 3.8-7).

Pelagic species account for approximately 97 percent of the average annual catch within the SOCAL OPAREAs. Flatfish, demersal fish, and other fish associated with the bottom account for only about 3 percent of the average annual catch of fish. This may be attributable to the small area occupied by shallow shelves within the SOCAL OPAREAs. Bottom depths over most of the SOCAL OPAREAs exceed 3,280 ft (1,000 m) and most of the SOCAL OPAREAs exceeds depths of 656 ft (200 m).

Table 3.7-7: Annual Catch of Fish and Invertebrates in the SOCAL OPAREAs, 2002 to 2005

	Pounds Landed				
Species	**2002**	**2003**	**2004**	**2005**	**Average**
Tuna, yellowfin	28,028	4,232	312,372	204,676	137,327
Tuna, bluefin	13,886	53,118	1,954	446,953	128,978
Tuna, albacore	1,028,659	746,020	220,666	14,644	502,497
Other tuna	371	25,045	236,482	800,617	265,629
Mackerel, Pacific	6,519,784	8,092,431	6,319,168	6,654,799	6,896,546
Mackerel, jack	1,928,990	251,934	2,226,576	300,844	1,177,086
Swordfish	395,297	402,062	311,165	326,097	358,655
Sardine, Pacific	60,811,734	39,120,029	29,236,968	28,059,117	39,306,962
Anchovy, northern	1,528,657	482,289	164,093	834,161	752,300
Other pelagic fish	218,955	122,167	583,389	83,448	251,990
Sharks and rays	337,751	327,735	168,351	273,497	276,833
Flatfish	168,046	112,849	129,566	102,171	128,158
Rockfish	94,986	86,095	93,570	47,754	80,601
Demersal Fish	762,889	805,607	498,411	483,409	637,579
Total Fish	**73,840,845**	**49,312,433**	**40,503,031**	**38,633,333**	**50,572,410**
Abalone	0	0	0	0	0
Squid	59,715,687	7,437,305	15,425,229	66,672,527	37,312,687
Lobster	380,100	408,984	500,747	437,391	431,805
Other Crustaceans	295,945	331,872	326,250	316,909	317,744
Urchins	3,440,213	2,252,967	2,511,129	2,151,238	2,588,887
Other Invertebrates	392,498	205,009	120,340	121,257	209,776
Total Invertebrates	**64,224,443**	**10,636,301**	**18,883,395**	**69,698,177**	**40,860,579**
Grand Total	**138,065,287**	**59,948,734**	**59,386,426**	**108,331,509**	**91,432,989**
Source: CDFG 2007					

The average annual catch of crustaceans is about half lobster (average 343,289 lbs [155 metric tons] per year) and half spot prawns (average 263,802 lbs [120 metric tons] per year). In 2004, lobsters were worth $7.14 per lb and spot prawns were worth $9.98 per lb (CDFG 2007). Thus, the catch of crustaceans in the SOCAL OPAREAs was worth an average of $3,400,000 per year. In comparison, the annual catch of squid was worth approximately $6,571,353, and urchins were worth about $2,700,000, whereas other invertebrates (e.g., snails, sea cucumbers) were worth about $120,000 per year.

Seasonal Abundance

Cold season ("cold-water") oceanographic conditions typically extend from November to April, and warm season ("warm-water") conditions from May to October. When presenting and discussing seasonal distribution and abundance in the SOCAL OPAREAs, the "oceanographic seasons" have been used because they better coincide with changes in fish distribution. The catch in the SOCAL OPAREAs is about two times higher in fall and winter than in spring or summer (Table 3.7-8). The high catches in fall and winter are mainly attributable to high catches of squid and Pacific sardine.

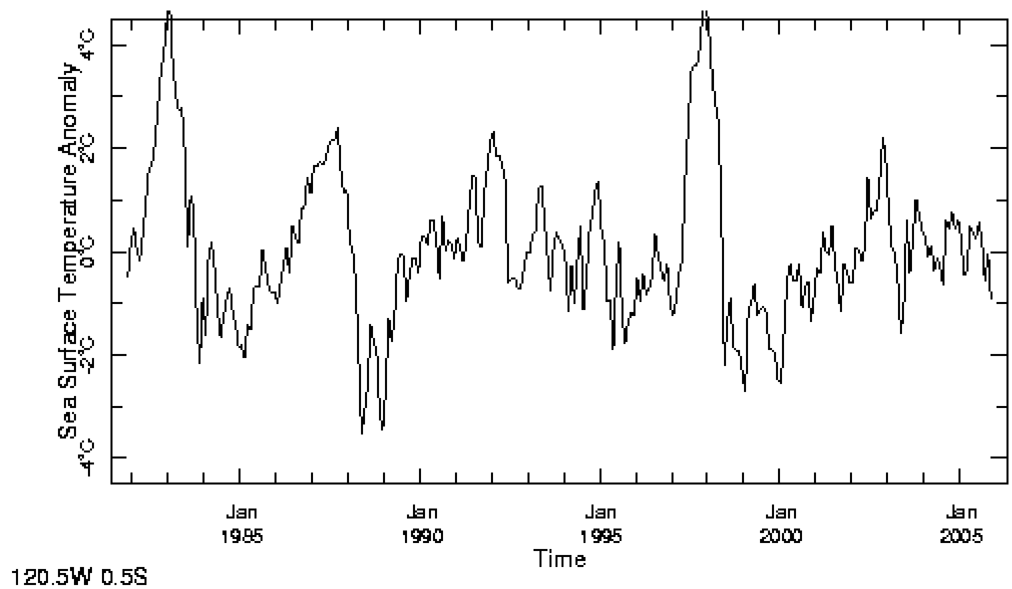
Table 3.7-8: Seasonal Catch in the SOCAL OPAREAs from 2002 to 2005

	Pounds Landed			
Species	**Winter**	**Spring**	**Summer**	**Fall**
Tuna, yellowfin	20,700	1,189	523,556	3,863
Tuna, bluefin	0	3,207	505,071	6,435
Tuna, albacore	21	834,925	941,901	234,340
Other tuna	0	0	1,051,369	11,145
Mackerel, Pacific	3,756,415	2,231,904	16,170,186	5,430,490
Mackerel, jack	2,133,770	804,343	849,277	920,954
Swordfish	726	121,526	555,751	756,617
Sardine, Pacific	62,763,574	22,046,219	33,340,215	39,077,832
Anchovy, northern	1,828,119	866,874	167,394	146,813
Other pelagic fish	11,219	195,195	643,930	139,555
Sharks and rays	88,221	387,291	258,521	423,752
Flatfish	181,976	165,108	63,949	101,606
Rockfish	75,892	98,383	84,615	63,516
Demersal Fish	490,584	1,075,026	563,674	439,875
Total Fish	71,351,218	28,831,192	55,719,409	47,756,793
Fish Seasonal Average	**17,837,804**	**7,207,798**	**13,929,852**	**11,939,198**
Abalone	0	0	0	0
Squid	42,685,948	3,063,250	12,471,486	91,030,064
Lobster	134,368	0	798,232	794,622
Other Crustaceans	342,563	437,420	317,400	173,594
Urchins	2,251,340	1,963,969	3,216,898	2,923,340
Other Invertebrates	352,223	376,362	58,759	51,705
Total Invertebrates	45,766,441	5,841,001	16,862,773	94,973,326
Invert Seasonal Average	**11,441,610**	**1,460,250**	**4,215,693**	**23,743,331**
Total Seasonal Average	**29,279,415**	**8,668,048**	**18,145,546**	**35,682,530**
Source: CDFG 2007				

Variations in Abundance in Relation to Oceanographic Conditions

Annual variations in abundance of fish are, in large measure, related to the prevailing oceanographic regime. The physical oceanographic regime in the SOCAL Range Complex is dynamic and affects the abundance and distribution of fishes (Lenarz et al. 1995, MacCall 1996). Short-term fluctuations associated with an El Niño event are superimposed on long-term changes in oceanographic conditions.

During El Niño events, upwelling of deep, relatively cold, nutrient-rich water ceases or is much reduced and water temperatures rise, causing southern species to expand their distribution northward and northerly species to retreat farther north. The two largest El Niño events of the century were during 1982–1983 and 1997–1998 (IRI/LDEO 1998) (Figure 3.7-1). A long-lived El Niño began in late 1991 and extended into 1993 (Figure 3.7-1). During the 2002 to 2005 period, for which we present catch data, there was not an El Niño event.



Note: Average of 2000 to 2004. Oceanographic Seasons Have Been Used; Feb-Apr = Winter, May-July = Spring, etc.
Source: IRI/LDEO 1998, 2006.

Figure 3.7-2: Monthly Mean Sea Surface Temperature Anomaly in the Eastern Equatorial Pacific

Spatial Distribution of the Catch

The commercial catch is not evenly distributed throughout the SOCAL OPAREAs since the catch in Territorial Waters are an order of magnitude greater than in non-Territorial Waters (Table 3.7-9). This is primarily due to high catches of Pacific sardines, mackerel, and squid, which are generally present along the mainland or island shelf. Pelagic species, such as tuna and swordfish are generally present in offshore, non-territorial waters. Average annual catch of major species and of all fish and fish and invertebrates combined for each CDFG statistical block within the SOCAL OPAREAs for the years 2002 to 2005 are shown in Figures 3.7-3 to 3.7-9.

Table 3.7-9: Average Annual Commercial Catch (lb) for 2002–2005 in the SOCAL OPAREAs

	Pounds Landed	
Species	**Territorial Waters**	**Non-Territorial Waters**
Tuna, yellowfin	82,148	55,179
Tuna, bluefin	3,602	125,076
Tuna, albacore	103,796	399,001
Other tuna	123,601	142,027
Mackerel, Pacific	6,880,466	16,783
Mackerel, jack	1,176,806	280
Swordfish	241,512	117,143
Sardine, Pacific	39,268,255	38,705
Anchovy, northern	752,300	0
Other pelagic fish	93,622	153,891
Sharks and rays	152,836	82,735
Flatfish	126,632	1,528
Rockfish	66,489	14,113
Demersal Fish	578,997	63,060
Total Fish	**49,651,063**	**1,209,519**
Abalone	0	0
Squid	37,287,838	24,849
Lobster	420,807	10,998
Other Crustaceans	313,987	3,812
Urchins	2,569,962	18,925
Other invertebrates	208,025	1,696
Total Invertebrates	**40,800,619**	**60,280**
Grand Total	**90,451,682**	**1,269,799**
Source: CDFG 2007		

Most tuna in the SOCAL OPAREAs were caught in the southern portion of the catch block area, extending from the mainland coast and beyond the Tanner/Cortes Banks (Figure 3.7-3). Both Pacific mackerel and Pacific sardine were generally caught adjacent to the mainland coast and offshore islands (Figures 3.7-4 and 3.7-5). Within the SOCAL OPAREAs, most of the total fish catch was taken off the mainland coast, adjacent to the islands, and in the vicinity of the Tanner/Cortes Banks (Figure 3.7-6). Invertebrate species, both squid and urchins were mostly taken off the mainland coast and adjacent to the islands (Figure 3.7-7 and 3.7-8).

In general, the north, west, and south coasts of SCI are good fishing areas for urchins, bottom fish, and lobster. Lobsters are caught in traps set at depths to 360 ft (110 m) (Guth 1999). Lobster fishing is better off the north and west coasts of SCI than off the east coast (Jackaloni 1999). Lobster season lasts from October to March. Sea urchins are mainly caught off the north, west, and south coasts of SCI close to shore (Figures 3.7-7 and 3.7-10). Sea urchins are caught by divers and the fishery occurs on rocky bottoms with kelp at depths of 10–100 ft (3–30 m) (Halmay 1999). Sea urchins are not fished much on the east side of the island; although suitable habitat is present, the sea state precludes much fishing activity.

The area around Castle Rock is an important fishing area (Halmay 1999). The area is very productive out to depths of 60 ft or 2 mi (3,200 m) in some directions. China Point and Pyramid Cove are desirable anchorages for commercial fishers because they are protected from the wind (Halmay 1999). However, these areas are inside a live-fire shore bombardment range which is designated as a Danger Zone (33 C.F.R. § 334.950) so they are not open to the public at all times. The Navy notifies the public when the area is closed via the SCORE website, NOTMARs, and NOTAMs. Caution must be used in these areas. Prawns are caught in traps at depths of up to 1,200 ft (366 m) all around the island, from February to November (Guth 1999).

The east coast of the island is a good fishing area for barracuda, tuna, and yellowtail (Halmay 1999; Fletcher 1999; Helgren 1999; Jackaloni 1999). Migratory species are most plentiful off the east coast in summer and during warm years.

Sport Fishing

Sport fishing is an important activity in the SOCAL OPAREAs. Major sport fish species include albacore, yellowfin tuna, shallow water rockfish, yellowtail rockfish, kelp bass, yellowtail, California sheephead, ocean whitefish, dolphin, marlin, barracuda, and lingcod (Fletcher 1999; Helgren 1999). The nearshore recreational fishery occurs at depths of 30 to 100 ft (9 to 30 m) (Fletcher 1999). Sport fishers also fish for bluefin tuna, yellowfin tuna, yellowtail rockfish, and rock cod in the vicinity of the islands and on the Tanner/Cortes Banks (Fletcher 1999; Helgren 1999).

Diving

Divers fish for sea urchins along the western, northern, and southern coasts to depths of 100 ft (30 m) (Fletcher 1999). Divers also take gorgonians and black coral (Figure 3.7-10). The exclusive use, safety, security, and danger zones are described in 33 C.F.R. Parts 110, 165, and 334 as being restricted to naval vessels or otherwise presenting a significant hazard to mariners. Whereas civilian use is restricted during military operations, at other times the areas may be open but users must check in with Navy range control officials.

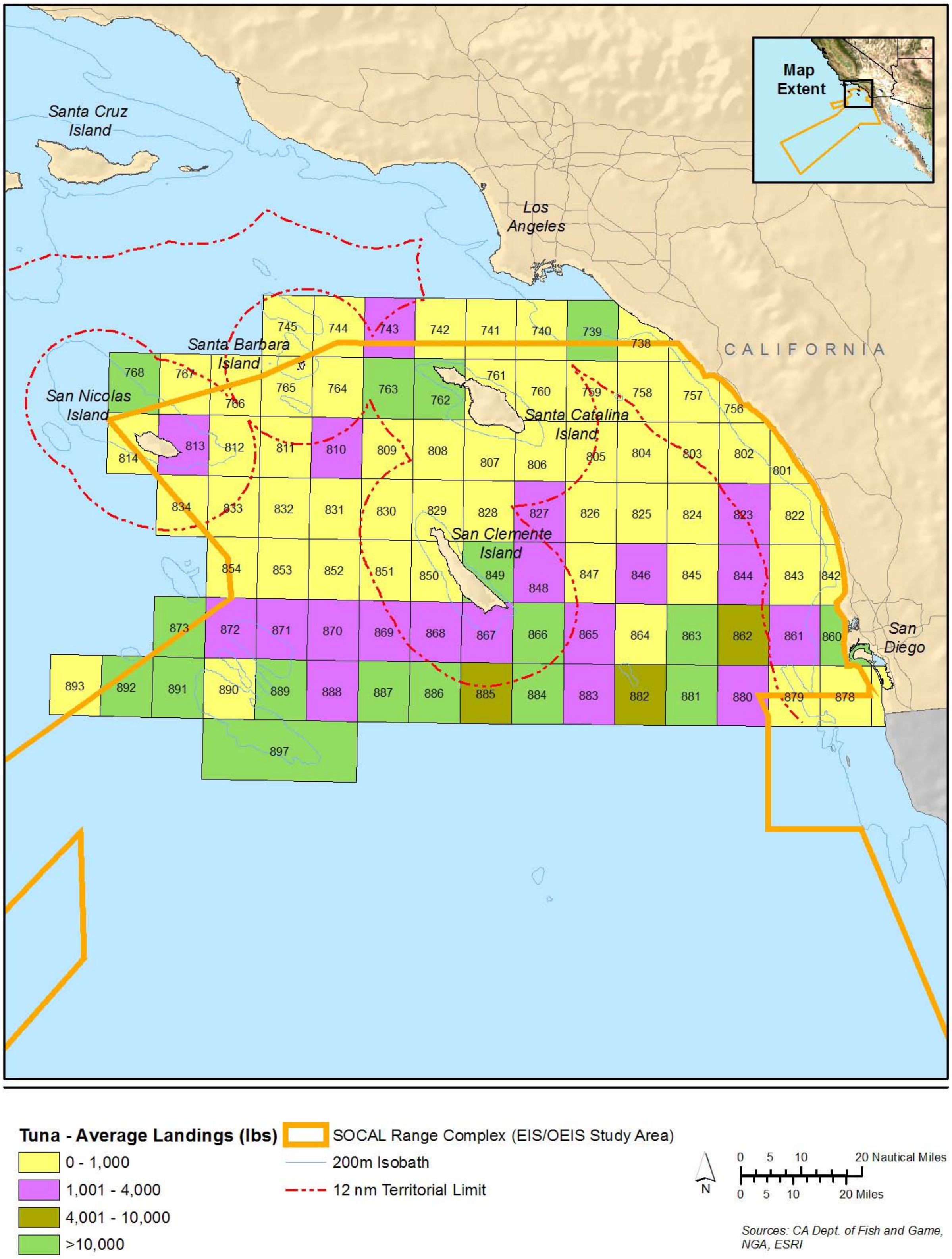


Figure 3.7-3: Average Annual Catch of Species of Tuna in Each CDFG Statistical Block in the SOCAL OPAREAs, 2002–2005

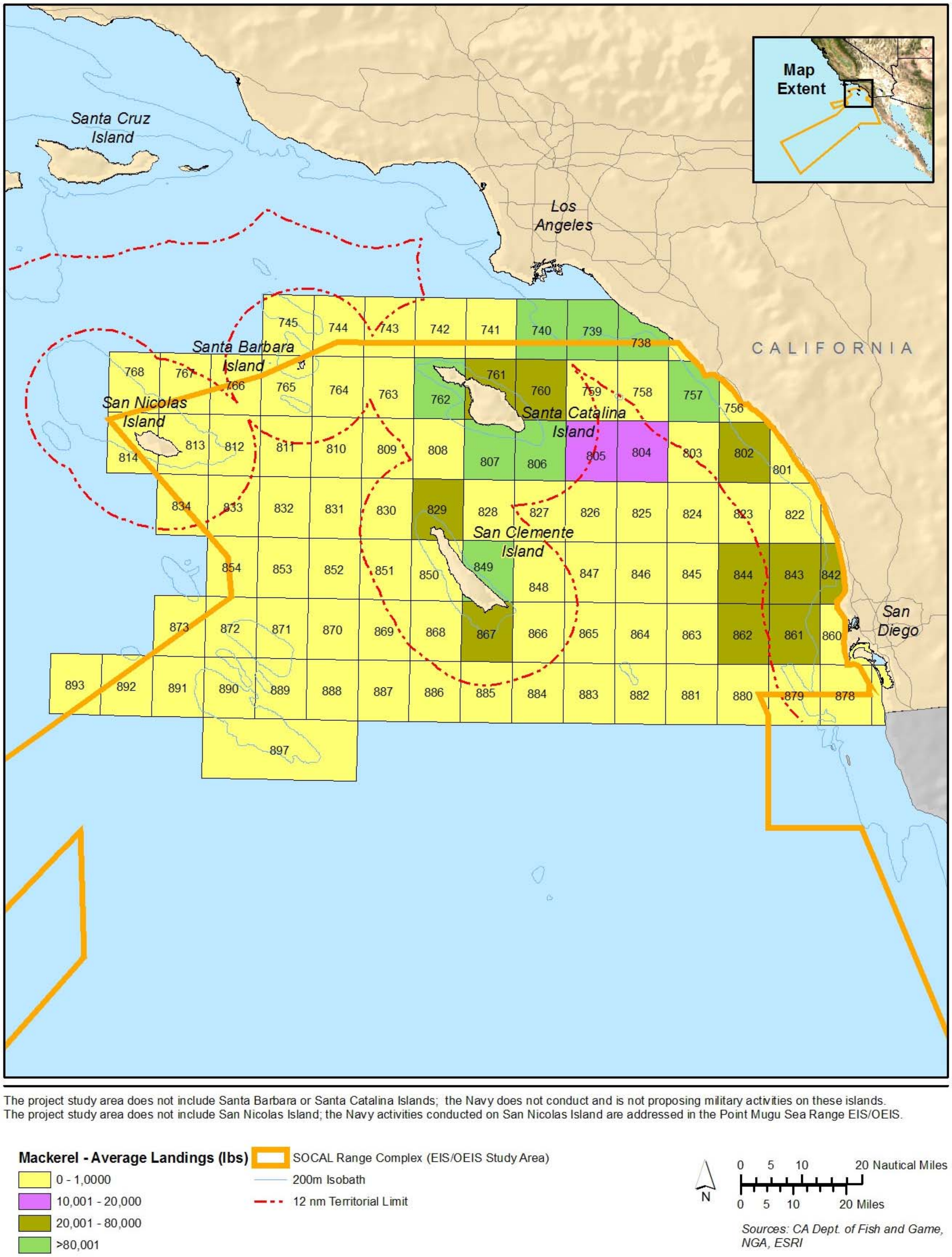
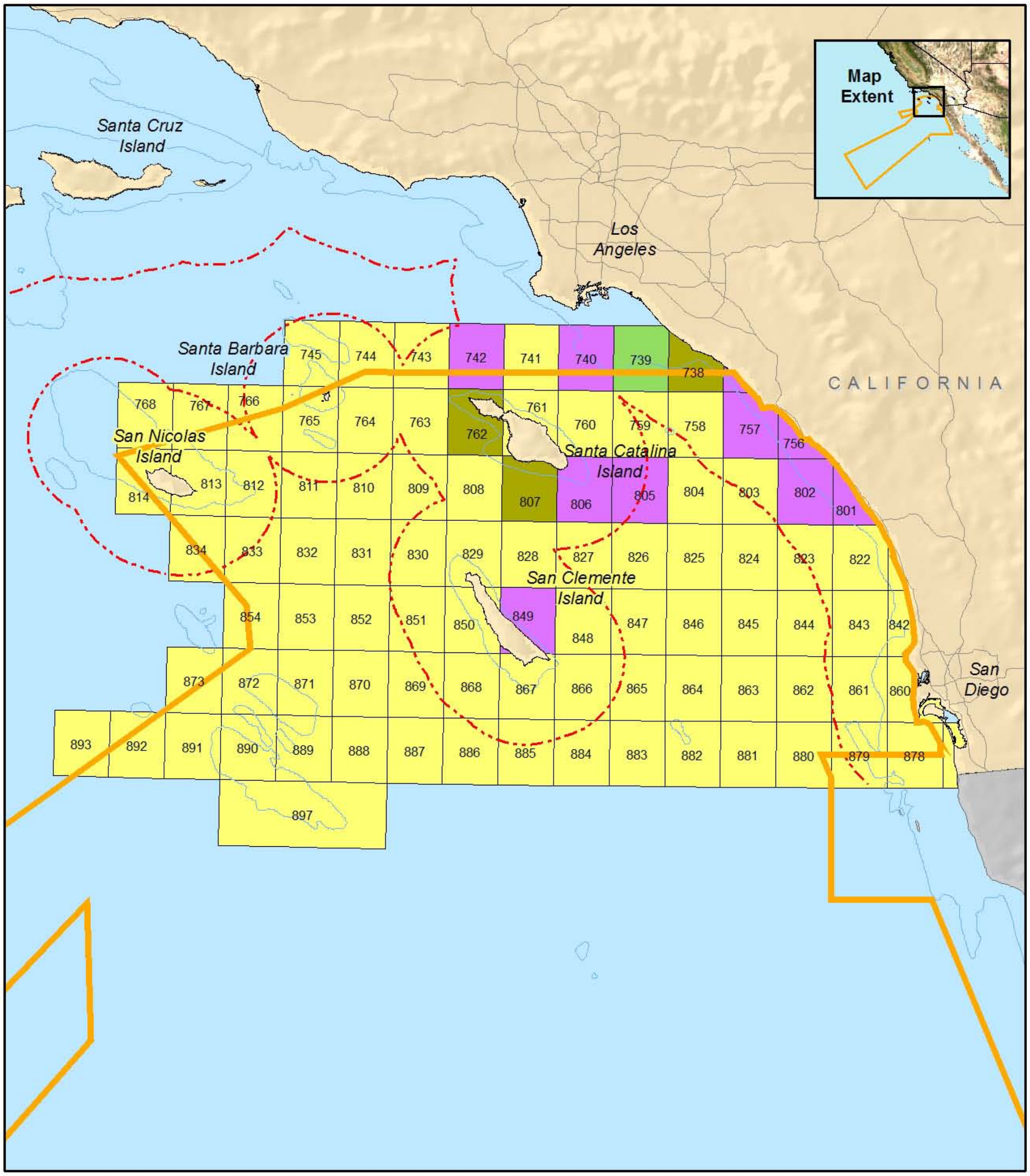


Figure 3.7-4: Average Annual Catch of Pacific Mackerel in Each CDFG Statistical Block in the SOCAL OPAREAs, 2002–2005



The project study area does not include Santa Barbara or Santa Catalina Islands; the Navy does not conduct and is not proposing military activities on these islands.
The project study area does not include San Nicolas Island; the Navy activities conducted on San Nicolas Island are addressed in the Point Mugu Sea Range EIS/OEIS.

Sardines - Average Landings (lbs)
- 0 - 100,000
- 100,001 - 3,200,000
- 3,200,001 - 11,100,000
- >11,100,001

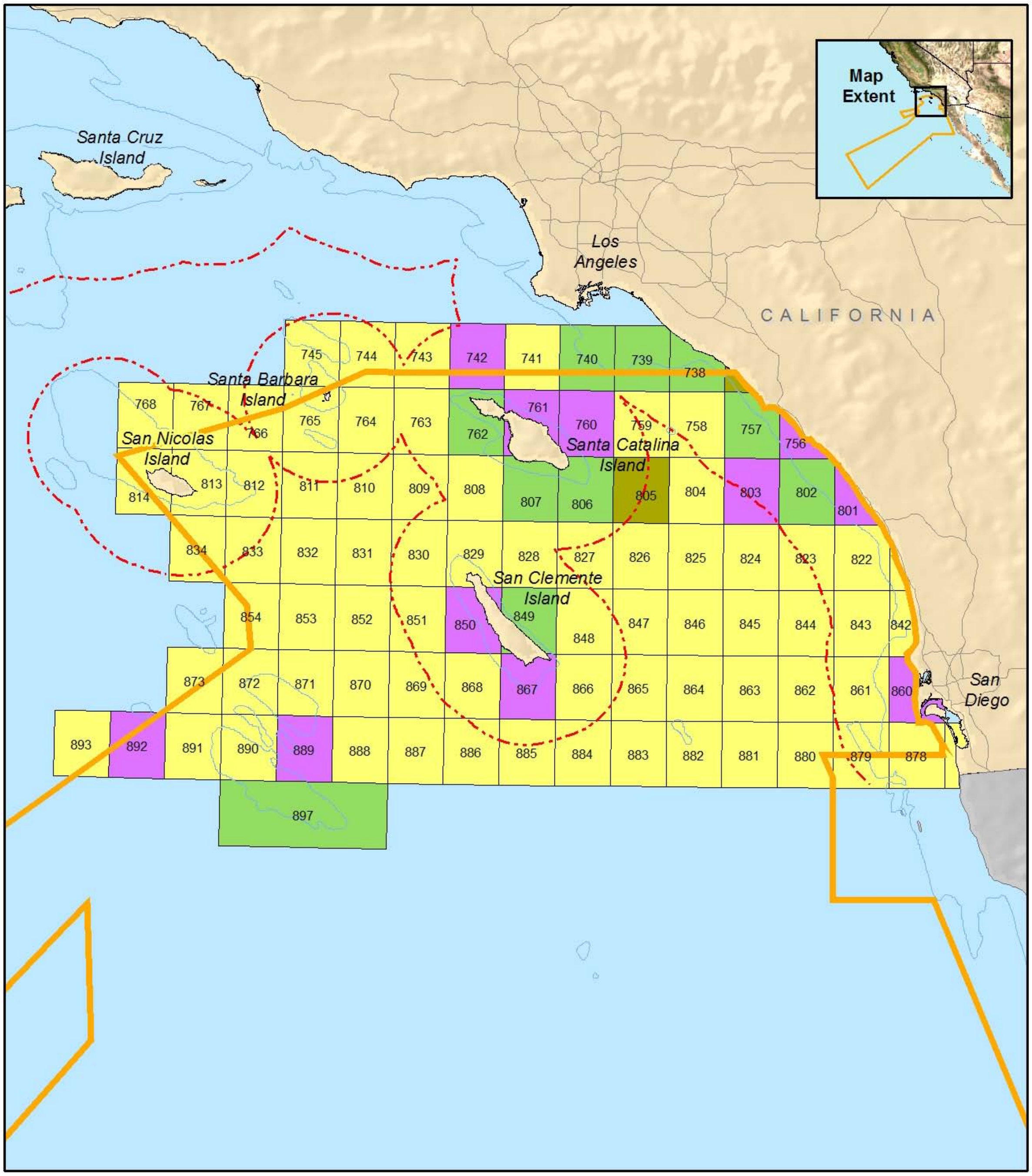
SOCAL Range Complex (EIS/OEIS Study Area)
200m Isobath
12 nm Territorial Limit

N

0 5 10 20 Nautical Miles
0 5 10 20 Miles

Sources: CA Dept. of Fish and Game, NGA, ESRI

Figure 3.7-5: Average Annual Catch of Pacific Sardine in Each CDFG Statistical Block in the SOCAL OPAREAs, 2002–2005



The project study area does not include Santa Barbara or Santa Catalina Islands; the Navy does not conduct and is not proposing military activities on these islands.
The project study area does not include San Nicolas Island; the Navy activities conducted on San Nicolas Island are addressed in the Point Mugu Sea Range EIS/OEIS.

All Fish - Average Landings (lbs)

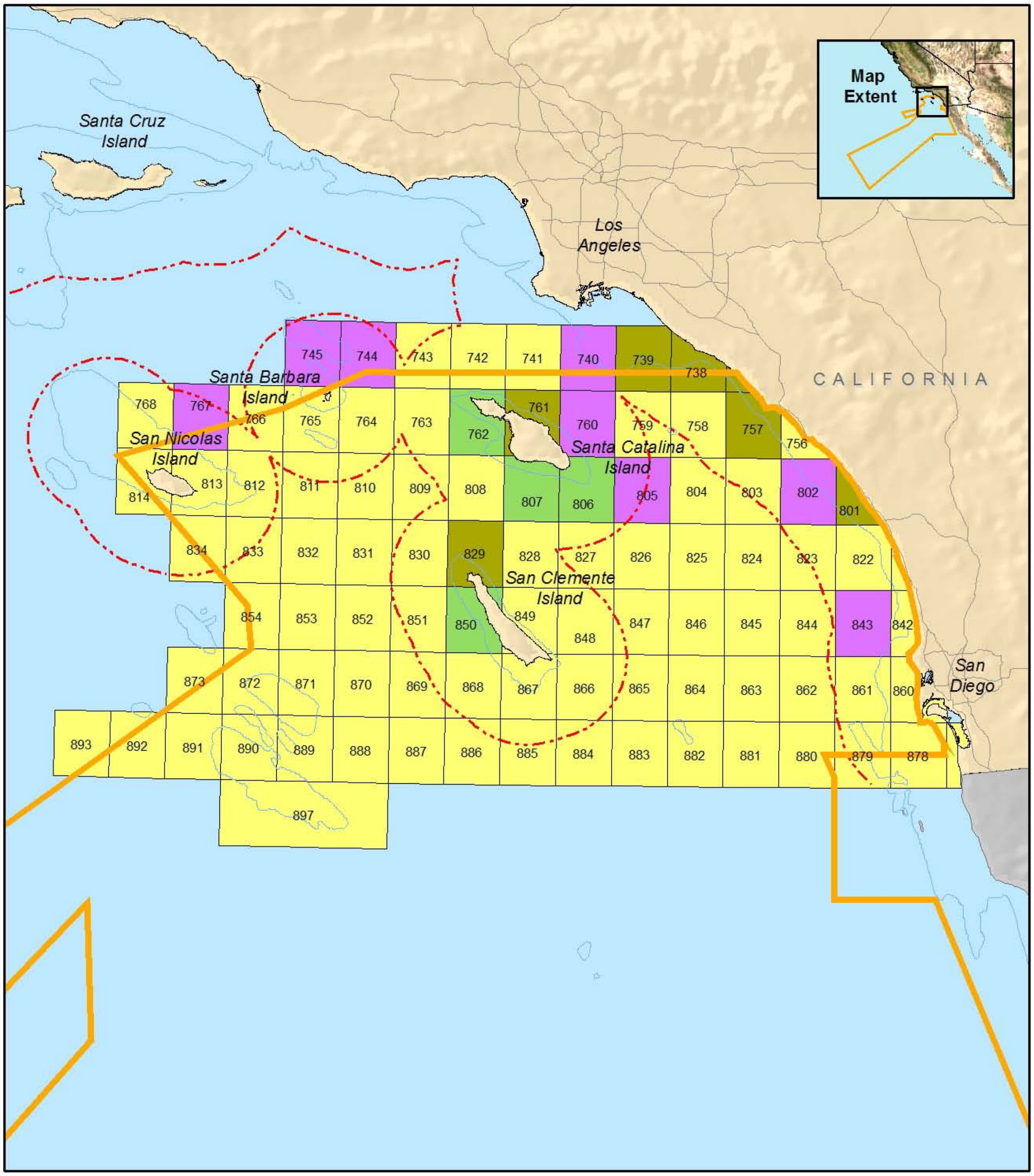
- 0 - 100,000
- 100,001 - 200,000
- 200,001 - 300,000
- > 300,001

SOCAL Range Complex (EIS/OEIS Study Area)
200m Isobath
12 nm Territorial Limit

N
0 5 10 20 Nautical Miles
0 5 10 20 Miles

Sources: CA Dept. of Fish and Game, NGA, ESRI

Figure 3.7-6: Average Annual Catch of All Fish Species in Each CDFG Statistical Block in the SOCAL OPAREAs, 2002–2005



The project study area does not include Santa Barbara or Santa Catalina Islands; the Navy does not conduct and is not proposing military activities on these islands.
The project study area does not include San Nicolas Island; the Navy activities conducted on San Nicolas Island are addressed in the Point Mugu Sea Range EIS/OEIS.

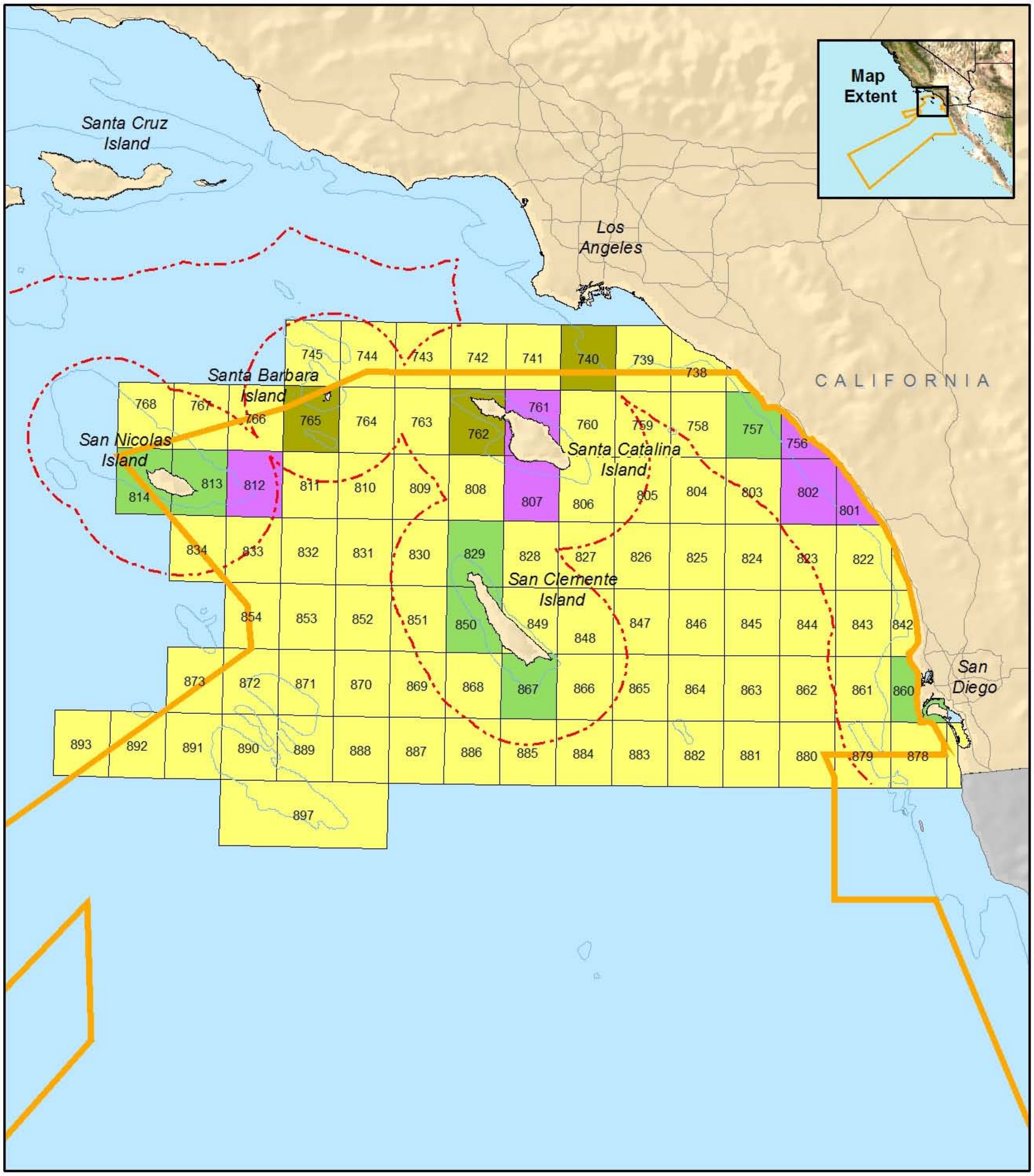
Squid - Average Landings (lbs)
- 0 - 100,000
- 100,001 - 400,000
- 400,001 - 1,500,000
- > 1,500,001

SOCAL Range Complex (EIS/OEIS Study Area)
200m Isobath
12 nm Territorial Limit

N
0 5 10 20 Nautical Miles
0 5 10 20 Miles

Sources: CA Dept. of Fish and Game, NGA, ESRI

Figure 3.7-7: Average Annual Catch of Squid in Each CDFG Statistical Block in the SOCAL OPAREAs, 2002–2005



The project study area does not include Santa Barbara or Santa Catalina Islands; the Navy does not conduct and is not proposing military activities on these islands.
The project study area does not include San Nicolas Island; the Navy activities conducted on San Nicolas Island are addressed in the Point Mugu Sea Range EIS/OEIS.

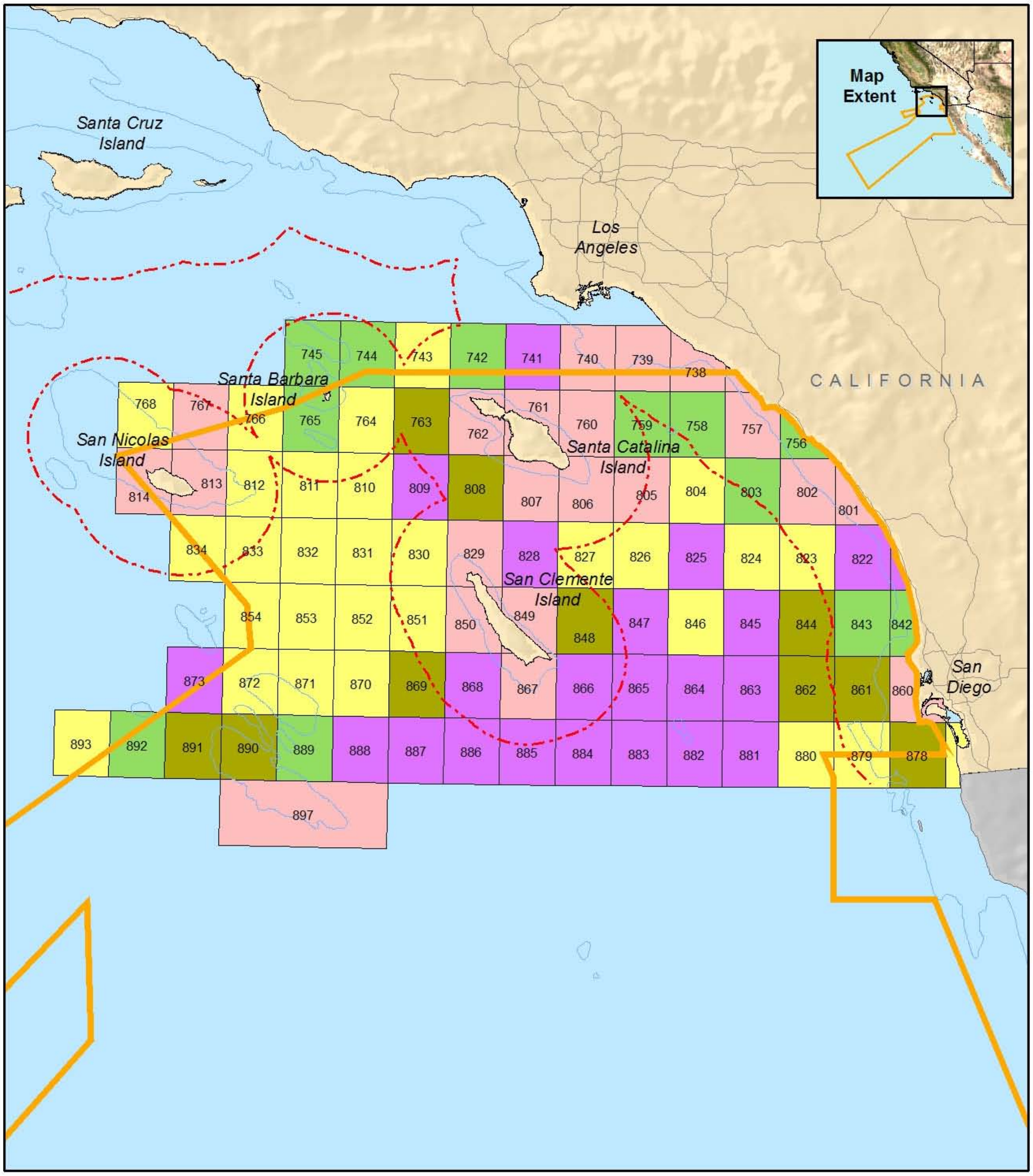
Urchins - Average Landings (lbs)
- 0 - 10,000
- 10,001 - 30,000
- 30,001 - 90,000
- > 90,001

SOCAL Range Complex (EIS/OEIS Study Area)
200m Isobath
12 nm Territorial Limit

N
0 5 10 20 Nautical Miles
0 5 10 20 Miles

Sources: CA Dept. of Fish and Game, NGA, ESRI

Figure 3.7-8: Average Annual Catch of Sea Urchins in Each CDFG Statistical Block in the SOCAL OPAREAs, 2002–2005



The project study area does not include Santa Barbara or Santa Catalina Islands; the Navy does not conduct and is not proposing military activities on these islands.
The project study area does not include San Nicolas Island; the Navy activities conducted on San Nicolas Island are addressed in the Point Mugu Sea Range EIS/OEIS.

All Fish and Invertebrates - Average Landings (lbs)
- 0 - 20,000
- 20,001 - 60,000
- 60,001 - 100,000
- 100,001 - 230,000
- > 230,001

SOCAL Range Complex (EIS/OEIS Study Area)
12 nm Territorial Limit
200m Isobath

N
0 5 10 20 Nautical Miles
0 5 10 20 Miles

Sources: CA Dept. of Fish and Game, NGA, ESRI

Figure 3.7-9: Average Annual Catch of All Fish and Invertebrates in Each CDFG Statistical Block in the SOCAL OPAREAs, 2002–2005

Figure 3.7-10: Sea Urchin and Other Invertebrate Fishing Areas at San Clemente Island

Special Areas – Essential Fish Habitat

The Magnuson-Stevens Fisheries Conservation and Management Act (MSFCMA) (16 United States Code [U.S.C.] §1801 et seq.), mandates identification and conservation of Essential Fish Habitat (EFH). The MSFCMA defines EFH as those waters and substrates necessary (required to support a sustainable fishery and the managed species) to fish for spawning, breeding, feeding, or growth to maturity (i.e., full life cycle). These waters include aquatic areas and their associated physical, chemical, and biological properties used by fish, and may include areas historically used by fish. Substrate types include sediment, hard bottom, structures underlying the waters, and associated biological communities.

A habitat type is also identified to focus conservation efforts: Habitat Areas of Particular Concern (HAPC). These subsets of EFH are rare, sensitive, ecologically important, or located in an area that is already stressed. Federal agencies are required to consult with the NOAA Fisheries Service and to prepare an EFH Assessment describing potential adverse affects of their activities on EFH (see Appendix E).

NMFS and the Fishery Management Council have developed Fishery Management Plans (FMPs) to manage the fishery and address fish habitat issues, specifically the principle that there will be no net loss of the productive capacity of habitats that sustain commercial, recreational, and native fisheries. The SOCAL Range Complex contains EFH for 109 species covered under three FMPs. These 109 managed species include 83 species of groundfish that live on or near the bottom (e.g., rockfish and flatfish), six pelagic species that live in the water column (e.g., anchovies, mackerel, and squid), and 13 highly migratory species including tuna, billfish, and sharks.

Pacific Groundfish Fishery Management Plan

All marine waters in the SOCAL Range Complex offshore to depths of 3,500 meters (m) (1,914 fathoms) are designated as EFH for groundfish managed species (seamounts out to 200 nm [370 km] offshore are also included). The Pacific Groundfish FMP divides EFH into seven composite habitats including their waters, substrates, and biological communities, and include:

- Rocky Shelf – includes waters, substrate and associated biological communities living on or within 33 ft (10 m) overlying rocky areas on the continental shelf, excluding canyons, from the high tide line to the continental shelf break;
- Non-Rocky Shelf – includes waters, substrate and associated biological communities living on or within 33 ft (10 m) overlying substrates of the continental shelf, excluding rocky shelf and canyons, from the high tide line to the continental shelf;
- Canyon – submarine canyons;
- Continental Slope/Basin – includes waters, substrate and associated biological communities living in the deepest 66 ft (20 m) of the water column over the continental slope and basin, seaward of the shelf break extending to the westward boundary of the EEZ. The shelf break at SCI occurs at an approximate depth of 656 ft (200 m);
- Neritic Zone – includes waters and biological communities living in the water column more than 33 ft (10 m) above the continental shelf; and
- Oceanic Zone – includes waters and biological communities living in the water column more than 66 ft (20 m) above the continental slope and abyssal plain, extending to the westward boundary of the EEZ (PFMC 2006).

The 83 groundfish species managed by the Pacific Groundfish FMP range throughout the EEZ and occupy diverse habitats at all stages in their life histories (see Appendix E for list of managed species and EFH designations). Some species are broadly dispersed during specific life stages, especially those with pelagic eggs and larvae. The distribution of other species and/or life stages may be relatively limited, as with adults of many nearshore rockfish which show strong affinities to a particular location or substrate type. Estuaries, sea grass beds, canopy kelp, rocky reefs, and other "areas of interest" (e.g., seamounts, offshore banks, canyons) are designated HAPCs for groundfish managed species.

Coastal Pelagic Species Fishery Management Plan

The Coastal Pelagic Species (CPS) FMP includes four finfish (northern anchovy, Pacific sardine, Pacific (chub) mackerel, jack mackerel), and two invertebrates, market squid and krill. The CPS inhabit the pelagic realm, i.e., live in the water column, not near the sea floor, and are usually found from the surface to 3,281 ft (1,000 m) deep (PFMC 2005). See Appendix E for list of managed species, life histories, and EFH designations.

CPS are harvested directly and incidentally (as bycatch) in other fisheries. Usually targeted with "round-haul" gear including purse seines, drum seines, lampara nets, and dip nets, they are also taken as bycatch in midwater trawls, pelagic trawls, gillnets, trammel nets, trolls, pots, hook-and-line, and jigs. Market squid are fished nocturnally using bright lights to attract the squid to the surface. They are pumped directly from the sea into the hold of the boat, or taken with an encircling net (PFMC 2005).

Most of the CPS commercial fleet is located in California, mainly in Los Angeles, Santa Barbara-Ventura, and, Monterey. About 75 percent of the market squid and Pacific sardine catch are exported, mainly to China, Australia (where they are used to feed farmed tuna), and Japan (where they are used as bait for longline fisheries).

EFH for CPS includes all marine and estuarine waters above the thermocline from the shoreline to 200 nm (370 km) offshore. No HAPCs have been adopted for CPS in the SOCAL Range Complex.

Highly Migratory Species Fishery Management Plan

The term "highly migratory species" (HMS) derives from Article 64 of the United Nations Convention on the Law of the Sea. Although the Convention does not provide an operational definition of the term, an annex to it lists species considered highly migratory by parties to the Convention. In general, these species have a wide geographic distribution, both inside and outside countries' 200-mile zones, and undertake migrations of significant but variable distances across oceans for feeding or reproduction. They are pelagic species, which means they do not live near the sea floor, and mostly live in the open ocean, although they may spend part of their life cycle in nearshore waters. They are harvested by U.S. commercial and recreational fishers and by foreign fishing fleets. Only a small fraction of the total harvest is taken within U.S. waters.

The HMS FMP authorizes the Fishery Management Council to actively manage the following species (see Appendix E for list of managed species, life histories, and EFH designations):

- Tunas: north Pacific albacore, yellowfin, bigeye, skipjack, and northern bluefin;
- Sharks: common thresher, pelagic thresher, bigeye thresher, shortfin mako, blue;
- Billfish/swordfish: striped marlin, Pacific swordfish; and
- Other: dorado (also known as dolphin fish and mahi-mahi).

Under the FMP, the Fishery Management Council monitors other species for informational purposes, and some species including great white sharks, megamouth sharks, basking sharks, Pacific halibut, and Pacific salmon-are designated as prohibited. If fishers targeting highly migratory species catch these species, they must release them immediately.

EFH for HMS includes all marine waters from the shoreline to 200 nm (370 km) offshore., and no HAPCs have been adopted for HMS in the SOCAL Range Complex.

3.7.1.1.2 Sensitivity of Fish to Acoustic Energy

Fishes, like other vertebrates, have a variety of different sensory systems that enable them to glean information from the world around them (see volumes by Atema et al. 1988 and by Collin and Marshall 2003 for thorough reviews of fish sensory systems). While each of the sensory systems may have some overlap in providing a fish with information about a particular stimulus (e.g., an animal might see and hear a predator), different sensory systems may be most appropriate to serve an animal in a particular situation. Thus, vision is often most useful when a fish is close to the source of the signal, in daylight, and when the water is clear. However, vision does not work well at night, or in deep waters. Chemical signals can be highly specific (e.g., a particular pheromone used to indicate danger). However, chemical signals travel slowly in still water, and diffusion of the chemicals depends upon currents and so chemical signals are not directional and, in many cases, they may diffuse quickly to a non-detectable level. As a consequence, chemical signals may not be effective over long distances.

In contrast, acoustic signals in water travel very rapidly, travel great distances without substantially attenuating (declining in level) in open water, and they are highly directional. Thus, acoustic signals provide the potential for two animals that are some distance apart to communicate quickly (reviewed in Zelick et al. 1999; Popper et al. 2003).

Since sound is potentially such a good source of information, fishes have evolved two sensory systems to detect acoustic signals, and many species use sound for communication (e.g., mating, territorial behavior – see Zelick et al. 1999 for review). The two systems are the ear, for detection of sound above perhaps 20 hertz (Hz) to 1 kHz or more, and the lateral line for detection of hydrodynamic signals (water motion) from less than 1 Hz to perhaps 100 or 200 Hz. The inner ear in fish functions very much like the ear found in all other vertebrates, including mammals. The lateral line, in contrast, is only found in fish and a few amphibian (frogs) species. It consists of a series of receptors along the body of the fish. Together, the ear and lateral line are often referred to as the octavolateralis system.

Sound in Water

The basic physical principles of sound in water are the same as sound in air (see Rogers and Cox 1988; Kalmijn 1988, Kalmijn1989). Any sound source produces both pressure waves and actual motion of the medium particles. However, whereas in air the actual particle motion attenuates very rapidly and is often inconsequential even a few centimeters from a sound source, particle motion travels (propagates) much further in water due to the much greater density of water than air. One therefore often sees reference to the “acoustic near field” and the “acoustic far field” in the literature on fish hearing, with the former referring to the particle motion component of the sound and the latter the pressure. There is often the misconception that the near field component is only present close to the source. Indeed, all propagating sound in water has both pressure and particle motion components, but after some distance, often defined as the point at a distance of wavelength of the sound divided by 2 pi ($\lambda/2\pi$), the pressure component of the signal dominates, though particle motion is still present and potentially important for fish (e.g., Rogers and Cox 1988, Kalmijn 1988, Kalmijn 1989). For a 500 Hz signal, this point is about 0.5 m from the source.

The critical point to note is that fish detect both pressure and particle motion, whereas terrestrial vertebrates generally only detect pressure. Fish directly detect particle motion using the inner ear (see below). Pressure signals, however, are initially detected by the gas-filled swim bladder or other bubble of air in the body. The air bubble then vibrates and therefore serves as a small sound source which “reradiates” (or resends) the signal to the inner ear as a near field particle motion. Note, the ear can only detect particle motion directly, and it needs the air bubble to produce particle motion from the pressure component of the signal.

What follows is that if a fish is able to only detect particle motion, it is most sensitive to sounds when the source is nearby due to the substantial attenuation of the particle motion signal as it propagates away from the sound source. As the signal level gets lower (further from the source), the signal ultimately gets below the minimum level detectable by the ear (the threshold). Fish that detect both particle motion and pressure generally are more sensitive to sound than are fish that only detect particle motion. This is the case since the pressure component of the signal attenuates much less over distance than does the particle motion, although both particle motion and pressure are always present in the signal as it propagates from the source.

One very critical difference between particle motion and pressure is that fish pressure signals are not directional. Thus, for fish, as to any observer with a single pressure detector, pressure does not appear to come from any direction (e.g., Popper et al. 2003, Fay 2005). In contrast, particle motion is highly directional and this is detectable by the ear itself. Accordingly, fish appear to use the particle motion component of a sound field to glean information about sound source direction. This makes particle motion an extremely important signal to fish.

Since both pressure and particle motion are important to fish, it becomes critical that in design of experiments to test the effects of sound on fish (and fish hearing in general), the signal must be understood not only in terms of its pressure levels, but also in terms of the particle motion component. This has not been done in most experiments on effects of human-generated sound to date, with the exception of one study on effects of seismic airguns on fish (Popper et al. 2005).

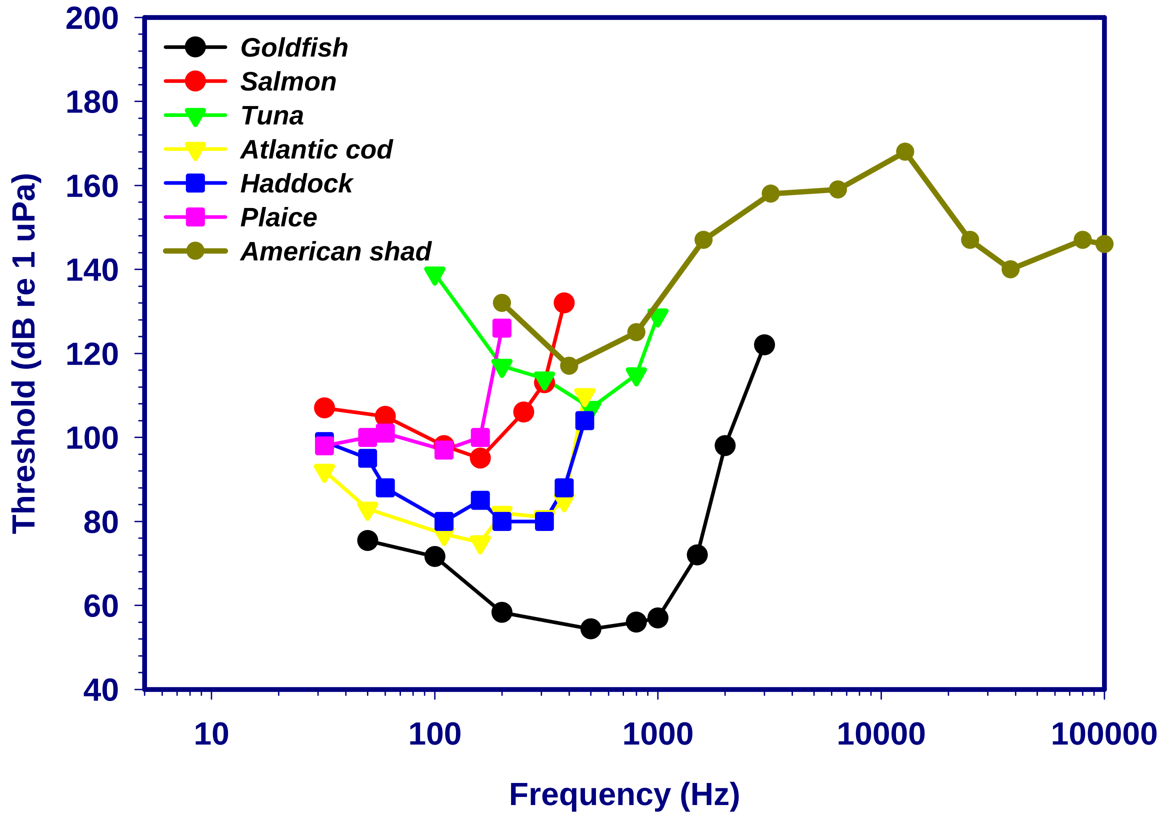
What do Fish Hear?

Basic data on hearing provides information about the range of frequencies that a fish can detect, and the lowest sound level that an animal is able to detect at a particular frequency. This level is often called the "threshold." Sounds that are above threshold are detectable by fish. It therefore follows that if a fish can hear a biologically irrelevant human-generated sound (e.g., sonar, ship noise), such sound might interfere with the ability of fish to detect other biologically relevant signals. In effect, anthropogenic sounds and explosions may affect behavior, and result in short and long-term tissue damage, but only at significantly high levels. Importantly, to date there has been not any experimental determination of an association of such effects from military mid- and high-frequency active sonars.

Hearing thresholds have been determined for perhaps 100 of the more than 29,000 living fish species (Figure 3.7-11) (see Fay 1988, Popper et al. 2003, Ladich and Popper 2004, Nedwell et al. 2004 for data on hearing thresholds). These studies show that, with few exceptions, fish cannot hear sounds above about 3-4 kHz, and that the majority of species are only able to detect sounds to 1 kHz or even below. In contrast, a healthy young human can detect sounds to about 20 kHz, and dolphins and bats can detect sounds to well over 100 kHz. There have also been studies on a few species of cartilaginous

fish, with results suggesting that they detect sounds to no more than 600 or 800 Hz (e.g., Fay 1988, Casper et al. 2003).

Besides being able to detect sounds, a critical role for hearing is to be able to discriminate between different sounds (e.g., frequency and intensity), detect biologically relevant sounds in the presence of background noises, and determine the direction and location of a sound source in the space around the animal. While data are available on these tasks for only a few fish species, all species studied appear to be able to discriminate sounds of different intensities and frequencies (reviewed in Fay and Megela-Simmons 1999, Popper et al. 2003) and perform sound source localization (reviewed in Popper et al. 2003, Fay 2005).



Note: Goldfish and American shad are species with specializations that enhance hearing sensitivity and/or increase the range of sounds detectable by the animal. The other species are hearing generalists. Most of these data were obtained using methods where fish were conditioned to respond to a sound when it was present. Each data point represents the lowest sound level (threshold) the species could detect at a particular frequency. Data for American shad are truncated at 100 kHz so as to keep the size of the graph reasonable, but it should be noted that this species can hear sounds to at least 180 kHz (Mann et al. 1997). Note that these data represent pressure thresholds, despite the fact that some of the species (e.g., salmon, tuna) are primarily sensitive to the particle motion component of a sound field, something that was not generally measured at the time of the studies.

Figure 3.7-11: Hearing curves (audiograms) for select teleost fishes (see Fay 1988 and Nedwell et al. 2004 for data).

Fish are also able to detect signals in the presence of background noise (reviewed in Fay and Megela-Simmons 1999, Popper et al. 2003). The results of these studies show that fish hearing is affected by the presence of background noise that is in the same general frequency band as the biologically relevant signal. In other words, if a fish has a particular threshold for a biologically relevant sound in a quiet environment, and a background noise that contains energy in the same frequency range is introduced, this will decrease the ability of the fish to detect the biologically relevant signal. In effect, the threshold for the biologically relevant signal will become poorer.

The significance of this finding is that if background noise is increased, such as a result of human-generated sources, it may be harder for a fish to detect the biologically relevant sounds that it needs to survive.

Sound Detection Mechanisms

While bony and cartilaginous fish have no external structures for hearing, such as the human pinna (outer ear), they do have an inner ear which is similar in structure and function to the inner ear of terrestrial vertebrates. The outer and middle ears of terrestrial vertebrates serve to change the impedance of sound traveling in air to that of the fluids of the inner ear. However, since fishes already live in a fluid environment, there is no need for impedance matching to stimulate the inner ear. At the same time, since the fish ear and body are the same density as water, they will move along with the sound field. While this might result in the fish not detecting the sound, the ear also contains very dense calcareous structures, the otoliths, which move at a different amplitude and phase from the rest of the body. This provides the mechanism by which fish hear.

The ear of a fish has three semicircular canals that are involved in determining the angular movements of the fish. The ear also has three otolith organs, the saccule, lagena, and utricle, that are involved in both determining the position of the fish relative to gravity and detection of sound and information about such sounds. Each of the otolith organs contains an otolith that lies in close proximity to a sensory epithelium.

The sensory epithelium (or macula) in each otolith organ of fish contains mechanoreceptive sensory hair cells that are virtually the same as found in the mechanoreceptive cells of the lateral line and in the inner ear of terrestrial vertebrates. All parts of the ear have the same kind of cell to detect movement, whether it be movement caused by sound or movements of the head relative to gravity.

Hearing Generalists and Specialists

Very often, fish are referred to as “hearing generalists” (or non-specialists) or “hearing specialists” (e.g., Fay 1988, Popper et al. 2003, Ladich and Popper 2004). Hearing generalists generally detect sound to no more than 1 to 1.5 kHz, whereas specialists are generally able to detect sounds to above 1.5 kHz (see Figure 3.7-11). And, in the frequency range of hearing that the specialists and generalists overlap, the specialists generally have lower thresholds than generalists, meaning that they can detect quieter (lower intensity) sounds. Furthermore, it has often been suggested that generalists only detect the particle motion component of the sound field, whereas the specialists detect both particle motion and pressure (see Popper et al. 2003).

However, while the terms hearing generalist and specialist have been useful, it is now becoming clear that the dichotomy between generalists and specialists is not very distinct. Instead, investigators are now coming to the realization that many species that do not hear particularly well still detect pressure as well as particle motion and pressure. However, these species often have poorer pressure detection than those fishes that have a wider hearing bandwidth and greater sensitivity (see Popper and Schilt, 2008).

It is important to note that hearing specialization is not limited to just a few fish taxa. Instead, there are hearing specialists that have evolved in many very diverse fish groups. Moreover, there are instances where one species hears very well while a very closely related species does not hear well. The only “generalizations” that one can make is that all cartilaginous fish are likely to be hearing generalists, while all otophysan fishes (goldfish, catfish, and relatives) are hearing specialists. It is also likely that bony fish without an air bubble such as a swim bladder (see below) are, like cartilaginous fishes, hearing generalists. These fish include all flatfish, some tuna, and a variety of other taxonomically diverse species.

Ancillary Structures for Hearing Specializations

All species of fish respond to sound by detecting relative motion between the otoliths and the sensory hair cells. However, many species, and most effectively the hearing specialists, also detect sounds using the air-filled swim bladder in the abdominal cavity. The swim bladder is used for a variety of different functions in fish. It probably evolved as a mechanism to maintain buoyancy in the water column, but later evolved to have multiple functions.

The other two roles of the swim bladder are in sound production and hearing (e.g., Zelick et al. 1999; Popper et al. 2003). In sound production, the air in the swim bladder is vibrated by the sound producing structures (often muscles that are integral to the swim bladder wall) and serves as a radiator of the sound into the water (see Zelick et al. 1999).

For hearing, the swim bladder serves to re-radiate sound energy to the ear. This happens since the air in the swim bladder is of a very different density than the rest of the fish body. Thus, in the presence of sound the air starts to vibrate. The vibrating gas re-radiates energy which then stimulates the inner ear by moving the otolith relative to the sensory epithelium. However, in species that have the swim bladder some distance from the ear, any re-radiated sound attenuates a great deal before it reaches the ear. Thus, these species probably do not detect the pressure component of the sound field as well as fish where the swim bladder comes closer to the ear.

In contrast, hearing specialists always have some kind of acoustic coupling between the swim bladder and the inner ear to reduce attenuation and assure that the signal from the swim bladder gets to the ear. In the goldfish and its relatives, the otophysan fishes, there is a series of bones, the Weberian ossicles, which connect the swim bladder to the ear. When the walls of the swim bladder vibrate in a sound field, the ossicles move and carry the sound directly to the inner ear. Removal of the swim bladder in these fish results in a drastic loss of hearing range and sensitivity (reviewed in Popper et al. 2003).

Besides species with Weberian ossicles, other fishes have evolved a number of different strategies to enhance hearing. For example, the swim bladder may have one or two anterior projections that actually contact one of the otolith organs. In this way, the motion of the swim bladder walls directly couples to the inner ear of these species (see discussion in Popper et al. 2003).

Lateral Line

The lateral line system is a specialized sensory receptor found on the body that enables detection of the hydrodynamic component of a sound field or other water motions relative to the fish (reviewed in Coombs and Montgomery 1999, Webb et al. 2008). The lateral line is most sensitive to stimuli that occur within a few body lengths of the animal and to signals that are from below 1 Hz to a few hundred Hz (Coombs and Montgomery 1999; Webb et al. 2008). The lateral line is involved with schooling behavior, where fish swim in a cohesive formation with many other fish and it is also involved with detecting the presence of near-by moving objects, such as food. Finally, the lateral line is an important determinant of current speed and direction, providing useful information to fishes that live in streams or where tidal flows dominate.

The only study on the effect of exposure to sound on the lateral line system suggests no effect on these sensory cells by very intense pure tone signals (Hastings et al. 1996). However, since this study was limited to one (freshwater) species and only to pure tones, extrapolation to other sounds is not warranted and further work needs to be done on any potential lateral line effects on other species and with other types of sounds.

Overview of Fish Hearing Capabilities

Determination of hearing capability has only been done for fewer than 100 of the more than 29,000 fish species (Fay 1988, Popper et al. 2003, Ladich and Popper 2004, Nedwell et al. 2004). Much of this data is summarized in Table 3.7-10 for species of marine fish that have been studied and that could potentially be in areas where sonar or other Navy sound sources might be used. This data set, while very limited, suggests that the majority of marine species are hearing generalists, although it must be kept in mind that there are virtually no data for species that live at great ocean depths and it is possible that such species, living in a lightless environment, may have evolved excellent hearing to help them get an auditory "image" of their environment (e.g., Popper 1980).

While it is hard to generalize as to which fish taxa are hearing generalists or specialists since specialists have evolved in a wide range of fish taxa (see, for example, Holocentridae and Sciaenidae in Table 3.7-10), there may be some broad generalizations as to hearing capabilities of different groups. For example, it is likely that all, or the vast majority of species in the following groups would have hearing capabilities that would include them as hearing generalists. These include: cartilaginous fishes (Casper et al. 2003, Casper and Mann 2006, Myrberg 2001), scorpaeniforms (i.e., scorpionfishes, searobins, sculpins) (Tavolga and Wodinsky 1963), scombrids (i.e., albacores, bonitos, mackerels, tunas) (Iversen 1967, Iversen 1969, Song et al. 2006), and more specifically, midshipman fish (*Porichthys notatus*) (Sisneros and Bass 2003), Atlantic salmon (*Salmo salar*) (Hawkins and Johnstone 1978) and other salmonids (e.g., Popper et al. 2007), and all toadfish in the family Batrachoididae (see Table 3.7-10 for species).

Marine hearing specialists include some Holocentridae ("soldierfish" and "squirrelfish") (Coombs and Popper 1979) and some Sciaenidae (drums and croakers) (reviewed in Ramcharitar et al. 2006b) (see Table 3.7-10). In addition, all of the clupeids (herrings, shads, alewives, anchovies) are able to detect sounds to over 3 kHz. And, more specifically, members of the clupeid family Alosinae, which includes menhaden and shad, are able to detect sounds to well over 100 kHz (e.g., Enger 1967, Mann et al. 2001, Mann et al. 2005).

Variability in Hearing Among Groups of Fish

Hearing capabilities vary considerably between different fish species (Figure 3.7-11), and there is no clear correlation between hearing capability and environment, even though some investigators (e.g., Amoser and Ladich 2005) have argued that the level of ambient noise in a particular environment might have some impact on hearing capabilities of a species. However, the evidence for this suggestion is very limited, and there are species that live in close proximity to one another, and which are closely related taxonomically, that have different hearing capabilities. This is widely seen within the family Sciaenidae, where there is broad diversity in hearing capabilities and hearing structures (data reviewed in Ramcharitar et al. 2006b). This is also seen in the family Holocentridae. In this group, the shoulderbar soldierfish (*Myripristis kuntee*) and the Hawaiian squirrelfish (*Sargocentron xantherythrum*) live near one another on the same reefs, yet *Sargocentron* detects sounds from below 100 Hz to about 800 Hz, whereas *Myripristis* is able to detect sounds from 100 Hz to over 3 kHz, and it can hear much lower intensity sounds than can *Sargocentron* (Coombs and Popper 1979, see also Tavolga and Wodinsky 1963).

Among all fishes studied to date, perhaps the greatest variability has been found within the economically important family Sciaenidae (i.e., drumfish, weakfish, croaker) where there is extensive diversity in inner ear structure and the relationship between the swim bladder and the inner ear (all data on hearing and sound production in Sciaenidae is reviewed in Ramcharitar et al. 2006b) (see Table 3.7-10). Specifically, the Atlantic croaker's (*Micropogonias undulatus*) swim bladder comes near the ear but does not actually touch it. However, the swim bladders in the spot (*Leiostomus xanthurus*) and black drum (*Pogonias cromis*) are further from the ear and lack anterior horns or diverticulae. These differences are associated with variation in both sound production and hearing capabilities (Ramcharitar et al. 2006b). Ramcharitar and Popper (2004) found that the black drum detects sounds from 0.1 to 0.8 kHz and was most sensitive between 0.1 and 0.5 kHz, while the Atlantic croaker detects sounds from 0.1 to 1.0 kHz and was most sensitive at 0.3 kHz. Additionally, Ramcharitar et al. (2006a) found that weakfish (*Cynoscion regalis*) is able to detect frequencies up to 2.0 kHz, while spot can hear only up to 0.7 kHz.

The sciaenid with the greatest hearing sensitivity discovered thus far is the silver perch (*Bairdiella chrysoura*), a species which has auditory thresholds similar to goldfish and which is able to respond to sounds up to 4.0 kHz (Ramcharitar et al. 2004). Silver perch swim bladders have anterior horns that terminate close to the ear.

Marine Hearing Specialists

The majority of marine fish studied to date are hearing generalists. However, a few species have been shown to have a broad hearing range suggesting that they are specialists. These include some holocentrids and sciaenids, as discussed above. There is also evidence, based on structure of the ear and the relationship between the ear and the swim bladder that at least some deep-sea species, including myctophids, may be hearing specialists (Popper 1977, Popper1980), although it has not been possible to do actual measures of hearing on these fish from great depths.

The most significant studies have shown that all herring like fishes (order Clupeiformes) are hearing specialists and able to detect sounds to at least 3 – 4 kHz, and that some members of this order, in the sub-family Alosinae, are able to detect sounds to over 180 kHz (Figure 3.7-11) (Mann et al. 1997, 1998, 2001, 2005; Gregory and Clabburn 2003). Significantly, there is evidence that detection of ultrasound (defined by the investigators as sounds over 20 kHz) in these species is mediated through one of the otolithic organs of the inner ear, the utricle (Higgs et al. 2004, Plachta et al. 2004). While there is no evidence from field studies, laboratory data leads to the suggestion that detection of ultrasound probably arose to enable these fish to hear the echolocation sounds of odontocete predators and avoid capture (Mann et al. 1998, Plachta and Popper 2003). This is supported by field studies showing that several Alosinae clupeids avoid ultrasonic sources. These include the alewife (*Alosa pseudoharengus*) (Dunning et al. 1992, Ross et al. 1996), blueback herring (*A. aestivalis*) (Nestler et al. 2002), Gulf menhaden (*Brevoortia patronus*) (Mann et al. 2001), and American shad (*A. sapidissima*) (Mann et al. 1997, 1998, 2001). Thus, masking of ultrasound by mid- or high-frequency sonar could potentially affect the ability of these species to avoid predation.

Although few non-clupeid species have been tested for ultrasound (Mann et al. 2001), the only non-clupeid species shown to possibly be able to detect ultrasound is the cod (*Gadus morhua*) (Astrup and Møhl 1993). However, in Astrup and Møhl’s (1993) study it is feasible that the cod was detecting the stimulus using touch receptors that were over driven by very intense fish-finding sonar emissions (Astrup 1999, Ladich and Popper 2004). Nevertheless, Astrup and Møhl (1993) indicated that cod have ultrasound thresholds of up to 38 kHz at 185 to 200 dB re 1 µPa-m, which likely only allows for detection of odontocete’s clicks at distances no greater than 10 to 30 m (33 to 98 ft) (Astrup 1999).

Finally, while most otophysan species are freshwater, a few species inhabit marine waters. In the one study of such species, Popper and Tavolga (1981) determined that the hardhead sea catfish (*Ariopsis felis*) was able to detect sounds from 0.05 to 1.0 kHz, which is a narrower frequency range than that common to freshwater otophysans (i.e., above 3.0 kHz) (Popper et al. 2003). However, hearing sensitivity below about 500 Hz was much better in the hardhead sea catfish than in virtually all other hearing specialists studied to date (Table 3-7.10, Fay 1988, Popper et al. 2003).

Marine Hearing Generalists

As mentioned above, investigations into the hearing ability of marine bony fishes have most often yielded results exhibiting a narrower hearing range and less sensitive hearing than specialists. This was first demonstrated in a variety of marine fishes by Tavolga and Wodinsky (1963), and later demonstrated in taxonomically and ecologically diverse marine species (reviews in Fay 1988, Popper et al. 2003, Ladich and Popper 2004).

By examining the morphology of the inner ear of bluefin tuna (*Thunnus thynnus*), Song et al. (2006) hypothesized that this species probably does not detect sounds to much over 1 kHz (if that high). This research concurred with the few other studies conducted on tuna species. Iversen (1967) found that yellowfin tuna (*T. albacares*) can detect sounds from 0.05 to 1.1 kHz, with best sensitivity of 89 dB (re 1 µPa) at 0.5 kHz. Kawakawa (*Euthynnus affinis*) appear to be able to detect sounds from 0.1 to 1.1 kHz but with best sensitivity of 107 dB (re 1 µPa) at 0.5 kHz (Iversen 1969). Additionally, Popper (1981) looked at the inner ear structure of a skipjack tuna (*Katsuwonus pelamis*) and found it to be typical of a hearing generalist. While only a few species of tuna have been studied, and in a number of fish groups both generalists and specialists exist, it is reasonable to suggest that unless bluefin tuna are exposed to very high intensity sounds from which they cannot swim away, short- and long-term effects may be minimal or non-existent (Song et al. 2006).

Some damselfish have been shown to be able to hear frequencies of up to 2 kHz, with best sensitivity well below 1 kHz. Egner and Mann (2005) found that juvenile sergeant major damselfish (*Abudefduf saxatilis*) were most sensitive to lower frequencies (0.1 to 0.4 kHz), however, larger fish (greater than 50 millimeters) responded to sounds up to 1.6 kHz. Still, the sergeant major damselfish is considered to have poor sensitivity in comparison even to other hearing generalists (Egner and Mann 2005). Kenyon (1996) studied another marine generalist, the bicolor damselfish (*Stegastes partitus*), and found responses to sounds up to 1.6 kHz with the most sensitive frequency at 0.5 kHz. Further, larval and juvenile Nagasaki damselfish (*Pomacentrus nagasakiensis*) have been found to hear at frequencies between 0.1 and 2 kHz, however, they are most sensitive to frequencies below 0.3 kHz (Wright et al. 2005, 2007). Thus, damselfish appear to be primarily generalists.

Female oyster toadfish (*Opsanus tau*) apparently use the auditory sense to detect and locate vocalizing males during the breeding season (e.g., Winn 1967). Interestingly, female midshipman fish (*Porichthys notatus*) (in the same family as the oyster toadfish) go through a shift in hearing sensitivity depending on their reproductive status. Reproductive females showed temporal encoding up to 0.34 kHz, while non-reproductive females showed comparable encoding only up to 0.1 kHz (Sisneros and Bass 2003).

The hearing capability of Atlantic salmon (*Salmo salar*) indicates relatively poor sensitivity to sound (Hawkins and Johnstone 1978). Laboratory experiments yielded responses only to 580 Hz and only at high sound levels. The Atlantic salmon is considered to be a hearing generalist, and this is probably the case for all other salmonids studied to date based on studies of hearing (e.g., Popper et al. 2007, Wysocki et al. 2007) and inner ear morphology (e.g., Popper 1976, 1977).

Furthermore, investigations into the inner ear structure of the long-spined bullhead (*Taurulus bubalis*, order Scorpaeniformes) have suggested that these fishes have generalist hearing abilities, and this is supported by their lack of a swim bladder (Lovell et al. 2005). While it is impossible to extrapolate from this species to all members of this large group of taxonomically diverse fishes, studies of hearing in another species in this group, the leopard robin (*Prionotus scitulus*), suggest that it is probably not able to detect sound to much above 800 Hz, indicating that it would be a hearing generalist (Tavolga and Wodinsky 1963). However, since the leopard sea robin has a swim bladder, and the long-spined bullhead does not, this illustrates the diversity of species in this order and makes extrapolation on hearing from these two fishes to all members of the group very difficult to do.

A number of hearing generalists can detect very low frequencies of sound. Detection of very low frequencies, or infrasound, was not investigated until fairly recently since most laboratory sound sources were unable to produce undistorted tones below 20 to 30 Hz. In addition, most earlier measures of fish hearing indicated a steadily declining sensitivity towards lower frequencies (Fay 1988), suggesting that fish would not detect low frequencies. However, as has been pointed out in the literature, often the problem with measuring lower frequency hearing (e.g., below 50 or 100 Hz) was simply that the sound sources available (underwater loud speakers) were not capable of producing lower frequency sounds, or the acoustics of the tanks in which the studies were conducted prevented lower frequency sounds from being effectively used.

Infrasound sensitivity in fish was first demonstrated in the Atlantic cod (*Gadus morhua*) (Sand and Karlsen 1986). This species can detect sounds down to about 10 Hz and is sensitive to particle motion of the sound field and not to pressure. Other species shown to detect infrasound include the plaice flatfish (*Pleuronectes platessa*) (Karlsen 1992), and the European eel (*Anguilla anguilla*) (Sand et al. 2000).

The sensitivity of at least some species of fish to infrasound may theoretically provide the animals with a wide range of information about the environment than detection of somewhat higher frequencies. An obvious potential use for this sensitivity is detection of moving objects in the surroundings, where infrasound could be important in, for instance, courtship and prey-predator interactions. Juvenile salmonids display strong avoidance reactions to near-by infrasound (Knudsen et al. 1992, 1994), and it is reasonable to suggest that such behavior has evolved as a protection against predators.

More recently, Sand and Karlsen (2000) proposed the hypothesis that fish may also use the ambient infrasounds in the ocean, which are produced by things like waves, tides, and other large scale motions, for orientation during migration. This would be in the form of an inertial guidance system where the fish detect surface waves and other large scale infrasound motions as part of their system to detect linear acceleration, and in this way migrate long distances.

An important issue with respect to infrasound relates to the distance at which such signals are detected. It is clear that fish can detect such sounds. However, behavioral responses only seem to occur when fish are well within the acoustic near field of the sound source. Thus, it is likely that the responses are to the particle motion component of the infrasound.

Hearing Capabilities of Elasmobranchs and Other “Fish”

Bony fishes are not the only species that may be impacted by environmental sounds. The two other groups to consider are the jawless fish (Agnatha – lamprey) and the cartilaginous fishes (i.e., elasmobranchs; the sharks and rays). While there are some lamprey in the marine environment, virtually nothing is known as to whether they hear or not. They do have ears, but these are relatively primitive compared to the ears of other vertebrates. No one has investigated whether the ear can detect sound (reviewed in Popper and Hoxter 1987).

The cartilaginous fishes are important parts of the marine ecosystem and many species are top predators. While there have been some studies on their hearing, these have not been extensive. However, available data suggests detection of sounds from 0.02 to 1 kHz, with best sensitivity at lower ranges (Myrberg 2001, Casper et al. 2003, Casper and Mann 2006). Though fewer than 10 elasmobranch species have been tested for hearing thresholds (reviewed in Fay 1988), it is likely that all elasmobranchs only detect low frequency sounds because they lack a swim bladder or other pressure detector. At the same time, the ear in a number of elasmobranch species whose hearing has not been tested is very large with numerous sensory hair cells (e.g., Corwin 1981, 1989). Thus, it is possible that future studies will demonstrate somewhat better hearing in those species than is now known.

There is also evidence that elasmobranchs can detect and respond to human-generated sounds. Myrberg and colleagues did experiments in which they played back sounds and attracted a number of different shark species to the sound source (e.g., Myrberg et al. 1969, 1972, 1976; Nelson and Johnson 1972). The results of these studies showed that sharks were attracted to pulsed low-frequency sounds (below several hundred Hz), in the same frequency range of sounds that might be produced by struggling prey (or divers in the water). However, sharks are not known to be attracted by continuous signals or higher frequencies (which they cannot hear).

Data on Fish Hearing

Table 3.7-10 provides data on the hearing capabilities of all of the marine fish species that have been studied to date. However, before examining the data in the table, a number of important points must be made.

- In order to conform to the most recent taxonomic studies of the species, the table uses current scientific names for a number of species rather than the scientific names used at the time that the research paper was written. Source for names is www.fishbase.org.
- The data in the table were primarily compiled by two sources, Fay (1988) and Nedwell et al. (2004). Since the Nedwell et al. (2004) study was not published, the data were checked, where possible, against Fay (1988) or original sources.
- The data in the table for "best sensitivity" is only provided to give a sense of where the best hearing was for that species. However, since thresholds are often variable, this information should be used with utmost caution.
- It may generally be said that fish with a hearing range that only extends to 1.5 kHz are more likely to be hearing generalists, whereas fish with higher frequency hearing would be considered specialists.
- It is critical to note that comparison of the data in the table between species must be done with considerable caution. Most importantly, data were obtained in very different ways for the various species, and it is highly likely that different experimental methods yield different results in terms of range of hearing and in hearing sensitivity. Thus, data obtained using behavioral measures, such as those done by Tavolga and Wodinksy (1963) for a variety of marine fishes provide data in terms of what animals actually detected since the animals were required to do a behavioral task whenever they detected a sound.
- In contrast, studies performed using auditory evoked potentials (AEP), often called auditory brainstem response (ABR), a very effective general measure of hearing that is being widely used today, tends, in fishes, to generally provide results that indicate a somewhat narrower hearing range and possibly different sensitivity (thresholds) than obtained using behavioral methods. The difference is that ABR is a measure that does not involve any response on the part of the fish. Instead, ABR is a measure of the brainstem response and does not measure the integrated output of the auditory system (e.g. cortical process, decision making, etc.). Examples of data from ABR studies include the work of Casper et al. (2003) and Ramcharitar et al. (2004, 2006a).
- Many of the species, as shown, are hearing generalists and these species respond best primarily to particle motion rather than pressure, as discussed earlier. However, the vast majority of the species were tested with pressure signals and the particle motion signal was not calibrated. Thus, hearing sensitivity data, and hearing range, may be somewhat different if particle motion had been calibrated. Accordingly, while the table gives a general sense of hearing of different species, caution must be taken in extrapolation to other species, and in interpretation of the data.

Table 3.7-10: Marine Fish Hearing Sensitivity

Family	Description of Family	Common Name	Scientific Name	Hearing Range (Hz) Low	Hearing Range (Hz) High	Best Sensitivity (Hz)	Reference
Albulidae	Bonefishes	Bonefish	*Albula vulpes*	100	700	300	Tavolga 1974a
Anguillidae	Eels	European eel	*Anguilla anguilla*	10	300	40-100	Jerkø et al. 1989
Ariidae	Catfish	Hardhead sea catfish	*Ariopsis felis* [1]	50	1,000	100	Popper and Tavolga 1981
Batrachoididae	Toadfishes	Midshipman[2]	*Porichthys notatus*	65	385		Sisneros 2007
		Oyster toadfish	*Opsanus tau*	100	800	200	Fish and Offutt 1972
		Gulf toadfish	*Opsanus beta*			<1,000	Remage-Healy et al. 2006
Clupeidae	Herrings, shads, menhaden, sardines	Alewife	*Alosa pseudoharengus*		120+		Dunning et al. 1992
		Blueback herring	*Alosa aestivalis*		120+		Dunning et al. 1992
		American shad	*Alosa sapidissima*	0.1	180	200-800 and 25-150	Mann et al. 1997
		Gulf menhaden	*Brevoortia patronus*		100+		Mann et al. 2001
		Bay anchovy	*Anchoa mitchilli*		4,000		Mann et al. 2001
		Scaled sardine	*Harengula jaguana*		4,000		Mann et al. 2001
		Spanish sardine	*Sardinella aurita*		4,000		Mann et al. 2001
		Pacific herring	*Clupea pallasii*	100	5,000		Mann et al. 2005

[1] Formerly *Arius felis*

[2] Data obtained using saccular potentials, a method that does not necessarily reveal the full bandwidth of hearing.

Family	Description of Family	Common Name	Scientific Name	Hearing Range (Hz) Low	High	Best Sensitivity (Hz)	Reference
Chondrichthyes [Class]	Rays, sharks, skates	Data are for several different species		200	1,000		See Fay 1988; Casper et al. 2003
Cottidae	Sculpins	Long-spined bullhead	*Taurulus bubalis*				Lovell et al. 2005
Gadidae	Cods, gadiforms, grenadiers, hakes	Atlantic Cod	*Gadus morhua*	2	500	20	Chapman and Hawkins 1973, Sand and Karlsen 1986
		Ling	*Molva molva*	60	550	200	Chapman 1973
		Pollack	*Pollachius pollachius*	40	470	60	Chapman 1973
		Haddock	*Melanogrammus aeglefinus*	40	470	110-300	Chapman 1973
Gobidae	Gobies	Black goby	*Gobius niger*	100	800		Dijkgraaf 1952
Holocentridae	Squirrelfish and soldierfish	Shoulderbar soldierfish	*Myripristis kuntee*	100	3,000	400-500	Coombs and Popper 1979
		Hawaiian squirrelfish	*Sargocentron xantherythrum**	100	800		Coombs and Popper 1979
		Squirrelfish	*Holocentrus adscensionis**	100	2,800	600-1,000	Tavolga and Wodinsky 1963
		Dusky squirrelfish	*Sargocentron vexillarium**	100	1,200	600	Tavolga and Wodinsky 1963
Labridae	Wrasses	Tautog	*Tautoga onitis*	10	500	37 - 50	Offutt 1971
		Blue-head wrasse	*Thalassoma bifasciatum*	100	1,300	300 – 600	Tavolga and Wodinksy 1963

Family	Description of Family	Common Name	Scientific Name	Hearing Range (Hz) Low	Hearing Range (Hz) High	Best Sensitivity (Hz)	Reference
Lutjanidae	Snappers	Schoolmaster snapper	*Lutjanus apodus*	100	1,000	300	Tavolga and Wodinksy 1963
Myctophidae[3]	Lanternfishes	Warming's lanternfish	*Ceratoscopelus warmingii*	Specialist			Popper 1977
Pleuronectidae	Flatfish[4]	Dab	*Limanda limanda*	30	270	100	Chapman and Sand 1974
		European plaice	*Pleuronectes platessa*	30	200	110	
Pomadasyidae	Grunts	Blue striped grunt	*Haemulon sciurus*	100	1,000		Tavolga and Wodinsky 1963
Pomacentridae	Damselfish[5]	Sergeant major damselfish	*Abudefduf saxatilis*	100	1,600	100-400	Egner and Mann 2005
		Bicolor damselfish	*Stegastes partitus*	100	1,000	500	Myrberg and Spires 1980
		Nagasaki damselfish	*Pomacentrus nagasakiensis*	100	2,000	<300	Wright et al. 2005, 2007
		Threespot damselfish	*Stegatus planifrons**	100	1,200	500-600	Myrberg and Spires 1980
		Longfish damselfish	*Stegatus diencaeus**	100	1,200	500-600	Myrberg and Spires 1980
		Honey gregory	*Stegatus diencaeus**	100	1,200	500-600	Myrberg and Spires 1980
		Cocoa damselfish	*Stegatus variabilis**	100	1,200	500	Myrberg and Spires 1980

[3] Several other species in this family also showed saccular specializations suggesting that the fish would be a hearing specialist. However, no behavioral or physiological data are available.

[4] Note, data for these species should be expressed in particle motion since it has no swim bladder. See Chapman and Sand, 1974 for discussion.

[5] Formerly all members of this group were *Eupomocentrus*. Some have now been changed to *Stegatus* and are so indicated in this table (as per www.fishbase.org).

Family	Description of Family	Common Name	Scientific Name	Hearing Range (Hz)		Best Sensitivity (Hz)	Reference
				Low	High		
		Beaugregory[6]	*Stegatus leucostictus*[*]	100	1,200	500-600	Myrberg and Spires 1980
		Dusky damselfish	*Stegastes adustus*[*, 7]	100	1,200	400-600	Myrberg and Spires 1980
Salmonidae	Salmons	Atlantic salmon	*Salmo salar*	<100	580		Hawkins and Johnstone 1978, Knudsen et al. 1994
Sciaenidae	Drums, weakfish, croakers	Atlantic croaker	*Micropogonias undulatus*	100	1,000	300	Ramcharitar and Popper 2004
		Spotted seatrout	*Cynoscion nebulosus*	Generalist			Ramcharitar et al. 2001
		Southern kingcroaker	*Menticirrhus americanus*	Generalist			Ramcharitar et al. 2001
		Spot	*Leiostomus xanthurus*	200	700	400	Ramcharitar et al. 2006a
		Black drum	*Pogonias cromis*	100	800	100-500	Ramcharitar and Popper 2004
		Weakfish	*Cynoscion regalis*	200	2,000	500	Ramcharitar et al. 2006a
		Silver perch	*Bairdiella chrysoura*	100	4,000	600-800	Ramcharitar et al. 2004
		Cubbyu	*Pareques acuminatus*	100	2,000	400-1,000	Tavolga and Wodinsky 1963
Scombridae	Albacores, bonitos, mackerels, tunas	Bluefin tuna	*Thunnus thynnus*	Generalist			Song et al. 2006
		Yellowfin tuna	*Thunnus albacares*	500	1,100		Iversen 1967

[6] Similar results in Tavolga and Wodinsky 1963.

[7] Formerly *Eupomacentrus dorsopunicans*.

Family	Description of Family	Common Name	Scientific Name	Hearing Range (Hz) Low	Hearing Range (Hz) High	Best Sensitivity (Hz)	Reference
		Kawakawa	*Euthynnus affinis*	100	1,100	500	Iversen 1969
		Skipjack tuna	*Katsuwonus pelamis*	Generalist			Popper 1977
Serranidae	Seabasses, groupers	Red hind	*Epinephelus guttatus*	100	1,100	200	Tavolga and Wodinsky 1963
Sparidae	Porgies	Pinfish	*Lagodon rhomboides*	100	1,000	300	Tavolga 1974b
Triglidae	Scorpionfishes, searobins, sculpins	Leopard searobin	*Prionotus scitulus*	100	~800	390	Tavolga and Wodinsky 1963

Data were compiled from reviews in Fay (1988) and Nedwell et al. (2004). See the very important caveats about the data in the text. For a number of additional species, we can only surmise about hearing capabilities from morphological data. These data are shown in gray, with a suggestion as to hearing capabilities based only on morphology. Scientific names marked with an asterisk have a different name in the literature. The updated names come from www.fishbase.org.

As a consequence of these differences in techniques, as well as differences in sound fields used and differences in experimental paradigms, one must be extremely cautious in comparing data between different species when they were tested in different ways and/or in different laboratories. While general comparisons are possible (e.g., which species are generalists and which are specialists), more detailed comparisons, such as of thresholds, should be done with utmost caution since one investigator may have been measuring pressure and another particle motion. At the same time, it should be noted that when different species were tested in the same lab, using the same experimental approach, it is possible to make comparative statements about hearing among the species used since all would have been subject to the same sound field.

3.7.1.1.3 Rare, Threatened, and Endangered Species

Steelhead

Steelhead (Oncorhynchus mykiss) are members of the Family Salmonidae (e.g., salmon and trout), and may exhibit either an anadromous life style, where they migrate as juveniles from freshwater habitats to marine environments and return to freshwater habitats to spawn, or they may exhibit a freshwater residency, where they spend their entire life in freshwater (McEwan and Jackson 1996). In 1997, National Marine Fisheries Service (NMFS) listed the southern California Evolutionary Significant Unit (ESU) of West Coast steelhead as endangered (Federal Register: August 18, 1997 [Volume 62, Number 159, Pages 43937-43954]). The southern California ESU range for the steelhead extends from Santa Maria River south to San Mateo Creek (NMFS 2002). It was expanded in 2002 to include streams south of Malibu Creek, specifically Topanga and San Mateo creeks (Figure 3.7-12; NMFS 2002). The lower portion of San Mateo Creek flows through Camp Pendleton, and into the SOCAL OPAREAs (USMC 2001). Except for a possible small population of anadromous steelhead located in San Mateo Creek, the species is considered to be completely extirpated from the Santa Monica Mountains in California to the U.S./Mexico border (WCSBRT 2003).

Figure 3.7-12: Adult steelhead trout potential marine habitat range in the SOCAL OPAREAs and vicinity.

Very little life history information is available for the southern California ESU (NMFS 1997). There is high variability in life history for this species, in terms of when and if adults become anadromous and utilize the marine environment, because of southern California's variable seasonal and annual climatic conditions. Some winters produce heavy rainfalls and flooding, which allow juvenile steelhead easier access to the ocean. Conversely, dry seasons and periods of drought close the mouths of coastal streams limiting access to marine waters by juvenile steelhead.

Tidewater Goby

The tidewater goby (*Eucyclogobius newberryi*) is listed as endangered. It is a small fish that inhabits coastal brackish water habitats entirely within California, ranging from Tillas Slough (mouth of the Smith River, Del Norte County) near the Oregon border south to Agua Hedionda Lagoon (northern San Diego County). The tidewater goby is known to have formerly inhabited at least 134 localities. Presently 23 (17 percent) of the 134 documented localities are considered extirpated and 55 to 70 (41 to 52 percent) of the localities are naturally so small or have been degraded over time that long-term persistence is uncertain (USFWS 2005).

Tidewater gobies are uniquely adapted to coastal lagoons and the uppermost brackish zone of larger estuaries, rarely invading marine or freshwater habitats. The species is typically found in water less than 3.3 ft (1 m) deep and salinities of less than 12 parts per thousand. Principal threats to the tidewater goby include loss and modification of habitat, water diversions, predatory and competitive introduced fish species, habitat channelization, and degraded water quality.

Tidewater goby critical habitat includes 10 coastal stream segments in Orange and San Diego Counties, California (USFWS 2000). Critical habitat includes the stream channels and their associated wetlands, flood plains, and estuaries. These habitat areas provide for the primary biological needs of foraging, sheltering, reproduction, and dispersal, which are essential for the conservation of the tidewater goby. Information exists suggesting that critical habitat boundaries should be revised (USFWS 2002).

Green Sturgeon

The southern population of green sturgeon (*Acipenser medirostris*) was recently listed as a threatened species (April 7, 2006; 71 FR 17757). This species consists of coastal and Central Valley populations south of the Eel River, with the only known spawning population in the Sacramento River. Less is known about the green sturgeon's distribution south of its spawning grounds and geographic range. Although anecdotal information suggests that they may be found in the Southern California Bight, given the lack of observations or incidences of bycatch in southern California fisheries, they are likely rare visitors to the area.

Chinook Salmon

In the United States, chinook salmon (*Oncorhynchus tshawytscha*) are found from the Bering Strait area off Alaska south to Southern California. Historically, they ranged as far south as the Ventura River, California. NOAA Fisheries has identified 17 evolutionarily significant units (ESUs) of chinook salmon in Washington, Oregon, Idaho and California. Each ESU is treated as a separate species under the ESA. Little is known regarding the oceanic distribution of chinook salmon originating from Southern California rivers, and although anecdotal information suggests that they may be found in the Southern California Bight, given the lack of observations or incidences of bycatch in southern California fisheries, they are likely rare visitors to the area.

Table 3.7-11: Common and Scientific Names of Fishes Mentioned in the Text

Family	Common Family Name	Common Name	Scientific Name
Sharks and Ray			
Heterodontidae	Bullhead sharks	Horn shark	*Heterodontus francisci*
Scyliorhinidae	Cat sharks	Swell shark	*Cephaloscyllium ventriosum*
Triakididae	Smoothhounds	Gray smoothhound	*Mustelus californicus*
Squatinidae	Angel sharks	Pacific angel shark	*Squatina californica*
Rhinobatidae	Guitarfishes	Shovelnose guitarfish	*Rhinobatos productus*
Dasyatididae	Stingrays	Round stingray	*Urophus halleri*
Myliobatididae	Eagle rays	Bat ray	*Myliobatis californica*
Bony Fishes			
Muraenidae	Moray eels	California moray	*Gymnothorax mordax*
Clupeidae	Herrings	Pacific sardine	*Sardinops sagax caeruleus*
Engraulididae	Anchovies	Northern anchovy	*Engraulis mordax*
		Deepbody anchovy	*Anchoa compressa*
		Slough anchovy	*Anchoa delicatissima*
Osmeridae	Smelts	Surf smelt	*Hypomesus pretiosus*
Synodontidae	Lizardfishes	California lizardfish	*Synodus luciopes*
Merlucidae	Hakes	Pacific hake	*Merlucius productus*
Ophididae	Cusk-eels	Spotted cusk-eel	*Chilara taylori*
		Basketweave cusk-eel	*Ophiodon scrippsae*
Zoarcidae	Eelpouts	Blackbelly eelpout	*Lycodes pacificus*
Batrachoididae	Toadfishes	Specklefin midshipman	*Porichthys myraster*
		Plainfin midshipman	*Porichthys notatus*
Cyprinodontidae	Killfish	California killifish	*Fundulus parvipinnis*
Atherinidae	Silversides	Topsmelt	*Atherinopsis affinis*
		Jacksmelt	*Atherinopsis californiensis*
		California grunion	*Leuresthes tenuis*
Sygnathidae	Pipefishes	Kelp pipefish	*Sygnathus californiensis*
Scorpanidae	Scorpionfish and rockfish	California scorpionfish	*Scorpaena guttata*
		Kelp rockfish	*Sebastes atrovirens*
		Brown rockfish	*Sebastes auriculatus*
		Gopher rockfish	*Sebastes carnatus*
		Black-and-yellow rockfish	*Sebastes chrysomelas*
		Calico rockfish	*Sebastes dalli*
		Splitnose rockfish	*Sebastes diploproa*
		Vermilion rockfish	*Sebastes miniatus*
		Blue rockfish	*Sebastes mystinus*
		Bocaccio rockfish	*Sebastes paucispinis*
		Grass rockfish	*Sebastes rastrelliger*
		Stripetail rockfish	*Sebastes saxicola*
		Halfbanded rockfish	*Sebastes semicinctus*
		Olive rockfish	*Sebastes serranoides*
		Treefish rockfish	*Sebastes serriceps*

Family	Common Family Name	Common Name	Scientific Name
Anoplomatidae	Sablefish and skilfishes	Sablefish	*Anoplopoma fimbria*
Hexagrammidae	Greenlings and lingcod	Lingcod	*Ophiodon elongatus*
		Painted greenling	*Oxylebius pictus*
Zaniolepididiae	Combfishes	Shortspine combfish	*Zaniolepis frenata*
		Longspine combfish	*Zaniolepis latipinus*
Cottidae	Sculpins	Coralline sculpin	*Artedius corallinus*
		Roughback sculpin	*Chitonotus pugetensis*
		Yellowchin sculpin	*Icelinus quadriseratus*
		Lavender sculpin	*Leiocottus hirundo*
		Pacific staghorn sculpin	*Leptocottus armatus*
		Snubnose sculpin	*Orthonopias tricas*
		Cabezon	*Scorpaenichthys marmoratus*
Agonidae	Poachers	Pygmy poacher	*Odontopyxis trispinosa*
		Blacktip poacher	*Xeneretmus latifrons*
Serranidae	Sea basses and groupers	(Calico) kelp bass	*Paralabrax clathratus*
		Barred sand bass	*Paralabrax nebulifer*
Malacanthidae	Tilefishes	Ocean whitefish	*Caulolatius princeps*
Carangidae	Jacks	Yellowtail	*Seriola lalandi*
		Jack mackerel	*Trachurus symmetricus*
Coryphaenidae	Dolphins	Dolphin (fish)	*Coryphaena hippurus*
Haemulidae	Grunts	Sargo	*Anisotremus davidsonii*
		Salema	*Xenisticus californiensis*
Sciaenidae	Croakers	Black croaker	*Cheilotrema saturnum*
		White croaker	*Genyonemus lineatus*
		Spotfin croaker	*Roncador sternsii*
		Queenfish	*Seriphus politus*
		California corbina	*Menticirrhus undulatus*
		Yellowfin croaker	*Umbrina roncador*
Kyphosidae	Sea chubs	Opaleye	*Girella nigricans*
		Zebraperch	*Hermosilla azurea*
		Halfmoon	*Medialuna californiensis*
Embiotocidae	Surfperches	Barred surfperch	*Amphistichus argenteus*
		Kelp surfperch	*Brachyistius frenatus*
		Shiner surfperch	*Cymatogaster aggregata*
		Pile surfperch	*Damalichthys vacca*
		Black surfperch	*Embiotoca jacksoni*
		Striped surfperch	*Embiotoca lateralis*
		Walleye surfperch	*Hyperprosopon argenteum*
		Rainbow surfperch	*Hypsurus caryi*
		Dwarf surfperch	*Micrometrus minimus*
		White surfperch	*Phanerdon furcatus*
		Rubberlip surfperch	*Rhacochilus toxotes*

Family	Common Family Name	Common Name	Scientific Name
Pomacentride	Damselfishes	Blacksmith	*Chromis punctipinnis*
		Garibaldi	*Hypsypops rubicundus*
Sphyraenidae	California barracuda	California barracuda	*Sphyraena argentea*
Labridae	Wrasses	Rock wrasse	*Halichoeres semicinctus*
		Señorita	*Oxyjulis californica*
		California sheephead	*Semicossyphus pulcher*
Clinidae	Kelpfishes	Island kelpfish	*Alloclinus holderi*
		Spotted kelpfish	*Gibbonsia elegans*
		Kelpfish	*Gibbonsia* spp
		Giant kelpfish	*Heterostichus rostratus*
Gobidae	Gobies	Arrow goby	*Clevlandia ios*
		Blackeye goby	*Coryphopterus nicholsii*
		Blue banded goby	*Lythrypnus dalli*
		Bay goby	*Lepidogobius lepidus*
		Zebra goby	*Lythrypnus zebra*
		Tidewater goby	*Eucyclogobius newberryi*
Scombridae	Mackerels and tunas	Skipjack tuna	*Katsuwonus pelamis*
		Pacific bonito	*Sarda chiliensis*
		Pacific mackerel	*Scomber japonicus*
		Albacore tuna	*Thunnus alalunga*
		Yellowfin tuna	*Thunnus albacares*
		Bluefin tuna	*Thunnus thynnus*
Xiphiidae	Swordfishes	Swordfish	*Xiphias gladius*
Istiophoridae	Billfishes	Stripped marlin	*Tetrapterus audax*
Bothidae	Lefteye flounders	Pacific sanddab	*Citharichthys sordidus*
		Speckled sanddab	*Citharichthys stigmaeus*
		Longfin sanddab	*Citharichthys xanthostigmata*
		Bigmouth sole	*Hippoglossina stomata*
		California halibut	*Paralichthys californicus*
		Fantail sole	*Xystreurys liolepis*
Pleuronectidae	Righteye flounders	Rex sole	*Glyptocephalus zachiyrus*
		Diamond tubot	*Hypsopsetta guttulata*
		Slender sole	*Liopsetta exilis*
		Dover sole	*Microstomus pacificus*
		English sole	*Parophyrus vetulus*
		Hornyhead turbot	*Pleuronectes verticalis*
		English sole	*Pleuronectes vetulus*
		Turbot	*Pleuronichthys coenosus*
		Curlfin turbot	*Pleuronichthys decurens*
Salmonidae	Trout and Salmon	Steelhead	*Oncorhynchus mykiss*
		Chinook salmon	*Oncorhynchus tshawytscha*
Acipenseridae	Sturgeon	Green sturgeon	*Acipenser medirostris*
Cynoglossidae	Tonguefishes	California tonguefish	*Sympharus atricauda*

3.7.2 Environmental Consequences

The analysis of effects on fish concerns direct physical injury, i.e., the potential for death, injury, or failure to reach (or an increase in the time needed to reach) the next developmental stage was used to evaluate potential effects on fish eggs, larvae, and adult fish. Data are available to enable some predictions about the likelihood and extent of these kinds of effects.

Essential Fish Habitat (EFH) is located within the region of influence and consists of three management units: (1) Coastal Pelagic, (2) Groundfish, and (3) Highly Migratory. There are Fishery Conservation Management Plans that identify and describe each EFH. For the purpose of this analysis, potential effects were considered to determine adverse impacts to EFH. See Appendix E for full EFH Assessment.

Mitigation measures for activities involving underwater detonations, implemented for marine mammals and sea turtles, also offer protections to habitats associated with fish communities.

3.7.2.1 Approach to Analysis

In this section, the approach to the assessment of effects on fish is presented, as well as a review of the literature on potential effects common to most activities. These include noise; disturbance; and non-acoustic effects of contaminants, debris, and discarded expendable material.

Effects on fish and the distances at which behavioral effects can occur depend on the nature of the sound, the hearing ability of the fish, and species-specific behavioral responses to sound. Changes in fish behavior can, at times, reduce their catchability and thus affect fisheries.

The following methods were used to assess potential effects of noise on fish. Received noise levels that correspond to the various types of effects on fish were evaluated. Effects include physical damage to fish, short-term behavioral reactions, long-term behavioral reactions, and changes in distribution.

The relative abundance of each species of fish (Tables 3.7-3 and 3.7-4) present within the area encompassed within noise/effect contours above was estimated. Whether there was an effect within each noise/effect contour was then determined. The “no effect” determination would include cases where there were no effects on fish or inconsequential changes in their behavior. If there was an effect, it was described in terms of relative numbers affected versus total relative population on the range.

Whereas baseline conditions describe the relative abundance of fish as estimated from fisheries data, estimates of the absolute abundance of fish for the area of interest are not available. There are some available estimates of abundance for a few shallow areas off the California coast, but it is not possible to determine if abundance off San Clemente Island (SCI) is similar. Thus, effects on fish are expressed in relative terms.

There are two types of sound sources that are of major concern to fish and fisheries: (1) strong underwater shock pulses that can cause physical damage to fish, and (2) underwater sounds that could cause disturbance to fish and affect their biology or catchability by fishers. Both types of sound can cause changes in fish distribution and/or behavior. This assessment focuses on potential effects on fish. Effects on commercial and recreational fisheries themselves are discussed in Section 3.14.

3.7.2.1.1 Effects of Human-Generated Sound on Fish

There have been very few studies on the effects that human-generated sound may have on fish. These have been reviewed in a number of places (e.g., NRC 1994, 2003, Popper 2003, Popper et al. 2004, Hastings and Popper 2005), and some more recent experimental studies have provided additional insight into the issues (e.g., Govoni et al. 2003, McCauley et al. 2003, Popper et al. 2005, 2007, Song et al. in press). Most investigations, however, have been in the gray literature (non peer-reviewed reports – see Hastings and Popper, 2005 for an extensive critical review of this material). While some of these studies provide insight into effects of sound on fish, as mentioned earlier, the majority of the gray literature studies often lack appropriate controls, statistical rigor, and/or expert analysis of the results.

There are a wide range of potential effects on fish that range from no effect at all (e.g., the fish does not detect the sound or it "ignores" the sound) to immediate mortality. In between these extremes are a range of potential effects that parallel the potential effects on marine mammals that were illustrated by Richardson et al. (1995). These include, but may not be limited to:

- No effect behaviorally or physiologically: The animal may not detect the signal, or the signal is not one that would elicit any response from the fish.
- Small and inconsequential behavioral effects: Fish may show a temporary "awareness" of the presence of the sound but soon return to normal activities.
- Behavioral changes that result in the fish moving from its current site: This may involve leaving a feeding or breeding ground. This affect may be temporary, in that the fish return to the site after some period of time (perhaps after a period of acclimation or when the sound terminates), or permanent.
- Temporary loss of hearing (often called Temporary Threshold Shift – TTS): This recovers over minutes, hours, or days.
- Physical damage to auditory or non-auditory tissues (e.g., swim bladder, blood vessels, brain): The damage may be only temporary, and the tissue "heals" with little impact on fish survival, or it may be more long-term, permanent, or may result in death. Death from physical damage could be a direct effect of the tissue damage or the result of the fish being more subject to predation than a healthy individual.

Studies on effects on hearing have generally been of two types. In one set of studies, the investigators exposed fish to long-term increases in background noise to determine if there are changes in hearing, growth, or survival of the fish. Such studies were directed at developing some understanding of how fish might be affected if they lived in an area with constant and increasing shipping or in the presence of a wind farm, or in areas where there are long-term acoustic tests. Other similar environments might be aquaculture facilities or large marine aquaria. In most of these studies examining long-term exposure, the sound intensity was well below any that might be expected to have immediate damage to fish (e.g., damage tissues such as the swim bladder or blood vessels).

In the second type of studies, fish were exposed to short duration but high intensity signals such as might be found near a high intensity sonar, pile driving, or seismic airgun survey. The investigators in such studies were examining whether there was not only hearing loss and other long-term effects, but also short-term effects that could result in death to the exposed fish.

Effects of Long-Duration Increases in Background Sounds on Fish

Effects of long-duration relatively low intensity sounds (e.g., below 170 – 180 dB re 1 μPa received level ([RL]) indicate that there is little or no effect of long-term exposure on hearing generalists (e.g., Scholik and Yan 2001, Amoser and Ladich 2003, Smith et al. 2004a,b, Wysocki et al. 2007). The longest of these studies exposed young rainbow trout (*Oncorhynchus mykiss*), to a level of noise equivalent to one that fish would experience in an aquaculture facility (e.g., on the order of 150 dB re 1 μPa RL) for about nine months. The investigators found no effect on hearing or on any other measures including growth and effects on the immune system as compared to fish raised at 110 dB re 1 μPa RL. The sound level used in the study would be equivalent to ambient sound in the same environment without the presence of pumps and other noise sources of an aquaculture facility (Wysocki et al. 2007).

Studies on hearing specialists have shown that there is some hearing loss after several days or weeks of exposure to increased background sounds, although the hearing loss seems to recover (e.g., Scholik and Yan 2002, Smith et al. 2004b, 2006). Smith et al. (2004a, 2006) investigated the goldfish (*Carassius auratus*). They exposed fish to noise at 170 dB re 1 μPa and there was a clear relationship between the level of the exposure sound and the amount of hearing loss. There was also a direct correlation of level of hearing loss and the duration of exposure, up to 24-hours, after which time the maximum hearing loss was found.

Similarly, Wysocki and Ladich (2005) investigated the influence of noise exposure on the auditory sensitivity of two freshwater hearing specialists, the goldfish and the lined Raphael catfish (*Platydoras costatus*), and on a freshwater hearing generalist, a sunfish (*Lepomis gibbosus*). Baseline thresholds showed greatest hearing sensitivity around 0.5 kHz in the goldfish and catfish and at 0.1 kHz in the sunfish. For the hearing specialists (goldfish and catfish), continuous white noise of 130 dB re 1 μPa RL resulted in a significant threshold shift of 23 to 44 dB. In contrast, the auditory thresholds in the hearing generalist (sunfish) declined by 7 to 11 dB.

In summary, and while data are limited to a few freshwater species, it appears that some increase in ambient noise level, even to above 170 dB re 1 μPa does not permanently alter the hearing ability of the hearing generalist species studied, even if the increase in sound level is for an extended period of time. However, this may not be the case for all hearing generalists, though it is likely that any temporary hearing loss in such species would be considerably less than for specialists receiving the same noise exposure. But, it is critical to note that more extensive data are needed on additional species, and if there are places where the ambient levels exceed 170 – 180 dB, it would be important to do a quantitative study of effects of long-term sound exposure at these levels.

It is also clear that there is a larger temporary hearing loss in hearing specialists. Again, however, extrapolation from the few freshwater species to other species (freshwater or marine) must be done with caution until there are data for a wider range of species, and especially species with other types of hearing specializations than those found in the species studied to date (all of which are otophysan fishes and have the same specializations to enhance hearing).

Effects of High Intensity Sounds on Fish

There is a small group of studies that discusses effects of high intensity sound on fish. However, as discussed in Hastings and Popper (2005), much of this literature has not been peer reviewed, and there are substantial issues with regard to the actual effects of these sounds on fish. More recently, however, there have been two studies of the effects of high intensity sound on fish that, using experimental approaches, provided insight into overall effects of these sounds on hearing and on auditory and non-auditory tissues. One study tested effects of seismic airguns, a highly impulsive and intense sound source, while the other study examined the effects of SURTASS LFA sonar. Since these studies are the first that examined effects on hearing and physiology, they will be discussed in some detail. These studies not only provide important data, but also suggest ways in which future experiments need to be conducted. This discussion will be followed by a brief overview of other studies that have been done, some of which may provide a small degree of insight into potential effects of human-generated sound on fish.

Effects of Seismic Airguns on Fish

Popper et al. (2005; Song et al. in press) examined the effects of exposure to a seismic airgun array on three species of fish found in the Mackenzie River Delta near Inuvik, Northwest Territories, Canada.

The species included a hearing specialist, the lake chub (*Couesius plumbeus*), and two hearing generalists, the northern pike (*Esox lucius*), and the broad whitefish (*Coregonus nasus*) (a salmonid). In this study, fish in cages were exposed to 5 or 20 shots from a 730 in^3 (12,000 cc) calibrated airgun array. And, unlike earlier studies, the received exposure levels were not only determined for RMS sound pressure level, but also for peak sound levels and for SELs (e.g., average mean peak SPL 207 dB re 1 μPa RL; mean RMS sound level 197 dB re 1 μPa RL; mean SEL 177 dB re 1 $\mu Pa^2 s$).

The results showed a temporary hearing loss for both lake chub and northern pike, but not for the broad whitefish, to both 5 and 20 airgun shots. Hearing loss was on the order of 20 to 25 dB at some frequencies for both the northern pike and lake chub, and full recovery of hearing took place within 18 hours after sound exposure. While a full pathological study was not conducted, fish of all three species survived the sound exposure and were alive more than 24 hours after exposure. Those fish of all three species had intact swim bladders and there was no apparent external or internal damage to other body tissues (e.g., no bleeding or grossly damaged tissues), although it is important to note that the observer in this case (unlike in the following LFA study) was not a trained pathologist. Recent examination of the ear tissues by an expert pathologist showed no damage to sensory hair cells in any of the fish exposed to sound (Song et al., submitted).

A critical result of this study was that it demonstrated differences in the effects of airguns on the hearing thresholds of different species. In effect, these results substantiate the argument made by Hastings et al. (1996) and McCauley et al. (2003) that it is difficult to extrapolate between species with regard to the effects of intense sounds.

Experiments conducted by Skalski et al. (1992), Dalen and Raknes (1985), Dalen and Knutsen (1986), and Engas et al. (1996) demonstrated that some fish were forced to the bottom and others driven from the area in response to low-frequency airgun noise. The authors speculated that catch per unit effort would return to normal quickly in their experimental area because behavior of the fish returned to normal minutes after the sounds ceased.

Effects of SURTASS LFA Sonar on Fish

Popper et al. (2007) studied the effect of SURTASS LFA on hearing, the structure of the ear, and select non-auditory systems in the rainbow trout (*Oncorhynchus mykiss*) and channel catfish (*Ictalurus punctatus*) (also Halvorsen et al. 2006).

The SURTASS LFA sonar study was conducted in an acoustic free-field environment that enabled the investigators to have a calibrated sound source and to monitor the sound field throughout the experiments. In brief, experimental fish were placed in a test tank, lowered to depth, and exposed to LFA sonar for 324 or 648 seconds, an exposure duration that is far greater than any fish in the wild would get since, in the wild, the sound source is on a vessel moving past the far slower swimming fish. For a single tone, the maximum RL was approximately 193 dB re 1 μPa at 196 Hz and the level was uniform within the test tank to within approximately ±3 dB. The signals were produced by a single SURTASS LFA sonar transmitter giving an approximate source level of 215 dB. Following exposure, hearing was measured in the test animals. Animals were also sacrificed for examination of auditory and non-auditory tissues to determine any non-hearing effects. All results from experimental animals were compared to results obtained from baseline control and control animals.

A number of results came from this study. Most importantly, no fish died as a result of exposure to the experimental source signals. Fish all appeared healthy and active until they were sacrificed or returned to the fish farm from which they were purchased. In addition, the study employed the expertise of an expert fish pathologist who used double-blind methods to analyze the tissues of the fish exposed to the sonar source, and compared these to control animals. The results clearly showed that there were no pathological effects from sound exposure including no effects on all major body tissues (brain, swim bladder, heart, liver, gonads, blood, etc.). There was no damage to the swim bladder and no bleeding as a result of LFA sonar exposure. Furthermore, there were no short- or long-term effects on ear tissue (Popper et al. 2007, also Kane et al. in prep.).

Moreover, behavior of caged fish after sound exposure was no different than that prior to tests. It is critical to note, however, that behavior of fish in a cage in no way suggests anything about how fish would respond to a comparable signal in the wild. Just as the behavior of humans exposed to a noxious stimulus might show different behavior if in a closed room as compared to being out-of-doors, it is likely that the behaviors shown by fish to stimuli will also differ, depending upon their environment.

The study also incorporated effects of sound exposure on hearing both immediately post exposure and for several days thereafter to determine if there were any long-term effects, or if hearing loss showed up at some point post exposure. Catfish and some specimens of rainbow trout showed 10-20 dB of hearing loss immediately after exposure to the LFA sonar when compared to baseline and control animals; however another group of rainbow trout showed no hearing loss. Recovery in trout took at least 48 hours, but studies could not be completed. The different results between rainbow trout groups is difficult to understand, but may be due to developmental or genetic differences in the various groups of fish. Catfish hearing returned to, or close to, normal within about 24 hours.

Additional Sonar Data

While there are no other data on the effects of sonar on fish, there are two recent unpublished reports of some relevance since it examined the effects on fish of a mid-frequency sonar (1.5 to 6.5 kHz) on larval and juvenile fish of several species (Jørgensen et al. 2005, Kvadsheim and Sevaldsen 2005). In this study, larval and juvenile fish were exposed to simulated sonar signals in order to investigate potential effects on survival, development, and behavior. The study used herring (*Clupea harengus*) (standard lengths 2 to 5 cm), Atlantic cod (*Gadus morhua*) (standard length 2 and 6 cm), saithe (*Pollachius virens*) (4 cm), and spotted wolffish (*Anarhichas minor*) (4 cm) at different developmental stages.

Fish were placed in plastic bags 3 m from the sonar source and exposed to between four and 100 pulses of 1-second duration of pure tones at 1.5, 4 and 6.5 kHz. Sound levels at the location of the fish ranged from 150 to 189 dB. There were no effects on fish behavior during or after exposure to sound (other than some startle or panic movements by herring for sounds at 1.5 kHz) and there were no effects on behavior, growth (length and weight), or survival of fish kept as long as 34 days post exposure. All exposed animals were compared to controls that received similar treatment except for actual exposure to the sound. Excellent pathology of internal organs showed no damage as a result of sound exposure. The only exception to almost full survival was exposure of two groups of herring tested with sound pressure levels (SPLs) of 189 dB, where there was a post-exposure mortality of 20 to 30 percent. While these were statistically significant losses, it is important to note that this sound level was only tested once and so it is not known if this increased mortality was due to the level of the test signal or to other unknown factors.

In a follow-up unpublished analysis of these data, Kvadsheim and Sevaldsen (2005) sought to understand whether the mid-frequency continuous wave (CW) signals used by Jørgensen et al. (2005) would have a significant impact on larvae and juveniles in the wild exposed to this sonar. The investigators concluded that the extent of damage/death induced by the sonar would be below the level of loss of larval and juvenile fish from natural causes, and so no concerns should be raised. The only issue they did suggest needs to be considered is when the CW signal is at the resonance frequency of the swim bladders of small clupeids. If this is the case, the investigators predict (based on minimal data that is in need of replication) that such sounds might increase the mortality of small clupeids that have swim bladders that would resonate.

Other High Intensity Sources

A number of other sources have been examined for potential effects on fish. These have been critically and thoroughly reviewed recently by Hastings and Popper (2005) and so only brief mention will be made of a number of such studies.

One of the sources of most concern is pile driving, as occurs during the building of bridges, piers, off-shore wind farms, and the like. There have been a number of studies that suggest that the sounds from pile driving, and particularly from driving of larger piles, kill fish that are very close to the source. The source levels in such cases often exceed 230 dB re 1 µPa (peak) and there is some evidence of tissue damage accompanying exposure (e.g., Caltrans 2001, 2004, reviewed in Hastings and Popper 2005). However, there is reason for concern in analysis of such data since, in many cases the only dead fish that were observed were those that came to the surface. It is not clear whether fish that did not come to the surface survived the exposure to the sounds, or died and were carried away by currents.

There are also a number of gray literature experimental studies that placed fish in cages at different distances from the pile driving operations and attempted to measure mortality and tissue damage as a result of sound exposure. However, in most cases the studies' (e.g., Caltrans 2001, 2004, Abbott et al. 2002, 2005, Nedwell et al. 2003) work was done with few or no controls, and the behavioral and histopathological observations done very crudely (the exception being Abbott et al. 2005). As a consequence of these limited and unpublished data, it is not possible to know the real effects of pile driving on fish.

In a widely cited unpublished report, Turnpenny et al. (1994) examined the behavior of three species of fish in a pool in response to different sounds. While this report has been cited repeatedly as being the basis for concern about the effects of human-generated sound on fish, there are substantial issues with the work that make the results unusable for helping understand the potential effects of any sound on fish, including mid- and high-frequency sounds. The problem with this study is that there was a complete lack of calibration of the sound field at different frequencies and depths in the test tank, as discussed in detail in Hastings and Popper (2005). The issue is that in enclosed chambers that have an interface with air, such as tanks and pools used by Turnpenny et al., the sound field is known to be very complex and will change significantly with frequency and depth. Thus, it is impossible to know the stimulus that was actually received by the fish. Moreover, the work done by Turnpenny et al. was not replicated by the investigators even within the study, and so it is not known if the results were artifact, or were a consequence of some uncalibrated aspects of the sound field that cannot be related, in any way, to human-generated high intensity sounds in the field, at any frequency range.

Several additional studies have examined effects of high intensity sounds on the ear. While there was no effect on ear tissue in either the SURTASS LFA study (Popper et al., 2007) or the study of effects of seismic airguns on hearing (Popper et al. 2005, Song et al. in press), three earlier studies suggested that there may be some loss of sensory hair cells due to high intensity sources. However, none of these studies concurrently investigated effects on hearing or non-auditory tissues. Enger (1981) showed some loss of sensory cells after exposure to pure tones in the Atlantic cod. A similar result was shown for the lagena of the oscar (*Astronotus oscellatus*), a cichlid fish, after an hour of continuous exposure (Hastings et al. 1996). In neither study was the hair cell loss more than a relatively small percent of the total sensory hair cells in the hearing organs.

Most recently, McCauley et al. (2003) showed loss of a small percent of sensory hair cells in the saccule (the only end organ studied) of the pink snapper (*Pagrus auratus*), and this loss continued to increase (but never to become a major proportion of sensory cells) for up to at least 53 days post exposure. It is not known if this hair cell loss, or the ones in the Atlantic cod or oscar, would result in hearing loss since fish have tens or even hundreds of thousands of sensory hair cells in each otolithic organ (Popper and Hoxter 1984, Lombarte and Popper 1994) and only a small portion were affected by the sound. The question remains as to why McCauley et al. (2003) found damage to sensory hair cells while Popper et al. (2005) did not. The problem is that there are so many differences in the studies, including species, precise sound source, spectrum of the sound (the Popper et al. 2005 study was in relatively shallow water with poor low-frequency propagation), that it is hard to even speculate.

Beyond these studies, there have also been questions raised as to the effects of other sound sources such as shipping, wind farm operations, and the like. However, there are limited or no data on actual effects of the sounds produced by these sources on any aspect of fish biology.

Intraspecific Variation in Effects

One unexpected finding in several of the recent studies is that there appears to be variation in the effects of sound, and on hearing, that may be a correlated with environment, developmental history, or even genetics.

During the aforementioned LFA sonar study on rainbow trout, Popper et al. (2007) found that some fish showed a hearing loss, but other animals, obtained a year later but from the same supplier and handled precisely as the fish used in the earlier part of the study, showed no hearing loss. The conclusion reached by Popper et al. (2007) was that the differences in responses may have been related to differences in genetic stock or some aspect of early development in the two groups of fish studied.

The idea of a developmental effect was strengthened by findings of Wysocki et al. (2007) who found differences in hearing sensitivity of rainbow trout that were from the same genetic stock, but that were treated slightly differently in the egg stage. This is further supported by studies on hatchery-reared Chinook salmon (*Oncorhynchus tshawytscha*) which showed that some animals from the same stock and age class had statistical differences in their hearing capabilities that was statistically correlated with differences in otolith structure (Oxman et al. 2007). While a clear correlation could not be made between these differences in otolith structure and specific factors, there is strong reason to believe that the differences resulted from environmental effects during development.

The conclusion one must reach from these findings is that there is not only variation in effects of intense sound sources on different species, but that there may also be differences based on genetics or development. Indeed, one can go even further and suggest that there may ultimately be differences in effects of sound on fish (or lack of effects) that are related to fish age as well as development and genetics since it was shown by Popper et al. (2005) that identical seismic airgun exposures had very different effects on hearing in young-of-the-year northern pike and sexually mature animals.

Effects of Anthropogenic Sound on Behavior

There have been very few studies of the effects of anthropogenic sounds on the behavior of wild (unrestrained) fishes. This includes not only immediate effects on fish that are close to the source but also effects on fish that are further from the source.

Several studies have demonstrated that human-generated sounds may affect the behavior of at least a few species of fish. Engås et al. (1996) and Engås and Løkkeborg (2002) examined movement of fish during and after a seismic airgun study although they were not able to actually observe the behavior of fish per se. Instead, they measured catch rate of haddock and Atlantic cod as an indicator of fish behavior. These investigators found that there was a significant decline in catch rate of haddock (*Melanogrammus aeglefinus*) and Atlantic cod (*Gadus morhua*) that lasted for several days after termination of airgun use. Catch rate subsequently returned to normal. The conclusion reached by the investigators was that the decline in catch rate resulted from the fish moving away from the fishing site as a result of the airgun sounds. However, the investigators did not actually observe behavior, and it is possible that the fish just changed depth. Another alternative explanation is that the airguns actually killed the fish in the area, and the return to normal catch rate occurred because of other fish entering the fishing areas.

More recent work from the same group (Slotte et al. 2004) showed parallel results for several additional pelagic species including blue whiting and Norwegian spring spawning herring. However, unlike earlier studies from this group, Slotte et al. used fishing sonar to observe behavior of the local fish schools. They reported that fishes in the area of the airguns appeared to go to greater depths after the airgun exposure compared to their vertical position prior to the airgun usage. Moreover, the abundance of animals 30-50 km away from the ensonification increased, suggesting that migrating fish would not enter the zone of seismic activity. It should be pointed out that the results of these studies have been refuted by Gausland (2003) who, in a non peer-reviewed study, suggested that catch decline was from factors other than exposure to airguns and that the data were not statistically different than the normal variation in catch rates over several seasons.

Similarly Skalski et al. (1992) showed a 52% decrease in rockfish (*Sebastes* sp.) catch when the area of catch was exposed to a single airgun emission at 186-191 dB re 1 μPa (mean peak level) (see also Pearson et al. 1987, 1992). They also demonstrated that fishes would show a startle response to sounds as low as 160 dB, but this level of sound did not appear to elicit decline in catch.

Wardle et al. (2001) used a video system to examine the behaviors of fish and invertebrates on a coral reef in response to emissions from seismic airguns that were carefully calibrated and measured to have a peak level of 210 dB re 1 µPa at 16 m from the source and 195 dB re 1 µPa at 109 m from the source. They found no substantial or permanent changes in the behavior of the fish or invertebrates on the reef throughout the course of the study, and no animals appeared to leave the reef. There was no indication of any observed damage to the animals.

Culik et al. (2001) and Gearin et al. (2000) studied how noise may affect fish behavior by looking at the effects of mid-frequency sound produced by acoustic devices designed to deter marine mammals from gillnet fisheries. Gearin et al. (2000) studied responses of adult sockeye salmon (*Oncorhynchus nerka*) and sturgeon (*Acipenser* sp.) to pinger sounds. They found that fish did not exhibit any reaction or behavior change to the onset of the sounds of pingers that produced broadband energy with peaks at 2 kHz or 20 kHz. This demonstrated that the alarm was either inaudible to the salmon and sturgeon, or that neither species was disturbed by the mid-frequency sound (Gearin et al., 2000). Based on hearing threshold data (Table 3.7-10), it is highly likely that the salmonids did not hear the sounds.

Culik et al. (2001) did a very limited number of experiments to determine catch rate of herring (*Clupea harengus*) in the presence of pingers producing sounds that overlapped the frequency range of hearing of herring (2.7 kHz to over 160 kHz). They found no change in catch rate in gill nets with or without the higher frequency (> 20 kHz) sounds present, although there was an increase in catch rate with the signals from 2.7 kHz to 19 kHz (a different source than the higher frequency source). The results could mean that the fish did not “pay attention” to the higher frequency sound or that they did not hear it, but that lower frequency sounds may be attractive to fish. At the same time, it should be noted that there were no behavioral observations on the fish, and so how the fish actually responded when they detected the sound is not known.

The low-frequency (<2 kHz) sounds of large vessels or accelerating small vessels usually caused an initial avoidance response among the herring. The startle response was observed occasionally. Avoidance ended within 10 seconds of the “departure” of the vessel. After the initial response, 25 percent of the fish groups habituated to the sound of the large vessel and 75 percent of the responsive fish groups habituated to the sound of the small boat. Chapman and Hawkins (1969) also noted that fish adjust rapidly to high underwater sound levels, and Schwartz and Greer (1984) found no reactions to an echosounder and playbacks of sonar signals which were much higher than that of the MFA in the Proposed Action.

Masking

Any sound detectable by a fish can have an impact on behavior by preventing the fish from hearing biologically important sounds including those produced by prey or predators (Myrberg 1980, Popper et al. 2003). This inability to perceive biologically relevant sounds as a result of the presence of other sounds is called masking. Masking may take place whenever the received level of a signal heard by an animal exceeds ambient noise levels or the hearing threshold of the animal. Masking is found among all vertebrate groups, and the auditory system in all vertebrates, including fishes, is capable of limiting the effects of masking signals, especially when they are in a different frequency range than the signal of biological relevance (Fay, 1988, Fay and Megela-Simmons 1999).

One of the problems with existing fish masking data is that the bulk of the studies have been done with goldfish, a freshwater hearing specialist. The data on other species are much less extensive. As a result, less is known about masking in non-specialist and marine species. Tavolga (1974a, b) studied the effects of noise on pure-tone detection in two non-specialists and found that the masking effect was generally a linear function of masking level, independent of frequency. In addition, Buerkle (1968, 1969) studied five frequency bandwidths for Atlantic cod in the 20 to 340 Hz region and showed masking in all hearing ranges. Chapman and Hawkins (1973) found that ambient noise at higher sea states in the ocean have masking effects in cod, haddock, and Pollock, and similar results were suggested for several sciaenid species by Ramcharitar and Popper (2004). Thus, based on limited data, it appears that for fish, as for mammals, masking may be most problematic in the frequency region of the signal of the masker. Thus, for mid-frequency sonars, which are well outside the range of hearing of most all fish species, there is little likelihood of masking taking place for biologically relevant signals to fish since the fish will not hear the masker.

There have been a few field studies which may suggest that masking could have an impact on wild fish. Gannon et al. (2005) showed that bottlenose dolphins (*Tursiops truncatus*) move toward acoustic playbacks of the vocalization of Gulf toadfish (*Opsanus beta*). Bottlenose dolphins employ a variety of vocalizations during social communication including low-frequency pops. Toadfish may be able to best detect the low-frequency pops since their hearing is best below 1 kHz, and there is some indication that toadfish have reduced levels of calling when bottlenose dolphins approach (Remage-Healey et al. 2006). Silver perch have also been shown to decrease calls when exposed to playbacks of dolphin whistles mixed with other biological sounds (Luczkovich et al. 2000). Results of the Luczkovich et al. (2000) study, however, must be viewed with caution because it is not clear what sound may have elicited the silver perch response (Ramcharitar et al. 2006a).

Of considerable concern is that human-generated sounds could mask the ability of fish to use communication sounds, especially when the fish are communicating over some distance. In effect, the masking sound may limit the distance over which fish can communicate, thereby having an impact on important components of the behavior of fish. For example, the sciaenids, which are primarily inshore species, are probably the most active sound producers among fish, and the sounds produced by males are used to “call” females to breeding sights (Ramcharitar et al. 2001; reviewed in Ramcharitar et al. 2006a). If the females are not able to hear the reproductive sounds of the males, this could have a significant impact on the reproductive success of a population of sciaenids.

Also potentially vulnerable to masking is navigation by larval fish, although the data to support such an idea are still exceedingly limited. There is indication that larvae of some species may have the potential to navigate to juvenile and adult habitat by listening for sounds emitted from a reef (either due to animal sounds or non-biological sources such as surf action) (e.g., Higgs 2005). In a study of an Australian reef system, the sound signature emitted from fish choruses was between 0.8 and 1.6 kHz (Cato 1978) and could be detected by hydrophones 5 to 8 km (3 to 4 NM) from the reef (McCauley and Cato 2000). This bandwidth is within the detectable bandwidth of adults and larvae of the few species of reef fish that have been studied (Kenyon 1996, Myrberg 1980). At the same time, it has not been demonstrated conclusively that sound, or sound alone, is an attractant of larval fish to a reef, and the number of species tested has been very limited. Moreover, there is also evidence that larval fish may be using other kinds of sensory cues, such as chemical signals, instead of, or alongside of, sound (e.g., Atema et al. 2002, Higgs et al. 2005).

Finally, it should be noted that even if a masker prevents a larval (or any) fish from hearing biologically relevant sounds for a short period of time (e.g., while a sonar-emitting ship is passing), this may have no biological effect on the fish since they would be able to detect the relevant sounds before and after the masking, and thus would likely be able to find the source of the sounds.

Stress

Although an increase in background sound may cause stress in humans, there have been few studies on fish (e.g., Smith et al. 2004a, Remage-Healey et al. 2006, Wysocki et al. 2006, 2007). There is some indication of physiological effects on fish such as a change in hormone levels and altered behavior in some (Pickering 1981, Smith et al. 2004a, b), but not all, species tested to date (e.g., Wysocki et al. 2007). Sverdrup et al. (1994) found that Atlantic salmon subjected to up to 10 explosions to simulate seismic blasts released primary stress hormones, adrenaline and cortisol, as a biochemical response. There was no mortality. All experimental subjects returned to their normal physiological levels within 72 hours of exposure. Since stress affects human health, it seems reasonable that stress from loud sound may impact fish health, but available information is too limited to adequately address the issue.

Eggs and Larvae

One additional area of concern is whether high intensity sounds may have an impact on eggs and larvae of fish. Eggs and larvae do not move very much and so must be considered as a stationary object with regard to a moving navy sound source. Thus, the time for impact of sound is relatively small since there is no movement relative to the navy vessel.

There have been few studies on effects of sound on eggs and larvae (reviewed extensively in Hastings and Popper 2005) and there are no definitive conclusions to be reached. At the same time, many of the studies have used non-acoustic mechanical signals such as dropping the eggs and larvae or subjecting them to explosions (e.g., Jensen and Alderice 1983, 1989, Dwyer et al. 1993). Other studies have placed the eggs and/or larvae in very small chambers (e.g., Banner and Hyatt 1973) where the acoustics are not suitable for comparison with what might happen in a free sound field (and even in the small chambers, results are highly equivocal).

Several studies did examine effects of sounds on fish eggs and larvae. One non peer-reviewed study using sounds from 115-140 dB (re 1 µPa, peak) on eggs and embryos in Lake Pend Oreille (Idaho) reported normal survival or hatching, but few data were provided to evaluate the results (Bennett et al., 1994). In another study, Kostyuchenko (1973) reported damage to eggs of several marine species at up to 20 m from a source designed to mimic seismic airguns, but few data were given as to effects. Similarly, Booman et al. (1996) investigated the effects of seismic airguns on eggs, larvae, and fry and found significant mortality in several different marine species (Atlantic cod, saithe, herring) at a variety of ages, but only when the specimens were within about 5 m of the source. The most substantial effects were to fish that were within 1.4 m of the source. While the authors suggested damage to some cells such as those of the lateral line, few data were reported and the study is in need of replication. Moreover, it should be noted that the eggs and larvae were very close to the airgun array, and at such close distances the particle velocity of the signal would be exceedingly large. However, the received sound pressure and particle velocity were not measured in this study.

Conclusions - Effects

The data obtained to date on effects of sound on fish are very limited both in terms of number of well-controlled studies and in number of species tested. Moreover, there are significant limits in the range of data available for any particular type of sound source. And finally, most of the data currently available has little to do with actual behavior of fish in response to sound in their normal environment. There is also almost nothing known about stress effects of any kind(s) of sound on fish.

Mortality and Damage to Non-auditory Tissues

The results to date show only the most limited mortality, and then only when fish are very close to an intense sound source. Thus, whereas there is evidence that fish within a few meters of a pile driving operation will potentially be killed, very limited data (and data from poorly designed experiments) suggest that fish further from the source are not killed, and may not be harmed. It should be noted, however, that these and other studies showing mortality (to any sound source) need to be extended and replicated in order to understand the effects of the most intense sound on fish.

It is also becoming a bit clearer (again, albeit from very few studies) that those species of fish tested at a distance from the source where the sound level is below source level, show no mortality and possibly no long-term effects. Of course, it is recognized that it is very difficult to extrapolate from the data available (e.g., Popper et al. 2005, 2007) since only a few sound types have been tested, and even within a single sound type there have to be questions about effects of multiple exposures and duration of exposure. Still, the results to date are of considerable interest and importance, and clearly show that exposure to many types of loud sounds may have little or no affect on fish. And, if one considers that the vast majority of fish exposed to a loud sound are probably some distance from a source, where the sound level has attenuated considerably, one can start to predict that only a very small number of animals in a large population will ever be killed or damaged by sounds.

Effects on Fish Behavior

The more critical issue, however, is the effect of human-generated sound on the behavior of wild animals, and whether exposure to the sounds will alter the behavior of fish in a manner that will affect its way of living – such as where it tries to find food or how well it can find a mate. With the exception of just a few field studies, there are no data on behavioral effects, and most of these studies are very limited in scope and all are related to seismic airguns. Because of the limited ways in which behavior of fish in these studies were "observed" (often by doing catch rates, which tell nothing about how fish really react to a sound), there really are no data on the most critical questions regarding behavior.

Indeed, the fundamental questions are how fish behave during and after exposure to a sound as compared to their "normal" pre-exposure behavior. This requires observations of a large number of animals over a large area for a considerable period of time before and after exposure to sound sources, as well as during exposure. Only with such data is it possible to tell how sounds affect overall behavior (including movement) of animals.

Increased Background Sound

In addition to questions about how fish movements change in response to sounds, there are also questions as to whether any increase in background sound has an effect on more subtle aspects of behavior, such as the ability of a fish to hear a potential mate or predator, or to glean information about its general environment. There is a body of literature that shows that the sound detection ability of fish can be "masked" by the presence of other sounds within the range of hearing of the fish. Just as a human has trouble hearing another person as the room they are in gets noisier, it is likely that the same effect occurs for fish (as well as all other animals). In effect, acoustic communication and orientation of fish may potentially be restricted by noise regimes in their environment that are within the hearing range of the fish.

While it is possible to suggest behavioral effects on fish, there have been few laboratory, and no field, studies to show the nature of any effects of increased background noise on fish behavior. At the same time, it is clear from the literature on masking in fish, as for other vertebrates, that the major effect on hearing is when the added sound is within the hearing range of the animal. Moreover, the bulk of the masking effect is at frequencies around that of the masker. Thus, a 2 kHz masker will only mask detection of sounds around 2 kHz, and a 500 Hz masker will primarily impact hearing in a band around 500 Hz.

As a consequence, if there is a background sound of 2 kHz, as might be expected from some mid-frequency sonars, and the fish in question does not hear at that frequency, there will be no masking, and no affect on any kind of behavior. Moreover, since the bulk of fish communication sounds are well below 1 kHz (e.g., Zelick et al. 1999), even if a fish is exposed to a 2 kHz masker which affects hearing at around 2 kHz, detection of biologically relevant sounds (e.g., of mates) will not be masked.

Indeed, many of the human-generated sounds in the marine environment are outside the detection range of most species of marine fish studied to date (see Figure 3.7-11 and Table 3.7-10). In particular, it appears that the majority of marine species have hearing ranges that are well below the frequencies of the mid- and high-frequency range of the operational sonars used in Navy exercises, and therefore, the sound sources do not have the potential to mask key environmental sounds. The few fish species that have been shown to be able to detect mid- and high-frequencies, such as the clupeids (herrings, shads, and relatives), do not have their best sensitivities in the range of the operational sonars. Additionally, vocal marine fish largely communicate below the range of mid- and high-frequency levels used in Navy exercises.

Implications of Temporary Hearing Loss (TTS)

Another related issue is the impact of temporary hearing loss, referred to as temporary threshold shift (TTS), on fish. This effect has been demonstrated in several fish species where investigators used exposure to either long-term increased background levels (e.g., Smith et al. 2004a) or intense, but short-term, sounds (e.g., Popper et al. 2005), as discussed above. At the same time, there is no evidence of permanent hearing loss (e.g., deafness), often referred to in the mammalian literature as permanent threshold shift (PTS), in fish. Indeed, unlike in mammals where deafness often occurs as a result of the death and thus permanent loss of sensory hair cells, sensory hair cells of the ear in fish are replaced after they are damaged or killed (Lombarte et al. 1993, Smith et al. 2006). As a consequence, any hearing loss in fish may be as temporary as the time course needed to repair or replace the sensory cells that were damaged or destroyed (e.g., Smith et al. 2006).

TTS in fish, as in mammals, is defined as a recoverable hearing loss. Generally there is recovery to normal hearing levels, but the time-course for recovery depends on the intensity and duration of the TTS-evoking signal. There are no data that allows one to “model” expected TTS in fish for different signals, and developing such a model will require far more data than currently available. Moreover, the data would have to be from a large number of fish species since there is so much variability in hearing capabilities and in auditory structure.

A fundamentally critical question regarding TTS is how much the temporary loss of hearing would impact survival of fish. During a period of hearing loss, fish will potentially be less sensitive to sounds produced by predators or prey, or to other acoustic information about their environment. The question then becomes how much TTS is behaviorally significant for survival. However, there have yet to be any studies that examine this issue.

At the same time, the majority of marine fish species are hearing generalists and so cannot hear mid- and high-frequency sonar. Thus, there is little or no likelihood of there being TTS as a result of exposure to these sonars, or any other source above 1.5 kHz. It is possible that mid-frequency sonars are detectable by some hearing specialists such as a number of sciaenid species and clupeids. However, the likelihood of TTS in these species is small since the duration of exposure of animals to a moving source is probably very low since exposure to a maximum sound level (generally well below the source level) would only be for a few seconds as the navy vessel moves by.

Stress

While the major questions on effects of sound relate to behavior of fish in the wild, a more subtle issue is whether the sounds potentially affect the animal through increased stress. In effect, even when there are no apparent direct effects on fish as manifest by hearing loss, tissue damage, or changes in behavior, it is possible that there are more subtle effects on the endocrine or immune systems that could, over a long period of time, decrease the survival or reproductive success of animals. While there have been a few studies that have looked at things such as cortisol levels in response to sound, these studies have been very limited in scope and in species studied.

Eggs and Larvae

Finally, while eggs and larvae must be of concern, the few studies of the effects of sounds on eggs and larvae do not lead to any conclusions with how sound would impact survival. And of the few potentially useful studies, most were done with sources that are very different than sonar. Instead, they employed seismic airguns or mechanical shock. While a few results suggest some potential effects on eggs and larvae, such studies need to be replicated and designed to ask direct questions about whether sounds, and particularly mid- and high-frequency sounds, would have any potential impact on eggs and larvae.

3.7.2.1.2 Explosives and Other Impulsive Signals

Effects of Impulsive Sounds

There are few studies on the effects of impulsive sounds on fish, and no studies that incorporated mid- or high-frequency signals. The most comprehensive studies using impulsive sounds are from seismic airguns (e.g., Popper et al. 2005, Song et al. in prep). Additional studies have included those on pile driving (reviewed in Hastings and Popper 2005) and explosives (e.g., Yelverton et al. 1975, Keevin et al. 1997, Govoni et al. 2003; reviewed in Hastings and Popper 2005).

As discussed earlier, the airgun studies on very few species resulted in a small hearing loss in several species, with complete recovery within 18 hours (Popper et al. 2005). Other species showed no hearing loss with the same exposure. There appeared to be no effects on the structure of the ear (Song et al. submitted), and a limited examination of non-auditory tissues, including the swim bladder, showed no apparent damage (Popper et al. 2005). One other study of effects of an airgun exposure showed some damage to the sensory cells of the ear (McCauley et al. 2003), but it is hard to understand the differences between the two studies. However, the two studies had different methods of exposing fish, and used different species. There are other studies that have demonstrated some behavioral effects on fish during airgun exposure used in seismic exploration (e.g., Pearson et al. 1987, 1992, Engås et al. 1996, Engås and Løkkeborg 2002, Slotte et al. 2004), but the data are limited and it would be very difficult to extrapolate to other species, as well as to other sound sources.

Explosive Sources

A number of studies have examined the effects of explosives on fish. These are reviewed in detail in Hastings and Popper (2005). One of the real problems with these studies is that they are highly variable and so extrapolation from one study to another, or to other sources, such as those used by the Navy, is not really possible. While many of these studies show that fish are killed if they are near the source, and there are some suggestions that there is a correlation between size of the fish and death (Yelverton et al. 1975), little is known about the very important issues of non-mortality damage in the short- and long-term, and nothing is known about effects on behavior of fish.

The major issue in explosives is that the gas oscillations induced in the swim bladder or other air bubble in fishes caused by high sound pressure levels can potentially result in tearing or rupturing of the chamber. This has been suggested to occur in some (but not all) species in several gray literature unpublished reports on effects of explosives (e.g., Aplin 1947, Coker and Hollis 1950, Gaspin 1975, Yelverton et al. 1975), whereas other published studies do not show such rupture (e.g., the very well done peer reviewed study by Govoni et al. 2003). Key variables that appear to control the physical interaction of sound with fishes include the size of the fish relative to the wavelength of sound, mass of the fish, anatomical variation, and location of the fish in the water column relative to the sound source (e.g., Yelverton et al. 1975, Govoni et al. 2003).

Explosive blast pressure waves consist of an extremely high peak pressure with very rapid rise times (< 1 ms). Yelverton et al. (1975) exposed eight different species of freshwater fish to blasts of 1-lb spheres of Pentolite in an artificial pond. The test specimens ranged from 0.02 g (guppy) to 744 g (large carp) body mass and included small and large animals from each species. The fish were exposed to blasts having extremely high peak overpressures with varying impulse lengths. The investigators found what appears to be a direct correlation between body mass and the magnitude of the "impulse," characterized by the product of peak overpressure and the time it took the overpressure to rise and fall back to zero (units in psi-ms), which caused 50% mortality (see Hastings and Popper 2005 for detailed analysis).

One issue raised by Yelverton et al. (1975) was whether there was a difference in lethality between fish which have their swim bladders connected by a duct to the gut and fish which do not have such an opening. The issue is that it is potentially possible that a fish with such a connection could rapidly release gas from the swim bladder on compression, thereby not increasing its internal pressure. However, Yelverton et al. (1975) found no correlation between lethal effects on fish and the presence or lack of connection to the gut.

While these data suggest that fishes with both types of swim bladders are affected in the same way by explosive blasts, this may not be the case for other types of sounds, and especially those with longer rise or fall times that would allow time for a biomechanical response of the swim bladder (Hastings and Popper 2005). Moreover, there is some evidence that the effects of explosives on fishes without a swim bladder are less than those on fishes with a swim bladder (e.g., Gaspin 1975, Geortner et al. 1994, Keevin et al. 1997). Thus, if internal damage is, even in part, an indirect result of swim bladder (or other air bubble) damage, fishes without this organ may show very different secondary effects after exposure to high sound pressure levels. Still, it must be understood that the data on effects of impulsive sources and explosives on fish are limited in number and quality of the studies, and in the diversity of fish species studied. Thus, extrapolation from the few studies available to other species or other devices must be done with the utmost caution.

In a more recent published report, Govoni et al. (2003) found damage to a number of organs in juvenile pinfish (*Lagodon rhomboids*) and spot (*Leiostomus xanthurus*) when they were exposed to submarine detonations at a distance of 3.6 m, and most of the effects, according to the authors, were sublethal. Effects on other organ systems that would be considered irreversible (and presumably lethal) only occurred in a small percentage of fish exposed to the explosives. Moreover, there was virtually no effect on the same sized animals when they were at a distance of 7.5 m, and more pinfish than spot were affected.

Based upon currently available data it is not possible to predict specific effects of Navy impulsive sources on fish. At the same time, there are several results that are at least suggestive of potential effects that result in death or damage. First, there are data from impulsive sources such as pile driving and seismic airguns that indicate that any mortality declines with distance, presumably because of lower signal levels. Second, there is also evidence from studies of explosives (Yelverton et al. 1975) that smaller animals are more affected than larger animals. Finally, there is also some evidence that fish without an air bubble, such as flatfish and sharks and rays, are less likely to be affected by explosives and other sources than are fish with a swim bladder or other air bubble.

Yet, as indicated for other sources, the evidence of short- and long-term behavioral effects, as defined by changes in fish movement, etc., is non-existent. Thus, we still do not know if the presence of an explosion or an impulsive source at some distance, while not physically harming a fish, will alter its behavior in any significant way.

3.7.2.1.3 General Conclusions of Sounds on Fish

As discussed, the extent of data, and particularly scientifically peer-reviewed data, on the effects of high intensity sounds on fish is exceedingly limited. Some of these limitations include:

- Types of sources tested;
- Effects of individual sources as they vary by such things as intensity, repetition rate, spectrum, distance to the animal, etc.;
- Number of species tested with any particular source;
- The ability to extrapolate between species that are anatomically, physiologically, and/or taxonomically, different;
- Potential differences, even within a species as related to fish size (and mass) and/or developmental history;
- Differences in the sound field at the fish, even when studies have used the same type of sound source (e.g., seismic airgun);
- Poor quality experimental design and controls in many of the studies to date;
- Lack of behavioral studies that examine the effects on, and responses of, fish in their natural habitat to high intensity signals;
- Lack of studies on how sound may impact stress, and the short- and long-term effects of acoustic stress on fish; and
- Lack of studies on eggs and larvae that specifically use sounds of interest to the Navy.

At the same time, in considering potential sources that are in the mid- and high-frequency range, a number of potential effects are clearly eliminated. Most significantly, since the vast majority of fish species studied to date are hearing generalists and cannot hear sounds above 500 to 1,500 Hz (depending upon the species), there are not likely to be behavioral effects on these species from higher frequency sounds.

Moreover, even those marine species that may hear above 1.5 kHz, such as a few sciaenids and the clupeids (and relatives), have relatively poor hearing above 1.5 kHz as compared to their hearing sensitivity at lower frequencies. Thus, it is reasonable to suggest that even among the species that have hearing ranges that overlap with some mid- and high-frequency sounds, it is likely that the fish will only actually hear the sounds if the fish and source are very close to one another. And, finally, since the vast majority of sounds that are of biological relevance to fish are below 1 kHz (e.g., Zelick et al. 1999; Ladich and Popper 2004), even if a fish detects a mid- or high-frequency sound, these sounds will not mask detection of lower frequency biologically relevant sounds.

Thus, a reasonable conclusion, even without more data, is that there will be few, and more likely no, impacts on the behavior of fish.

At the same time, it is possible that very intense mid- and high-frequency signals, and particularly explosives, could have a physical impact on fish, resulting in damage to the swim bladder and other organ systems. However, even these kinds of effects have only been shown in a few cases in response to explosives, and only when the fish has been very close to the source. Such effects have never been shown to any Navy sonar. Moreover, at greater distances (the distance clearly would depend on the intensity of the signal from the source) there appears to be little or no impact on fish, and particularly no impact on fish that do not have a swim bladder or other air bubble that would be affected by rapid pressure changes.

3.7.2.1.4 Acoustic Effects of Common Activities

Aircraft, Missile and Target Overflights

There are aircraft, missile, and target overflights during undersea warfare exercises; torpedo and aerial and submarine target recovery operations; air-to-air and surface-to-air missile firing exercises; electronic warfare exercises; air strikes and Close Air Support (CAS) exercises; Mining Exercises (MINEXs); Sea, Air, Land (SEAL) training; and other exercises. Relatively few low-altitude (<1,000 ft) flights of fixed-wing aircraft and missiles are conducted in the SOCAL OPAREAs, and many are of short (minutes) duration. Helicopter overflights or hovering at altitudes of 100–1,000 ft (30-305 m) are also part of some activities.

Sound does not transmit well from air to water (Section 3.5). Predicted sound levels resulting from HC-130 aircraft flying at 1,000 ft and 250 ft were 110 and 121 dB re 1 µPa, respectively, directly under the flight path at a depth of 1 ft (maximum one-third octave level for frequencies 20 Hz–5 kHz). The same sound levels resulting from an HH-60 helicopter flying at 1,000 ft, flying at 100 ft, and hovering 10 ft were 110, 129, and 143 dB re 1 µPa directly under the helicopter at a depth of 1 ft (USAF 1999). The sound levels would decline at increasing lateral distances from the aircraft's track or location and with increasing depth in the water, and the underwater sounds originating from the aircraft would decline rapidly after the aircraft has passed.

It is unlikely that these sound levels would cause physical damage or even behavioral effects in fish, based on the sound levels that have been found to cause such effects.

Effects of underwater noise attributable to aircraft, missile, and target overflights on fish are anticipated to be minimal.

Muzzle Blast

When a gun is fired from a surface ship, a blast wave propagates away from the gun muzzle. When the blast wave meets the water, most of the energy is reflected back into the air, but some energy is transmitted into the water. A series of pressure measurements were taken during the firing of a 5-inch gun aboard the USS Cole in June 2000 (Dahlgren 2000). The average peak pressure measured was about 200 dB re 1 µPa at the point of the air and water interface. Down-range peak pressure level, estimated for spherical spreading of the sound in water**,** would be 160 dB re 1 µPa at 100 m (328 ft) and 185 dB re 1 µPa at ~5.5 m (18 ft). The resulting ensonified areas (semi-circles with radius 100 and 5.5 m) would be 0.015 square kilometer (km^2) and ~50 m^2.

Because fish apparently only react to impulsive sounds >160 dB, only those in the 0.015-km^2 area would be affected, and effects would be limited to short-term, transitory alarm or startle responses.

Effects of Underwater Explosions

Underwater explosions occur during the SEAL Basic Underwater Demolitions (BUD/S) course, SEAL platoon training exercises, live-fire and bombing of seaborne targets, and use of the Improved Extended Echo Ranging (IEER) sonobuoy in Anti-submarine Warfare (ASW). Concern about potential fish mortality associated with the use of underwater explosives led military researchers to develop mathematical and computer models that predict safe ranges for fish and other animals from explosions of various sizes (e.g., Yelverton et al. 1973; Goertner 1994).

Young's (1991) equations for 90 percent survivability were used to estimate fish mortality in the Seawolf Shipshock Trial Environmental Impact Statement (EIS) (DoN 1998). In that document, Yelverton's (1981) equations were used to predict survival of fish with swim bladders. Young's equations apply to simple explosives, and several of the explosives used in the SOCAL OPAREAs have a more complicated configuration and blast parameters. Thus, impulse and effects were computed separately. In addition, the Seawolf Shipshock Trials were conducted in open water, where blast effects are predicted more easily. Most of the explosives used in the SOCAL OPAREAs are detonated in shallow water, and the shock waves propagate into deep water over a hardbottom and so represent a more complicated situation than that depicted in the Shipshock EISs (DoN 1998).

The impulse levels that kill or damage fish with swim bladders have been determined empirically to be as follows (from Yelverton 1981):

50 percent Mortality	$\ln(I)=3.6136 + 0.3201 \ln(M)$
1 percent Mortality	$\ln(I)=3.0158 + 0.3201 \ln(M)$
No Injuries	$\ln(I)=2.0042 + 0.3201 \ln(M)$

where I = impulse (in Pascal·seconds or Pa·s) and M = body mass of a fish (g) with a swim bladder. Yelverton (1981) cautioned against using these equations for fish weighing more than a few kg because fish used in the experiments from which these equations were derived did not weigh more than 2.2 lb (1 kg). Based on the Yelverton equations, we estimate that small fish (0.5 lb or 0.2 kg) with swim bladders would not be injured by impulses up to 42 Pa·s, while larger fish (125 lb or 57 kg) with swim bladders would not be injured by impulses as large as 247 Pa·s (Table 3-7.12).

There are three underwater explosive exercises conducted in Northwest Harbor: the single charge (SC) exercise, the multiple-charge obstacle loading (OL) exercise, and the multiple-charge mat-weave (MW) exercise. Measurements of the propagated pressures in live-fire tests during SC, OL, and MW exercises at Northwest Harbor were conducted in 2002 and 2003 as part of a study to evaluate underwater explosive propagation models in very shallow water (VSW) (DoN 2005). The measurements made in those tests provide an in-place characterization of pressure propagation for all three training exercises as they are actually conducted at Northwest Harbor. That is, actual measurements, as opposed to model predictions, are used as the basis for determining mitigation ranges in the SC, OL, and MW exercises at Northwest Harbor.

The propagation of pressure waves was found to be substantially different between Northwest Harbor and tests conducted at Naval Amphibious Base (NAB) which is a clean hard sand range. For example, in SC exercises, measurements of propagated peak-peak pressures at about 1000 ft for 15 lb charges detonated in 15 ft of water – on and 2 ft off the bottom at both sites - produced peak-pressures that were only about ¼ as large at Northwest Harbor as those at NAB. Energies measured at similar distances for these same shots did not show substantial differences between sites. However, at Northwest Harbor, there was added extraneous noise in the recording system that added to the sums of energies calculated from that data. That is, the actual energies in the water at Northwest Harbor were, likely, less than those at NAB.

The position of single charges - on and 2 ft off the bottom - had similar effects on propagated peak-pressures at both sites. That is, off-bottom positions produced consistently higher peak-pressures than on-bottom positions as measured at about 200, 500, and 1000 ft distances. Off-bottom 15 lb charges in 15 ft of water produced between 43 – 67 % greater peak-pressures than on-bottom charges. In an extremely shallow depth of 6 ft, the off-bottom placement of a 15 lb charge produced about 94% greater peak-pressure than a similar on-bottom charge as measured at about 190 ft distance. The SC exercises in the proposed action only use on-bottom positions and the MW exercise at Northwest Harbor uses on-bottom charge placement in about 5 ft of water.

The data from both sites also show a trend that is not typically seen in explosions occurring in deeper water with the charges in the upper portion of the water column. For most of the SC detonations and both the OL and MW detonations, the deeper measuring gages at distance showed lower peak-pressures and energies. Usually, the highest pressures and energies are measured at the deepest depths due to bottom-reflected pressure waves, refraction etc. In the case of the multiple-explosive OL exercise, the deepest gages were at 79 and 66% of the water depth at about 800 and 1800 ft distances, respectively.

These gages measured about half the peak-pressure and less than half of the total energy between 100 Hz and 40 KHz than were recorded by the gages in the upper half of the column. In the MW exercise, the effect was not seen at about 1000 ft distance, but a similar trend was seen at about 2300 ft. While the data are suggestive of a general trend for VSW detonations and VSW propagation, the deepest gages in many cases did not extend down close enough to the bottom and thus, such a general conclusion cannot be drawn.

Measurements made during the OL and MW exercises demonstrated an important finding with regard to multiple-charge detonations. In those exercises, the propagated pressure-waves are substantially smaller than would be expected for single charges with weights equal to the aggregate weights of the individual charges. Aggregation of multiple charge-weights is often done in the absence of empirical data or applicable models. Further, the differences are much greater than can be accounted for by the sound attenuating properties of Northwest Harbor. For the OL exercise with 16, 20-lb charges of C4, measurements at about 800 ft distance show received peak-pressures less than would be expected from a single 20-lb charge of C4. It was concluded that the OL detonations are too small, too fast, too far apart, and too separated in time for their propagated pressure waves to overlap – i. e., to sum with - each other to any substantial degree. Further, the essentially random distribution of charges on the eight obstacles make the obtained results representative of propagated pressure-waves in past and future OL exercises at that site. For the MW exercise, the measured peak-pressures at about 1000 ft were those that would be expected from only a few pounds of TNT at that distance. In the MW exercise, the complicated geometry of long linear charges, arranged in a lattice, provides an explanation for the obtained results – results that also are representative of past and future MW exercises.

As stated previously, most of the explosives used in the SOCAL OPAREAs are detonated in shallow water and therefore, large pelagic species (e.g. tuna, swordfish) are less likely to be affected, whereas, smaller species, some of which may be schooling species (e.g. sardines, anchovy) are more likely to be affected. In addition, ichthyoplankton and other organisms floating on or near the water surface are unlikely to be affected unless they are close to the detonation point.

Table 3.7-12: Impulses that Would Cause No Injury, 1% Mortality, or 50% Mortality to Common Species of Fish that Occur in the SOCAL Range Complex and That Have Swim Bladders

Species	Body Mass Lb	Body Mass Kg	Swim Bladder	Habitat: Inshore	Habitat: Offshore	Habitat: Water Column	Injury (Impulse Pascal·seconds): No Injury	1% Mortality	50% Mortality
Yellowfin tuna	125	56.8	R[1]		X	Pelagic	247	679	1234
Skipjack tuna	25	11.4	N/R		X	Pelagic	147	405	737
Bluefin tuna	30	13.6	R		X	Pelagic	156	430	781
Albacore	50	22.7	Y		X	Pelagic	184	506	920
Pacific mackerel	2	0.9	Y	X	X	Pelagic	66	181	328
Pacific sardine	0.5	0.2	Y	X	X	Pelagic	42	116	211
Flatfish	1.5	0.7	N	X	X	Bottom	N/A	N/A	N/A
Rockfish	1	0.5	Y	X		Bottom/Pelagic	53	145	271
Goby	0.1	0.05	Y	X		Bottom	25	69	126
Señorita	1	0.5	Y	X		Water Column	53	145	263
Kelp bass	9	4.1	Y	X		Water Column	106	292	532
California sheephead	15	6.8	Y	X		Bottom	125	344	626

[1] R means reduced, N means none, Y means has swim bladder, N/A – not applicable, no swim bladder.
Results derived from applying Yelverton's (1981) equations to typical fish weights

Effects of Shock Waves from Inert Mines, Bombs, Missiles and Targets Striking the Water's Surface

Mines, inert bombs, or intact missiles or targets fall into the waters of the SOCAL OPAREAs during the following exercises:

- Mine Laying Exercise
- Missile Firing (Air-to-Air, Air-to-Surface, or Surface-to-Air))
- Missile Flight Tests
- Sinking Exercise
- Stinger Firing
- Bombing Exercise
- Gunnery Exercise (Air-to-Surface or Surface-to-Air)

Mines, inert bombs, and intact missiles and targets could impact the water with great force and produce a large impulse and loud noise. Physical disruption of the water column by the shock wave and bubble pulse is a localized, temporary effect, and would be limited to within tens of meters of the impact area and would persist for a matter of minutes. Physical and chemical properties would be temporarily affected (e.g., increased oxygen concentrations due to turbulent mixing with the atmosphere), but there would be no lasting adverse effect on the water column habitat from this physical disruption. Large objects hitting the water produce noises with source levels on the order of 240 to 271 dB re 1 µPa and pulse durations of 0.1 to 2 milliseconds, depending on the size of the object (McLennan 1997). Impulses of this magnitude could injure fish. Because the rise times of these shock waves are very short, the impulses causing injury and mortality derived for explosive sources were used to estimate effects of shock pulses created by missile and target effects. The impulses causing 50 percent mortality for fish of various sizes are shown in Table 3.7-12. The distances from impact sites for various missiles, targets, and mines within which impulses could cause 50 percent mortality are also shown in this table.

Table 3.7-13: Impulses (Pa·s) Causing 50% Mortality of Fish of Various Sizes and Zones of Influence for Various Missiles, Targets, and Mines that Hit the Water Intact

Fish Size	Body Weight (kg)	50% Mortality[1] (Pa·s)	Zone of Influence (m) for 50% Mortality[1]							
			Missiles			Targets		Mines		
			Standard	Side-winder	Stinger	BQM-74	BATS	MK-18A1	MK-62	MK-76
Small	0.05	129	29	9	1	17	0	0	5	0
Small	0.5	271	14	5	0	9	0	0	3	0
Medium	1	338	12	4	0	7	0	0	3	0
Large	7	631	6	3	0	5	0	0	2	0

[1] Calculated using the methods in Koski et al. (1998)

To estimate mortality of fish, the numbers of each kind of missile, target, and mine hitting the water was multiplied by the area of impact (from Table 3.7-13) and the density of fish in the area estimated from average catch block data. In each of the exercises mentioned above, an amount of fish equivalent to <1 lb (0.45 kg) of commercial fish catch is killed annually. Therefore, effects of shock waves from mines, inert bombs, and intact missiles and targets hitting the water surface on fish are expected to be localized and minimal.

Sonar

This section presents an evaluation of the potential sonar effects on fish resulting from the implementation of the proposed action. There have been few directed studies on the impact of sonar on fish (Jørgensen et al 2005, Kvadsheim and Sevaldsen 2005). Some marine fishes may be able to detect mid-frequency sounds, but the most sensitive hearing range of most marine fishes is generally below the mid-frequency bandwidth. As discussed in the Affected Environment section, studies indicate that most marine fish are hearing generalists and have their best hearing sensitivity at or below 300 Hz (Popper 2003). It has been demonstrated that a few marine specialist species can detect sounds to 4,000 Hz and some to even above 120 kHz, however, a gap in the sensitivity exists from 3,200 Hz to 12,500 Hz for at least one of these species, the American shad (Dunning et al. 1992; Mann et al. 1998; Mann et al. 2001; Nestler et al. 2002; Popper and Carlson 1998; Popper et al. 2004; Ross et al. 1996). Marine species that can hear in the mid-frequency range do not hear best at the frequencies of the operational sonars. Fish can only hear a sound at the edge of their hearing frequency sensitivity range if the sound is very loud. Thus, it is expected that most marine hearing specialists will be able to detect the lowest frequencies of the loudest pings of operational sonars and some, such as some clupeids, will be able to detect the entire range only if in close proximity to the loudest pings (i.e. 56 m [184 ft] of a FM signal at 225 dB re 1 µPa, see Kvadsheim and Sevaldsen 2005).

Studies have shown that hearing generalists normally experience only minor or no hearing loss when exposed to continuous noise, but that hearing specialists may be affected by noise exposure. Exposure to loud sound can result in significant threshold shifts in hearing specialists. Studies thus far have shown these threshold shifts are temporary (Scholik and Yan 2001; Smith et al. 2004a; Smith et al. 2004b), but it is not known that they lead to any long term behavioral disruptions in fish that are biologically significant. The only experiments to have shown mortality in fish due to mid-frequency active (MFA) sonar have been investigations into the effects on juvenile herring exposed to intense MFA sonar. This is not to say, however, that fish, no matter what their hearing sensitivity, are not prone to injury as a result of exposure to MFA sonar. Individual juvenile fish with a swim bladder resonance in the frequency range of the operational sonars, and especially hearing specialists such as some clupeid species, may experience injury or mortality. The resonance frequency will depend on fish species, size and depth (McCartney and Stubbs, 1971; Løvik and Hovem, 1979). The swimbladder is a vital part of a system that amplifies the vibrations which reach the fish's hearing organs and at resonance the swimbladders may absorb much of the acoustic energy in the impinging sound wave (Sevaldsen and Kvadsheim, 2004). The resulting oscillations may cause mortality or harm the swimbladder itself or the auditory organs (Jørgensen et al. 2005). Kvadsheim and Sevaldsen (2005) found the zone within which injury may be caused in Atlantic herring at high levels of CW-signal MFA sonar (225 dB re 1 µPa), would be to a radius of 178 m (584 ft) and to a depth of 228 m (748 ft) (if the sonar is placed 50 m [164 ft] deep). Lowering the source level by 25 dB reduced the ranges by over a 100 m (328 ft). For a FM-signal, injury was predicted to occur over a radius of 56 m (184 ft) and to a depth of 106 m (358 ft). Lowering of the source level of the FM-signal by 25 dB reduced the ranges by over 50 m (164 ft). Kvadsheim and Sevaldsen (2005) determined the effects to the Atlantic herring population are likely to be insignificant considering the natural mortality rate of juvenile fish and the limited exposure of the fish to the sound source (Jørgensen et al. 2005). The physiological effect of sonars on adult fish is expected to be less than for juvenile fish because adult fish are in a more robust stage of development, the swim bladder frequencies will be outside the range of the frequency of MFA sonar, and adult fish have more ability to move from an unpleasant stimulus (Kvadsheim and Sevaldsen 2005). Kvadsheim and Sevaldsen (2005) suggested frequencies, depending on fish length, for which Atlantic herring would most likely be affected by Continuous Wave (CW) signals are listed in Table 3.7-14. Ultrasound detecting clupeids (Pacific sardine [*Sardinops sagax*]) within the SOCAL OPAREAs may have similar reactions to MFA sonar as found by Jørgensen et al. (2005) and Kvadsheim and Sevaldsen (2005) because of their similarities in hearing sensitivity. Just as Kvadsheim and Sevaldsen (2005) determined that MFA sonar would not have a significant effect on Atlantic herring populations, a significant impact is not expected to sardines and other juvenile fish species populations in the SOCAL OPAREAs even though some sonar levels have been shown to be powerful enough to cause injury to particular size classes of juvenile herring from the water's surface to the seafloor. Sound sources will be moving, so exposure is limited, and CW signals, the type considered to cause most impact, will rarely be used.

Popper et al. (2007) exposed rainbow trout to high intensity low-frequency sonar (maximum RL was approximately 193 dB re 1 μPa at 196 Hz) for 324 or 648 seconds. Fish exhibited a slight behavioral reaction, and one group exhibited a 20 dB auditory threshold shift at one frequency. No direct mortality, morphological changes, or physical trauma was noted as a result of these exposures. The authors point out, however, that the experimental conditions represented an extreme worst-case example with longer than typical exposures for LF sonar, use of a stationary source, and confined animals. These results, therefore, may not be reflective of expected real-world exposures from low-frequency sonar operations.

Studies have indicated that acoustic communication and orientation of fish may be restricted by noise regimes in their environment (Wysocki and Ladich 2005). Although some species may be able to produce sound at higher frequencies (> 1 kHz), vocal marine fish largely communicate below the range of mid-frequency levels used in the proposed action. Further, most marine fish species are not expected to able to detect sounds in the mid-frequency range of the operational sonars used in the proposed action. The few fish species that have been shown to be able to detect mid-frequencies do not have their best sensitivities in the range of the operational sonars. Thus, these fish can only hear mid-frequency sounds when they are very loud (i.e. when sonars are operating at their highest energy levels and fish are within a few meters). Considering the low frequency detection of most marine species and the limited time of exposure due to the moving sound sources, the MFA sound sources used in the proposed action do not have the potential to significantly mask key environmental sounds.

Based on the evaluation presented herein, the likelihood of significant effects to individual fish from the proposed use of MFA sonar is low. While the consequences of MFA sonar may affect some individual fish (e.g. herring) the overall effects to populations will be minimal when compared to their natural daily mortality rates. Overall, the effects of this action are likely to be minimal considering the few fish species that will be able to detect sound in the frequencies of the proposed action and the limited exposure of juvenile fish with swim bladder resonance in the frequencies of the sound sources.

Table 3.7-14: Frequency bands for which a juvenile herring are likely to be affected during the use of CW-sonar signals. The effective frequency band is defined based on the expected resonance frequencies of the swim bladder of the juvenile Atlantic herring, as estimated from the length of the fish using the empirical model of Løvik & Hoven (1979) +/- 1 kHz bandwidth (McCartney & Stubbs 1971) (based on Kvadsheim and Sevaldsen 2005)

Atlantic herring length	Effective frequency band
2.5-3 cm	3-6 kHz
3-4 cm	2-5 kHz
5-6 cm	1.5-3 kHz
6-10 cm	1-3 kHz

3.7.2.1.5 Non-Acoustic Effects of Common Activities

Munitions Constituents

Munitions constituents can be released from sonobuoys, submarine targets, torpedoes, missiles, aerial targets, and underwater explosions. Petroleum hydrocarbons released during an accident are harmful to fish. Jet fuel is toxic to fish but floats and vaporizes very quickly. Assuming that a target disintegrates on contact with the water, its fuel will be spread over a large area and dissipate quickly. In addition, fuel spills and material released from weapons and targets would occur at different locations and at different times. The water quality analysis of all current and proposed operations found that concentrations of all constituents of concern associated with the release of materials into the SOCAL OPAREAs were well below water quality criteria established to protect aquatic life (refer to Section

3.4, Water Resources). Effects on marine fish associated with the release of munitions constituents, carbon, and Kevlar pieces and other materials are expected to be minimal.

Falling Debris and Small Arms Rounds

Most missiles hit their target or are disabled before hitting the water. Thus, most of these missiles and targets hit the water as fragments, which quickly dissipate their kinetic energy within a short distance from the surface. Similarly, expended small-arms rounds may also strike the water surface with sufficient force to cause injury. Most fish swim some distance below the surface of the water. Therefore, fewer fish are exposed to mortality from falling fragments whose effects are limited to the near surface than mortality from intact missiles and targets whose effects can extend well below the water surface. Effects of falling debris and small arms rounds on fish are expected to be minimal.

Flares and Chaff

An extensive review of literature, combined with controlled experiments, revealed that chaff and self-defense flare use pose little risk to the environment or animals (U.S. Air Force 1997; Naval Research Laboratory 1999). The materials in chaff are generally non-toxic except in quantities significantly larger than those any marine fish could reasonably be exposed to from normal usage. Particulate tests and a screening health risk assessment concluded that the concern about chaff breaking down into respirable particle sizes is not a significant issue. Experiments have shown that animals should not suffer toxic or physical effects from chaff ingestion (U.S. Air Force 1997; Naval Research Laboratory 1999). There is no published evidence that chaff exposure has caused the death of a marine fish, and experiments have shown no direct effects of chaff on marine animals (U.S. Air Force 1997; Naval Research Laboratory 1999). Effects of chaff on fish are expected to be minimal.

Toxicity is not a concern with self-defense flares since the primary material in flares, magnesium, has low toxicity (U.S. Air Force 1997) and will normally combust before striking the land or sea surface. It is unlikely that marine fish would ingest flare material because it sinks rapidly. Although impulse cartridges and initiators used in some flares contain chromium and lead, a screening health risk assessment concluded that they do not present a significant health risk in the environment (U.S. Air Force 1997). Effects of flares on fish are expected to be minimal.

3.7.2.2 No Action Alternative

3.7.2.2.1 SOCAL OPAREAs

Anti-Air Warfare (AAW) Training

Air Combat Maneuvers (ACM). No ordnance is released during this exercise. Aspects of the exercise that have potential effects on fish are fixed-wing overflights, which are discussed in Section 3.7.2.1.3, and impacts are expected to be minimal.

Air Defense Exercise (ADEX). These operations vary widely in the numbers of ships and aircraft involved and consist of a full array of tactics and procedures that are practiced between air and surface units for defense of the force. No weapons are fired. Aspects of the exercise that have potential effects on fish are fixed-wing overflights which are discussed in Section 3.7.2.1.3, and impacts are expected to be minimal.

Missile Firing Exercises (MISSILEX.): Aspects of the exercise that have potential effects on fish are aircraft overflights, missile launches, falling debris, shock waves from intact targets and missiles hitting the water, and presence of debris (fragments of missiles and targets, parachutes, chaff, and flares). These are discussed in Sections 3.7.2.1.1, 3.7.2.1.2, 3.7.2.1.3, and 3.7.2.1.4, and impacts are expected to be minimal.

Surface-to-Air Gunnery Exercise (GUNEX S-A): Aspects of the exercise that have potential effects on fish are fixed-wing overflights, surface firing noise, shock waves from munitions hitting the water, and munitions constituents. All of these are discussed in Section 3.7.2.1.1, 3.7.2.1.3, and 3.7.2.1.4, and impacts are expected to be minimal.

Anti-Submarine Warfare (ASW) Training

Most weapons and devices used during ASW Training exercises would be recovered at the conclusion of the exercises; however, some targets (e.g., MK-39 Expendable Mobile Training Target [EMATT]) and sonobuoys would be discarded at sea. Aspects of the exercise that have potential effects on fish are aircraft overflights, sonar, sonobuoys hitting the water surface, and in the case of IEER sonobuoys, underwater detonations. Shockwave effects are discussed in Section 3.7.2.1.1, sonobuoys in Section 3.7.2.1.2, and aircraft overflights in Section 3.7.2.1.3.

Surface ship sonar operates at a center frequency of 3.5 or 7.5 kHz. The ship is moving at a slow speed as it emits sonar signals. Only a few species of fish may be able to hear the relatively high frequencies of these sonar transmissions and they would have a high hearing threshold for them. These fish would hear sonar sounds only at close range and for a short period of time.

The dipping sonar is active for a relatively short time during the exercises. The center frequency of this sonar is 4.1 kHz. Active sonobuoys are also active for short periods, and have a center frequency of 8 kHz. Torpedoes emit sounds at a center frequency of 20 kHz. The pulse is highly directional and the torpedo travels at a very high speed. Thus, an animal would be exposed to sounds from a torpedo for a very brief period of time and only within a narrow cone of water ahead of the torpedo.

Those few species of fish that can hear the high frequency signals from active sonobuoys and dipping sonar would have hearing and disturbance thresholds such that they would likely not detect the signals. Those species would have to be within tens of meters from the active sonobuoys and dipping sonar, and a few hundreds of meters from ship sonars, to experience disturbance. Effects on fish behavior for those species that can hear and that do respond to the sounds would be transitory and of no biological consequence to the fish. Most species would probably not hear the sounds and would therefore experience no disturbance.

Anti-Surface Warfare Training

Visit Board Search and Seizure (VBSS). Visit Board Search and Seizure would occur 56 times per year and requires one SH-60L aircraft and one Torpedo Weapons Retrieval (TWR) support boat to perform the operation. Aspects of the exercise that have potential effects on fish are hovering helicopters, and small arms rounds hitting the water surface. These are discussed in Sections 3.7.2.1.3 and 3.7.2.1.4, and impacts are expected to be minimal.

Anti-Surface Missile (MISSILEX A-S). Aspects of the exercise that have potential effects on fish are hovering helicopters, missile launches, small arms rounds hitting the water, shock waves from intact missiles and bombs hitting the water, and presence of debris (missile, bomb, and target fragments). All of these except live bombs are discussed in Sections 3.7.2.1.1, 3.7.2.1.3, and 3.7.2.1.4, and impacts are expected to be minimal.

Based on estimates from CDFG catch block data collected within the SOCAL OPAREAs from 2001 to 2004, the areas of 50 percent fish mortality for the GBU-12s and GBU-16s were computed using the Yelverton equation. An estimated 264.8 lb (120.2 kg) of fish catch were killed annually, representing 0.023 percent of the catches around SCI.

Air-to-Surface Bombing. This exercise involves helicopters using missiles and other munitions and FA-18 fighters using live bombs and inert training munitions against maneuverable, high-speed, towed, seaborne targets approved for destruction. On average, two aircraft are involved in each exercise, a combination of FA-18 Hornets or Super Hornets flying at 10,000–20,000 ft (3,048-6,096 m); SH-60B, SH-60F, and HH-60H Seahawk helicopters flying at ~500 ft (152 m); and S-3 Vikings, P-3 Orions, and EA-6B Prowlers operating altitudes of ~25,000 ft (7,620 m). Vessels involved in each exercise are a

QST-25 or ROBOSKI to tow the target, and a Torpedo Weapons Retriever (TWR) for recovery. In the No Action Alternative, there are 79 operations annually, during which a total of 222 inert MK-76s, 13 inert MK-20 Rockeye CBUs, and 8 inert MK-82s are dropped, and 31 MK-82s (each with 192 lb [87 kg] net weight of explosive) and 8 MK-83s (each with 445 lb [202 kg] net weight of explosive) detonate near the surface (5-ft [1.5-m] depth) in deep (>4,922 ft [1,500 m]) water.

Aspects of the exercise that have potential effects on fish are fixed- and rotary-wing aircraft overflights, small arms rounds hitting the water, shock waves from bombs hitting the water, and presence of debris (fragments of targets, bombs, and other munitions). All of these except live bombs are discussed in Sections 3.7.2.1.1, 3.7.2.1.3, and 3.7.2.1.4, and impacts are expected to be minimal.

Based on estimates from CDFG catch block data collected within the SOCAL OPAREAs from 2001 to 2004, the areas of 50 percent fish mortality for the MK-82s and MK-83s were computed using the Yelverton equation. An estimated 489.5 lb (208.5 kg) of fish catch were killed annually, representing 0.038 percent of the catches around SCI.

Air-to-Surface Gunnery (GUNEX A-S). Aspects of the exercise that have potential effects on fish are rotary-wing aircraft overflights, surface firing noise, presence of debris (targets), shock waves from munitions hitting the water, and munitions constituents. These are discussed in Sections 3.8.2.1.3, and 3.8.2.1.4, and impacts are expected to be minimal.

Surface-to-Surface Gunnery Exercise (GUNEX S-S). Aspects of the exercise that have potential effects on fish are surface firing noise, presence of debris (targets), shock waves from munitions hitting the water, and munitions constituents. These are discussed in Sections 3.7.2.1.1, 3.7.2.1.2, 3.7.2.1.3, and 3.7.2.1.4, and impacts are expected to be minimal.

Sinking Exercise (SINKEX). A SINKEX is conducted only occasionally, typically during a Joint Task Force Exercise (JTFEX), and is conducted under a permit from the USEPA. Aspects of the exercise that have potential effects on fish are aircraft overflights, active sonar, surface firing noise, shock waves from munitions hitting the water, munitions constituents, missile launches, falling debris, shock waves, underwater detonations, and presence of debris (fragments of missiles and targets, parachutes, chaff, and flares). These are discussed in Sections 3.7.2.1.1, 3.7.2.1.2, 3.7.2.1.3, and 3.7.2.1.4, and impacts are expected to be minimal.

<u>Amphibious Warfare</u>

Naval Surface Fire Support (NSFS). In the No Action Alternative, the exercise is conducted 47 times annually. Aspects of the exercise that have potential effects on fish are fixed- and rotary-wing overflights and surface firing noise. All of these are discussed in Section 3.8.2.1.3, and impacts are expected to be minimal.

Expeditionary Firing Exercise (EFEX). In the No Action Alternative, this exercise is conducted six times annually in Territorial Waters. Aspects of the exercise that have potential effects on fish are fixed- and rotary-wing overflights and surface firing noise. All of these are discussed in Sections 3.8.2.1.3, and impacts are expected to be minimal.

Expeditionary Assault Battalion Landing. This operation does not occur under the No Action Alternative; therefore, no impacts are occurring.

Stinger Air-Defense Missile Firing. This operation does not occur in the baseline operations and therefore does not occur under the No Action Alternative. Therefore, no effects on fish result from this operation.

Amphibious Landings and Raids (on SCI). Potential impacts on fish from Amphibious Landings and Raids would be due to the beach landings associated with bringing personnel ashore. Landings typically would occur on sandy beaches, which are very dynamic habitats that support relatively fewer organisms than rocky intertidal habitats, but may also introduce hazardous materials (i.e., fuel and oil) that may affect marine organisms; however, impacts on fish from hazardous materials are expected to be minimal because of the low likelihood and low volumes of spills, and their dispersion and degradation in the marine environment. Other aspects are discussed in Section 3.7.2.1.2, and impacts are expected to be minimal.

Amphibious Operations – CPAAA. This covers a wide range of amphibious operations which occur at the Camp Pendleton Amphibious Assault Area (CPAAA), supporting needs for 1st Reconnaissance Battalion, Special Operations Training Group (SOTG) I MEF, Assault Amphibian School Battalion, Boat Company 5th Marine Regiment, Naval Beach Group ONE. Operations can range from ship-to-shore, beach traffic control, amphibious assaults, and beach salvage operations. No live or inert ordnance is authorized. The only aspects that may affect fish are fixed- and rotary-wing aircraft overflights. These are discussed in Section 3.8.2.1.3, and impacts are expected to be minimal.

<u>Electronic Warfare</u>

Electronic Combat (EC) Operations. Typical EC activities include threat avoidance training, signals analysis, and the use of airborne and surface electronic jamming devices to defeat tracking radar systems. In the No Action Alternative, there are 748 operations annually, with no ordnance expended. Aspects of the exercise that have potential effects on fish are fixed- and rotary-wing aircraft overflights. These are discussed in Section 3.7.2.1.3, and impacts are expected to be minimal.

<u>Mine Warfare</u>

MIW training includes Small Object Avoidance (SOA), Mine Neutralization (MCM) Exercises and Mine Laying Exercises (MINEX). SOA training is conducted at the Kingfisher Range and the Shallow Water Training Range (SWTR) Extension, while MCM training is currently conducted on the Kingfisher Range and offshore areas in the Tanner and Cortez Banks. MCM training engages ships' crews in the use of sonar for mine detection and avoidance, and minefield navigation and reporting. The proposed extension of the SOAR is intended for use in such training. MINEX events involve aircraft dropping inert training shapes, and less frequently submarine mine laying. MINEX events are conducted on the MINEX Training Ranges in the Castle Rock, Eel Point, China Point, and Pyramid Head areas offshore of SCI.

SOA and MCM operations involving ships transiting through a field of tethered mine shapes using their AN/SQS-53 and -56 sonars. In the No Action Alternative, the exercise is carried out 44 times per year on the Kingfisher Range. Aspects of the exercise that have potential effects on fish are aircraft overflights, sonar, and sonobuoys hitting the water surface. Shockwave effects are discussed in Section 3.7.2.1.1, sonobuoys in Section 3.7.2.1.2, and aircraft overflights in Section 3.7.2.1.3, and impacts are expected to be minimal.

In the single aircraft MINEX, the aircraft makes multiple passes dropping one or more inert training shapes (e.g., MK-76, MK18A1) in the various mine ranges near SCI. A normal operation usually consists of dropping four inert mine shapes. The shapes are scored for accuracy as they enter the water and would not be recovered. In the multiple aircraft exercise, mines shapes are dropped in a coordinated deployment pattern. The final location of each mine would be scored and the shapes would be recovered, some by marine mammals. In FY04, operations were conducted using 86 inert mine shapes (64 not recovered).

Aircraft drop inert mines on the Mine Training Range (MTR)-1, MTR-2, China Point, Pyramid Head, and Offshore SWTR Extension ranges. In the No Action Alternative, there are 17 operations annually, during which a total of 64 MK-76 practice bombs, 10 MK-18A1 mines, and 12 MK-62 mines are dropped.

Aspects of the exercise that have potential effects on fish are aircraft overflights, shock waves from mines hitting the water, and falling debris. Shockwave effects are discussed in Section 3.7.2.1.1, aircraft overflights in Section 3.7.2.1.3, and debris in Section 3.7.2.1.4, and impacts are expected to be minimal.

Naval Special Warfare (NSW) Training

NSW Center Underwater Demolitions. Navy SEAL underwater demolitions training takes place in shallow waters primarily in Northwest Harbor at depths of 5–20 ft. Detonations include 5-lb (2.3-kg) C-4 blocks, 20-lb (9-kg) C-4 blocks, haversacks containing 20 lb (9 kg) of C-4, limpets, a Mat Weave made from 10 MK-75 50-lb (23-kg) tubular charges, and an Obstacle Loading charge consisting of 16 haversacks each containing 20 lb (9 kg) of C-4 arranged in a particular configuration. The total weights and total numbers per year of each kind of detonation and operation are shown for each type of explosive in Table 3.7-15.

Table 3.7-15: Net Explosive Weight (NEW), in Pounds, of Underwater Demolitions and Numbers of Demolitions and Operations Conducted in Northwest Harbor During the No Action Alternative

Type of Explosive	NEW (lb)	Detonations per year	Operations per year
5-lb C-4	6.7	608	72
20-lb C-4/Haversack	26.8	8284	72
Limpet	5.5	504	72
Mat Weave	830	28	14
Obstacle Loading*	428.8	14	14
* In distributed multiple charges			

There are 19 mi^2 (49 km^2) of fish habitat around all of SCI within the 12-fathom (22-m) contour. Mortality of fish in the relatively small areas in Northwest Harbor and Horse Beach Cove would have minimal effects on fish populations in shallow waters around SCI. As described, the demolitions take place in waters of less than 1 to about 3 fathoms depth just off the shoreline, which restricts the area covered to a smaller nearshore wedge shape rather than a larger circular area. Furthermore, even with the larger multiple-charge events, the pressure propagated is less than that of the smallest of the multiple charges in the Obstacle Loading demolition and only several pounds of TNT in the case of the Mat Weave demolition. Using Yelverton's calculations for 1 to 10 lb (0.5 to 4.5 kg) fish inhabiting the water column (e.g., kelp-bass, senorita) and iso-velocity curves developed from very shallow water explosion tests at Northwest Harbor, SCI (NSWC/Anteon Corp. 2005), the approximate zone of influence for between 250 and 500 psi (the 50% mortality for these fish sizes) would be between 60 and 125 ft (18 to 38 m). At 125 ft (38 m) of propagation, this would conservatively affect approximately 49,000 ft^2 (4,500 m^2) of available habitat (assuming a circular area of impact, although as stated above, a smaller wedge shaped area of impact is more realistic). Given the difficulty in estimating the exact areas of influence in those restricted very-shallow-water conditions and the difficulty of estimating fish populations in such small nearshore areas, estimates of fish injuries and deaths by species are not made for Northwest Harbor and Horse Beach Cove. Additionally, evidence indicates that such operations are not harmful to the long-term fish populations in Northwest Harbor. Fish injured or killed there must be rapidly replaced because fish were abundant at kelp monitoring sites in 2003 and 2004, and diversity is similar to other Channel Islands within similar oceanographic regimes such as Catalina and Santa Barbara Islands (Kushner and Rich 2004).

The area of physical effects on fish habitat in Northwest Harbor is very limited in extent. Effects of explosives on sand habitats in shallow water would be inconsequential compared to the effects of waves, nearshore currents, and storms in redistributing sediment. Because of the small area affected, the small loss of sandy bottom habitat caused by underwater demolitions training has a minimal effect on territorial nearshore fish populations of SCI.

UAV Training. This operation involves several unmanned aircraft, three Pointer ships, and several support boats to conduct photo imaging and capture the onshore, nearshore, and offshore environments. There are no aspects of the exercise that have potential effects on fish.

Insertion/Extraction. Potential impacts on fish from insertion/extraction operations would be due to the beach landings associated with bringing marines ashore. Combat Rubber Raiding Craft (CRRC) landings typically would occur on sandy beaches, which are very dynamic habitats that support relatively fewer organisms than rocky intertidal habitats. The landing of small CRRCs themselves causes minimal disturbance to the shoreline, and though fuel and oil could potentially be spilled from the CRRCs' engines that may affect marine organisms, any releases would be very small and have a minimal effect. Other aspects of the exercise that have potential effects on fish are rotary- and fixed-wing overflights and landing, beach disturbance, and noise from the use of live ordnance onshore and at sea. All of these but beach disturbance are discussed in Sections 3.7.2.1.2, 3.7.2.1.3, and 3.7.2.1.4. Beach disturbance is not a concern, as they are a dynamic habitat that does not support sensitive fish species.

NSW Boat Operations. Special Boat Team 12 conducts boat training throughout the SOCAL Range Complex. Boat operations occur in the open ocean between Naval Amphibious Base Coronado, SCI, Seal Beach Port Hueneme, Camp Pendleton, and SSTC. No aspects of this operation effects fish.

SEAL Platoon Operations. The only aspect of the exercise that has potential effects on fish is aircraft overflights. Aircraft traffic is discussed in Section 3.7.2.1.3, and impacts are expected to be minimal. Beach disturbance is not a concern, as the beaches are a dynamic habitat that does not support sensitive fish species.

NSW Direct Action. Aspects of the exercise that have potential effects on fish are beach disturbance, and noise from the use of live ordnance onshore and at sea. All of these but beach disturbance are discussed in Sections 3.7.2.1.2, 3.7.2.1.3, and 3.7.2.1.4, and impacts are expected to be minimal. Beach disturbance is not a concern, as they are a dynamic habitat that does not support sensitive fish species.

<u>Strike</u>

Bombing Exercise (BOMBEX Land). This operation combines long-range strike missions and close air support (CAS), integrated with the movement of ground forces. All activity occurs in SHOBA, and aspects of the exercise that have potential effects on fish are aircraft overflights. Aircraft overflights are discussed in Section 3.8.2.1.3, and impacts are expected to be minimal.

Combat Search and Rescue (CSAR). The operation can include reconnaissance aircraft to find the downed aircrew, helicopters to conduct the rescue, and fighter aircraft to perform CAS to protect both the downed aircrews and the rescue helicopters. It occurs on SCI south of the airfield and north of SHOBA. In the No Action Alternative, there is one operation annually. Aspects of the exercise that have potential effects on fish are aircraft overflights. Aircraft overflights are discussed in Section 3.7.2.1.3, and impacts are expected to be minimal.

<u>Research, Development, Test and Evaluation (RDT&E)</u>

Ship Tracking and Torpedo Tests. Aspects of the exercise that have potential effects on fish are hovering helicopters and sonar. Aircraft overflights are discussed in Section 3.7.2.1.3. The MK-54 torpedoes and MK-30 and MK-39 EMATT acoustic training targets are considered to have non-problematic source levels.

Unmanned Underwater Vehicle (UUV) Tests. This test involves underwater video, electronics, and hardware. No ordnance is involved and impacts are expected to be minimal.

Sonobuoy Quality Assurance (QA)/Quality Control (QC) Tests. In each test, an aircraft (in 98 percent of tests, a NC-12B King Air, otherwise a P-3 Orion) flies at 500-ft (152-m) altitude for ~2 hours, dropping sonobuoys into deep water to test and evaluate manufacturer compliance with the Navy's required operational and technical specifications. Three types of sonobuoys are tested: passive (SSQ-53D/F, SSQ-77A), active (SSQ-62E), and bathythermograph (SSQ-36B). Those units that perform satisfactorily are scuttled and not recovered, and those that fail to meet operational criteria are recovered. In half of the tests, a surface vessel (Acoustic Explorer) is present near the sonobuoy impact area to monitor safety and testing, and to retrieve any malfunctioning devices. About 14 percent of the sonobuoys are recovered.

In the No Action Alternative, the test is conducted 117 times a year in the San Clemente Island Underwater Range (SCIUR), ~2.5 nm (4.6 km) east of Naval Ordnance Test Station (NOTS) Pier, in 3,500 ft (1,067 m) of water. Numbers of sonobuoys dropped annually are 184 SSQ-36Bs, 1,863 SSQ-53D/Fs, 552 SSQ-62Es, and 419 SSQ-77As. Aspects of the exercise that have potential effects on fish are fixed-wing overflights, active sonobuoys, and the presence of debris (sonobuoys and parachutes). All of these except active sonobuoys are discussed in Sections 3.7.2.1.3 and 3.7.2.1.4, and impacts are expected to be minimal. The SSQ-62E is considered non-problematic as its source level is 201 dB.

Ocean Engineering Tests. Ocean Engineering is long-term environmental testing that involves the ocean deployment of hardware, cabling, mine and MCM equipment, underwater tools and equipment, and related components. The test items are placed in appropriate locations in the water and/or on the seafloor to measure the long-term effect of exposure to the marine environment. Tests are conducted on the east side of SCI from North Light Pier to NOTS pier, and are supported by ocean-going research vessels, various small boats, shore cranes and support vehicles, and divers. There are no aspects of the test that have potential effects on fish.

Marine Mammal Mine Shape Location and Research: This activity involves the deployment of trained bottlenose dolphins and California sea lions to locate and retrieve inert mine shapes. One Boston Whaler is used for each deployment, and the Acoustic Explorer is used in 20 percent of deployments. No ordnance is involved. The recoverable mine shapes emit pings for retrieval purposes. Tests are conducted in Range areas MTR-1 and MTR-2. In the No Action Alternative, there are five operations. The only aspect of the training that has potential effects on fish is pingers.

High-frequency (28–45 kHz) pingers with source levels of 175 dB re 1 µPa-m are attached to about 40 percent of the inert mines to allow recovery. The moderately high frequencies emitted by these pingers are inaudible or at most only faintly audible to most fish. High frequency sounds attenuate rapidly in seawater, so any disturbance effects would be localized if they occur at all.

Unmanned Aerial Vehicles (UAV) Tests. UAV is used to evaluate basing, maintenance, and operating concepts of the GNAT vehicle. A vessel (Acoustic Explorer) is used in support of ~40 percent of the tests. There are no aspects of the tests that have potential effects on fish.

Missile Flight Tests. Two tests are conducted annually in the No Action Alternative. Aspects of the tests that have potential effects on fish are fixed- and rotary-wing aircraft overflights, shock waves from missiles hitting the water, and debris (missiles, chaff, flares, and smoke). All of these are discussed in Sections 3.7.2.1.3 and 3.7.2.1.4, and impacts are expected to be minimal.

Naval Undersea Warfare Center (NUWC) Acoustics Tests. The Naval Undersea Warfare Center (NUWC) currently conducts a number of tests, including Weapon System Accuracy Trials (WSATs); Sensor Accuracy Tests (SATs); Surface Ship Radiated Noise Measurement (SSRNM) tests; At-Sea Bearing Accuracy Tests (ASBATS); Acoustic Trials (ACTRLs); and USW Readiness Evaluation Facility (USWREF). Only WSAT, SAT, and USWREF, which evaluate all ships equipped with hull-mounted AN/SQS-53C and AN/SQS-56, use sonar. Eight MK-46 torpedoes are used annually, but the noise they produce is considered non-problematic. In the No Action Alternative, there are 46 operations. The only aspect of the tests that has potential effects on fish is sonar.

Surface ship sonar emits at a center frequency of 3.5 or 7.5 kHz. The ship is moving at a slow speed as it emits sonar signals. Only a few species of fish may be able to hear the relatively high frequencies of these sonar transmissions and they would have a high hearing threshold for them. These fish would hear sonar sounds only at close range and for a short period of time. Effects on fish behavior for those species that can hear and that do respond to the sounds would be transitory and of no biological consequence to the fish. Most species would probably not hear the sounds and would therefore experience no disturbance.

Naval Auxiliary Landing Field (NALF) SCI Airfield Activities

In the No Action Alternative, operations are conducted 26,376 times a year in NALF SCI Class D Airspace. Aspects of the exercise that have potential effects on fish are fixed- and rotary-wing aircraft overflights, landings, and takeoffs. Effects of overflights are discussed in Section 3.7.2.1.3, and impacts are expected to be minimal.

3.7.2.2.2 Rare, Threatened, and Endangered Species

Steelhead and Other Anadromous Species

There is only one documented report of a steelhead in the SOCAL OPAREAs; a 51 cm steelhead was landed at Dana Point Harbor, California (approximately 8.7 miles (14 km) south of Laguna Beach and 7.5 miles (12 km) north of Camp Pendleton) in December 2002 (Figure 3.7-10) (Strege 2003). There is the possibility that adult steelhead, green sturgeon, and chinook salmon could be found within the SOCAL OPAREAs, although they are considered to be extremely rare in this area. Activities in the SOCAL Range Complex that could potentially impact anadromous species, such as in-water detonations occur in nearshore waters of SCI or in open ocean habitats. These fishes are believed to inhabit nearshore coastal waters, which have access to streams that are used for spawning (Figure 3.7-11). Therefore, there operations within the SOCAL OPAREAs are not likely to affect anadromous species and consultation under the ESA is not required.

Tidewater Goby

Since tidewater gobies inhabit coastal lagoons and the uppermost brackish zone of larger estuaries, no activities could affect tidewater goby because activities in the SOCAL Range Complex encompass nearshore and open ocean habitats and not coastal lagoons and estuaries. Operations within the SOCAL OPAREAs are not likely to affect this species and consultation under the ESA is not required.

3.7.2.2.3 Essential Fish Habitat

This section briefly discusses the potential impacts by the proposed actions to EFH and managed species. Despite nearshore and offshore designations of the SOCAL OPAREAs, species within all FMPs may utilize both nearshore and offshore areas during their lives, as eggs and larvae for most species are planktonic and can occur in nearshore and offshore waters, while adults may be present in nearshore and/or offshore waters. Therefore, all project activities can potentially affect a lifestage of a managed species.

Adverse effects mean any impact that reduces quality and/or quantity of EFH, and may include direct or indirect physical, chemical, or biological alterations of the waters or substrate and loss of, or injury to, benthic organisms, prey species and their habitat, and other ecosystem components, if such modifications reduce the quality and/or quantity of EFH. Adverse effects to EFH may result from actions occurring within EFH or outside of EFH and may include site-specific or habitat-wide impacts, including individual, cumulative, or synergistic consequences of actions (50 CFR 600.810(a)).

The proposed operations in the SOCAL OPAREAs have the potential to result in the following impacts:

- Physical disruption of open ocean habitat;
- Physical destruction or adverse modification of benthic habitats;
- Alteration of water or sediment quality from debris or discharge; and
- Cumulative impacts.

Each impact and operations associated with those impacts are discussed in Section 3.7.2, with a more detailed analysis in Appendix E – EFH Assessment. Although temporary unavoidable impacts associated with several operations may result in localized adverse impacts to some managed species, it has been concluded that there will be no adverse effects to EFH and managed species, and no consultation is required.

3.7.2.3 Alternative 1

Alternative 1 is a proposal designed to meet Navy and DoD current and near-term operational training requirements. If Alternative 1 were to be selected, in addition to accommodating training operations currently conducted, the SOCAL Range Complex would support an increase in training operations including Major Range Events and force structure changes associated with introduction of new weapons systems, vessels, and aircraft into the Fleet. Under Alternative 1, baseline-training operations would be increased. In addition, training and operations associated with force structure changes would be implemented for the LCS, MV-22 Osprey, the EA-18G Growler, and the SH-60R/S Seahawk Multi-Mission Helicopter. Force structure changes associated with new weapons systems would include Offensive Mine Counter Measure (OMCM) systems.

3.7.2.3.1 SOCAL OPAREAs

<u>Anti-Air Warfare (AAW) Training</u>

AAW Operations are conducted more often in Alternative 1 than in the No Action Alternative (Table 2-7). The total number of operations increases from 4,386 to 4,857 from the No Action Alternative to Alternative 1, an increase of 10.7 percent.

As described in Section 3.7.2.2.1, AAW operations are expected to have a minimal effect on fish, and the small change in the numbers of exercises would not change those predictions.

<u>Anti-Submarine Warfare (ASW) Training</u>

ASW Operations are conducted more often in Alternative 1 than in the No Action Alternative (Table 2-7). The total number of operations increases from 1,693 to 2,969 from the No Action Alternative to Alternative 1, an increase of 75 percent.

As described in Section 3.7.2.2.1, ASW operations are expected to have a minimal effect on fish, and the small change in the numbers of exercises would not change those predictions.

<u>Anti-Surface Warfare Training</u>

Anti-Surface Warfare Operations are conducted more often in Alternative 1 than in the No Action Alternative (Table 2-7). The total number of operations increases from 498 to 565 from the No Action Alternative to Alternative 1, an increase of 13.5 percent.

As described in Section 3.7.2.2.1, Anti-Surface Warfare operations are expected to have a minimal effect on fish, and the small change in the numbers of exercises would not change those predictions.

Amphibious Warfare

Amphibious Warfare Operations are conducted more often in Alternative 1 than in the No Action Alternative (Table 2-7). The total number of operations increases from approximately 2,265 to approximately 2,366 from the No Action Alternative to Alternative 1, an increase of 4.5 percent.

As described in Section 3.7.2.2.1, most of the operations have minimal effects on fish. The small change in the numbers of exercises would not change those predictions. For those operations that are not currently conducted, the analysis is provided below.

Expeditionary Assault Battalion Landing. Under Alternative 1, battalion landing operations will be conducted at SCI. Aspects of the exercise that have potential effects on fish are rotary- and fixed-wing overflights and landing, and noise from the use of live ordnance onshore and at sea. All of these are discussed in Sections 3.7.2.1.3 and 3.7.2.1.4, and impacts are expected to be minimal.

Stinger Air-Defense Missile Firing. The USMC Stinger firings are conducted from positions onshore in SHOBA, one for shoulder-launched missiles, and another for launching from a Light Armored Vehicle (LAV). The targets, launched from SHOBA in the China Point area, are either solid-rocket-powered, non-reusable Ballistic Aerial Targets (BATS) or small, gasoline-powered, remote-controlled aircraft (RPVs) that land in SHOBA and can be used repeatedly if not damaged by the missile. This exercise would occur three times per year in Alternative 1, with eight BATS launched in each exercise. Aspects of the exercise that have potential effects on fish are falling debris, shock waves from missiles or BATS landing in the water, and debris (fragments of missiles and BATS). These are discussed in Section 3.7.2.1.3 and 3.7.2.1.4, and impacts are expected to be minimal.

Electronic Warfare

Electronic Combat (EC) Operations. The number of EC operations would increase from 748 to 755 operations per year. Effects from EC operations to fish would be similar to those described under the No Action Alternative, and are expected to be minimal.

Mine Warfare

The number of mine countermeasures (MCM) operations would increase from 44 to 46 operations per year. As described in Section 3.7.2.2.1, impacts are expected to be minimal.

The number of mine neutralization operations would increase from 0 to 732 operations per year, and the potential impacts of OAMCM systems on fish would primarily be associated with the expenditure of ordnance and incidental release of other materials in exercises that would be conducted in SWAT 1 (offshore), Pyramid Cove, MTR-1, MTR-2, and Northwest Harbor. The resulting debris and/or discharges may affect the physical and chemical properties of surrounding marine waters, in turn affecting fish. The analysis of water quality effects associated with OAMCM systems is provided in Section 3.4, Water Quality, and indicates that effects from mine neutralization operations to water quality are anticipated to be minimal. In addition, as described in Section 3.7.2.1.3 and 3.7.2.1.4, impacts from mine neutralization are expected to be minimal.

The number of MINEX operations would be the same as the No Action Alternative (i.e., 17 operations per year), and as described in Section 3.7.2.2.1, and impacts are expected to be minimal.

Naval Special Warfare (NSW) Training

NSW Operations are conducted more often in Alternative 1 than in the No Action Alternative (Table 2-7). The total number of operations increases from 1,503 to 2,118 from the No Action Alternative to Alternative 1, an increase of 40.7 percent. As described in Section 3.7.2.2.1, all of the operations have minimal effects on fish, although a small increase in fish mortality is anticipated from the increase in underwater demolitions.

Strike

Bombing Exercise (BOMBEX Land). The number of BOMBEX Land operations would increase from 176 to 197 operations per year. Effects from BOMBEX Land operations to fish would be similar to those described under the No Action Alternative, and are expected to be minimal.

Combat Search and Rescue (CSAR). Under Alternative 1, the number of CSAR operations would increase from 7 in the No Action Alternative to 8 operations per year; however, effects from CSAR operations to fish would be similar to those described under the No Action Alternative, and are expected to be minimal.

Non-Combatant Operations

Explosive Ordnance Disposal (EOD). Under Alternative 1, the number of EOD operations would increase from 4 in the No Action Alternative to 5 operations per year; however, no impacts to fish are expected because EOD Operations would occur within designated land areas on SCI.

Research, Development, Test and Evaluation (RDT&E)

RDT&E Operations increase in Alternative 1 than in the No Action Alternative (Table 2-7). The total number of operations increases from 481 to 517 from the No Action Alternative to Alternative 1, an increase of 7.5 percent. As described in Section 3.7.2.2.1, all of the operations have minimal effects on fish. The small change in the numbers of exercises would not change those predictions.

Naval Auxiliary Landing Field (NALF) SCI Airfield Activities

Under Alternative 1, the number of NALF operations would increase from the No Action Alternative to 28,000, and since operations occur within designated land areas on SCI, impacts to fish would be similar to those described for the No Action Alternative, and are expected to be minimal.

New Platforms/Vehicles

The introduction of the future platforms such as the LCS, MV-22, P8A Poseidon, EA-18G Growler, and MH-60R Seahawk Multi-Mission Helicopter, assuming that use and usage areas will remain similar to platforms that they are replacing will have minimal impacts to fish.

3.7.2.3.2 Rare, Threatened, and Endangered Species

Impacts to steelhead, green sturgeon, chinook salmon, and tidewater goby are not expected as described previously for the No Action Alternative (see Section 3.7.2.2.2), and the small change in the number of exercises would not change those predictions. Consultation with the resource agencies is not required.

3.7.2.3.3 Essential Fish Habitat

Adverse impacts to EFH are not expected as described previously for the No Action Alternative (see Section 3.7.2.2.3 and Appendix E – EFH Assessment), and the small change in the number of exercises would not change those predictions. Consultation with the resource agencies is not required.

3.7.2.4 Alternative 2

3.7.2.4.1 SOCAL OPAREAs

Anti-Air Warfare (AAW) Training

AAW Operations are conducted more often in Alternative 2 than in the No Action Alternative (Table 2-8). The total number of operations increases from 4,386 to 4,889 from the No Action Alternative to Alternative 1, an increase of 11.5 percent.

As described in Section 3.7.2.2.1, AAW operations are expected to have a minimal effect on fish, and the small change in the numbers of exercises would not change those predictions.

Anti-Submarine Warfare (ASW) Training

ASW Operations are conducted more often in Alternative 2 than in the No Action Alternative (Table 2-8). The total number of operations increases from 1,693 to 2.971 from the No Action Alternative to Alternative 1, an increase of 75.5 percent.

As described in Section 3.7.2.2.1, ASW operations are expected to have a minimal effect on fish, and the change in the number of exercises would not change those predictions.

Anti-Surface Warfare Training

Anti-Surface Warfare Operations are conducted more often in Alternative 2 than in the No Action Alternative (Table 2-8). The total number of operations increases from 498 to 592 from the No Action Alternative to Alternative 2, an increase of 18.9 percent.

As described in Section 3.7.2.2.1, Anti-Surface Warfare operations are expected to have a minimal effect on fish, and the small change in the numbers of exercises would not change those predictions.

Amphibious Warfare

Amphibious Warfare Operations are conducted more often in Alternative 2 than in the No Action Alternative (Table 2-8). The total number of operations increases from approximately 2,265 to approximately 2,408 from the No Action Alternative to Alternative 2, an increase of 6.3 percent.

As described in Section 3.7.2.2.1, most of the operations have minimal effects on fish. The small change in the numbers of exercises would not change those predictions. For those operations that are not currently conducted, the analysis is provided below.

Expeditionary Assault Battalion Landing. Under Alternative 2, two battalion landing operations will be conducted at SCI. Aspects of the exercise that have potential effects on fish are rotary- and fixed-wing overflights and landing, and noise from the use of live ordnance onshore and at sea. All of these are discussed in Sections 3.7.2.1.3 and 3.7.2.1.4, and impacts are expected to be minimal.

Stinger Air-Defense Missile Firing. This exercise would occur four times per year in Alternative 2, with eight BATS launched in each exercise. Aspects of the exercise that have potential effects on fish are falling debris, shock waves from missiles or BATS landing in the water, and debris (fragments of missiles and BATS). These are discussed in Section 3.7.2.1.3 and 3.7.2.1.4, and impacts are expected to be minimal.

Electronic Warfare

Electronic Combat (EC) Operations. Under Alternative 2, the number of EC operations would increase from 748 to 775 operations per year. Effects from EC operations to fish would be similar to those described under the No Action Alternative, and are expected to be minimal.

Mine Warfare

The number of MCM operations would increase from 44 to 48 operations per year, and the number of Mining Training operations would increase from 17 to 18 operations per year. As described in Section 3.7.2.2.1, impacts are expected to be minimal, and the small change in the numbers of exercises would not change those predictions.

The number of mine neutralization operations would increase from 0 in the No-Action Alternative to 732 operations per year. As described in Section 3.7.2.3.1, impacts are expected to be minimal.

Naval Special Warfare (NSW) Training

NSW Operations are conducted more often in Alternative 2 than in the No Action Alternative (Table 2-8). The total number of operations increases from 1,503 in the No Action Alternative to 2,320 in Alternative 2, an increase of 54.4 percent.

As described in Section 3.7.2.2.1, all of the operations have minimal effects on fish, although an increase in fish mortality is anticipated from the increase in underwater demolitions.

Strike

Bombing Exercise (BOMBEX Land). Under Alternative 2, the number of BOMBEX Land operations would increase from 176 to 216 operations per year. Effects from BOMBEX Land operations to fish would be similar to those described under the No Action Alternative, and are expected to be minimal.

Combat Search and Rescue (CSAR). Under Alternative 2, the number of CSAR operations would increase from 7 in the No Action Alternative to 8 operations per year; however, effects from CSAR operations to fish would be similar to those described under the No Action Alternative, and are expected to be minimal.

Non-Combatant Operations

Explosive Ordnance Disposal (EOD). Under Alternative 2, the number of EOD operations would increase from 4 in the No Action Alternative to 10 operations per year; however, no impacts to fish are expected because EOD Operations would occur within designated land areas on SCI.

Research, Development, Test and Evaluation (RDT&E)

RDT&E Operations increase in Alternative 2 from the No Action Alternative (Table 2-8). The total number of operations increases from 481 to 606 from the No Action Alternative to Alternative 2, an increase of 25.9 percent. As described in Section 3.7.2.2.1, all of the operations have minimal effects on fish, and the change in the number of exercises would not change those predictions.

Naval Auxiliary Landing Field (NALF) SCI Airfield Activities

Under Alternative 2, the number of NALF operations would decrease from the No Action Alternative to 33,000, and since operations occur within designated land areas on SCI, impacts to fish would be similar to those described for the No Action Alternative, and are expected to be minimal.

New Platforms/Vehicles

The introduction of the future platforms such as the LCS, MV-22, P8A Poseidon, EA-18G Growler, and MH-60R Seahawk Multi-Mission Helicopter, assuming that use and usage areas will remain similar to platforms that they are replacing will have minimal impacts to fish.

SOCAL Range Complex Enhancements

Commercial Air Services Increase. Under Alternative 2, an increase in Commercial Air Services would be implemented. No aspect of this operation would affect fish.

Shallow Water Minefield. The Navy proposes to construct a shallow water minefield in the SOCAL Range Complex. Multiple site options off Tanner Bank, Cortes Bank, La Jolla, and Point Loma have been identified with consideration being given to bathymetry and required capabilities.

Shallow water minefield support of submarine MCM training requires a depth of 250-420 ft (76-128 m), and a sandy bottom and flat contour in an area relatively free from high swells and waves. The size of the area should be a minimum of 2x2 nm (3.7x3.7 km) and optimally 3x3 nm (5.6x5.6 km). Mine shapes would be approximately 600 yards (549 m) apart and 30-35 inches (0.8-0.9 m) in size, and would consist of a mix of recoverable/replaceable bottom shapes (~10 cylinders weighed down with cement) and moored shapes (~15 shapes, no bottom drilling required for mooring). Localized impacts to fish would occur during installation of the mine shapes; however, based on the project criteria, no sensitive habitat or species will be affected by the installation of the shallow water minefield (see Threatened and Endangered Section), and therefore, impacts from installation of a shallow water minefield are expected to be minimal.

SWTR Extension. This component of the Proposed Action is to instrument and use two extensions of the current SOAR, one 250-nm^2 (463-km^2) area to the west in the area of the Tanner/Cortes Banks, and one 250-nm^2 (463-km^2) area between SOAR and the southern section of SCI. The SWTR instrumentation is a system of underwater acoustic transducer devices, called nodes, connected by cable to each other and to a land-based facility where the collected range data are used to evaluate the performance of participants in shallow water training exercises. The transducer nodes are capable of both transmitting and receiving acoustic signals from ships operating within the SWTR Extension.

Since the exact cable route has not been decided, it is not possible to determine if sensitive habitat will be affected by the SWTR Extension. Assuming that rocky or sensitive habitats are avoided, the activities that could affect fish are associated with the construction of the SWTR Extension, which are discussed in Section 3.6.3.4 (Marine Plants and Invertebrates), and are anticipated to be minimal.

3.7.2.4.2 Rare, Threatened, and Endangered Species

Impacts to steelhead, green sturgeon, chinook salmon, and tidewater goby are not expected as described previously for the No Action Alternative (see Section 3.7.2.2.2), and the small change in the number of exercises would not change those predictions. Consultation with the resource agencies is not required.

3.7.2.4.3 Essential Fish Habitat

Adverse impacts to EFH are not expected as described previously for the No Action Alternative (see Section 3.7.2.2.3 and Appendix E – EFH Assessment), and the small change in the number of exercises would not change those predictions. Consultation with the resource agencies is not required.

3.7.3 Mitigation Measures

Mitigation measures for activities involving underwater detonations, implemented for marine mammals and sea turtles, also offer protections to habitats associated with fish communities. No additional mitigation measures are proposed or warranted because no substantial effects on fish or fish habitat were identified.

3.7.4 Unavoidable Adverse Environmental Effects

No unavoidable environmental effects were identified.

3.7.5 Summary of Effects by Alternative

Table 3.7-16 presents a summary of effects and mitigation measures for the No Action, Alternative 1, and Alternative 2.

Table 3.7-16: Fish Summary of Effects

Alternative	NEPA (On-Land and U.S. Territorial Waters)	EO 12114 (Non-U.S. Territorial Waters)
No Action Alternative	• Relatively small numbers of fish would be killed by shock waves from mines, inert bombs, and intact missiles and targets hitting the water surface. These and several other types of activities common to many exercises or tests have minimal effects on fish: aircraft, missile, and target overflights; muzzle blast from 5-in naval guns, release of munitions constituents; falling debris and small arms rounds; entanglement in military-related debris; and chaff and flares. • Because only a few species of fish may be able to hear the relatively higher frequencies of mid-frequency sonar, effects of sonar used in the ASW and MIW exercises on fish are minimal. • Most SHOBA Operations and Amphibious Warfare outside of SHOBA either have no potential effects on fish or only have potential effects similar to aircraft overflights. • Most NSW operations take place on land or only have potential effects from aircraft overflights; so there are no potential effects on fish. Underwater demolitions exercises in Northwest Harbor will result in fish kills, but the area affected is relatively small and affects nearshore fish populations of SCI. • The only SPAWAR test that has any potential effects is Underwater Acoustics Testing, which involves mid-frequency sonar, but effects on fish are minimal (see effects of sonar used in the ASW and MIW exercises, above). • No impacts to threatened and endangered species. • No adverse impacts to EFH.	• Relatively small numbers of fish would be killed by shock waves from mines, inert bombs, and intact missiles and targets hitting the water surface. These and several other types of activities common to many exercises or tests have minimal effects on fish: aircraft, missile, and target overflights; muzzle blast from 5-in naval guns, release of munitions constituents; falling debris and small arms rounds; entanglement in military-related debris; and chaff and flares. • Because only a few species of fish may be able to hear the relatively higher frequencies of mid-frequency sonar, effects of sonar used in the ASW and MIW exercises on fish in are minimal. • No impacts to threatened and endangered species. • No adverse impacts to EFH.

Alternative	NEPA (On-Land and U.S. Territorial Waters)	EO 12114 (Non-U.S. Territorial Waters)
Alternative 1	• Impacts as described in the No Action Alternative plus the following: • New Platforms and Vehicles will have similar effects as the platforms that they are replacing, and will have minimal impacts to fish. • Small increases in the number of Offshore Operations, SHOBA Operations, Underwater Demolitions exercises, and RDT&E tests would result in minimal impacts to fish. • No impacts to threatened and endangered species. • No adverse impacts to EFH.	• Impacts as described in the No Action Alternative plus the following: • Impacts to fish from Major Range Events would be similar to those described for ASU, AAW, ASUW, NSW, and AMW operations and would be minimal. • Small increases in the number of Offshore Operations would result in minimal impacts to fish. • No impacts to threatened and endangered species. • No adverse impacts to EFH.
Alternative 2 (Preferred Alternative)	• Impacts same as described for No Action Alternative and Alternative 1, plus the following. • Construction of a shallow water minefield and SWTR Extension would result in localized impacts to fish during installation; however, based on the project criteria, no sensitive habitat or species will be affected, and therefore, impacts to fish would be minimal. • No impacts to threatened and endangered species. • No adverse impacts to EFH.	• Impacts same as described for No Action Alternative and Alternative 1, plus the following. • Construction of a shallow water minefield and SWTR Extension would result in localized impacts to fish; however, based on the project criteria, no sensitive habitat or species will be affected, and therefore, impacts to fish would be minimal. • No impacts to threatened and endangered species. • No adverse impacts to EFH.

3.8 Sea Turtles

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3.8 SEA TURTLES

Sea turtles are long lived reptiles that can be found throughout the world's tropical, subtropical, and temperate seas (Caribbean Conservation Corporation and Sea Turtle Survival League 2003). There are seven living species of sea turtles from two distinct families, the *Cheloniidae* (hard-shelled sea turtles; six species) and the *Dermochelyidae* (leatherback turtle; one species). These two families can be distinguished from one another on the basis of their carapace (upper shell) and other morphological features.

Over the last few centuries, sea turtle populations have declined dramatically due to anthropogenic (human-related) activities such as coastal development, oil exploration, commercial fishing, marine-based recreation, pollution, and over-harvesting (Natural Research Council 1990; Eckert 1995). As a result, all six species of sea turtles found in U.S. waters are currently listed as either threatened or endangered under the ESA.

Sea turtles are highly adapted for life in the marine environment. Unlike terrestrial and freshwater turtles, sea turtles possess powerful, modified forelimbs (or flippers) that enable them to swim continuously for extended periods of time (Wyneken 1997). They also have compact and streamlined bodies that help to reduce drag. Additionally, sea turtles are among the longest and deepest diving of the air-breathing vertebrates, spending as little as 3 to 6 percent of their time at the water's surface (Lutcavage and Lutz 1997). Sea turtles often travel thousands of miles between their nesting beaches and feeding grounds, which makes the aforementioned suite of adaptations very important (Ernst et al. 1994; Meylan 1995).

Sea turtle traits and behaviors also help protect them from predation. Sea turtles have a tough outer shell and grow to a large size as adults; mature leatherback turtles (*Dermochelys coriacea*) can weigh up to 2,091 lb (Eckert and Luginbuhl 1988). Sea turtles cannot withdraw their head or limbs into their shell, so growing to a large size as adults is important.

Although they are specialized for life at sea, sea turtles begin their lives on land. Aside from this brief terrestrial period, which lasts approximately 3 months as eggs and an additional few minutes to a few hours as hatchlings scrambling to the surf, sea turtles are rarely encountered out of the water. Sexually mature females return to land in order to nest, while certain species in the Hawaiian Islands, Australia, and the Galapagos Islands haul out on land in order to bask (Carr 1995; Spotila et al. 1997). Sea turtles bask to thermoregulate, elude predators, avoid harmful mating encounters, and possibly to accelerate the development of their eggs, accelerate their metabolism, and destroy aquatic algae growth on their carapaces (Whittow and Balazs 1982; Spotila et al. 1997). On occasion, sea turtles can unintentionally end up on land if they are dead, sick, injured, or cold-stunned. These events, also known as strandings, can be caused by either biotic (e.g., predation and disease) or abiotic (e.g., water temperature) factors.

Female sea turtles nest in tropical, subtropical, and warm-temperate latitudes, often in the same region or on the same beach where they hatched (Miller 1997). Upon selecting a suitable nesting beach, most sea turtles tend to re-nest in close proximity during subsequent nesting attempts. The leatherback turtle is a notable divergence from this pattern. This species nests primarily on beaches with little reef or rock offshore. On these types of beaches erosion reduces the probability of nest survival. To compensate, leatherbacks scatter their nests over larger geographic areas and lay on average two times as many clutches as other species (Eckert 1987).

Four species of sea turtles occur at sea off the coast of southern California: loggerhead (*Caretta caretta*); eastern Pacific green (*Chelonia agassizi*); olive ridley (*Lepidochelys olivacea*) and leatherback (*Dermochelys coriacea*). The eastern Pacific green, also known as the black sea turtle, is considered by some to be a subspecies of the green sea turtle (*Chelonia mydas*). None of the four species is known to nest on southern California beaches. Regular nesting by leatherbacks and olive ridley turtles occurs along the Pacific coast of Baja California Sur, which is the northernmost known nesting site in the eastern north Pacific (Fritts et al. 1982; Sarti-M. et al. 1996; López-Castro et al. 2000). Due to the primarily oceanic distributions of the leatherback, loggerhead, and olive ridley turtles off Southern California, the southwestern portion of the SOCAL OPAREAs is designated as an area of primary occurrence for all sea turtle species (DoN 2005); their presence within the SOCAL OPAREAs is considered rare. There is also an area of primary occurrence in southern San Diego Bay due to the year-round prevalence of green turtles in those waters near the warm water outflow of a power plant. All are currently listed as either endangered or threatened under the ESA.

The distribution of sea turtles is strongly affected by seasonal changes in ocean temperature (Radovich 1961). In general, sightings increase during summer as warm water moves northward along the coast (Stinson 1984). Sightings may also be more numerous in warm years compared to cold years.

Sea turtles typically remain submerged for several minutes to several hours depending upon their activity state (Standora et al. 1984; 1994; Renaud and Carpenter 1994). Long periods of submergence hamper detection and confound census efforts.

Young loggerhead, green, and olive ridley turtles are believed to move offshore into open ocean convergence zones where abundant food attracts predators, including sea turtles (Carr 1987; NRC 1990; NMFS and USFWS 1998a; Gooding and Magnuson 1967). A survey of the eastern tropical Pacific found that sea turtles were present during 15 percent of observations in habitats of floating debris and material of biological origin (flotsam) (Pitman 1990; Arenas and Hall 1992).

Stinson (1984) reported that over 60 percent of eastern Pacific green and olive ridley turtles observed in California waters were in waters less than 165 ft (50 m) in depth. Green turtles were often observed along shore in areas of eelgrass. Loggerheads and leatherbacks were observed over a broader range of depths out to 3,300 ft (1,000 m). When sea turtles reach subadult size, they move to the shallow, nearshore benthic feeding grounds of adults (Carr 1987; NRC 1990; NMFS and USFWS 1998b). Aerial surveys off California, Oregon, and Washington have shown that most leatherbacks occur in slope waters and that few occur over the continental shelf (Eckert 1993). Tracking studies found that migrating leatherback turtles often travel parallel to deepwater contours ranging in depth from 650 to 11,500 ft (200 to 3,500 m) (Morreale et al. 1994).

3.8.1 Affected Environment

3.8.1.1 Existing Conditions

3.8.1.1.1 Sea Turtle Species

Green Turtle (Chelonia mydas)

The green turtle was listed under the ESA as in July 1978, because of overexploitation for commercial and other purposes, the lack of adequate regulatory mechanisms and effective enforcement, evidence of declining numbers, and habitat loss and degradation (NMFS and USFWS 1998b). The breeding populations off Florida and the Pacific coast of Mexico are listed as endangered, whereas all others are classified as threatened.

Green turtle hatchlings are 2 inches (50 milimeters [mm]) long, and weigh approximately one ounce (oz) (28 grams [g]). Growth rates of juveniles, sub-adults, and adult green turtles measured at seven resident sites in the Hawaiian Archipelago revealed substantial variation; with annual growth rates ranging from highs of 4.5 cm to 6.25 cm at one location to lows of 0.25 cm to 1.5 cm at another location. These differences are probably a function of food availability and quality (Balazs 1980). It is estimated that green turtles reach sexual maturity sometime between 20 and fifty years of age. Adults can grow to more than 3 feet (ft) (0.91 meters [m]) long (straight carapace length [SCL]) and weigh 300-350 pounds (lbs) (136-159 kilograms (kg)).

The worldwide green sea turtle population is estimated at 88,520 nesting females (Spotila 2004). The worldwide population has declined 50–70 percent since 1900. In Michoacán, Mexico, the nesting colony declined from 25,000 in the 1970s to the current level of approximately 850 (Spotila 2004).

The green turtle is widely distributed in tropical and subtropical waters near continental coasts and around islands. Green turtles typically migrate along coastal routes from rookeries to feeding grounds, although some populations conduct trans-oceanic migrations (e.g., Ascension Island–Brazil). Hatchlings are epipelagic (surface dwelling in the open sea) for ~1–3 years. They live in bays and along protected shorelines, and feed during the day on seagrass and algae (Bjorndal 1982). Juvenile and sub-adult green turtles may travel thousands of kilometers before they return to breeding and nesting grounds (Carr et al. 19787).

The green turtle is the only genus of sea turtle that is mostly herbivorous (Mortimer 1995). Throughout most of its range, the green turtle forages primarily on seagrass, and on algae when seagrass is absent (Carr 1952; Pritchard 1971; Balazs et al. 1995; Mortimer 1995). Occasionally, green turtles will consume macrozooplankton, including jellyfish, kelp, sponges (Carr 1952), and mangrove leaves (Pritchard 1971).

Green turtles typically make dives shallower than 30 m (Hochscheid et al., 1999; Hays et al., 2000), although they have been observed at depths of 73 to 110 m in the eastern Pacific Ocean (Berkson, 1967). The maximum dive time recorded for a juvenile green turtle around the Hawaiian Islands is 66 min, with routine dives ranging from 9 to 23 min (Brill et al. 1995).

Major nesting beaches for green turtles are found throughout the western and eastern Atlantic, Indian Ocean, and western Pacific (EuroTurtle, 2001). However, there are no known nesting sites on the U.S. west coast (NMFS and USFWS 1998b).

Stinson (1984) reviewed sea turtle sighting records from northern Baja California to Alaska, and determined that the east Pacific green turtle was the most commonly observed hard-shelled sea turtle on the Pacific coast. Most of the sightings (62.0 percent) were reported from northern Baja California and southern California. The northernmost reported resident population occurs in San Diego Bay (Stinson 1984; Dutton and McDonald 1990a; 1990b; 1992; Dutton et al. 1994). Green turtles are sighted year-round in the waters of southern California, with the highest frequency of sightings occurring during the warm summer months of July–October (Stinson 1984). In waters south of Point Conception, Stinson (1984) found this seasonal sighting pattern to be independent of inter-year temperature fluctuations. North of Point Conception, more sightings occurred during warmer years.

South of the United States, green turtles are widely distributed in the coastal waters of Mexico and Central America (e.g., Cliffton et al. 1982; Cornelius 1982). Along the coast of Mexico and Central America, the main aggregations of East Pacific green turtles occur in the breeding grounds of Michoacán, Mexico (August-January) and year-round in the feeding areas such as those located on the west coast of Baja California, in the Gulf of California (Sea of Cortez) and along the coast of Oaxaca (NMFS and USFWS 1998b). Bahía de Los Angelos in the Gulf of California is an important foraging area for green turtles (Seminoff et al. 2003).

According to tag-recovery data for the eastern Pacific Ocean, green turtle migrations occur between the northern and southern extremes of their range. Recoveries of nesting females tagged on the beaches of Michoacán have been documented from throughout Central America and also from Mexican waters, primarily from the Gulf of California and adjacent waters, and from the coast of Oaxaca. IATTC data suggest that green turtles are rare near the Mexican coast, and are only present during October through December (NMFS and USFWS 1998b).

Although the green turtle is the most common sea turtle off the coast of California, it would be rare in the Environmental Impact Statement (EIS) Study Area, if it occurred at all, because it occurs mainly in shallow waters where it can feed on seagrass and sea algae.

Leatherback Turtle (Dermochelys coriacea)

The leatherback turtle was listed under the ESA as Endangered throughout its range in June 1970. Critical habitat has not been identified for this species in the Pacific, largely because nesting is not known to occur and important foraging areas have not been identified (NMFS and USFWS 1998a).

Leatherback hatchlings are approximately 2-3 in (50-77 cm) in length and weigh approximately 1.4-1.8 oz (40-50 g). The incremental growth observed in two recaptured juvenile leatherbacks after 1 and 1.5 months foraging in Delaware Bay was 1.9 and 3.0 cm in length and 1.5 and 2.7 kg in weight, respectively. This equates to an average growth rate of approximately 2.0 cm SCL and 1.5 kg per month during the summer (Eggers et al. 2001). The adult leatherback is the largest turtle in the world. Mature males and females can be as long as six and a half ft (2 m) and weigh almost 2000 lbs. (900 kg).

The world leatherback turtle population is currently estimated at 35,860 females (Spotila 2004). Leatherbacks are seriously declining at all major Pacific basin rookeries. Nesting along the Pacific coast of Mexico declined at an annual rate of 22 percent over the last 12 years, and the Malaysian population represents 1 percent of the levels recorded in the 1950s (NMFS 2006).

The leatherback is the largest and most widely distributed sea turtle, ranging far from its tropical and subtropical breeding grounds. It has the most extensive range of any adult, being found from 71ºN to 47ºS (Eckert, 1995). Leatherbacks are highly pelagic and approach coastal waters only during the reproductive season (EuroTurtle 2001). Hatchling leatherbacks are pelagic, but nothing is known about their distribution for the first four years (Musick and Limpus 1997). Post-nesting adult leatherbacks appear to migrate along bathymetric contours from 200 to 3500 m (Morreale et al. 1994), and most of the eastern Pacific nesting stocks migrate south (NMFS 2002a).

Leatherbacks feed mainly on jellyfish, tunicates, and other epipelagic soft-bodied invertebrates (Hartog and van Nierop 1984; Davenport and Balazs 1991). There is evidence that leatherbacks are associated with oceanic front systems, such as shelf breaks and the edges of oceanic gyre systems where their prey is concentrated (Lira et al. 1996).

This species is one of the deepest divers in the ocean, with dives deeper than 1000 m (Eckert et al. 1988). The leatherback dives continually and spends short periods of time on the surface between dives (Eckert et al. 1986; Southwood et al. 1998). Typical dive durations averaged 6.9–14.5 min per dive, with a maximum of 42 min (Eckert et al. 1996). During migrations or long distance movements, leatherbacks maximize swimming efficiency by traveling within 5 m of the surface (Eckert 2002).

After analyzing some 363 records of sea turtles sighted along the Pacific coast of North America, Stinson (1984) concluded that the leatherback was the most common sea turtle in U.S. waters north of Mexico. Sightings and incidental capture data indicate that leatherbacks are found in Alaska as far north as 60°N, 145°W, and as far west as the Aleutian Islands, and documented encounters extend southward through the waters of British Columbia, Washington and Oregon, and California (NMFS and USFWS 1998a).

Leatherbacks occur north of central California during the summer and fall, when sea surface temperatures are highest (Dohl et al. 1983; Brueggeman 1991). There is some evidence that they follow the 16ºC isotherm into Monterey Bay, and the length of their stay apparently depends on prey availability (Starbird et al. 1993). Some aerial surveys of California, Oregon, and Washington waters suggest that most leatherbacks occur in continental slope waters and fewer occur over the continental shelf. There were 96 sightings of leatherbacks within 50 km of Monterey Bay from 1986 to 1991, mostly by recreational boaters (Starbird et al. 1993). Fishermen "regularly" catch leatherbacks in drift/gill nets off Monterey Bay (NMFS and USFWS 1998a).

The leatherback turtle is rare in the waters in and near SCI. It likely would be encountered only in the offshore waters of the SOCAL OPAREAs because of its preference for the pelagic habitat, and likely only in July–September.

Loggerhead Turtle (Caretta caretta)

The loggerhead turtle was listed under the ESA as threatened throughout its range in July 1978, primarily because of direct take, incidental capture in various fisheries, and the alteration and destruction of its habitat (NMFS 2002c).

At emergence, hatchlings average 1.8 in (45 mm) in length and weigh approximately 0.04 lbs (20 g). They reach sexual maturity at about 35 years of age. Mean SCL of adults in the southeastern U.S. is approximately 36 in (92 cm); corresponding weight is about 250 lbs (113 kg).

The global population of loggerhead turtles is estimated at 43,320–44,560 nesting females (Spotila 2004). In the Pacific, loggerheads nest mostly in Japan and Australia, and populations nesting there declined markedly between the 1970s and 1990s (NMFS 2002c). The Pacific population of nesting females is estimated at 1,200 (Spotila 2004).

The loggerhead is a widely distributed species, occurring in coastal tropical and subtropical waters around the world. Loggerhead turtles undertake long migrations that take them far from their breeding grounds. They prefer to feed in coastal bays and estuaries, and in the shallow waters along continental shelves. Adult loggerheads feed on a variety of benthic fauna like conchs, crabs, shrimp, sea urchins, sponges, and fish. During migration through the open sea, they eat jellyfish, pteropods, floating mollusks, floating egg clusters, flying fish, and squid.

On average, loggerhead turtles spend over 90 percent of their time underwater (Byles 1988; Renaud and Carpenter 1994). In the North Pacific Ocean, two loggerheads tagged with satellite-linked depth recorders spent about 40 percent of their time in the top meter and virtually all their time shallower than 100 m; 70 percent of the dives were no deeper than 5 m (Polovina et al. 2003). Off Japan, virtually all the dives of two loggerheads between nesting were shallower than 30 m (Sakamoto et al., 1993). Routine dives can last 4–172 min (Byles 1988; Sakamoto et al. 1990; Renaud and Carpenter 1994). Small juvenile loggerheads live at or near the surface; for the 6-12 years spent at sea as juveniles, they spend 75% of their time in the top 5 m of water (Spotila 2004). Juveniles spend more time on the surface in deep, offshore areas than in shallow, nearshore waters (Lutcavage and Lutz 1997).

There are no reported loggerhead nesting sites in the eastern or central Pacific (NMFS 2002c). Most of the loggerheads in the eastern Pacific are believed to originate from beaches in Japan, where the nesting season is late May–August (NMFS and USFWS 1998c). The size structure of loggerheads in coastal and nearshore waters of the eastern and western Pacific suggest that Pacific loggerheads have a pelagic stage similar to that in the Atlantic (NMFS 2002c); loggerheads spend the first 6–12 years of their lives at sea (Spotila, 2004). Large aggregations (thousands) of mainly juveniles and subadult loggerheads are found off the southwestern coast of Baja California (Nichols et al. 2000), in a band starting about 30 km offshore and extending out at least another 30 km with maximum abundance at Bahia Magdalena (NMFS and USFWS 1998c). Bartlett (1989 in NMFS and USFWS 1998c) reported the range of sizes to be 20-80 cm shell length (mean = 60 cm); no hatchlings or mature adults were present. Concentrations ranged from one to five turtles per km² at peak sightings in good weather. Some loggerheads also enter the Gulf of California; Seminoff et al. (2003) recorded them at Bahía de Los Angeles and the

Infiernillo Channel, but the low capture per unit effort suggested that the Gulf of California may not provide critical habitat for loggerhead turtles in the eastern Pacific.

Most records of loggerheads off the U.S. west coat are from southern California (Stinson, 1984; Guess, 1981a, 1981b), but there are a few sightings from Washington (Hodge 1982) and Alaska (Bane, 1992). Most of the sightings in northern U.S. waters are of juveniles; of 43 records summarized by Stinson (1984), only a few may have been adults or near adults e.g., in the Channel Islands and in Encinitas, California. Sightings are typically confined to the summer months in the eastern Pacific, peaking in July–September off southern California and southwestern Baja California (Stinson, 1984; NMFS and USFWS, 1998c).

Olive Ridley Turtle (Lepidochelys olivacea)

The olive ridley turtle was listed under the ESA as endangered for the Pacific Mexican nesting population and threatened for all other populations in July 1978. The endangered classification was based on the extensive over-harvesting of olive ridleys in Mexico, which caused a severe population decline (NMFS and USFWS 1998d).

Hatchlings emerge weighing less than an one oz (< 28g) and measuring about 1.5 inches (3.8 cm). Adult turtles are relatively small, weighing on average around 100 lbs (45 kg). Olive ridleys reach sexual maturity around 15 years. The size and morphology of the olive ridley varies from region to region. Nesting females vary in size between 22 and 31 inches (56-79 cm) SCL with the largest animals being observed on the Pacific coast of Mexico.

The olive ridley is the most abundant sea turtle in the world. The worldwide population of olive ridley turtles is estimated at ~2 million nesting females (Spotila 2004). Worldwide, olive ridleys are in serious decline (Spotila 2004), but most nesting populations along the Pacific coast of Mexico and Costa Rica appear to be stable or increasing, after an initial large decline because of harvesting of adults (NMFS, 2002d).

The olive ridley has a large range in tropical and subtropical regions in the Pacific, Indian, and south Atlantic oceans, and is generally found between 40ºN and 40ºS. Most olive ridley turtles lead a primarily pelagic existence. The Pacific population migrates throughout the Pacific, from their nesting grounds in Mexico and Central America to the North Pacific (NMFS, 2002d). The post-nesting migration routes of olive ridleys tracked via satellite from Costa Rica traversed thousands of kilometers of deep oceanic waters ranging from Mexico to Peru, and more than 1,864 mi (3,000 km) out into the central Pacific (Plotkin et al., 1994). The olive ridley is the most abundant sea turtle in the open ocean waters of the eastern tropical Pacific Ocean (Pitman 1990).

Olive ridley turtles are primarily carnivorous and opportunistic. They consume snails, clams, sessile and pelagic tunicates, bottom fish, fish eggs, crabs, oysters, sea urchins, shrimp, pelagic jellyfish, and pelagic red crab (Fritts 1981; Marquez 1990; Mortimer 1995). Olive ridley turtles can dive and feed at considerable depths (260–1,000 ft [80–300 m]) (Eckert 1995), although only about 10% of their time is spent at depths greater than 100 m (Eckert et al. 1986; Polovina et al. 2003). In the eastern tropical Pacific Ocean, at least 25% of their total dive time is spent in the permanent thermocline, located at 20–100 m (Parker et al. 2003). Olive ridleys spend considerable time at the surface basking, presumably in an effort to speed their metabolism and digestion after a deep dive (Spotila 2004). In the open ocean of the eastern Pacific, olive ridley turtles are often seen near flotsam, possibly feeding on associated fish and invertebrates (Pitman 1992). In the North Pacific Ocean, two olive ridleys tagged with satellite-linked depth recorders spent about 20 percent of their time in the top meter and about 10 percent of their time deeper than 100 m; 70 percent of the dives were no deeper than 5 m (Polovina et al. 2003).

Females and males begin to aggregate in “reproductive patches” near their nesting beaches two months before the nesting season, and most mating is generally assumed to occur near the nesting beaches (NMFS 2002d). Most olive ridleys nest synchronously in huge colonies called “arribadas”, with several thousand females nesting at the same time; others nest alone, out of sequence with the arribada (Kalb and Owens 1994). The arribadas usually last from three to seven nights (April 1994). Most females lay two clutches of eggs with an inter-nesting period of 1–2 months (Plotkin et al. 1994). Radio-tracking studies showed that females that nested in arribadas remain within 3 mi (5 km) of the beach most of the time during the inter-nesting period (Kalb and Owens 1994). Solitary nesting also occurs, but numbers are much lower than in arribadas, and there are other differences in behavior.

Although most mating is generally assumed to occur near nesting beaches, Pitman (1990) observed olive ridleys mating at sea, as far as 1850 km from the nearest mainland, during every month of the year except March and December. However, there was a sharp peak in offshore mating activity during August and September, corresponding with peak breeding activity in mainland populations. Turtles observed during NMFS/SWFC dolphin surveys during July–December 1998 and 1999 were captured; 50 of 324 were involved in mating (Kopitsky et al. 2002). Aggregations of turtles, sometimes >100 individuals, have been observed as far offshore as 120°W, ~3000 km from shore (Arenas and Hall 1991).

In the eastern Pacific, the largest nesting concentrations occur in southern Mexico and northern Costa Rica, with stragglers nesting as far north as southern Baja California (Fritts et al. 1982) and as far south as Peru (Brown and Brown 1982). Of the 160,000 olive ridleys nesting annually in Mexico, only 3 are in northern Baja and 71 are in southern Baja (NMFS and USFWS 1998d). Olive ridleys nest throughout the year in the eastern Pacific with peak months, including major arribadas, occurring from September through December (NMFS and USFWS 1998d). There is no known nesting on the U.S. west coast.

Outside of the breeding season, the turtles disperse, but little is known of their behavior. Neither males nor females migrate to one specific foraging area, but exhibit a nomadic movement pattern and occupy a series of feeding area in the oceanic waters (Plotkin et al., 1994). Sightings of large aggregations of ridleys at sea (e.g., Oliver 1946) have led to unconfirmed speculation that turtles travel in large flotillas between nesting beaches and feeding areas (Márquez 1990). Arenas and Hall (1991) reported aggregations of over 100 animals as far offshore as 120ºW.

Tagged turtles nesting in Costa Rica were recovered as far south as Peru, as far north as Oaxaca, Mexico, and offshore to a distance of 1,243 mi (2,000 km) (Cornelius and Robinson 1986 in NMFS and USFWS, 1998d). Data collected during tuna fishing cruises from Baja California to Ecuador and from the coast to almost 150ºW indicated that the two most important areas in the Pacific for the olive ridley are the central American coast and the nursery/feeding area off Colombia and Ecuador, where both adults (mostly females) and juveniles are often seen (NMFS and USFWS 1998d).

At-sea occurrences in the U.S. and waters under U.S. jurisdiction are limited to the west coast of the continental U.S. (Stinson 1984) and Hawaii. Many published records located north of southern California are of dead, stranded turtles. Known records from Alaska (n=3) were all dead stranded turtles (Hodge and Wing 2000), and an olive ridley stranded on the ocean side of Point Reyes Peninsula was also dead (Evens 1993). However, there are also a number of California sightings of live olive ridleys. Hubbs (1977) reported a pair mating off the La Jolla coast, and an adult hooked by a fisherman in Los Angeles Harbor in 1983 (NMFS and USFWS 1998d). In October 2001, a live adult male was found entangled in fishing line ~1 km west of Muir Point off Marin County, and in November 2002 an olive ridley was observed swimming up to and hauling out on Shell Beach in Tomales Bay State Park (Steiner and Walder 2005).

3.8.1.1.2 Sea Turtle Hearing

Sea turtles do not have an auditory meatus or pinna that channels sound to the middle ear, nor do they have a specialized tympanum (eardrum). Instead, they have a cutaneous layer and underlying subcutaneous fatty layer that function as a tympanic membrane. The subcutaneous fatty layer receives and transmits sound to the extracolumella, a cartilaginous disk, located at the entrance to the columella, a long, thin bone that extends from the middle ear cavity to the entrance of the inner ear or otic cavity (Ridgway et al. 1969). Sound arriving at the inner ear via the columella is transduced by the bones of the middle ear. Sound also arrives by bone conduction through the skull. Sea turtle auditory sensitivity is not well studied, though a few preliminary investigations suggest that it is limited to low frequency bandwidths, such as the sounds of waves breaking on a beach.

The role of underwater low frequency hearing in sea turtles is unclear. It has been suggested that sea turtles may use acoustic signals from their environment as guideposts during migration and as a cue to identify their natal beaches (Lenhardt et al. 1983). The range of maximum sensitivity for sea turtles is 100 to 800 Hz, with an upper limit of about 2,000 Hz (Lenhardt 1994). Hearing below 80 Hz is less sensitive but still potentially usable to the animal (Lenhardt 1994). Ridgway et al. (1969) used aerial and mechanical stimulation to measure the cochlea in three specimens of green turtle, and concluded that they have a useful hearing span of perhaps 60 to 1,000 Hz, but hear best from about 200 Hz up to 700 Hz, with their sensitivity falling off considerably below 200 Hz. The maximum sensitivity for one animal was at 300 Hz, and for another was at 400 Hz. At the 400 Hz frequency, the turtle's hearing threshold was about 64 dB in air (approximately 126 dB in water). At 70 Hz, it was about 70 dB in air. Bartol et al. (1999) reported that juvenile loggerhead sea turtles (*Caretta caretta*) hear sounds between 250 and 1,000 Hz.

Lenhardt et al. (1983) applied audio frequency vibrations at 250 Hz and 500 Hz to the heads of loggerheads and Kemp’s ridleys submerged in salt water to observe their behavior, measure the attenuation of the vibrations, and assess any neural-evoked response. These stimuli (250 Hz, 500 Hz) were chosen as representative of the lowest sensitivity area of marine turtle hearing (Wever, 1978). At the maximum upper limit of the vibratory delivery system, the turtles exhibited abrupt movements, slight retraction of the head, and extension of the limbs in the process of swimming. Lenhardt et al. (1983) concluded that bone-conducted hearing appears to be a reception mechanism for at least some of the sea turtle species, with the skull and shell acting as receiving surfaces. Finally, sensitivity even within the optimal hearing range is apparently low as threshold detection levels in water are relatively high at 160 to 200 dB re 1 μPa (Lenhardt 1994).

3.8.1.2 Current Mitigation Measures

The comprehensive suite of protective measures and SOPs implemented by the Navy to reduce impacts to marine mammals also serves to mitigate potential impacts on sea turtles. In particular, personnel and watchstander training, establishment of turtle-free exclusion zones for underwater detonations of explosives, and pre- and post-exercise surveys, all serve to reduce or eliminate potential impacts of Navy activities on sea turtles that may be present in the vicinity. Applicable mitigation measures, as described in detail in Chapter 5, are summarized here

3.8.1.2.1 Personnel Training – Watchstanders and Lookouts

The use of shipboard lookouts is a critical component of all Navy protective measures. Navy shipboard lookouts (also referred to as "watchstanders") are highly qualified and experienced observers of the marine environment. Their duties require that they report all objects sighted in the water to the officer of the deck (OOD) (e.g., trash, a periscope, marine mammals, sea turtles) and all disturbances (e.g., surface disturbance, discoloration) that may be indicative of a threat to the vessel and its crew. There are personnel serving as lookouts on station at all times (day and night) when a ship or surfaced submarine is moving through the water.

3.8.1.2.2 Operating Procedures & Collision Avoidance

- Prior to major exercises, a Letter of Instruction, Mitigation Measures Message or Environmental Annex to the Operational Order will be issued to further disseminate the personnel training requirement and general marine species protective measures.
- COs will make use of marine species detection cues and information to limit interaction with marine species to the maximum extent possible consistent with safety of the ship.
- Where feasible and consistent with mission and safety, vessels will avoid closing to within 200-yds of sea turtles.
- Floating weeds and kelp, algal mats, clusters of seabirds, and jellyfish are good indicators of sea turtles and marine mammals. Therefore, increased vigilance in watching for sea turtles and marine mammals will be taken where these are present.

3.8.1.2.3 Measures for Specific Training Events

Surface-to-Surface Gunnery (5-inch, 76 mm, 20 mm, 25 mm and 30 mm explosive rounds)

- Lookouts will visually survey for floating weeds and kelp, and algal mats which may be inhabited by immature sea turtles in the target area. Intended impact shall not be within 600 yds (585 m) of known or observed floating weeds and kelp, and algal mats.
- For exercises using targets towed by a vessel or aircraft, target-towing vessels/aircraft shall maintain a trained lookout for sea turtles. If a sea turtle is sighted in the vicinity, the tow aircraft/vessel will immediately notify the firing vessel, which will suspend the exercise until the area is clear.
- A 600 yard radius buffer zone will be established around the intended target.
- From the intended firing position, trained lookouts will survey the buffer zone for sea turtles prior to commencement and during the exercise as long as practicable.
- The exercise will be conducted only when the buffer zone is visible and sea turtles are not detected within it.

Surface-to-Surface Gunnery (non-explosive rounds)

- Lookouts will visually survey for floating weeds and kelp, and algal mats which may be inhabited by immature sea turtles in the target area. Intended impact will not be within 200 yds (183 m) of known or observed floating weeds and kelp, and algal mats.
- A 200 yd (183 m) radius buffer zone will be established around the intended target.
- From the intended firing position, trained lookouts will survey the buffer zone for sea turtles prior to commencement and during the exercise as long as practicable.

- If applicable, target towing vessels will maintain a lookout. If a sea turtle is sighted in the vicinity of the exercise, the tow vessel will immediately notify the firing vessel in order to secure gunnery firing until the area is clear.
- The exercise will be conducted only when the buffer zone is visible and sea turtles are not detected within the target area and the buffer zone.

Surface-to-Air Gunnery (explosive and non-explosive rounds)

- Vessels will orient the geometry of gunnery exercises in order to prevent debris from falling in the area of sightedsea turtles, algal mats, and floating kelp.
- Vessels will expedite the recovery of any parachute deploying aerial targets to reduce the potential for entanglement of sea turtles.
- Target towing aircraft shall maintain a lookout. If a sea turtle is sighted in the vicinity of the exercise, the tow aircraft will immediately notify the firing vessel in order to secure gunnery firing until the area is clear.

Air-to-Surface Gunnery (explosive and non-explosive rounds)

- If surface vessels are involved, lookouts will visually survey for floating kelp, which may be inhabited by immature sea turtles, in the target area. Impact should not occur within 200 yds (183 m) of known or observed floating weeds and kelp or algal mats.
- A 200 yd (183 m) radius buffer zone will be established around the intended target.
- If surface vessels are involved, lookout(s) will visually survey the buffer zone for sea turtles prior to and during the exercise.
- Aerial surveillance of the buffer zone for sea turtles will be conducted prior to commencement of the exercise. Aerial surveillance altitude of 500 feet to 1,500 feet (ft) (152 - 456 m) is optimum. Aircraft crew/pilot will maintain visual watch during exercises. Release of ordnance through cloud cover is prohibited: aircraft must be able to actually see ordnance impact areas.
- The exercise will be conducted only if sea turtles are not visible within the buffer zone.

Small Arms Training - (grenades, explosive and non-explosive rounds)

- Lookouts will visually survey for floating weeds or kelp, algal mats, marine mammals, and sea turtles. Weapons will not be fired in the direction of known or observed floating weeds or kelp, algal mats, and sea turtles.

Air-to-Surface At-Sea Bombing Exercises (explosive bombs and cluster munitions, rockets)

- If surface vessels are involved, trained lookouts will survey for floating kelp, which may be inhabited by immature sea turtles. Ordnance shall not be targeted to impact within 1,000 yds (914 m) of known or observed floating kelp, sea turtles, or marine mammals.
- A buffer zone of 1,000 yd (914 m) radius will be established around the intended target.
- Aircraft will visually survey the target and buffer zone for sea turtles prior to and during the exercise. The survey of the impact area will be made by flying at 1,500 feet or lower, if safe to do so, and at the slowest safe speed. Release of ordnance through cloud cover is prohibited: aircraft must be able to actually see ordnance impact areas. Survey aircraft should employ most effective search tactics and capabilities.
- The exercises will be conducted only if sea turtles are not visible within the buffer zone.

Air-to-Surface At-Sea Bombing Exercises (non-explosive bombs and cluster munitions, rockets)

- If surface vessels are involved, trained lookouts will survey for floating kelp, which may be inhabited by immature sea turtles, and for sea turtles and marine mammals. Ordnance shall not be targeted to impact within 1,000 yds (914 m) of known or observed floating kelp, sea turtles, or marine mammals.
- A 1,000 yd (914 m) radius buffer zone will be established around the intended target.
- Aircraft will visually survey the target and buffer zone for sea turtles prior to and during the exercise. The survey of the impact area will be made by flying at 1,500 ft (152 m) or lower, if safe to do so, and at the slowest safe speed. Release of ordnance through cloud cover is prohibited: aircraft must be able to actually see ordnance impact areas. Survey aircraft should employ most effective search tactics and capabilities.
- The exercise will be conducted only if sea turtles are not visible within the buffer zone.

Air-to-Surface Missile Exercises (explosive and non-explosive)

- Ordnance shall not be targeted to impact within 1,800 yds (1646 m) of known or observed floating kelp, which may be inhabited by immature sea turtles, or coral reefs.
- Aircraft will visually survey the target area for sea turtles. Visual inspection of the target area will be made by flying at 1,500 (457 m) feet or lower, if safe to do so, and at slowest safe speed. Firing or range clearance aircraft must be able to actually see ordnance impact areas. Explosive ordnance shall not be targeted to impact within 1,800 yds (1646 m) of sighted marine mammals and sea turtles.

Underwater Detonations (up to 20-lb charges)

To ensure protection of sea turtles during underwater detonation training, the operating area must be determined to be clear of sea turtles prior to detonation.

Exclusion Zones

All Mine Warfare and Mine Countermeasures Operations involving the use of explosive charges must include exclusion zones for sea turtles to prevent physical and/or acoustic effects to those species. These exclusion zones shall extend in a 700-yard arc radius around the detonation site.

Pre-Exercise Surveys

For Demolition and Ship Mine Countermeasures Operations, pre-exercise survey shall be conducted within 30 minutes prior to the commencement of the scheduled explosive event. The survey may be conducted from the surface, by divers, and/or from the air, and personnel shall be alert to the presence of any sea turtle. Should such an animal be present within the survey area, the exercise shall be paused until the animal voluntarily leaves the area. The Navy will suspend detonation exercises and ensure the area is clear for a full 30 minutes prior to detonation. Personnel will record any sea turtle observations during the exercise as well as measures taken if species are detected within the exclusion zone.

Post-Exercise Surveys

Surveys within the same radius shall also be conducted within 30 minutes after the completion of the explosive event.

Mining Operations

Mining Operations involve aerial drops of inert training shapes on target points. Aircrews are scored for their ability to accurately hit the target points. Although this operation does not involve live ordnance, marine mammals have the potential to be injured if they are in the immediate vicinity of a target points; therefore, the safety zone shall be clear of sea turtles around the target location. To the maximum extent feasible, the Navy shall retrieve inert mine shapes dropped during Mining Operations.

Sink Exercise (SINKEX)

The selection of sites suitable for SINKEX involves a balance of operational suitability, requirements established under the Marine Protection, Research and Sanctuaries Act (MPRSA) permit granted to the Navy (40 Code of Federal Regulations § 229.2), and the identification of areas with a low likelihood of encountering Endangered Species Act (ESA) listed species, including sea turtles. The MPRSA permit requires vessels to be sunk in waters which are at least 1,000 fathoms (3,000 yds / 2742 m)) deep and at least 50 nm from land.

The Navy has developed range clearance procedures to maximize the probability of sighting any sea turtles or other protected species in the vicinity of an exercise (see Chapter 5).

3.8.2 Environmental Consequences

3.8.2.1 Approach to Analysis

3.8.2.1.1 Sonar

Mid-Frequency Active Sonar

Estimating the impacts on sea turtles from mid-frequency active sonar (MFAS) events is primarily based on the hearing sensitivities of each species. While there is no established criteria for harm or harrassment under the ESA, the potential for physiological effects from MFAS such as temporary or permananet threshold shifts exists, and can be used as a criteria for evaluating MFAS effects. Similarly, behavioral responses to acoustic sources can be used to evaluate species responsiveness to acoustic sources. Extrapolation from human and marine mammal data to turtles is inappropriate given the morphological differences between the auditory systems of mammals and turtles. However, the measured hearing threshold for green turtles (Ridgway et al. 1969; and by extrapolation, at least the olive ridley and loggerhead) is only slightly lower than the maximum MFAS levels to which these three species could be exposed and this hearing sensitivity data can be utilized to analyze potential effects. Sea turtles hear in the range of 30 to 2000 Hz with best sensitivity between 200 to 800 Hz (Ridgway et al. 1969; Lenhardt 1994). As such, noise sources within the frequency range of MFAS activities will be compared with the hearing sensitivity of sea turtles to evaluate potential effects.

High-Frequency Active Sonar

Estimation of the effects of high-frequency active sonar on sea turtles is conducted in the same manner as the evaluation of MFAS sources. As previously mentioned, sea turtles hear in the range of 30 to 2000 Hz with best sensitivity between 200 to 800 Hz (Ridgway et al. 1969; Lenhardt 1994), which is well below the range of high frequency (>10 kHz) sound sources that may be used in the SOCAL Range Complex. It is not believed that a temporary or permanent threshold shift would occur from an acoustic source with such a frequency disparity from the acoustic sensitivity range in any species. Given the lack of audiometric information in leatherback turtles, the potential for temporary threshold shifts must be classified as unknown but would likely follow those of other sea turtles. Therefore, no threshold shifts in green, olive ridley, loggerhead turtles, or leatherback turtles are expected; therefore, a detailed analysis of high-frequency active sonar sources is not carried forward in this analysis.

3.8.2.1.2 Underwater Detonation

Criteria and thresholds for estimating the impacts on sea turtles from a single underwater detonation event were determined from information on cetaceans used for the environmental assessments for the two Navy ship-shock trials: the *Seawolf* Final EIS (DoN 1998) and the *Churchill* Final EIS (DoN 2001a). During the analysis of the effects of explosions on marine mammals and sea turtles conducted by the Navy for the *Churchill* EIS, analysts compared the injury levels reported by the best of these experiments to the injury levels that would be predicted using the modified Goertner method and found them to be similar (DoN 2001a; Goertner 1982). The criteria and thresholds for injury and harassment are summarized in Table 3.8-1.

Table 3.8-1: Summary of Criteria and Acoustic Thresholds for Underwater Detonation Impacts to Marine Mammals but Also Used for Sea Turtles Because No Other Criteria Exists

	Criterion	Threshold
Level A Harassment Mortality	Onset of Severe Lung Injury	Goertner Modified Positive Impulse Indexed to 31 psi-ms
Injury	Tympanic membrane rupture Onset of slight lung injury	50% rate of rupture; 205 dB re 1 µPa^2-s (Energy Flux Density) Goertner Modified Positive Impulse Indexed to 13 psi-ms
Level B Harassment Non-Injury	Temporary Threshold Shift (TTS)	182 dB re 1 µPa^2-s maximum Energy Flux Density level in any 1/3-octave band at frequencies above 100 Hz for sea turtles.
Dual Criteria	Onset Temporary Threshold Shift	23 psi peak pressure level (for small explosives)
psi-ms = pounds per square inch-milliseconds, µPa^2-s = squared micropascal-second		

The criterion for non-injurious harassment is temporary threshold shift (TTS), which is a temporary, recoverable, loss of hearing sensitivity (NMFS 2001; DoN 2001a). The criterion for TTS is 182 dB re 1 squared micropascal-second (µPa^2-s) maximum Energy Flux Density Level (EL) level in any 1/3-octave band at frequencies >100 Hz for sea turtles. There is a second criterion for estimating TTS threshold: 12 pounds per square inch (psi) peak pressure. Navy policy is to use the 23 psi criterion for explosive charges less than 2,000 lb and the 12 psi criterion for explosive charges larger than 2,000 lb. It was introduced to provide a safety zone for TTS when the explosive or the animal approaches the sea surface (for which case the explosive energy is reduced but the peak pressure is not).

Two criteria are used for injury: onset of slight lung hemorrhage and 50 percent eardrum rupture (tympanic membrane [TM] rupture). These criteria are considered indicative of the onset of injury. The threshold for onset of slight lung injury is calculated for a small animal (a dolphin calf weighing 27 lb), and is given in terms of the "Goertner modified positive impulse," indexed to 13 psi-millisecond (ms) (DoN 2001a). In the absence of analagous data in chelonids, the criteria developed for marine mammals is also applied to sea turtles. This threshold is conservative since the positive impulse needed to cause injury is proportional to animal mass, and therefore, larger animals require a higher impulse to cause the onset of injury. The threshold for TM rupture corresponds to a 50 percent rate of rupture (i.e., 50 percent of animals exposed to the level are expected to suffer TM rupture); this is stated in terms of an EL value of 205 dB re 1 µPa^2-s. The criterion reflects the fact that TM rupture is not necessarily a serious or life-threatening injury, but is a useful index of possible injury that is well correlated with measures of permanent hearing impairment (e.g., Ketten 1998) indicates a 30 percent incidence of permanent threshold shift [PTS] at the same threshold).

The criterion for mortality for marine mammals used in the *Churchill* Final EIS is "onset of severe lung injury." This is conservative in that it corresponds to a 1 percent chance of mortal injury, and yet any animal experiencing onset severe lung injury is counted as a lethal exposure. The threshold is stated in terms of the Goertner (1982) modified positive impulse with value "indexed to 31 psi-ms." Since the Goertner approach depends on propagation, source/animal depths, and animal mass in a complex way, the actual impulse value corresponding to the 31-psi-ms index is a complicated calculation. Again, to be conservative, the *Churchill* analysis used the mass of a calf dolphin (at 26.9 lb), so that the threshold index is 30.5 psi-ms.

There is a lead time for set up and clearance of the impact area before any event using explosives takes place (may be 30 minutes to several hours). There will, therefore, be a long period of area monitoring before any detonation or live-fire event begins. Ordnance cannot be released until the target area is determined clear. Operations are immediately halted if marine mammals or sea turtles are observed within the target area. Operations are delayed until the animal clears the target area. All of these factors, along with the low density of sea turtles in the SOCAL Range Complex, serve to avoid the risk of harming sea turtles.

3.8.2.2 No Action Alternative

3.8.2.2.1 Mid-Frequency Active Sonar

Four species of sea turtles could potentially occur in the action area, all of which are protected under the ESA: leatherback, loggerhead, green turtle, and olive ridley turtles. There are no density estimates for sea turtles in the action area, and there are no established criteria for harm or harassment from sonar sources.

Studies indicate that the auditory capabilities of sea turtles are centered in the low-frequency range (<1000 hertz [Hz]). Ridgway et al. (1969) found that green turtles exhibit maximum hearing sensitivity between 200 and 700 Hz, and speculated that the turtles had a useful hearing span of 60–1000 Hz. (However, there was some response to strong vibrational signals at frequencies down to the lowest one tested—30 Hz.). Bartol et al. (1999) tested the response of juvenile loggerhead turtles to brief, low-frequency broadband clicks, and brief tone bursts at four frequencies from 250 to 1000 Hz. They demonstrated that loggerheads hear well between 250 and 1000 Hz; within that frequency range, the turtles were most sensitive at 250 Hz. A recent study on the effects of airguns on sea turtle behavior also suggests that sea turtles are most likely to respond to low-frequency sounds (McCauley et al. 2000). Green and loggerhead sea turtles will avoid air-gun arrays at 2 km and at 1 km, with received levels of 166 dB re 1 μPa and 175 dB re 1 μPa, respectively (McCauley et al. 2000). The sea turtles' response was consistent: above a level of about 166 dB re 1 μPa, the turtles noticeably increased their swimming activity. Above 175 dB re 1 μPa, their behavior became more erratic, possibly indicating that the turtles were agitated (McCauley et al. 2000).

The mid-frequency active sonar that has the lowest operating frequency operates at a center frequency of 3.5 kHz. Sea turtles hear in the range of 30 to 2000 Hz with best sensitivity between 200 to 800 Hz (Ridgway et al. 1969; Lenhardt 1994), which is well below the center operating frequency of the sonar. Hearing sensitivity even within this optimal hearing range is apparently low as threshold detection levels in water are relatively high at 160 to 200 dB re 1 μPa-m (Lenhardt 1994), which is only slightly lower than the operating levels of the sonar. It is not believed that a temporary threshold shift would occur at such a small margin over threshold in any species. Therefore, no threshold shifts in green, olive ridley, or loggerhead turtles are expected. Given the lack of audiometric information, the potential for temporary threshold shifts among leatherback turtles must be classified as unknown but would likely follow those of other sea turtles.

Even if sea turtles were able to sense the sonar output, it is unlikely that any physiological stress leading to endocrine and corticosteroid imbalances over the long term (allostatic loading) would result (McEwen and Lashley 2002). An example of plasma hormone responses to stress was described by Jessop et al. (2002) for breeding adult male green turtles. Using capture/restraint as a stressor, they found a smaller corticosterone response and significant decreases in plasma androgen for breeding migrant males as compared to nonbreeding males. These responses were highly correlated with the relatively poorer body condition and body length of the migrant breeders as compared to the nonmigrant and premigrant males. While this study illustrates the complex relationship between stress/physiological state and plasma hormone responses, these kinds of effects are unlikely for sea turtles from mid-frequency active sonar within the SOCAL Range Complex.

Any potential role of long-range acoustical perception in sea turtles has not been studied and is unclear at this time. The concept of sound masking is difficult, if not impossible, to apply to sea turtles. Although low-frequency hearing has not been studied in many sea turtle species, most of those that have been tested, exhibit low audiometric and behavioral sensitivity to low-frequency sound. It appears that if there were the potential for the mid frequency sonar to increase masking effects for any sea turtle species, it would be expected to be minimal. In addition, there will be no significant harm to sea turtles from active sonar activities.

Although there may be many hours of active ASW sonar events, the actual “pings” of the sonar signal may only occur several times a minute, as it is necessary for the ASW operators to listen for the return echo of the sonar ping before another ping is transmitted. Thus, acoustic sources used during ASW exercises in the action area are unlikely to affect sea turtles, most notably when directly compared to the hearing abilities of these species.

3.8.2.2.2 Underwater Detonations

There are no sea turtle nesting sites on the islands in the SOCAL Range Complex. There are no density estimates for sea turtles in the action area although it is known that densities are low. There are no established criteria for harm or harassment. Leatherback and olive ridley turtles likely would not occur in or near Northwest Harbor or Horse Beach Cove, because they are pelagic species.

Very little is known about the effects of underwater detonations on sea turtles. Analysis of data on the propogation effects of underwater detonations in very shallow water (VSW) indicates that such detonations would have not adversely affect the annual recruitment or survival of any sea turtle species and stocks. NSW in-water demolitions training and Extended Echo Ranging (EER)/Improved Extended Echo Ranging (IEER) sonobuoy detonations are unlikely to encounter sea turtles, due to the relatively small number of such exercises, and the mitigation measures described in Section 3.8.1.2.

3.8.2.2.3 Ship Collisions

Collisions between vessels and sea turtles are possible, but are unlikely. The Navy's standard operating procedures include a number of measures that will prevent a collision between a naval vessel and a sea turtle (see Section 3.8.1.2). Thus, the combination of the low initial probability of collision with sea turtle and the active attempts to avoid such an event reduces the likelihood of a ship colliding with a sea turtle to an extremely low level. Collisions with vessels are not likely to not affect sea turtle species.

3.8.2.2.4 Encounters with Military Debris

The Navy endeavors to recover expended training materials. Notwithstanding, it is not possible to recover all training debris, and some may be encountered by sea turtles in the waters of the SOCAL Range Complex. Debris related to military activities that is not recovered generally sinks; the amount that might remain on or near the sea surface is low, and the density of such debris in the SOCAL Range Complex would be very low. Types of training debris that might be encountered include: parachutes of various types (e.g., those employed by personnel or on targets, flares, or sonobuoys); torpedo guidance wires, torpedo "flex hoses;" cable assemblies used to facilitate target recovery; sonobuoys; and Expendable Mobile Acoustic Training Targets (EMATT)

Range debris is highly unlikely to affect sea turtles in the SOCALRange Complex (see DoN 1996). The following discussion addresses categories of debris.

Torpedo Guidance Wires. Torpedoes are equipped with a single-strand guidance wire, which is laid behind the torpedo as it moves through the water. At the end of a training torpedo run, the wire is released from the firing vessel and the torpedo to enable torpedo recovery. The wire sinks rapidly and settles on the ocean floor. Guidance wires are expended with each exercise torpedo launched. DoN (1996) analyzed the potential entanglement effects of torpedo control wires on sea turtles. The Navy analysis concluded that the potential for entanglement effects will be low for the following reasons:

- The guidance wire is a very fine, thin-gauge copper-cadmium core with a polyolefin coating. The tensile breaking strength of the wire is a maximum of 19 kg (42 lb) and can be broken by hand. With the exception of a chance encounter with the guidance wire while it was sinking to the sea floor (at an estimate rate of 0.2 m [0.5 ft] per second), a marine animal would be vulnerable to entanglement only if its diving and feeding patterns place it in contact with the bottom.

- The torpedo control wire is held stationary in the water column by drag forces as it is pulled from the torpedo in a relatively straight line until its length becomes sufficient for it to form a chain-like droop. When the wire is cut or broken, it is relatively straight and the physical characteristics of the wire prevent it from tangling, unlike the monofilament fishing lines and polypropylene ropes identified in the entanglement literatures.

While it is possible that a sea turtle would encounter a torpedo guidance wire as it sinks to the ocean floor, the likelihood of such an event is considered remote, as is the likelihood of entanglement after the wire has descended to and rests upon the ocean floor.

Parachutes. Aircraft-launched sonobuoys, flares, torpedoes, and EMATTs deploy nylon parachutes of varying sizes. At water impact, the parachute assembly is expended and sinks, as all of the material is negatively buoyant . Some components are metallic and will sink rapidly. Entanglement and the eventual drowning of a sea turtle in a parachute assembly would be unlikely, since such an event would require the parachute to land directly on an animal, or the animal would have to swim into it before it sinks. The expended material will accumulate on the ocean floor and will be covered by sediments over time, remaining on the ocean floor and reducing the potential for entanglement. If bottom currents are present, the canopy may billow (bulge) and pose an entanglement threat to sea turtles with bottom-feeding habits; however, the probability of a sea turtle encountering a submerged parachute assembly and the potential for accidental entanglement in the canopy or suspension lines is considered to be unlikely.

Torpedo Flex Hoses. Improved flex hoses or strong flex hoses will be expended during torpedo exercises. DoN (1996) analyzed the potential for the flex hoses to affect sea turtles. This analysis concluded that the potential entanglement effects to sea turtles will be insignificant for reasons similar to those stated for the potential entanglement effects of control wires:

- Due to weight, flex hoses will rapidly sing to the bottom upon release. With the exception of a chance encounter with the flex hose while it was sinking to the sea floor, a sea turtle would be vulnerable to entanglement only if its diving and feeding patterns placed it in contact with the bottom.
- Due to its stiffness, the 250-ft-long flex hose will not form loops that could entangle sea turtle.

EMATT. EMATTs are approximately 5 by 36 inches (in) (12 by 91 centimeters [cm]) and weigh approximately 21 pounds (lbs). EMATTs are much smaller than sonobuoys and ADCs. EMATTs, their batteries, parachutes, and other components will scuttle and sink to the ocean floor and will be covered by sediments over time. In addition, the small amount of expended material will be spread over a relatively large area. Due to the small size and low density of the materials, these components are not expected to float at the water surface or remain suspended within the water column. Over time, the amount of materials will accumulate on the ocean floor, but due to ocean currents, the materials will not likely settle in the same vicinity. There will be no significant impact to sea turtles from expended EMATTs or their components.

Falling Debris. There is an extremely low probability of injury to a sea turtle from falling debris such as munitions constituents, inert ordnance, or targets. The potential for impacts to sea turtles from sound or other energy released due to contact of debris with the water is considered remote.

3.8.2.2.5 Other Effects

Indirect effects on listed species could occur because of effects of the Proposed Action on their prey species. Leatherback turtle feed on jellyfish and other soft-bodied invertebrates, loggerhead turtles feed on benthic invertebrates (e.g., crabs, shrimp, and sea urchins), and green turtles feed on plant material.

3.8.2.3 Alternative 1

3.8.2.3.1 Mid-Frequency Active Sonar

The increased operations under Alternative 1 will result in an increase in the number of hours of training using mid-frequency active sonar sources. It is unlikely that sea turtles can detect sounds in the frequency range of this sonar and therefore increased mid-frequency active sonar training with sonar is unlikely to affect sea turtles.

3.8.2.3.2 Underwater Detonations

The increased operations under Alternative 1 would result in an increase in the number of underwater detonations during SINKEX, A-S MISSILEX, S-S MISSILEX, BOMBEX, and S-S GUNEX. Although the number of underwater detonations would increase, due to the clearance requirements for underwater detonations and live-fire events, sea turtles would not be within the area and therefore impacts are not anticipated.

3.8.2.3.3 Non-Acoustic Impacts

Non-acoustic impacts on sea turtles Alternative 1 would be substantially the same as impacts identified under the No Action Alternative. Under Alternative 1, increased operations would not increase the risk of collisions between Navy ships and sea turtles, given the extensive mitigation measures in effect to avoid such an event. Based on these standard operating procedures, collisions with sea turtles are not expected under Alternative 1. With regard to potential encounters between sea turtles and unrecovered military debris expended on the SOCAL Range Complex: debris related to military activities that is not recovered generally sinks; the amount that might remain on or near the sea surface is low, and the density of such debris in the SOCAL Range Complex would be very low under Alternative 1 as under the No Action Alternative. Impacts to sea turtles from expended debris are unlikely.

3.8.2.4 Alternative 2

3.8.2.4.1 Mid-Frequency Active Sonar

The increased operations under Alternative 2 will result in an increase in the number of hours of ASW training. It is unlikely that sea turtles can detect mid-frequency active sonar, therefore increased ASW training with sonar is unlikely to affect sea turtles.

3.8.2.4.2 Underwater Detonations

The increased operations under Alternative 2 would result in an increase in the number of underwater detonations during SINKEX, A-S MISSILEX, S-S MISSILEX, BOMBEX, and S-S GUNEX. Although the number of underwater detonations would increase, due to the clearance requirements for underwater detonations and live-fire events, sea turtles would not be within the area and therefore impacts are not anticipated.

The increased operations under Alternative 2 would result in an increase in IEER sonobuoy detonations but the numbers would be very small because of their distribution, the relatively small number of exercises, and the mitigation measures described in Section 3.8.1.2 Annual rates of adult survival likely would not be reduced, and recruitment would not be affected. IEER sonobuoy detonations will not have considerable effects on sea turtle species.

3.8.2.4.3 Non-Acoustic Impacts

Non-acoustic impacts on sea turtles Alternative 2 would be substantially the same as impacts identified under the No Action Alternative. Under Alternative 2, increased operations would not increase the risk of collisions between Navy ships and sea turtles, given the extensive mitigation measures in effect to avoid such an event. Based on these standard operating procedures, collisions with sea turtles are not expected under Alternative 2. With regard to potential encounters between sea turtles and unrecovered military debris expended on the SOCAL Range Complex: debris related to military activities that is not recovered generally sinks; the amount that might remain on or near the sea surface is low, and the density of such debris in the SOCAL Range Complex would be very low under Alternative 2 as under the No Action Alternative. Impacts to sea turtles from expended debris are unlikely.

3.8.2.4.4 Shallow Water Training Range (SWTR) Installation

Once underway during hydrophone array installation for the SWTR, the larger project vessels would move very slowly during cable installment activities (0 to 2 knots [0 to 3.7 km per hour]), and would not pose a collision threat to sea turtles that may be present in the vicinity. Entanglement of marine species is not likely because the rigidity of the cable that is designed to lay extended on the sea floor vice coil easily. Anchor and cable lines would be taut, posing no risk of entanglement or interaction with sea turtles that may be swimming in the area. Once installed on the seabed, the new cable and communications instruments would be equivalent to other hard structures on the seabed, again posing no risk of adverse effect on sea turtles. There are no documented incidents of sea turtle entanglement in a submarine cable during the past 50 years (Norman and Lopez 2002). The project vessels would abide by all appropriate Naval regulations regarding marine species sighting and reporting.

3.8.2.5 Threatened and Endangered Species

As listed in Section 3.8, there are four species of sea turtles that occur off the coast of California (loggerhead [*Caretta caretta*], eastern Pacific green [*Chelonia agassizi*], olive ridley [*Lepidochelys olivacea*], and leatherback [*Dermochelys coriacea*]), all are currently listed as either endangered or threatened under the Endangered Species Act (ESA). None of the four species is known to nest on southern California beaches. Regular nesting by leatherbacks and olive ridley turtles occurs along the Pacific coast of Baja California Sur, which is the northernmost known nesting site in the eastern north Pacific (Fritts et al. 1982; Sarti-M. et al. 1996; López-Castro et al. 2000). Due to the primarily oceanic distributions of the leatherback, loggerhead, and olive ridley turtles off Southern California, the southwestern portion of the SOCAL Range Complex is designated as an area of primary occurrence for all sea turtle species (DoN 2005); however, their presence within the SOCAL OPAREAs is considered rare. There is also an area of primary occurrence in southern San Diego Bay, adjacent to the SOCAL Range Complex, due to the year-round prevalence of green turtles in those waters near the warm water outflow of a power plant.

The spatial and temporal variability of both the occurrence of these four species of sea turtles and the operations within the SOCAL Range Complex combines to produce low probability that a direct or indirect effect would occur in relation to these species. It is nevertheless possible, if unlikely, that Navy activities in the SOCAL Range Complex may effect listed loggerhead, green, olive ridley, or leatherback sea turtles.

3.8.3 Mitigation Measures

3.8.3.1 Demolition and Ship MCM Operations (up to 20 lbs) and Outside of Very Shallow Depth

3.8.3.1.1 *Exclusion Zones*

All mine warfare and mine countermeasure operations involving the use of explosive charges must include exclusion zones for marine mammals and sea turtles to prevent physical and/or acoustic effects to those species. These exclusion zones shall extend in a 700-yard arc radius around the detonation site.

3.8.3.1.2 *Pre-Exercise Surveys*

For demolition and SMCM Operations, pre-exercise survey shall be conducted within 30 minutes prior to the commencement of the scheduled explosive event. The survey may be conducted from the surface, by divers, and/or from the air, and personnel shall be alert to the presence of any sea turtle. Should such an animal be present within the survey area, the exercise shall be paused until the animal voluntarily leaves the area.

3.8.3.1.3 *Post-Exercise Surveys*

Surveys within the same radius shall also be conducted within 30 minutes after the completion of the explosive event.

3.8.3.1.4 *Reporting*

Any evidence of a sea turtle that may have been injured or killed by the action shall be reported immediately to Commander, Pacific Fleet and Commander, Navy Region Southwest, Environmental Director.

3.8.3.2 Mining Operations

Mining Operations involve aerial drops of inert training shapes on floating targets. Aircrews are scored for their ability to accurately hit the target. This operation does not involve live ordnance. ,The probability is remote that a marine species would be in the exact spot in the ocean where an inert object is dropped. However, as a conservative measure, initial target points are briefly surveyed from the aircraft prior to inert ordnance drops, to ensure the intended drop area is clear of marine mammals and sea turtles. To the maximum extent feasible, the Navy shall retrieve inert mine shapes dropped during Mining Operations.

3.8.4 Unavoidable Adverse Environmental Effects

Due to the rarity of sea turtles in the SOCAL Range Complex and the mitigation measures in place, unavoidable environmental effects to sea turtles are not expected.

3.8.5 Summary of Effects by Alternative

Table 3.8-2 summarizes the water quality effects of the No Action Alternative, Alternative 1, and Alternative 2. For purposes of analyzing such effects under both NEPA and EO 12114, the Table allocates effects on a jurisdictional basis (i.e., under NEPA for actions or effects within U.S. Territory, and under EO 12114 for actions or effects outside U.S. Territory).

Table 3.8-2. Summary of Effects by Alternative

Alternative	NEPA (On-Land and U.S. Territorial Waters)	EO 12114 (Non-U.S. Territorial Waters)
No Action Alternative	• Active sonar will have limited effect on sea turtles due to hearing capabilities. • Underwater detonations associated with the SOCAL OPAREAs activities could affect sea turtles but it is unlikely due to their rarity in the SOCAL OPAREAs and implementation of mitigation measures. • Ship collisions are unlikely due to the rarity of sea turtles in the SOCAL OPAREAs and implementation of mitigation measures. • Other sources of impacts such as entanglement or falling debris, are unlikely to affect sea turtles because of the sparse distribution of sea turtles.	• Effects are expected to be the same as U.S. Territorial Waters.
Alternative 1	• Effects generally are the same as described for the No Action Alternative.	• Effects generally are the same as described for the No Action Alternative.
Alternative 2 (Preferred Alternative)	• Effects generally are the same as described for the No Action Alternative. • SWTR cable placement and Shallow Water Minefield mooring highly unlikely to affect Sea Turtles due to the slow speed of cable laying ships and the rigidity of the cable.	• Effects generally are the same as described for the No Action Alternative.
Mitigation	• Mitigation measures are in place for active sonar, general maritime procedures and underwater detonation.	• Mitigation measures are in place for active sonar, general maritime procedures and underwater detonation.

3.9 Marine Mammals

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3.9 MARINE MAMMALS

3.9.1 Introduction

The assessment of environmental affects of Navy activities in the Southern California (SOCAL) Range Complex on marine mammals is a complicated undertaking involving analysis of extensive data, including data obtained through use of highly technical modeling. This Section contains a summary of the affected environment and environmental impacts analysis. For additional detailed discussion, the reader is referred to Appendix F. Appendix F is organized as follows:

F.1. Overview and Technical Approach

F.2. Southern California Marine Mammals

F.3. Assessing Environmental Consequences

F.4. Modeling Acoustic and Explosive Effects

F.5. Current Mitigation Measures

F.7. Additional References

To aid the reader, Appendix F contains a separate Table of Contents.

Marine mammals inhabit varied marine environments ranging from deep ocean canyons to shallow esturarine waters. Their distribution is strongly affected by demographic, evolutionary, ecological, habitat preference, and anthropogenic factors (Bowen et al. 2002; Bjørge 2002; Forcada 2002; Stevick et al. 2002). The movements of marine mammals are often related to feeding or breeding activity (Stevick et al. 2002). A migration is a periodic movement of all, or significant components, of an animal population from one habitat to one or more other habitats and back again. Migration is an adaptation that allows an animal to congregate in areas where favorable environmental conditions exist for feeding, breeding, and/or other phases of the animal's life history (i.e., molting in pinnipeds). Some baleen whale species, such as humpback whales, make extensive annual migrations to low-latitude mating and calving grounds in the winter and to high-latitude feeding grounds in the summer (Corkeron and Connor 1999). Cetacean movements can also reflect the distribution and abundance of prey (Gaskin 1982; Payne et al. 1986; Kenney et al. 1996). Cetacean movements have also been linked to indirect indicators of prey, such as temperature variations, sea-surface chlorophyll-*a* concentration, and features such as bottom depth (Fiedler 2002). Oceanographic conditions such as upwelling zones, eddies, and turbulent mixing can create regionalized zones of enhanced productivity that are translated into zooplankton concentrations, and/or entrain prey.

Marine mammals addressed in this Draft Environmental Impact Statement (EIS)/Overseas Environmental Impact Statement (OEIS) (hereafter referred to as "EIS/OEIS") include members of two orders:

Order Cetacea, which includes whales, dolphins, and porpoises; and

Order Carnivora, which includes true seals (family *Phocidae*), sea lions and fur seals (family *Otariidae*), and sea otters (family *Mustelidae*)

Cetaceans spend their lives entirely at sea. Pinnipeds hunt and feed exclusively in the ocean, with certain species in the SOCAL Range Complex coming ashore to rest, molt, breed, and bear young. Sea otters, unlike other mustelids such as weasels, skunks, and wolverines, rarely come ashore and spend most of their life in the ocean where they regularly swim, feed, and rest.

Of the approximately 41 marine mammal species or stocks (based on the National Marine Fisheries Service [NMFS] Stock Assessment Reports; Carretta et al. 2007) that could be found within the SOCAL Range Complex, there are approximately 11 year-round species, 22 visiting species, six migratory species, and six infrequent and rare species (Dailey et al. 1993; Forney and Barlow 1998; U.S. Department of the Navy [DoN] 2002; 2005c; Carretta et al. 2007). Extensive natural history information for marine mammal species within Southern California has been summarized in previous works (Leatherwood et al. 1982; 1988; DoN 2002; Reeves et al. 2002; DoN 2005c; Carretta et al. 2007). For many species, the offshore waters of Southern California only constitute a small portion of their total range, although in some cases abundance may be seasonally high at certain times of the year. Other species, such as the gray whale (*Eschrichtius robustus*) only transit through during annual migrations between northern feeding grounds and breeding lagoons in Mexico.

In addition to those species listed under the Endangered Species Act (ESA), all marine mammals are protected under the Marine Mammal Protection Act (MMPA) of 1972, amended in 1994. The MMPA is administered by National Marine Fisheries Service (NMFS). The status of populations of cetaceans and pinnipeds that occur in the SOCAL Range Complex is briefly presented below and described in more detail in Appendix F.

The MMPA prohibits any person subject to the Act from taking a marine mammal within U.S. waters or on the high seas, without authorization from NMFS. The Navy determined that its activities occurring in U.S. waters and on the high seas may result in incidental takings of marine mammals by harassment. For that reason, the Navy is applying for authorization from NMFS for such takings.

3.9.2 Threatened and Endangered Marine Mammal Species

There are ten marine mammal species listed as endangered under the Endangered Species Act (ESA) with confirmed or possible occurrence in the SOCAL Range Complex. Three of these, North Pacific right whale (*Eubalaena japonica*), Steller sea lion (*Eumetopias jubatus*), and killer whale *(Orcinus orca)* Southern Resident Stock are considered to be extralimital and are not expected to be in the SOCAL Range Complex (DoN 2005). Navy activities in the SOCAL Range Complex will have no affect on these listed species.

The blue whale (*Balaenoptera musculus*), fin whale (*Balaenoptera physalus*), humpback whale (*Megaptera novaeangliae*), sei whale (*Balaenoptera borealis*), and sperm whale (*Physeter macrocephalus*), are expected to regularly occur in the SOCAL Range Complex, and Navy activities may affect these listed species (see Section 3.9.9). The Guadalupe fur seal (*Arctocephalus townsendi*) is a rare, occasional visitor in the SOCAL Range Complex, where Navy activities may affect this listed species (see Section 3.9.9). The range of the southern sea otter (*Enhydra lutris nereis*) currently extends to just north of Point conception. There is a translocated population at San Nicolas Island. Some sea otters originating from this translocated population have moved south of Point Conception. These and the translocated population are considered an “experimental population” for purposes of application of the ESA (USFWS 2007).

Stocks of all species listed as endangered under the ESA are automatically considered to be ‘depleted’ and ‘strategic’ under the MMPA. The specific definition of a strategic stock is complex, but in general it is a stock for which human activities may be having a deleterious effect on the population and it may not be sustainable. The stocks of blue, fin, sei, and humpback whales occurring off California are considered strategic (Barlow et al. 1997). In addition, the California/Oregon/Washington Stock of the short-finned pilot whale (*Globicephala macrorhynchus*) and sperm whale have been designated as strategic (Carreta et al. 2004; 2006).

Threatened or Endangered marine mammal species with known or possible occurrence in the SOCAL Range Complex are described in the following sections. More detailed information for each species is provided in Appendix F.

3.9.2.1 Listed Marine Mammal Species Likely to Occur In the SOCAL Range Complex

3.9.2.1.1 Blue whale (*Balaenoptera musculus*) Eastern North Pacific Stock

Listing Status—Blue whales are listed as endangered under the ESA, therefore the Eastern North Pacific Stock (formally the California/Oregon/Washington stock) is, considered a depleted and strategic stock under the MMPA.

Population Status—Population estimate for this stock of blue whales is 1,744 (CV =0.28) individuals (Carretta et al. 2007). The abundance of blue whales along the California coast has been increasing during the past two decades (Calambokidis et al. 1990; Barlow 1994; Calambokidis 1995).

Distribution—Blue whales that use the coastal waters of California are present there primarily from June to November, with a peak in blue whale calling intensity observed in September (Burtenshaw et al. 2004). Feeding grounds have been identified in coastal upwelling zones off the coast of California (Croll et al. 1998; Fiedler et al. 1998; Burtenshaw et al. 2004) and Baja California (Reilly and Thayer 1990).

Reproduction/Breeding—The eastern North Pacific stock feeds in waters from California to Alaska in summer and fall, migrates south to the waters of Mexico to Costa Rica in winter (NMFS 2006e) for breeding and to give birth (Mate et al.1999).

Acoustics—The frequency range of their vocalizations is 12 to 400 hertz (Hz), with dominant energy in the infrasonic range at 12 to 25 Hz (Ketten 1998; Mellinger and Clark 2003).

There is no information on the hearing abilities of blue whales.

3.9.2.1.2 Fin whale (*Balaenoptera physalus*) California/Oregon/Washington Stock

Listing—Fin whales are listed as endangered under the ESA, therefore the California/Oregon/Washington Stock is considered depleted and strategic under the MMPA. Critical habitat has not been designated for fin whales.

Population Status—There are considered to be three stocks in the North Pacific for management purposes: an Alaska Stock, a Hawaii Stock, and a California/Oregon/Washington Stock (Barlow et al. 1997). Currently, the best estimate for the California/Oregon/Washington Stock is 2,099 (CV = 0.18) individuals (Barlow and Forney 2007).

Distribution—In the northern hemisphere, most fin whales migrate seasonally from high Arctic feeding areas in summer to low latitude breeding and calving areas in winter. The North Pacific population summers from the Chukchi Sea to California, and winters from California southward (Gambell 1985). Aggregations of fin whales are found year-round off southern and central California (Dohl et al. 1983; Forney et al. 1995; Barlow 1997).

Reproduction/Breeding—Reproductive activities for fin whales occur primarily in low latitude areas in the winter (Reeves 1998; Carretta et al. 2007).

Acoustics—Fin whales produce calls with the lowest frequency and highest source levels of all cetaceans. Infrasonic (10-200 Hz), pattern sounds have been documented for fin whales (Watkins et al. 1987; Clark and Fristrup 1997; McDonald and Fox 1999; Charif et al. 2002). Charif et al. (2002) estimated source levels between 159-184 dB *re*:1 µPa-1 m for fin whales vocalizations recorded between Oregon and Northern California. Širović et al. (2007) reported that fin whales produced vocalizations with a source level of 189 ± 4 dB *re*:1 µPa-1 m over a range of 15–28 Hz and could be detected up to 56 km away.

There is no information on the hearing abilities of fin whales.

3.9.2.1.3 Humpback whale (*Megaptera novaeangliae*) Eastern North Pacific Stock

Listing Status—Humpback whales are listed as endangered under the ESA and therefore are classified as depleted and strategic stock under the MMPA. Critical habitat has not been designated for this species in waters off California, Oregon, and Washington.

Population Status- Three Pacific stocks of humpback whales are recognized in the Pacific Ocean and include the western North Pacific stock, central North Pacific stock, and eastern North Pacific stock Calambokidis et al. 1997; Baker et al. 1998). The Eastern North Pacific humpback whale stock is the one most likely to be encountered within Southern California. The most recent estimate of population size for the Eastern North Pacific Stock is 1,391 (CV = 0.22; Carretta et al. 2007).

Distribution—The Eastern North Pacific Stock inhabits waters from Costa Rica (Steiger et al. 1991) to southern British Columbia (Calambokidis et al. 1993). During summer months, North Pacific humpback whales feed in a nearly continuous band from southern California to the Aleutian Islands, Kamchatka Peninsula, and the Bering and Chukchi seas (Calambokidis et al., 2001). Humpback whales are mainly found in the Southern California from December through June (Calambokidis et al. 2001).

Reproduction/Breeding—Humpback whales migrate south from California to the waters off Mexico and Costa Rica to breed and to give birth (Calambokidis et al. 2004).

Acoustics—The best-known types of sounds produced by humpback whales are songs, which are thought to be breeding displays used only by adult males on breeding grounds (Matilla et al. 1987; Helweg et al. 1992; Clark and Clapham 2004). Social calls are from 20 Hz to over 10 kilohertz (kHz), with the highest energy below 3 kHz (D'Vincent et al. 1985; Silber, 1986; Simão and Moreira 2005). Recent information on the songs of humpback whales that measured harmonics up to 24 kHz and source levels of 151-173 decibels (dB) re 1 µPa suggest that their hearing may also extend to 24 kHz (Au et al. 2006).

Houser et al. (2001) constructed a humpback audiogram using a mathematical model based on the internal structure of the ear and estimated sensitivity to frequencies from 700 Hz to 10 kHz, with maximum relative sensitivity between 2 and 6 kHz.

3.9.2.1.4 Sei whale (*Balaenoptera borealis*) Eastern North Pacific Stock

Listing Status—Sei whales are listed as endangered under the ESA and therefore classified as depleted and strategic stock under the MMPA. Critical habitat has not been designated for this species for the eastern North Pacific stock.

Population Status—The most current population estimate for sei whales in the entire North Pacific (from 1977) is 9,110 (NMFS, 2006z). The current estimate for sei whales in the Eastern North Pacific stock is 56 (CV=0.61) individuals (Carretta et al. 2007).

Distribution—Pole-ward summer feeding migrations occur, and sei whales generally winter in warm temperate or subtropical waters. Historically, sei whales occurred in the California Current off central California (37ºN–39ºN), and they may have ranged as far south as the area west of the Channel Islands (Rice 1977). Sei whales were encountered there primarily during July–September, and had left California waters by mid-October. Recently, only one confirmed sighting of a sei whale (five possible sightings) were made in California waters during surveys (Mangels and Gerrodette 1994; Barlow, 1995; Forney et al. 1995).

Reproduction/Breeding—No breeding areas have been determined but calving is thought to occur from September to March (Rice 1977).

Acoustics—Sei whale vocalizations consist of paired sequences (0.5 to 0.8 sec, separated by 0.4 to 1.0 sec) of 7 to 20 short (4 milliseconds [msec]) frequency modulated sweeps between 1.5 and 3.5 kHz. While no data on hearing ability for this species are available, Ketten (1997) hypothesized that mysticetes have acute infrasonic hearing. Sei whales in the Antarctic produced broadband "growls" and "whooshes" at frequency of 433 ±192 kHz and source level of 156 ±3.6 dB re 1 µPa at 1 meter (m) (Mc Donald et al., 2005).

3.9.2.1.5 Sperm whale (*Physeter macrocephalus*) California/Oregon/Washington Stock

Listing Status—Sperm whales are listed as endangered under the ESA and therefore are considered depleted and strategic under the MMPA. Critical habitat has not been designated for sperm whales.

Population Status—The available data suggest that sperm whale abundance has been relatively stable in California waters since 1979 (Barlow 1994), but there is uncertainty about both the population size and the annual mortality rates. The sperm whale population is estimated to be 1,934 (CV=0.31) for the California/Oregon/Washington Stock (Barlow and Forney 2007).

Distribution—Sperm whales are found throughout the North Pacific and are distributed broadly from tropical and temperate waters to the Bering Sea. Sperm whales are rarely found in waters less than 300 ms in depth. The geographic distribution of the California/Oregon/Washington stock of sperm whales varies seasonally. Sperm whales are found year-round in California waters, but peak in abundance from April through mid-June and from the end of August to mid-November (NMFS 2006e).

Reproduction/Breeding—Calving generally occurs in the summer at lower latitudes and the tropics (DoN 2005).

Acoustics—Sperm whales produce short-duration (generally less than 3 sec), broadband clicks from about 0.1 to 30 kHz (Weilgart and Whitehead 1993, 1997; Goold and Jones 1995). The source levels can be up to 236 dB re 1 µPa-m (Møhl et al., 2003). The anatomy of the sperm whale's ear indicates that it hears high-frequency sounds and some ultrasonic hearing (Ketten 1992). Using auditory evoked potential measurements, a neonatal sperm whale responded to sounds from 2.5-60 kHz (Ridgway and Carder, 2001).

3.9.2.1.6 Guadalupe fur seal (*Arctocephalus townsendi*) Guadalupe Island, Mexico Stock

Listing Status—Guadalupe fur seals are listed as threatened under the ESA and therefore, are listed as depleted and a strategic stock under the MMPA. The state of California lists the Guadalupe fur seal as a fully protected mammal in the Fish and Game Code of California (Chapter 8, Section 4700, d), and it is also listed as a threatened species in the Fish and Game Commission California Code of Regulations (Title 14, Section 670.5, b, 6, H). Critical habitat has not been designated for this species in the U.S.

Population Status—The Guadalupe fur seal population has increased at an average annual rate of 13.7% from 1954 to 1993 (Gallo-Reynoso, 1994; Carretta et al. 2007), and it may be expanding its range (Gallo-Reynoso 1994; Le Boeuf and Bonnell 1980; Maravilla-Chavez and Lowry 1999). The most recent population estimate of Guadalupe fur seals was 7,408 (Carretta et al. 2007).

Distribution—The only breeding colony of Guadalupe fur seals is at Isla Guadalupe, Mexico, approximately 10 km south of the Southern California Range Complex. A few Guadalupe fur seals (1-2 per year) are haul-out at San Miguel Island in the Channel Islands, but do not breed or pup there (S. Melin, NMML-NMFS, Personal Communication). Distribution at sea is unknown (Reeves *et al*. 1992), but Guadalupe fur seals may migrate at least 600 km from the rookery sites, based on pelagic observations of individuals in the Southern California Bight (Seagars 1984).

Reproduction/Breeding—All breeding and pupping occurs from approximately June through late July on Isla Guadalupe and Isla Benito del Este in Baja Mexico (Gallo 1994) which are south of the SOCAL Range Complex.

Acoustics—There is no published information on the hearing range of the Guadalupe fur seal although it is most likely similar to other fur seals species. The underwater hearing range of the northern fur seal ranges from 0.5 Hz to 40 kHz (Moore and Schusterman 1987; Babushina et al. 1991). The best underwater hearing occurs between 4 and 17 to 28 kHz (Moore and Schusterman 1987; Babushina et al. 1991).

3.9.2.1.7 Sea otter (*Enhydra lutris nereis*) California Stock and Experimental Population (south of Point Conception)

Listing Status—The sea otter falls under the regulatory oversight of the USFWS, while all other species of marine mammals occurring within Southern California fall under the regulatory oversight of NMFS. The southern sea otter is listed as threatened under the ESA and therefore, considered depleted under the MMPA. The translocated population at San Nicolas Island (approximately 29 individuals) and those sea otters that migrate south of Point Conception are considered part of an experimental population and therefore are not considered threatened or endangered (USFWS 2007).

Population Status—Currently the sea otter population is estimated to be 3,026 from the spring 2007 survey, an increase of 12.4% from 2006 (Hatfield 2007). Acanthocephalan parasites (worms) in the intestines, *Toxoplasma gondii* encephalitis (single cell parasite), and shark attacks are the main causes of mortality in sea otters (Kreuder et al. 2003) and are likely responsible for the slow growth and periods of decline in the sea otter population (Estes et al. 2003).

Distribution—The southern sea otter's primary range is restricted to the coastal area of central California, from Half Moon Bay to Gaviota, located just south of Point Conception (Orr and Helm 1989; USFWS 1996, 2005; Tinker et al. 2006), plus a small translocated population (currently about 29 animals) around San Nicolas Island (Ralls et al. 1995; USFWS 1996; 2007). Only a limited number of sea otter sightings have been reported near SCI (only three sightings) (Leatherwood et al. 1978).

Reproduction/Breeding—Sea otters breed through out their range and have two peaks in pupping (January to March and October; USFWS 2003).

Acoustics and Hearing—In-air mother-pup contact vocalizations have most of their energy at 3 to 5 kHz, but there are higher harmonics (McShane et al. 1995; Richardson et al. 1995). There is no hearing data available for this species (Ketten 1998).

3.9.2.2 Listed Marine Mammal Species Not Likely to Occur In the SOCAL Range Complex

3.9.2.2.1 North Pacific right whale-(*Eubalaena japonica*)

The likelihood of a North Pacific right whale being present in the action area is extremely low. It may be the most endangered of the large whale species (Perry et al. 1999), and currently, there is no reliable population estimate, although the population in the eastern North Pacific Ocean is considered to be very small, perhaps in the tens to low hundreds of animals. Despite many years of systematic aerial and ship-based surveys for marine mammals off the western coast of the U.S., only seven documented sightings of right whales were made from 1990 through 2000 (Waite et al. 2003). Based on this information, it is highly unlikely for this species to be present in the action area, so consequently, this species will not be considered in greater detail in the remainder of this analysis.

3.9.2.2.2 Steller sea lion (*Eumetopias jubatus*)

Eastern Distinct Population Segment- Steller sea lions are also not expected to be present in the action area. Steller sea lions range along the North Pacific Rim from northern Japan to California (Loughlin et al. 1984), with centers of abundance and distribution in the Gulf of Alaska and Aleutian Islands, respectively. In U.S. waters, there are two separate stocks of Steller sea lions: an eastern U.S. stock, which includes animals east of Cape Suckling, Alaska (144oW longitude), and a western U.S. stock, which includes animals at and west of Cape Suckling (Loughlin 1997). The closest rookery to the action area is Año Nuevo Island, which declined by 85% between 1970 and 1987 (LeBoeuf et al. 1991). Pup counts at this location have declined steadily at approximately 5% annually since 1990 (Angliss and Lodge 2004). Steller sea lions are rarely sighted in Southern California waters and have not been documented interacting with southern California fisheries in over a decade. The last documented interaction with California-based fisheries was in northern California, in 1994, with the California/Oregon drift gillnet fishery (NMFS 2000). The last sighting of a Steller sea lion (a sub adult male) on the Channel Islands was in 1998 (Thorson et al. 1998). For the reasons listed above, Steller sea lions are not likely to be present in the action area, consequently, this species will not be considered in greater detail in the remainder of this analysis.

3.9.2.2.3 Killer whale (*Orcinus orca)* Southern Resident Stock

The Southern Resident stock of killer whale is not likely to be present within Southern California. Of the three stocks of killer whales, Eastern North Pacific (ENP) Southern Residents, ENP Offshores, and ENP transients, only the ENP Southern Resident stock is listed as endangered under the ESA. This stock is most commonly seen in the inland waters of Washington state and southern Vancouver Island; however, individuals from this stock have been observed in Monterey Bay, California in January, 2000 and March, 2003, near the Farallon Islands in February 2005 and off Point Reyes in January 2006 (Pacific Fishery Management Council (PFMC) and NMFS 2006). Although one killer whale from the non-ESA listed ENP Transient Stock was observed taken in the California/Oregon drift gillnet fishery in 1995 (Carretta et al. 2006), no ENP resident killer whales have been observed taken in any California-based fisheries. Based on the above known information, there is a very low likelihood of Southern Resident killer whales being present in the action area, so this species will not be considered in greater detail in the remainder this analysis.

3.9.3 Non-Threatened or Non-Endangered Cetaceans

A total of 22 species of cetaceans not listed under the ESA as threatened or endangered have been documented within southern California waters, as listed in Table 3.9-1 (Dailey et al. 1993; Forney and Barlow 1998; DoN 2002; 2005c; Carretta et al 2007). They include 19 species of toothed whales (odontocetes) and three species of baleen whales (mysticetes). At least ten of these 19 species generally can be found in the SOCAL Range Complex in moderate or high numbers either year-round or during annual migrations into or through the area: gray whale (*Eschrichtius robustus*), pygmy sperm whale (*Kogia breviceps*), bottlenose dolphin (*Tursiops truncatus*), pantroipcal spotted dolphin (*Stenella attenuata*), striped dolphin (Stenella coeruleoalba), short-beaked common dolphin (*Delphinus delphis*), Pacific white-sided dolphin (*Lagenorhynchus obliquidens*), Risso's dolphin (*Gampus griseus*), northern right whale dolphin (*Lissodelphis borealis*), and Dall's propise (*Phocoenoides dalli*).

Cetacean species occurring in the area of southern California are described below. All of these species are protected under the MMPA, but are not listed as endangered under the ESA, and not considered depleted or strategic under the MMPA. More detailed information for each species is provided in Appendix F.

3.9.3.1 Baleen Whales (Sub-Order Mysticeti)

3.9.3.1.1 Bryde's whale (*Balaenoptera edeni*) Eastern Tropical Pacific

Population Status—The best estimate of the entire eastern tropical Pacific population size is 11,163 (CV=0.20) individuals, with only an estimated 12 (CV = 2.0) individuals in California, Oregon and Washington waters (Carretta et al. 2007).

Distribution—The Bryde's whale is found in tropical and subtropical waters, generally not moving poleward of 40° in either hemisphere (Jefferson et al. 1993). Long migrations are not typical of Bryde's whales, though limited shifts in distribution toward and away from the equator, in winter and summer, respectively, have been observed (Cummings 1985). The species is rarely seen near the SOCAL Range Complex. None were sighted in the San Clemente Island Range Complex (SCIRC) during past surveys (U.S. Navy 1998; Carretta et al. 2000). Only one Bryde's whale has ever been positively identified in surveys of California coastal waters (Barlow 1994).

Reproduction/Breeding—Breeding and calving occur in warm temperate and tropical areas.

Acoustics—Calls vary regionally, yet all but one of the call types have a fundamental frequency below 60 Hz; they last from 0.25 sec to several seconds; and they are produced in extended sequences (Oleson et al. 2003). While no data on hearing ability for this species are available, Ketten (1997) hypothesized that mysticetes have acute infrasonic hearing.

3.9.3.1.2 Gray whale (*Eschrichtius robustus*) Eastern North Pacific

Population Status—The Eastern North Pacific stock was believed to consist of 26,635 (CV=0.10) individuals in 2002 (Anglis and Outlaw 2007).

Distribution—Most of the population summers in the Artic (Rice and Wolman 1971), whereas some individuals also summer along the Pacific coast from Vancouver Island to central California (Rice and Wolman 1971; Darling 1984; Nerini 1984). In October and November, the whales begin to migrate south and follow the shoreline south to breeding grounds on the west coast of Baja California (Braham 1984; Rugh 1984). Whales make the northbound migration from February to May (Rugh 2001).

Reproduction/Breeding—Although some calves are born along the coast of California, most are born in the shallow, protected waters on the Pacific coast of Baja California (Urban et al. 2003).

Acoustics—Gray whales produce broadband signals ranging from 100 Hz to 4 kHz (and up to 12 kHz) (Dahlheim et al. 1984; Jones and Swartz 2002). The structure of the gray whale ear is evolved for low-frequency hearing (Ketten, 1992). The ability of gray whales to hear frequencies below 2 kHz has been demonstrated in playback studies (Cummings and Thompson 1971; Dahlheim and Ljungblad 1990; Moore and Clarke 2002).

3.9.3.1.3 Minke whale (*Balaenoptera acutorostrata*) California/Oregon/Washington Stock

Population Status-The population abundance for offshore California, Oregon, and Washington stock is estimated to be 823 (CV=0.56) individuals (Barlow and Forney 2007).

Distribution—Minke whales occur year-round off California (Dohl et al. 1983; Barlow 1995; Forney et al. 1995). The minke whales found in waters off California, Oregon, and Washington appear to be resident in that area, and to have home ranges, whereas those farther north are migratory. Minke whale abundance in the Southern California Bight fluctuates dramatically through the year, with warm-water months being the period of greatest abundance (Dohl et al. 1981). Minke whales are found in the SOCAL OEIS/EIS study area throughout the year but in higher numbers June through December (Bonnell and Dailey 1993).

Reproduction/Breeding—Stewart and Leatherwood (1985) suggested that mating occurs in winter or early spring although it had never been observed.

Acoustics—Recorded vocalizations from minke whales have dominant frequencies of 60 Hz to greater than 12,000 Hz, depending on vocalization type (Richardson et al. 1995) and source levels, depending on vocalization type, range from 151 to 175 dB re 1 µPa-m (Ketten 1998). "Boings," recently confirmed to be produced by minke whales and suggested to be a breeding call, consist of a brief pulse at 1.3 kHz, followed by an amplitude-modulated call with greatest energy at 1.4 kHz (Rankin and Barlow 2003). While no data on hearing ability for this species are available, Ketten (1997) hypothesized that mysticetes have acute infrasonic hearing.

3.9.3.2 Toothed Whales (Odontocetes)

3.9.3.2.1 Baird's beaked whale (*Berardius bairdii*) California/Oregon/Washington Stock

Population Status—Population size for the California/Oregon/Washington Stock is estimated to be 1,005 (CV=0.37) individuals (Barlow and Forney 2007).

Distribution—Baird's beaked whales appear to occur mainly in deep waters over the continental slope, oceanic seamounts, and areas with submarine escarpments (Ohsumi 1983; Kasuya and Ohsumi 1984; Willis and Baird 1998; Kasuya 2002). No sightings were made during the 1998–1999 NMFS surveys offshore of San Clemente (Carretta et al. 2000).

Reproduction/Breeding—Mating generally occurs in October and November but little else is known of their reproductive behavior (Balcomb 1989).

Acoustics—MacLeod (1999) suggested that beaked whales use frequencies of between 300 Hz and 129 kHz for echolocation, and between 2 and 10 kHz, and possibly up to 16 kHz, for social communication. Both whistles and clicks have been recorded from Baird's beaked whales in the eastern North Pacific Ocean (Dawson et al. 1998). Cook et al. (2006) reported that the Gervais beaked whale (*Mesoplodon europeus*) could hear in the range of 5 to 80 kHz although no measurements were attempted above 80 kHz.

3.9.3.2.2 Bottlenose dolphin, Coastal (Tursiops truncatus) California Coastal Stock

Population Status—There are two distinct populations of bottlenose dolphins within Southern California, a coastal population found within 0.5 nm (0.9 km) of shore and a larger offshore population (Hansen 1990). Population size for the California Coastal Stock of the bottlenose dolphin is estimated to be 323 (CV=0.13) individuals (Carretta et al. 2007).

Distribution—The coastal population of bottlenose dolphins inhabits waters from Point Loma to San Pedro (Dohl et al. 1981; Hansen 1990). Bottlenose dolphins in the Southern California Bight appear to be highly mobile within a relatively narrow coastal zone (Defran et al. 1999), and exhibit no seasonal site fidelity to the region (Defran and Weller, 1999). Bottlenose dolphins are found in the SOCAL Range Complex throughout the year (Defran and Weller 1999).

Reproduction/Breeding—Newborn calves are seen through out the year and reproduction may be influenced by productivity and food abundance (Urian et al. 1996).

Acoustics—Bottlenose dolphins emit pulsed sounds (including clicks and burst-pulses) at 110 to 130 kHz with source levels of 218 to 228 dB re 1 μPa-m (peak to peak levels; Au, 1993) and narrow-band continuous sounds (whistles) at 3.5 to 14.5 kHz with source levels of 125 to 173 dB re 1 μPa-m (Ketten, 1998). The bottlenose dolphin has a functional high-frequency hearing limit of 160 kHz (Au 1993) and can hear sounds at frequencies as low as 40 to 125 Hz (Turl 1993) with a range of best sensitivity between 25 and 70 kHz (Nachtigall et al. 2000).

3.9.3.2.3 Bottlenose dolphin, Offshore (T*ursiops truncatus*) California/Oregon/Washington Offshore Stock

Population Status—Population size for the California/Oregon/Washington bottlenose dolphin stock is estimated to be 2,026 (CV=0.54) individuals (Barlow and Forney 2007).

Distribution—Offshore bottlenose dolphins are thought to have a continuous distribution in California (Mangels and Gerrodette, 1994). They have been found in the Southern California Bight and in waters as far north as ~41ºN (Barlow et al. 1997). Offshore bottlenose dolphins are found in the SOCAL OEIS/EIS study area throughout the year (Carretta et al. 2007).

Reproduction/Breeding—Newborn calves are seen through out the year and may be influenced by productivity and food abundance (Urian et al. 1996).

Acoustics—The acoustic abilities of offshore bottlenose dolphins is assume to be similar to the coastal population of bottlenose dolphins described in the previous discussion.

3.9.3.2.4 Cuvier's beaked whale (*Ziphius cavirostris*) California/Oregon/Washington Stock

Population Status—Population size for the California/Oregon/Washington Cuvier's beaked whale stock is estimated to be 4,342 (CV=0.58) individuals (Barlow and Forney 2007).

Distribution—The distribution and abundance of beaked whales are not well known because they are difficult to identify and sightings have not been identified to the species level. Cuvier's beaked whale appears to be the most abundant beaked whale in the area (almost 80% of sightings; Barlow and Gerrodette 1996). While they are sighted only during the cold-water season, it is unknown if Cuvier's beaked whales are found in the SOCAL OEIS/EIS study area year-round or shift distribution.

Reproductive/Breeding—Little is known of beaked whale reproductive behavior.

Acoustics—MacLeod (1999) suggested that beaked whales use frequencies of between 300 Hz and 129 kHz for echolocation, and between 2 and 10 kHz for social communication. Cuvier's beaked whales produce echolocation clicks at frequencies from 20 to 70 kHz (Zimmer et al. 2005) and only echolocated below 200 m (Tyack et al. 2006). Cook et al. (2006) reported that the Gervais beaked whale (*Mesoplodon europeus*) could hear in the range of 5 to 80 kHz although no measurements were attempted above 80 kHz.

3.9.3.2.5 Dall's porpoise (*Phocoenoides dalli*) California/Oregon/Washington stock

Population Status—Population size for the Washington/Oregon/California Dall's porpoise stock is estimated to be 85,955 (CV=0.45) individuals (Barlow and Forney 2007). No specific data are available regarding trends in population size in California or adjacent waters.

Distribution—Dall's porpoise's is probably the most abundant small cetacean in the North Pacific Ocean. Its abundance changes seasonally, probably in relation to water temperature. It is considered to be a cold-water species, and is rarely seen in areas where water temperatures exceed 17°C (Leatherwood et al. 1982). Its distribution shifts southward and nearshore in autumn, especially near the northern Channel Islands, and northward and offshore in late spring (Dohl et al. 1981; Leatherwood et al. 1987; Barlow et al. 1997; Forney and Barlow 1998). Dall's porpoises are found in the SOCAL Range Complex throughout the year (Forney and Barlow 1998).

Reproduction/Breeding—Calving occurs in the north Pacific from early June through late July (Ferrero and Walker 1999).

Acoustics—Only short duration pulsed sounds have been recorded for Dall's porpoise (Houck and Jefferson 1999). Dall's porpoises produce short-duration (50 to 1,500 µs), high-frequency, narrow band clicks, with peak energies between 120 and 160 kHz (Jefferson 1988). There are no published data on hearing ability of this species; Awbrey et al. (1979) reported estimates based on anatomy.

3.9.3.2.6 Dwarf sperm whale (*Kogia sima*) California/Oregon/Washington Stock

Population Status—Dwarf sperm whales within the U.S. Pacific EEZ are each divided into two discrete, non-contiguous areas: (1) Hawaiian waters, and (2) waters off California, Oregon, and Washington (Carretta et al. 2007). There is no estimate of the abundance for the California/Oregon/Washington stock of the dwarf sperm whale (Carretta et al. 2007).

Reproduction/Breeding—There is no information on the breeding behavior in this area.

Distribution—Along the U.S. west coast, sightings of the *Kogia* have been rare, although that is likely a reflection of their pelagic distribution and small size rather than their true abundance (Carretta et al. 2002). Dwarf sperm whales tend to occur closer to shore, often over the continental shelf (Rice 1998; Wang et al. 2002; MacLeod et al. 2004). The dwarf sperm whale more tropical, based at least partially on live sightings at sea from a large database from the eastern tropical Pacific Ocean (Wade and Gerrodette 1993).

Acoustics—There is no information available on dwarf sperm whale vocalizations or hearing capabilities.

3.9.3.2.7 False killer whale (*Pseudorca crassidens*) Not defined for this area

Population Status—This stock is listed as a strategic stock by NMFS because the estimated level of serious injury and mortality from the long-line fishery (Carretta et al. 2007). There is no population estimate for this area but false killer whales may be found south of the southern boundary of the SOCAL Range Complex.

Distribution—False killer whales are found in tropical and temperate waters, generally between 50°S and 50°N latitude with a few records north of 50°N in the Pacific and the Atlantic (Odell and McClune 1999). They are considered very rare in the SOCAL Range Complex (DoN 2005).

Reproduction/Breeding—Little is known of their reproductive behavior.

Acoustics—The dominant frequencies of false killer whale whistles are 4 to 9.5 kHz and their clicks are 25 to 30 kHz and 95 to 130 kHz (Thomas et al. 1990; Richardson et al. 1995). The source level is 220 to 228 dB re 1 µPa-m (Ketten 1998). Best hearing sensitivity measured for a false killer whale was around 16 to 64 kHz (Thomas et al. 1988, 1990). Yuen et al. (2005) tested a stranded false killer whale using auditory evoke potentials and found a hearing range of 4-44 kHz and with best sensitivity at 16-24 kHz.

3.9.3.2.8 Killer whale, Offshore (*Orcinus orca*) Eastern North Pacific Offshore

Population Status—Killer whales are segregated socially, genetically, and ecologically into three distinct groups: residents, transients, and offshore animals. Population size for all killer whales along the coasts of California, Oregon and Washington is estimated to be 1,340 (CV=0.31) individuals (Carretta et al. 2007).

Distribution—Killer whales from the Eastern North Pacific Southern Offshore Stock, range from Washington to the Southern California Bight and could occur in the Point Mugu Range Complex. No killer whales were sighted during the 1998–1999 NMFS surveys offshore of San Clemente Island (Carretta et al. 2000). There is a Los Angeles (LA) pod that occurs in southern California off the coasts of Los Angeles and Orange Counties (Black et al. 2003).

Reproduction/Breeding—There is no information the reproductive behavior of killer whales in this area.

Acoustics—The killer whale produces a wide variety of clicks and whistles, but most sounds are pulsed and at 1 to 6 kHz (Richardson et al. 1995). The upper limit of hearing is 100 kHz for this species. The most sensitive frequency, in both behavioral and in auditory brainstem response audiograms, has been determined to be 20 kHz (Szymanski et al. 1999).

3.9.3.2.9 Killer whale, Transient (*Orcinus orca*) Eastern North Pacific Transient

Population Status—The population estimate for the Eastern North Pacific Stock of transient killer whales is 346 (Carretta et al. 2007) and along the coast of California 105 killer whales have been identified by Forney et al. 2000).

Distribution—Little is known about the movements and range of the Eastern Pacific Transient stock (Caretta et al. 2007).

Reproduction/Breeding—There is no information the reproductive behavior of killer whales in this area.

Acoustics—The acoustic abilities of transient killer whales is assume to be similar to the population of killer whales described in the section on the killer whale offshore stock.

3.9.3.2.10 Long-beaked common dolphin (*Delphinus capensis*) California

Population Status—The population size is estimated to be 21,902 (CV = 0.50) individuals (Barlow and Forney 2007). Long-beaked common dolphins are a strategic stock under the MMPA. The numbers of both the short-beaked and long-beaked forms have been increasing, likely because of gradual warming of waters off California with the population shifting north (Heyning and Perrin 1994; Barlow et al. 1997; Forney 1997).

Distribution—Long-beaked common dolphins are usually found within 50 nm (92.5 km) of shore (Barlow et al. 1997, Bearzi 2005, 2006; Perrin et al. 1985; Barlow 1992 in Heyning et al. 1994). Long beaked common dolphins are found in the region throughout the year (Carretta et al. 2000), although abundance has been shown to change on both seasonal and inter-annual time scales in southern California (Dohl et al. 1986; Barlow 1995; Forney et al. 1995; Forney and Barlow 1998).

Reproduction/Breeding—The peak calving season occurs from spring and early summer (Forney 1994).

Acoustics—Clicks and whistles have dominant frequency ranges of 23 to 67 kHz and 0.5 to 18 kHz, respectively (Ketten 1998). An audiogram recorded using auditory evoked potential technique showed the bandwidth was up to 128 kHz (Popov and Klishin 1998).

3.9.3.2.11 Longman's beaked whale (*Indopacetus pacificus*) Undefined for SOCAL Range Complex

Population Status—There is no information on the population trend of Longman's beaked whale (Carretta et al. 2007).

Distribution—Longman's beaked whale sightings in the Eastern Tropical Pacific were south of 25°N Ferguson and Barlow (2001). The northernmost records in the eastern North Pacific Ocean are five sightings off Baja California, during an El Niño event (Gallo-Reynoso and Figueroa-Carranza 1995).

Reproduction/Breeding—There is no information the reproductive behavior of Longman's beaked whales in this area.

Acoustics—There is no information on Longman's beaked whale acoustics but they may be similar to other beaked whales. Blaineville's beaked whales echolocation clicks were recorded at frequencies from 20 to 40 kHz (Johnson et al. 2004) and Cuvier's beaked whales at frequencies from 20 to 70 kHz (Zimmer et al. 2005). Cook et al. (2006) reported that the Gervais beaked whale (*Mesoplodon europeus*) could hear in the range of 5 to 80 kHz although no measurements were attempted above 80 kHz.

3.9.3.2.12 Mesoplodont beaked whales (*Mesoplodon* spp.) California/Oregon/Washington

Population Status—Mesoplodonts are difficult to distinguish in the field. Five species of Mesoplodon may occur off the coast of southern California: Blainville's beaked whale (*M. densirostris*), Hubb's beaked whale (*M. carlhubbsi*), Perrin's beaked whale (*M. perrini*), pygmy beaked whale (*M. peruvianus*), and ginkgo-toothed beaked whale (*M. ginkgodens*) (Mead 1981). Until better methods are developed for distinguishing the different Mesoplodont species from one another, the management unit is defined to include all Mesoplodont populations. Population size of California/Oregon/Washington Stock of Mesoplodont beaked whales is estimated to be 1,177 (CV=0.40) individuals (Barlow and Forney 2007).

Distribution—Blainville's beaked whale is the Mesoplodon species with the widest distribution throughout the world (Mead 1989), although it is generally limited to tropical and warmer temperate waters (Leatherwood and Reeves 1983). Hubb's beaked whale occurs in temperate waters of the North Pacific (Mead 1989). Perrin's beaked whale was first discovered in 2002, when genetic analysis was carried out on four whales stranded between 1975 and 1979 in California, all along <80 km of beach just north of San Diego (Dalebout et al. 2002). The ginkgo-toothed beaked whale is only known from stranding records (Mead 1989). Two of the thirteen total records reported by Mead (1989) were from the eastern North Pacific, one from Del Mar, California, and one from Baja California. The species is hypothesized to occupy relatively cool areas in the temperate and tropical Pacific, where upwelling is known to occur, such as in the California and Peru Currents and the equatorial front (Palacios 1996b). The pygmy beaked whale is the smallest Mesoplodont (Reyes et al. 1991). The pygmy beaked whale is thought to occur between the latitudes 25°N and 15°S, from Baja California to Peru (Urbán-Ramírez and Aurioles-Gamboa 1992), Carretta et al. (2005) reported that is known to occur off the U.S. west coast, and Reeves et al. (2002) reported that it is also known to occur off southern California.

Reproduction/Breeding—There is no information the reproductive behavior of Mesoplodont whales in this area.

Acoustics—Rankin and Barlow (2007) reported on the vocalizations of Blaineville's beaked whales in Hawaii that included four mid frequency sounds: a frequency-modulated whistle and three frequency and amplitude modulated pulsed sounds within the range of 6 and 16 kHz. Vocalizations recorded from two juvenile Hubbs' beaked whales consisted of low and high frequency click trains ranging in frequency from 300 Hz to 80 kHz and whistles with a frequency range of 2.6 to 10.7 kHz and duration of 156 to 450 msec (Lynn and Reiss 1992; Marten 2000).

Cook et al. (2006) reported that the Gervais beaked whale (*Mesoplodon europeus*) could hear in the range of 5 to 80 kHz although no measurements were attempted above 80 kHz.

3.9.3.2.13 Northern right whale dolphin (*Lissodelphis borealis*) California/Oregon/Washington Stock

Population Status—There are no available data regarding trends in population size in California or adjacent waters. Population size of the California/Oregon/Washington Stock is estimated to be 11,097 (CV=0.26) individuals (Carretta et al. 2007).

Distribution—This species is endemic to the North Pacific Ocean, and is found primarily in temperate (8–19ºC) continental shelf and slope waters (Leatherwood and Walker 1979; Barlow et al. 1997). There is strong evidence of seasonal movements, probably related to water temperature. Peak numbers of northern right whale dolphins are seen in southern California in December and January.

Reproduction/Breeding—The calving season is unknown although small calves are seen in winter or early spring (Jefferson et al. 1994).

Acoustics—Clicks with high repetition rates and whistles have been recorded from animals at sea (Fish and Turl 1976; Leatherwood and Walker, 1979). Maximum source levels were approximately 170 dB 1 µPa-m (Fish and Turl 1976). Rankin et al. (2007) reported the mean frequency of individual echolocation clicks were 31.3 kHz (Range of 23 – 41 kHz; SD = 3.7 kHz). There is no published data on the hearing abilities of this species.

3.9.3.2.14 Pacific white-sided dolphin (*Lagenorhynchus obliquidens*) California/Oregon/Washington

Population Status—No population trends have been observed in California or adjacent waters. Size of the California/Oregon/Washington Stock is estimated to be 23,817 (CV=0.36) individuals (Barlow and Forney 2007).

Distribution—The Pacific white-sided dolphin is most common in waters over the continental shelf and slope. Peak abundance in California waters occurs from November to April (Leatherwood et al. 1984). Pacific white-sided dolphins are found in the SOCAL Range Complex throughout the year (Carretta et al. 2007).

Reproduction/Breeding—Calving occurs from June through August (Heise 1997)

Acoustics—Whistles are in the frequency range of 2 to 20 Hz (Richardson et al. 1995). Peak frequencies of the pulse trains for echolocation fall between 50 and 80 kHz; the peak amplitude is 170 dB re 1µPa-m (Fahner et al. 2004). Tremel et al. (1998) measured the underwater hearing sensitivity of the Pacific white-sided dolphin from 75 Hz through 150 kHz with the greatest sensitivities from 4 to 128 kHz.

3.9.3.2.15 Pantropical spotted dolphin (*Stenella attenuata*) Undefined for Southern California

Population Status—There are no abundance estimates available for this species in the NOAA Stock Assessment Reports for this area of the Pacific.

Distribution—The pantropical spotted dolphin can be found throughout tropical and some subtropical oceans of the world (Perrin and Hohn 1994). In the eastern Pacific, its range is from 25ºN (Baja California, Mexico) to 17ºS (southern Peru) (Perrin and Hohn 1994). There have been few sightings of pantropical spotted dolphins in the SOCAL Range Complex; therefore seasonal occurrence can not be determined (Waring et al. 2002).

Reproduction/Breeding—In the Eastern Tropical Pacific there are two calving peaks, one in spring and one in fall (Perrin and Hohn1994).

Acoustics—Pantropical spotted dolphin whistles have a dominant frequency range of 6.7 to 17.8 kHz (Ketten 1998). Click source levels between 197 and 220 dB re 1 µPa-m (peak to peak levels),within the range of 40-140 kHz, have been recorded for pantropical spotted dolphins (Schotten et al. 2004). There are no published hearing data for pantropical spotted dolphins (Ketten 1998).

3.9.3.2.16 Pygmy sperm whale (*Kogia breviceps*) California/Oregon/Washington Stock

Population Status—The pygmy sperm whale is not listed under the ESA, and the California/ Oregon/Washington Stock is not considered depleted or strategic under the MMPA. No population trends have been observed in California or adjacent waters. The size of the California/Oregon/Washington Stock is estimated to be 247 (CV = 1.06, Carretta et al. 2007).

Distribution—Both Kogia species have a worldwide distribution in tropical and temperate waters (Jefferson et al. 1993). There is a rare occurrence for Kogia inshore of the area of primary occurrence. Occurrence is expected to be the same throughout the year. There have been few sightings of pygmy sperm whales in the SOCAL Range Complex; therefore, seasonal occurrence can not be determined (Wade and Gerrodette 1993).

Reproduction/Breeding—There is no information on the breeding behavior in this area.

Acoustics—Pygmy sperm whale clicks range from 60 to 200 kHz, with a dominant frequency of 120 kHz (Richardson et al. 1995). An auditory brainstem response study indicates that pygmy sperm whales have their best hearing between 90 and 150 kHz (Ridgway and Carder 2001).

3.9.3.2.17 Risso's dolphin (*Grampus griseus*) California/Oregon/Washington Stock

Population Status—There are no quantitative data regarding trends in population size in California or adjacent waters, although sightings have become more frequent in the past 20 years. The population estimate of the California/Oregon/Washington Stock is 11,910 (CV=0.24) individuals (Barlow and Forney 2007).

Distribution—Risso's dolphins have been sighted in waters of the SOCAL Range Complex during all seasons. However, in most years, higher numbers are present during the cold-water months than during other times of the year (Forney and Barlow 1998). Risso's dolphins are found in the SOCAL Range Complex throughout the year (Carretta et al. 2000).

Reproduction/Breeding—There is no information on the breeding behavior in this area.

Acoustics—Corkeron and Van Parijs (2001) recorded five different whistle types, ranging in frequency from 4 to 22 kHz. A recent study established empirically that Risso's dolphins echolocate; estimated source levels were up to 216 dB re 1 μPa-m (peak to peak levels) with two prominent peaks in the range of 30-50 kHz and 80-100 kHz (Philips et al. 2003). The range of hearing in Risso's dolphins is 1.6-122.9 kHz with maximum sensitivity occurring between 8 and 64 kHz (Nachtigall et al. 1995).

3.9.3.2.18 Rough-toothed dolphin (*Steno bredanensis*) Undefined for Southern California

Population Status—There are no abundance estimates available for this species in the NOAA Stock Assessment Report for this area of the Pacific.

Distribution—Rough-toothed dolphins are typically found in tropical and warm temperate waters (Perrin and Walker, 1975 in Bonnell and Dailey 1993), rarely ranging north of 40°N or south of 35°S (Miyazaki and Perrin 1994). Sighting and stranding records in the eastern North Pacific Ocean are rare (e.g., Ferrero et al. 1994). There have been few sightings of rough-toothed dolphins in the SOCAL Range Complex; therefore seasonal occurrence can not be determined (Ferrero et al. 1994).

Reproduction/Breeding—There is no information on the breeding behavior in this area.

Acoustics—Echolocation clicks of rough-toothed dolphins are in the frequency range of 0.1 to 200 kHz, with a peak of about 25 kHz (Miyazaki and Perrin 1994; Yu et al. 2003). Whistles show a wide frequency range: 0.3 to >24 kHz (Yu et al. 2003). There is no published information on hearing ability of this species.

3.9.3.2.19 Short-beaked common dolphin (*Delphinus delphis*) California/Oregon/Washington Stock

Population Status—The short-beaked common dolphin is the most abundant cetacean off California (Dohl et al. 1981; Forney et al. 1995; Carretta et al. 2007). The single current management unit for the short-beaked common dolphin in this area is a California/Oregon/Washington Stock with a population estimate of 352,069 (CV = 0.18) individuals (Barlow and Forney 2007).

Distribution—The short-beaked common dolphin is distributed between the coast and at least 556 km from shore (Carretta et al. 2007). Short-beaked common dolphin abundance off California has increased dramatically since the late 1970s, along with a concomitant decrease in abundance in the ETP, suggesting a large-scale shift in the distribution of this species in the eastern North Pacific (Forney et al. 1995; Forney and Barlow 1998). Short beaked common dolphins are found in the SOCAL Range Complex throughout the year (Forney and Barlow 1998).

Reproduction/Breeding—The peak calving season occurs from spring and early summer (Forney 1994).

Acoustics—Clicks and whistles have dominant frequency ranges of 23 to 67 kHz and 0.5 to 18 kHz, respectively (Ketten 1998). Popov and Klishin (1998) recorded auditory brainstem responses from a common dolphin. The audiogram bandwidth was up to 128 kHz at a level of 100 dB above the minimum threshold. The minimum thresholds were observed at frequencies of 60 to 70 kHz.

3.9.3.2.20 Short-finned pilot whale (*Globicephala macrorhynchus*) California/Oregon/Washington Stock

Population Status—The short-finned pilot whale is not listed under the ESA, however, the California/Oregon/Washington Stock is considered strategic under the MMPA because the average human-caused mortality may not be sustainable (Barlow et al. 1997). Population size for the California/Oregon/Washington Stock is 350 (CV=0.48) individuals (Barlow and Forney 2007).

Distribution—Prior to the 1982–1983 El Niño event, short-finned pilot whales were commonly seen off southern California, with an apparently resident population around Santa Catalina Island (Dohl et al. 1981). After the El Niño event, they virtually disappeared from the region, and few sightings were made from 1984 to 1992. Short finned pilot whales are found in the SOCAL Range Complex throughout the year (Forney 1994).

Reproduction/Breeding—Calving and breeding primarily occurs in the summer (Jefferson et al. 1993).

Acoustics—Short-finned pilot whale whistles and clicks have a dominant frequency range of 2 to 14 kHz and a source level of 180 dB re 1 μPa-m (Fish and Turl 1976; Ketten 1998). There are no published hearing data available for this species.

3.9.3.2.21 Spinner dolphin (Stenella longirostris) Not defined for Southern California Stock

Population Status—Spinner dolphins are not found in California but inhabit the warm waters of Central America, therefore, they are a possible summer visitor to southern California or Mexican waters.

Distribution—Limits are near 40°N and 40°s (Jefferson et al. 1993). There have been few sightings of spinner dolphins in the SOCAL Range Complex; therefore, seasonal occurrence can not be determined (Forney 1994).

Reproductive/Breeding—There is no information on the breeding behavior in this area.

Acoustics—They produce whistles in the range of 1 to 22.5 kHz with the dominant frequency being 6.8 to 17.9 kHz (Richardson et al. 1995; Nedwell et al. 2004). They also display pulse burst sounds in the range of 5 to 60 kHz. Their echolocation clicks range up to at least 65 kHz (Richardson et al. 1995). For this species, there is no information on hearing.

3.9.3.2.22 Striped dolphin (*Stenella coeruleoalba*) California/Oregon/Washington Stock

Population Status—The best estimate of the size of the California/Oregon/Washington Stock is 18,976 (CV=0.28) individuals (Barlow and Forney 2007).

Distribution—Striped dolphins have a cosmopolitan distribution in tropical to warm temperate waters (Perrin *et al.* 1994a). In and near the SOCAL Range Complex, striped dolphins are found mostly offshore, and are much more common in the warm-water period. Striped dolphins are found in the SOCAL Range Complex throughout the year (Waring et al. 2002).

Reproduction/Breeding—There is no information on the breeding behavior in this area.

Acoustics—Striped dolphin whistles range from 6 to at least 24 kHz, with dominant frequencies ranging from 8 to 12.5 kHz (Richardson *et al*. 1995). The striped dolphin's range of most sensitive hearing is 29 to 123 kHz using standard psycho-acoustic techniques (Kastelein et al. 2003). Hearing ability became less sensitive below 32 kHz and above 120 kHz (Kastelein et al. 2003).

3.9.4 Non-Threatened and Non-Endangered Seals and Sea Lions (Order Carnivora)

Among marine mammals, two types of carnivores are found in southern California waters, namely, pinnipeds (seals, sea lions, and fur seals, discussed below), and mustelids (sea otters, an ESA-listed species discussed in Section 3.9.2).

The pinnipeds are divided into the three taxonomic families, phocids (true seals), otaridds (sea lions and fur seals) and odobenids (walrus). Only two of the families, phocids and otariids, are presently represented in southern California waters. Four species of pinnipeds not listed as threatened or endangered under the ESA may occur in the SOCAL Range Complex (Table 3.9-1). Three pinniped species, the California sea lion (*Zalophus californianus*), Pacific harbor seal (*Phoca vitulina richardii*), and northern elephant seal (*Mirounga angustirosiris*), regularly inhabit the SOCAL Range Complex for foraging, reproduction and resting. The fourth species, namely the northern fur seal (*Callorhinus ursinus*), is seen occasionally in southern California.

The California sea lion is the most abundant and breeds regularly on SCI. A small rookery is located on Santa Barbara Island (Le Boeuf and Bonnell 1980; Bonnell and Dailey 1993), and Guadalupe Island, just south of the Range Complex, is a major haul-out site (Bonnell and Dailey 1993; Ronald and Gots 2003; Lowry and Forney 2005). Large colonies of California sea lions are found on San Nicolas and San Miguel Islands.

Northern elephant seals spend little time nearshore, and pass through offshore waters four times a year as they travel to and from breeding/pupping, and molting areas on various islands and mainland sites along the Mexico and California coasts. Small colonies of northern elephant seals breed and haul out on Santa Barbara Island with large colonies on San Nicolas and San Miguel Islands (Bonnell and Dailey 1993; DoN 1998; 2002).

Small numbers of harbor seals are found hauled out on mainland and islands sites and forage in the nearshore waters of the SOCAL Range Complex, but are found in only moderate numbers compared to sea lions and elephant seals. The harbor seal occupies haul-out sites on mainland beaches and all of the Channel Islands, including Santa Barbara, Santa Catalina, and San Nicolas Islands (Lowry and Carretta 2003).

The overall abundance of California sea lions, Northern elephant seals, and harbor seals increased rapidly on the Channel Islands between the end of commercial exploitation in the 1920s and the mid-1980s. The growth rates of populations of some species appear to have declined after the mid~1980s, and some survey data suggested that localized populations of some species were declining. The declines may have been a result of either interspecific competition or population numbers having exceeded the carrying capacity of the environment (Stewart et al. 1993; Hanan 1996). For instance, harbor seals have declined in some areas of the Channel Islands where California sea lion or northern elephant seal populations have increased and out competed the harbor seals for haul-out space (M. Lowry, Pers. Comm). More recently most populations are increasing (Carretta et al. 2004), and in some cases seals have recently occupied new rookeries and haul-out areas. The aforementioned pinniped species are not listed as endangered or threatened under the ESA (Barlow et al. 1997).

3.9.4.1 Pinnipeds (Order Carnivora)

3.9.4.1.1 Northern Elephant Seal (*Mirounga angustirostris*) California Breeding Stock

Population Status—The California Breeding stock has recovered from near extinction in the early 1900s to an estimated 101,000 (Carretta et al. 2004).

Distribution—Northern elephant seals molt, breed, and give birth primarily on offshore islands off Baja California and California. About two thirds of the California population hauls out on San Miguel Island, about 32% on San Nicolas Island, and the remaining seals use Santa Rosa (1%), Santa Cruz, Anacapa, Santa Barbara, and San Clemente islands (Bonnell and Dailey 1993; U.S. Navy 1998; Carretta et al. 2000).

Reproduction/Breeding—Northern elephant seals haul out on land to give birth and breed from December through March, and pups remain hauled out through April.

Acoustics—As noted by Kastak and Schusterman (1999), evidence for underwater sound production by this species is scant. Burgess et al. (1998) detected possible vocalizations in the form of click trains that resembled those used by males for communication in air. The audiogram of the northern elephant seal indicates that this species is well-adapted for underwater hearing; sensitivity is best between 3.2 and 45 kHz, with greatest sensitivity at 6.4 kHz and an upper frequency cutoff of approximately 55 kHz (Kastak and Schusterman 1999).

3.9.4.1.2 Pacific Harbor Seal (*Phoca vitulina richardii*) California Stock

Population Status—The California population has increased from the mid-1960s to the mid-1990s, although the rate of increase may have slowed during the 1990s (Hanan 1996). The minimum population estimate of the California Stock is 25,720 (Carretta 2005).

Distribution—The Southern California Bight is near the southern limit of the harbor seal's range (Bonnell and Dailey 1993). Some harbor seals haul out and breed on Santa Barbara and Santa Catalina islands within the SOCAL Range Complex, but most harbor seals haul out further north.

Reproduction/Breeding—Pupping in late January, and pups start to become weaned in May. Breeding occurs between late March and early May.

Acoustics—Adult males produce low frequency vocalizations underwater during the breeding season (Hanggi and Schusterman 1994; Van Parijs et al. 2003). Male harbor seals produce communication sounds in the frequency range of 100 to 1,000 Hz (Richardson et al. 1995). The harbor seal hears almost equally well in air and underwater (Kastak and Schusterman 1998). Harbor seals hear best at frequencies from 1 to 180 kHz; the peak hearing sensitivity is at 32 kHz in water (Terhune and Turnball 1995; Kastak and Schusterman 1998; Wolski et al. 2003).

3.9.4.1.3 California Sea Lion (*Zalophus californianus*) United States Stock

Population Status—The California sea lion is not listed under the ESA, and the U.S. Stock, some of which occurs in the SOCAL Range Complex, is not considered a strategic stock under the MMPA. The minimum population estimate of the U.S. Stock, based on a 2001 census, is 138,881 (Carretta et al. 2007).

Distribution—Nearly all of the U.S. Stock (more than 95%) breeds and gives birth to pups on San Miguel, San Nicolas, and Santa Barbara islands, only one of which–Santa Barbara, the smallest–is in the SOCAL Range Complex. Smaller numbers of pups are born on San Clemente Island, the Farallon Islands, and Año Nuevo Island (Lowry et al. 1992). The California sea lion is by far the most commonly-sighted pinniped species at sea or on land in the vicinity of the SOCAL OEIS/EIS study area. They were sighted during all seasons and in all areas with survey coverage from nearshore to offshore areas (Carretta et al. 2000).

Reproduction/Breeding—The pupping and mating season for sea lions begins in late may and continues through July (Heath 2002).

Acoustics—California sea lions produce two types of underwater sounds: clicks (or short-duration sound pulses) and barks (Schusterman et al. 1966, 1967; Schusterman and Baillet 1969). All underwater sounds have most of their energy below 4 kHz (Schusterman et al. 1967). The range of maximal sensitivity underwater is between 1 and 28 kHz (Schusterman et al. 1972). Peak sensitivities in air are shifted to lower frequencies; the effective upper hearing limit is approximately 36 kHz (Schusterman 1974). The best range of sound detection is from 2 to 16 kHz (Schusterman 1974).

3.9.4.1.4 Northern Fur Seal (Callorhinus ursinus) San Miguel Island Stock

Listing Status—The Eastern Pacific Stock of northern fur seal is classified as a strategic stock because it is designated as depleted under the MMPA. The San Miguel Island Stock, which occurs north of the SOCAL OEIS/EIS study area, is not considered depleted or strategic under the MMPA.

Population Status—The range of the northern fur seal extends from southern California north to the Bering Sea, and west to the Okhotsk Sea and the Sea of Japan (Antonelis and Fiscus 1980). Two separate stocks of northern fur seals are recognized within U.S. waters, the Eastern Pacific Stock and the San Miguel Island Stock (Barlow et al. 1998). A minimum population estimate for the San Miguel Island Stock is 4,190 (Carretta et al. 2007).

Distribution—The Eastern Pacific Stock spends May–November in northern waters and at northern breeding colonies. In late November, females and young begin to arrive in offshore waters of California, with some animals moving south into continental shelf and slope waters. Maximum numbers are found in waters from 34ºN to 42ºN during February–April; most are found offshore of the continental slope. By early June, most seals of the eastern Pacific Stock have migrated back to northern waters (Antonelis and Fiscus 1980).

Reproduction/Breeding—The northern fur seal pupping and mating season begins in June and continues through July (Bonnell et al. 1978).

Acoustics—Northern fur seals produce underwater clicks, and in-air bleating, barking, coughing, and roaring sounds (Schusterman 1978; Richardson et al. 1995). The underwater hearing range of the northern fur seal ranges from 0.5 Hz to 40 kHz (Moore and Schusterman 1987; Babushina et al. 1991) with best underwater hearing occurring between 4 and 17 to 28 kHz (Moore and Schusterman 1987; Babushina et al. 1991). The maximum sensitivity in air is at 3 to 5 kHz (Babushina et al. 1991), after which there is an anomalous hearing loss at around 4 or 5 kHz (Moore and Schusterman 1987; Babushin 1999).

Table 3.9-1: Summary of Marine Mammal Species Found In Southern California Waters

Common Name Species Name	Abundance (CV)	Stock	Southern California Abundance	ESA/ MMPA Status	Annual Population Trend	Occurrence	Warm Season May-Oct	Cold Season Nov-
ESA Listed Species								
Blue whale *Balaenoptera musculus*	1,744 (0.28)	Eastern North Pacific	842 (0.20)	E, D, S	May be increasing	Seasonal; Arrive Apr-May; more common late summer to fall	YES	NO
Fin whale *Balaenoptera physalus*	2,099 (0.18)	California, Oregon, & Washington	359 (0.40)	E, D, S	May be increasing	Year round species; small population	YES MORE	YES LESS
Humpback whale *Megaptera novaeangliae*	1,391 (0.22)	California, Oregon, & Washington	36 (051)	E, D, S	Increasing 6-7%	Seasonal; More sightings around the northern Channel Islands	YES	NO
North Pacific right whale *Eubalaena japonica*	Unknown	Eastern North Pacific	Unknown	E, D, S	Unknown	Very rare: Rare throughout the Pacific; only 12 sightings in California since 1900	RARE	RARE
Sei whale *Balaenoptera borealis*	56 (0.61)	Eastern North Pacific	0 (7 Bryde's or Sei Whales)[3]	E, D, S	May be increasing	Rare; Less than three sightings within the last 30 years	UNK	UNK
Sperm whale *Physeter macrocephalus*	1,934 (0.31)	California, Oregon, & Washington	607 (0.57)	E, D, S	Unknown	Common year round; More likely in waters > 1000 m, most often > 2000 m	YES MORE	YES LESS
Guadalupe fur seal *Arctocephalus townsendi*	7,408	Mexico		T, D, S	Increasing 13.7%	Rare; Occasional visitor to northern Channel Islands; mainly breeds on Guadalupe Is., Mexico, May-Jul	UNK	UNK
Steller sea lion *Eumetopias jubatus*	6,555	California, Oregon, & Washington		T, D	Decreasing	Very rare; Summer distribution north of 36^{o}N; last seen in northern Channel Islands in 1998	NO	NO
Southern Sea Otter *Enhydra lutris*	2,359	California	~29 (from ground surveys)	T, D	Increasing	Main distribution at San Nicolas Island north of the SOCAL Range Complexis translocated population of approximately 29 animals is experimental population not considered endangered	YES	YES

Common Name Species Name	Abundance (CV)	Stock	Southern California Abundance	ESA/ MMPA Status	Annual Population Trend	Occurrence	Warm Season May-Oct	Cold Season Nov-
Non-ESA Listed Species								
Mysticetes								
Bryde's whale *Balaenoptera edeni*	12 (2.0)	Eastern Tropical Pacific	0 (7 Bryde's or Sei Whales)[3]		Unknown	Rare; Only one confirmed sighting in California	UNK	UNK
Gray whale *Eschrichtius robustus*	26,635 (0.10)	Eastern North Pacific	Population migrate through SOCAL		Increasing ~ 2.5%	Transient during seasonal migrations	NO	YES
Minke whale *Balaenoptera acutorostrata*	823 (0.56)	California, Oregon, & Washington	226 (1.02)		No Trends	Less common in summer; small numbers around northern Channel Islands	NO	YES
Odontocetes								
Baird's beaked whale *Berardius bairdii*	1,005 (0.37)	California, Oregon, & Washington	127 (1.14)		Unknown	Rare	UNK	UNK
Bottlenose dolphin coastal *Tursiops truncatus*	323 (012)	California Coastal	323 (0.12)		Stable	Limited, small population within one km of shore	YES	YES
Bottlenose dolphin offshore *Tursiops truncatus*	2,026 (0.54)	California Offshore	1,831 (0.47)		No Trend	Common	YES	YES
Cuvier's beaked whale *Ziphius cavirostris*	4,342 (0.58)	California, Oregon, & Washington	911 (0.68)		Unknown	Uncommon; seaward of 1000 m; only limited sightings in winter	YES	UNK
Dall's porpoise *Phocoenoides dalli*	85,955 (0.45)	California, Oregon, & Washington	727 (0.99)		Unknown	Common; year round cool water species; more abundant Nov-Apr	NO	YES
Dwarf sperm whale *Kogia sima*	Unknown	California, Oregon, & Washington	0		Unknown	Possible visitor; seaward of 500-1000 m; limited sightings over entire SCB	UNK	YES LESS
False killer whale *Pseudorca crassidens*	Unknown Rare	Eastern Tropical Pacific	Unknown		Unknown	Uncommon; warm water species; although stranding records from the Channel Islands	UNK	UNK
Killer whale offshore *Orcinus orca*	1,340 (0.31)	Eastern North Pacific	30 (0.73)		Unknown	Uncommon; occurs infrequently; more likely in winter	NO	YES

Common Name Species Name	Abundance (CV)	Stock	Southern California Abundance	ESA/ MMPA Status	Annual Population Trend	Occurrence	Warm Season May-Oct	Cold Season Nov-
Killer whale transient *Orcinus orca*	346	Eastern North Pacific	Unknown		Unknown	Uncommon; occurs infrequently; more likely in winter	NO	YES
Long-beaked common dolphin *Delphinus capensis*	21,902 (0.50)	California	17,530 (0.57)		Varies by oceanographi c conditions	Common; more inshore distribution	YES	YES
Mesoplodont beaked whales[1] *Mesoplodon spp.*	1,177 (0.40)	California, Oregon, & Washington	132 (0.96)		Unknown	Rare; seaward of 500-1000 m; limited sightings	UNK	UNK
Northern right whale dolphin *Lissodelphis borealis*	11,097 (0.26)	California, Oregon, & Washington	1,172 (0.52)		No Trend	Common; cool water species; more abundant Nov-Apr	YES	YES
Pacific white-sided dolphin *Lagenorhynchus obliguidens*	23,817 (0.36)	California, Oregon, & Washington	2,196 (0.71)		No Trend	Common; year round cool water species; more abundant Nov-Apr	YES LESS	YES MORE
Pantropical spotted dolphin *Stenella attenuate*	Unknown	Eastern Tropical Pacific	Unknown		Unknown	Rare	UNK	UNK
Pygmy sperm whale *Kogia breviceps*	247 (1.06)	California, Oregon, & Washington	0		Unknown	Rare; seaward of 500-1000 m; limited sightings over entire SCB	UNK	UNK
Risso's Dolphin *Grampus griseus*	11,910 (0.24)	California, Oregon, & Washington	3,418 (0.31)		No Trend	Common; present in summer, but higher densities Nov-Apr	YES LESS	YES MORE
Rough-toothed dolphin *Steno bredanensis*	Unknown	Tropical and warm temperate	Unknown		Unknown	Rare; more tropical offshore species	RARE	RARE
Short-beaked common dolphin *Delphinus delphis*	352,069 (0.18)	California, Oregon, & Washington	165,400 (0.19)		Varies with ocean-ographic conditions	Common; one of the most abundant SOCAL dolphins; higher summer densities	YES MORE	YES LESS
Short-finned pilot whale *Globicephala macrorhynchus*	350 (0.48)	California, Oregon, & Washington	118 (1.04)		Unknown	Uncommon; more common before 1982	UNK	UNK

Common Name Species Name	Abundance (CV)	Stock	Southern California Abundance	ESA/ MMPA Status	Annual Population Trend	Occurrence	Warm Season May-Oct	Cold Season Nov-
Spinner dolphin *Stenella longirostris*	2,805 (0.66)	Tropical and warm temperate	Unknown		Unknown	Rare	RARE	RARE
Striped dolphin *Stenella coeruleoalba*	18,976 (0.28)	California, Oregon, & Washington	12,529 (0.28)		No Trend	Occasional visitor; cool water oceanic species	NO	RARE
Pinnipeds								
Harbor seal *Phoca vitulina*	34,233	California	5,271 (All age classes from aerial counts)[4]		Stablizing	Common; Channel Islands haul-outs including SCI	YES	YES
Northern elephant seal *Mirounga angustirostris*	101,000	California Breeding	SNI 9,794 pups in 2000. SCI up to 16 through 2000 [5]		Increasing < 8,3%	Common; Channel Island haul-outs of different age classes; including SCI Dec-Mar and Apr-Aug; spend 8-10 months at sea	YES	YES
California sea lion *Zalophus californianus*	237,000	U.S. Stock	All pupping occurs in Southern California		Increasing 6.1%	Common; most common pinniped, Channel Islands breeding sites in summer	YES	YES
Northern fur seal *Callorhinus ursinus*	9,424	San Miguel Island	San Miguel Is. is within Southern California but is outside of the SOCAL Range Complex		Increasing 8.6%	Common; small population that breeds on San Miguel Is. May-Oct	YES MORE	YES LESS

[1]Stock or population abundance estimates and correlation of variance (CV) status under the Endangered Species Act (ESA) and the Marine Mammal Protection Act (MMPA), and the population trend are from NMFS 2006 Pacific Stock Assessment Reports (SAR) (Carretta et al., 2007), **E**=Endangered under the ESA; **D** = Depleted under the MMPA; and **S**=Strategic Stock under the MMPA. Due to lack of information, several beaked whale species have been grouped together under Mesoplodont by the National Marine Fisheries Service.

[2] Sources used to define trend are Carretta et al. (2007), and NMFS (2006e)

[3] Seven whales were identified as either Bryde's or Sei whales but could not be identified to the species level

[4] Lowry and Carretta (2003)

[5] Lowry (2002)

Southern California abundance is from Point Conception to the US-Mexican border

SOCAL oceanographic Warm Season defined as May-Oct; Cold Season defined as Nov-Apr: YES = likely to occur; MORE= more likely to occur within this season; NO= unlikely to occur; LESS= less likely to occur within this season, but possible.

3.9.5 Marine Mammal Abundance and Density Estimates for Southern California

Marine mammal species occurring off southern California include baleen whales (mysticetes), toothed whales (odontocetes), seals and sea lions (commonly referred to as pinnipeds), and sea otters. Baleen and toothed whales, collectively known as cetaceans, spend their entire lives in the water and spend most of the time (>90% for most species) entirely submerged below the surface. When at the surface, cetacean bodies are almost entirely below the water's surface, with only the blowhole exposed to allow breathing. This makes cetaceans difficult to locate visually and also exposes them to underwater noise, both natural and anthropogenic, essentially 100% of the time because their ears are nearly always below the water's surface. Seals and sea lions (pinnipeds) spend significant amounts of time out of the water during breeding, molting and hauling out periods. In the water, pinnipeds spend varying amounts of time underwater, as some species regularly undertake long, deep dives (e.g., elephant seals) and others are known to rest at the surface in large groups for long amounts of time (e.g., California sea lions). When not actively diving, pinnipeds at the surface often orient their bodies vertically in the water column and often hold their heads above the water surface. Consequently, pinnipeds may not be exposed to underwater sounds to the same extent as cetaceans. Sea otters generally do not spend significant amounts of time on land, but they also often hold their heads above the water's surface, reducing the amount of exposure to underwater sound.

For the purposes of this analysis, we have adopted a conservative approach to underwater noise and marine mammals:

Cetaceans – assume 100% of time is spent underwater and therefore exposed to underwater sound

Pinnipeds – adjust densities to account for time periods spent at breeding areas, haulouts, etc.; but for those animals in the water, assume 100% of time is spent underwater and therefore exposed to underwater sound

Sea otters – assume 100% of time is spent underwater and therefore exposed to underwater sound.

3.9.5.1 Density

The southern California region has been systematically surveyed for several years (1991-1993, 1996, 2001, 2005) by the National Marine Fisheries Service (NMFS), both via aircraft (e.g., Carretta and Forney, 1993) and vessel (e.g., Ferguson and Barlow, 2003; Barlow, 2003; Forney, 2007). Line-transect methods were used to analyze data collected from Southwest Fisheries Science Center (SWFSC) ship surveys in 1991, 1993, 1996, 2001, and 2005 off the U.S. west coast. A new multiple-covariate, line-transect approach (Marques and Buckland, 2003) was used to account for multiple factors that affect the distance at which cetaceans can be seen in different conditions. The most recent vessel survey was conducted out to 300 nm offshore California, Oregon and Washington by NMFS in summer and fall 2005 (Forney, 2007). There has also been regional survey effort in the area, particularly around San Clemente Island and in extreme near shore areas (e.g., Carretta et al., 2000; Carretta, 2003). Consequently there are several density estimates available for most cetacean species in southern California. Compiled densities from vessel surveys conducted since 1986 have been analyzed by NMFS, and were provided as Government Furnished Information (GFI). Density calculation procedures and protocols used by NFMS for this analysis are as described in Barlow (2007), Barlow and Forney (2007), and Forney (2007). These density compilations prorate densities of “unidentified” species groups (such as unidentified dolphins, small whales, rorquals, large whales, etc) with densities of identified species, so likely represent the most conservative densities at this time for the southern California region. Densities are presented for warm (May-October) and cold water (November-April) seasons in water depths >1000 m north of 30°N. Gray whale densities were taken from Carretta et al. (2000), and are applicable for January-April only. Species with rare or extralimital occurrence off southern California are included in the species summaries; however, there are no densities available and they are not included in Table 3.9-2. The geographic distributions of cetacean species for which densities are available in this area overlap completely with all seven sonar areas (shown in Figure 3.9-1), so further refinement of densities to sonar areas was not necessary. Area 8, includes all areas outside the seven depicted sonar areas that are within the quasi-rectangular region bounded in latitude by 29^{o} N and 34^{o} N, and in longitude by 120^{o} 30' W and 116^{o} 30' W. Area 8 is not shown on Figure 3.9-2.

Pinniped at-sea density is not often available because pinniped abundance is obtained via shore counts of animals at known rookeries and haulouts. Therefore, densities of pinnipeds were derived quite differently from those of cetaceans. Several parameters were identified from the literature, including area of stock occurrence, number of animals (which may vary seasonally) and season, and those parameters were then used to calculate density. Once density per "pinniped season" was determined, those values were prorated to fit the warm water (May-October) and cold water (November-April) seasons. Determining density in this manner is risky as the parameters used usually contain error (e.g., geographic range is not exactly known and needs to be estimated, abundance estimates usually have large variances) and, as is true of all density estimates, it assumes that animals are always distributed evenly within an area which is likely never true. However, this remains one of the few means available to determine at-sea density for pinnipeds.

Sea otters occur along the central California coast and there is an experimental population of relocated otters at San Nicolas Island.

3.9.5.2 Depth Distribution

There are limited depth distribution data for most marine mammals. This is especially true for cetaceans, as they must be tagged at-sea and by using a tag that either must be implanted in the skin/blubber in some manner or adhere to the skin. There is slightly more data for some pinnipeds, as they can be tagged while on shore during breeding or molting seasons and the tags can be glued to the pelage rather than implanted. There are a few different methodologies/techniques that can be used to determine depth distribution percentages, but by far the most widely used technique currently is the time-depth recorder. These instruments are attached to the animal for a fairly short period of time (several hours to a few days) via a suction cup or glue, and then retrieved immediately after detachment or when the animal returns to the beach. Depth information can also be collected via satellite tags, sonic tags, digital tags, and, for sperm whales, via acoustic tracking of sounds produced by the animal itself.

There are somewhat suitable depth distribution data for a few marine mammal species. Sample sizes are usually extremely small, nearly always fewer than 10 animals total and often only one or two animals. Depth distribution information often must be interpreted from other dive and/or preferred prey characteristics. Depth distributions for species for which no data are available are extrapolated from similar species.

Depth information for marine mammal species in the SOCAL region for which densities are available is included as Appendix F.

3.9.5.3 Density and Depth Distribution Combined

Density is nearly always reported for an area, e.g., animals per square kilometer (km^2). Analyses of survey results using Distance Sampling techniques include correction factors for animals at the surface but not seen as well as animals below the surface and not seen. Therefore, although the area (e.g., km^2) appears to represent only the surface of the water (two-dimensional), density actually implicitly includes animals anywhere within the water column under that surface area. Density assumes that animals are uniformly distributed within the prescribed area, even though this is likely rarely true. Marine mammals are usually clumped in areas of greater importance, for example, areas of high productivity, lower predation, safe calving, etc. Density can occasionally be calculated for smaller areas that are used regularly by marine mammals, but more often than not there are insufficient data to calculate density for small areas. Therefore, assuming an even distribution within the prescribed area remains the norm.

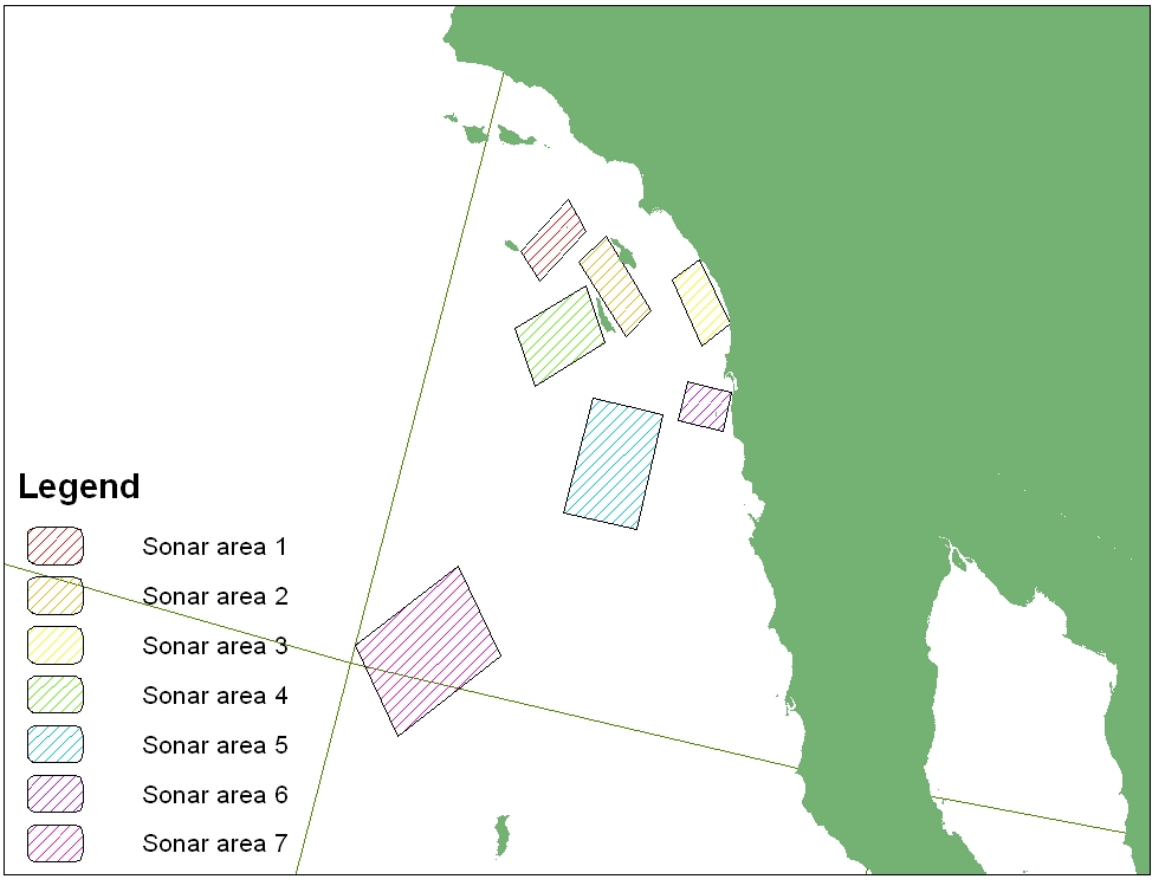

Figure: 3.9-1: Sonar Model Areas

Area 8 (not depicted) includes all areas outside the seven depicted areas that are within the quasi-rectangular region bounded in latitude by 29o N and 34o N, and in longitude by 120o 30’ W and 116o 30’ W.

Assuming that marine mammals are distributed evenly within the water column is not accurate. The ever-expanding database of marine mammal behavioral and physiological parameters obtained through tagging and other technologies has demonstrated that marine mammals use the water column in various ways, with some species capable of regular deep dives (<800 m) and others regularly diving to <200 m, regardless of the bottom depth. Assuming that all species are evenly distributed from surface to bottom is almost never appropriate and can present a distorted view of marine mammal distribution in any region.

By combining marine mammal density with depth distribution information, a more accurate three-dimensional density estimate is possible. These 3-D estimates allow more accurate modeling of potential marine mammal exposures from specific noise sources. The Marine

Resource Assessment (MRA) for the Southern California Operating Area lists 45 marine mammals in the "vicinity" of the SOCAL Range Complex (DoN 2005). However, several of the species listed in the MRA are rare or extralimital in southern California waters and do not regularly occur. Only species with regular occurrence and for which density is available are included in Table 3.9-2.

Table 3.9-2: Summary of Marine Mammal Densities Used for Exposure Modeling

Species Name	Warm Season density/km²	Cold Season density/km²	Source	Notes
ESA Species				
Blue whale	0.0041222	0.0041222	Barlow (2007)	
Fin whale	0.0024267	0.0008008	Barlow (2007)	
Humpback whale	0.0001613	0.0000984	Barlow (2007)	
Sei whale	0.0000081	0.000005	Barlow (2007)	
Sperm whale	0.0014313	0.0008731	Barlow (2007)	
Guadalupe fur seal	0.007	0.007	Gallo-Reynoso (1994)	Applicable to 100% of the seven sonar areas; unknown % in area 8
California sea otter	0.3	0.3	US Fish and Wildlife Service (2003)	Applicable to 0.06% of sonar area 1 and 0% of areas 2,3,4,5,6,7; unknown % of area 8
MYSTICETES				
Bryde's whale	0.0000081	0.0000081	Barlow (2007)	
Gray whale	0	0.051	Carretta et al. (2000)	Applies to Jan-Apr only
Minke whale	0.0010313	0.0010313	Barlow (2007)	
ODONTOCETES				
Baird's beaked whale	0.0001434	0.0001434	Barlow (2007)	
Bottlenose dolphin	0.0123205	0.0184808	Barlow (2007)	
Cuvier's beaked whale	0.0036883	0.0036883	Barlow (2007)	
Dall's porpoise	0.0016877	0.0081008	Barlow (2007)	
Killer whale	0.0000812	0.0000812	Barlow (2007)	
Long-beaked common dolphin	0.0965747	0.0366984	Barlow (2007)	
Mesoplodonts	0.0011125	0.0011125	Barlow (2007)	
Northern right whale dolphin	0.0056284	0.0270163	Barlow (2007)	
Pacific white-sided dolphin	0.0160748	0.0160748	Barlow (2007)	
Pygmy sperm whale	0.0013785	0.0013785	Barlow (2007)	
Short-finned pilot whale	0.0003315	0.0003315	Barlow (2007)	
Risso's dolphin	0.0180045	0.0540134	Barlow (2007)	
Short-beaked common dolphin	0.8299606	0.315385	Barlow (2007)	
Striped dolphin	0.0175442	0.0107019	Barlow (2007)	
Ziphiid whales	0.0008214	0.0008214	Barlow (2007)	

Species Name	Warm Season density/km^2	Cold Season density/km^2	Source	Notes
CARNIVORES - Pinnipeds and Sea Otter				
Northern elephant seal	0.042	0.025	Caretta et al. (2007); Lowry (2002)	Applicable to 100% of sonar areas 1 and 2, 94% of area 3, 18% of area 4 and 0% of areas 5,6,7; unknown % in area 8
Harbor seal	0.19	0.19	Lowry et al. (2005)	Applicable to 4% of sonar area 1, 20% of area 2, 5% of area 4, and 0% of areas 3,5,6,7; unknown % in area 8
California sea lion	0.605	0.87	Lowry and Maravilla-Chavez (2005)	Applicable to 100% of sonar areas 1,2,3 and 6; 49% of area 4, 62% of area 5 and 0% of area 7; unknown % in area 8
Northern fur seal	0.027	0.027	National Marine Fisheries Service (2006); Carretta et al. (2007)	applicable to 0% of the seven OPAREA sonar areas; unknown % in area 8

Lowry 2002, Lowry et al. (2005), Barlow (2007), and Carretta et al. (2007) are government furnished information from NMFS reports or technical memorandum.

3.9.6 Marine Mammal Acoustics

3.9.6.1 Cetaceans

Cetaceans have an auditory anatomy that follows the basic mammalian pattern, with some adaptations to the demands of hearing underwater. The typical mammalian ear is divided into an outer ear, middle ear, and inner ear. The outer ear is separated from the inner ear by a tympanic membrane, or eardrum. In terrestrial mammals, the outer ear, eardrum, and middle ear transmit airborne sound to the inner ear, where the sound is detected in a fluid. Since cetaceans already live in a fluid medium, they do not require this matching, and thus do not have an air-filled external ear canal. Sound may enter through the lower jaw in cetaceans (Brill *et al*. 1988; Ketten 1997, 2000). The inner ear is where sound energy is converted into neural signals that are transmitted to the central nervous system via the auditory nerve. Acoustic energy causes the basilar membrane in the cochlea to vibrate. Sensory cells at different positions along the basilar membrane are excited by different frequencies of sound (Tyack 1999). Baleen whales have inner ears that appear to be specialized for low-frequency hearing.

Marine mammal vocalizations often extend both above and below the range of human hearing; vocalizations with frequencies lower than 18 Hertz (Hz) are labeled as infrasonic and those higher than 20 kilohertz (kHz) as ultrasonic. Measured data on the hearing abilities of cetaceans are sparse and are non-existent for for the larger cetaceans such as the baleen whales. The auditory thresholds of some of the smaller odontocetes have been determined in captivity. It is generally believed that cetaceans should at least be sensitive to the frequencies of their own vocalizations. Comparisons of the anatomy of cetacean inner ears and models of the structural properties and the response to vibrations of the ear's components in different species provide an indication of likely sensitivity to various sound frequencies. The ears of small toothed whales are optimized for receiving high-frequency sound, while baleen whale inner ears are best in low to infrasonic frequencies (Ketten 1992, 1997, 1998).

Baleen whales primarily use the lower frequencies, producing tonal sounds in the frequency range of 15 to 3,000 Hz, with good suggested sensitivity from 20 Hz to 2 kHz depending on the species (Ketten 1998). Clark and Ellison (2004) suggested that baleen whales use low frequency sounds not only for long-range communication, but also as a simple form of echo ranging, using echoes to navigate and orient relative to physical features of the ocean. Information on auditory function in mysticetes is extremely lacking. Sensitivity to low-frequency sound by baleen whales has been inferred from observed vocalization frequencies, observed reactions to playback of sounds, and anatomical analyses of the auditory system.

Baleen whale vocalizations are composed primarily of frequencies below 1 kHz, and some contain fundamental frequencies as low as 16 Hz (Watkins *et al*. 1987; Richardson et al. 1995; Rivers 1997; Moore *et al*. 1998; Stafford *et al.* 1999; Wartzok and Ketten 1999). Although there is apparently much variation, the source levels of most baleen whale vocalizations lie in the range of 150-190 dB re 1 µPa at 1 m. Low-frequency vocalizations made by baleen whales and their corresponding auditory anatomy suggest that they have good low-frequency hearing (Ketten 2000), although specific data on sensitivity, frequency or intensity discrimination, or localization abilities are lacking. Marine mammals, like all mammals, have typical U-shaped audiograms that begin with relatively low sensitivity (high threshold) at some specified low frequency with increased sensitivity (low threshold) to a species specific optimum followed by a generally steep rise at higher frequencies (high threshold) (Fay 1988).

The majority of blue and fin whales vocalizations are less than 222 Hz (Cummings and Thompson 1971 Thompson et al. 1992; Berchok et al. 2003a, 2003b; Mellinger and Clarke 2003; Clarke 2004; Rankin et al. 2004). Blue whales produce a variety of low-frequency sounds in a 10-100 Hz band (Cummings and Thompson 1971; Edds 1982; Thompson and Friedl 1982; Alling and Payne 1991; McDonald et al. 1995; Clark and Fristrup, 1997; Rivers, 1997; Stafford et al., 1998; Stafford et al. 1999; McDonald et al. 2001). Off California, the most typical blue whale signals are very long, patterned sequences of tonal infrasonic sounds in the 15-100 Hz range (Aburto et al. 1997; Teranishi et al. 1997; McDonald et al. 2001; Oleson et al. 2005), and are typically infrequently produced by a small subset of males (Calambokidis et al. 2004; Oleson et al. 2005).

Fin whales produce a variety of low frequency sounds, primarily in the 15-200 Hz band (Watkins, 1981; Watkins et al. 1987; Edds, 1988; Thompson et al. 1992; McDonald and Fox 1999). The most typical signals are long, patterned sequences of short duration (0.5-2 seconds) infrasonic pulses in the 18-35 Hz range (Patterson and Hamilton 1964; Watkins et al. 1987).

Three sounds are produced by humpback whales: "songs" produced in late fall, winter, and spring by single animals; sounds produced by groups of humpback whales (possibly associated with aggressive behavior among males) on the winter breeding grounds; and sounds produced on the summer feeding grounds. Dominant frequencies of these songs range from 40 Hz to 4 kHz, with components of up to 8 kHz (Thompson et al. 1979; Richardson et al. 1995). Recent information on the songs of humpback whales that measured harmonics up to 24 kHz and source levels of 151-173 decibels (dB) re 1 µPa suggest that their hearing may also extend to 24 kHz (Au et al. 2006). Source levels average 155 dB re 1 µPa at 1 m and range from 144 to 174 dB re 1 µPa at 1 m (Thompson et al., 1979). Sounds often associated with possible aggressive behavior by males are quite different from songs, extending from 50 Hz to 10 kHz (or higher), with most energy in components below 3 kHz (Tyack and Whitehead 1983). Sounds are produced less frequently on summer feeding grounds and are at approximately 20-2000 Hz, with median durations of 0.2-0.8 sec and source levels of 175-192 dB re 1 µPa at 1 m (Thompson et al. 1986). Filter-bank models of the humpback whale's ear have been developed from anatomical features of the humpback's ear and optimization techniques (Houser et al. 2001), indicating that humpbacks are sensitive to frequencies between 700 Hz and 10 kHz.

Minke whales produce a variety of sounds, primarily in the 80-5,000 Hz range. In the Northern Hemisphere, sounds recorded include grunts, thumps, and ratchets from 80-850 Hz and pings and clicks from 3-20 kHz (Winn and Perkins 1976; Thompson et al. 1979; Stewart and Leatherwood 1985; Mellinger et al. 2000).

The toothed whales produce a wide variety of sounds, which include species-specific broadband “clicks” with peak energy between 10 and 200 kHz, individually variable “burst pulse” click trains, and constant frequency or frequency-modulated (FM) whistles ranging from 4 to 16 kHz (Wartzok and Ketten 1999). The general consensus is that the tonal vocalizations (whistles) produced by toothed whales play an important role in maintaining contact between dispersed individuals, while broadband clicks are used during echolocation (Wartzok and Ketten 1999). Burst pulses have also been strongly implicated in communication, with some scientists suggesting that they play an important role in agonistic encounters (McCowan and Reiss 1995), while others have proposed that they represent “emotive” signals in a broader sense, possibly representing graded communication signals (Herzing 1996). Sperm whales, however, are known to produce only clicks, which are used for both communication and echolocation (Whitehead 2003). Most of the energy of toothed whales social vocalizations is concentrated near 10 kHz, with source levels for whistles as high as 100-180 dB re 1 µPa at 1 m (Richardson et al. 1995). No odontocete has been shown audiometrically to have acute hearing (<80 dB re 1 µPa) below 500 Hz (DoN 2001). Sperm whales produce clicks, which may be used to echolocate (Mullins et al., 1988), with a frequency range from less than 100 Hz to 30 kHz and source levels up to 230 dB re 1 µPa 1 m or greater (Møhl et al. 2000). There are no specific data on the hearing sensitivity of sperm whales, but immature animals, at least, appear to have medium- and high-frequency hearing abilities similar to the other odontocete species tested (Carder and Ridgway 1990).

3.9.6.2 Pinnipeds

Sounds produced by pinnipeds include airborne and underwater vocalizations (Richardson et al. 1995). Calls include grunts, barks, and growls, in addition to the more conventional whistles, clicks, and pulses. The majority of pinniped sounds are in the sonic range (20 Hz to 20 kHz) (Ketten 1998; Wartzok and Ketten 1999). In general, phocids are far more vocal underwater than are otariids. Phocid calls are commonly between 100 Hz and 15 kHz, with peak spectra less than 5 kHz, but can range as high as 40 kHz (Ketten 1998; Wartzok and Ketten 1999). There is no evidence that pinnipeds echolocate (Schusterman et al. 2000). Pinniped hearing falls within the range of MFA sonar but to date there is little information on the effect of sonar on pinnipeds. Most of the acoustic behavior of pinnipeds takes place onshore at rookeries or just offshore for species that may hold territories in the water. The northern elephant seal produces loud, low-frequency in-air vocalizations (Bartholomew and Collias 1962). The mean fundamental frequencies are in the range of 147 to 334 Hz for adult males (Le Boeuf and Petrinovich 1974). The mean source level of the male-produced vocalizations during the breeding season is 110 dB re 20 µPa (Sanvito and Galimberti 2003). The harbor seal hears almost equally well in air and underwater (Kastak and Schusterman 1998). Harbor seals hear best at frequencies from 1 to 180 kHz; the peak hearing sensitivity is at 32 kHz in water and 12 kHz in air (Terhune and Turnball 1995; Kastak and Schusterman, 1998; Wolski et al. 2003). The range of maximal sensitivity underwater for the California sea lions is between 1 and 28 kHz (Schusterman et al. 1972). Functional underwater high frequency hearing limits are between 35 and 40 kHz, with peak sensitivities from 15 to 30 kHz (Schusterman et al. 1972).

In comparison with toothed whales, pinnipeds tend to have lower best frequencies, lower high-frequency cutoffs, and poorer sensitivity at the best frequency (Richardson et al. 1995). However, some pinnipeds (especially phocids) may have better sensitivity at low frequencies (<1 kHz) than do toothed whales (Richardson et al. 1995). The pinniped ear appears to have been constrained during its evolution by the necessity of functioning in two acoustically dissimilar media (air and water). The patterns of air and water hearing sensitivity appear to correspond to the patterns of life history of the pinniped species (Kastak and Schusterman 1998). Comparisons of the hearing characteristics of otariids and phocids suggest two types of pinniped ears, with phocids being better adapted for underwater hearing (Richardson et al. 1995; Kastak and Schusterman 1998; Ketten 1998; Wartzok and Ketten 1999). In phocids tested, peak sensitivities ranged between 10 and 30 kHz, with a functional high frequency limit of about 60 kHz (Richardson et al. 1995; Ketten 1998; Wartzok and Ketten 1999).

General reviews of cetacean and pinniped sound production and hearing may be found in Richardson et al. (1995), Edds-Walton (1997), Wartzok and Ketten (1999), and Au et al. (2000), May-Collado et al. (2007). For a discussion of acoustic concepts, terminology, and measurement procedures, as well as underwater sound propagation, refer to Urick (1983) and Richardson et al. (1995).

3.9.7 Analytical Framework For Assessing Marine Mammal Response to Sonar

3.9.7.1 Conceptual Framework

As summarized by the National Academies of Science (NAS), the possibility that human-generated sound could harm marine mammals or significantly interfere with their “normal” activities is an issue of increasing concern (National Research Council [NRC] 2005). This section of the authorization request evaluates the potential for the specific Navy acoustic sources used in the SOCAL Range Complex to result in harassment of marine mammals.

Marine mammals respond to various types of man-made sounds introduced in the ocean environment. Responses are typically subtle and can include shorter surfacings, shorter dives, fewer blows per surfacing, longer intervals between blows (breaths), ceasing or increasing vocalizations, shortening or lengthening vocalizations, and changing frequency or intensity of vocalizations (NRC, 2005). However, it is not known how these responses relate to significant effects (e.g., long-term effects or population consequences) (NRC, 2005). Assessing whether a sound may disturb or injure a marine mammal involves understanding the characteristics of the acoustic sources, the marine mammals that may be present in the vicinity of the sound, and the effects that sound may have on the physiology and behavior of those marine mammals. Although it is known that sound is important for marine mammal communication, navigation and foraging (NAS 2003; NRC 2005), there are many unknowns in assessing the effects and significance of marine mammals responses to sound exposures. For this reason, the Navy enlisted the expertise of National Marine Fisheries Service (NMFS) as the cooperating agency. Their input assisted the Navy in developing a conceptual analytical framework for evaluating what sound levels marine mammals might receive as a result of Navy training actions, whether marine mammals might respond to these exposures, and whether that response might have a mode of action on the biology or ecology of marine mammals such that the response should be considered a potential harassment. From this framework of evaluating the potential for harassment incidents to occur, an assessment of whether acoustic sources might impact populations, stocks or species of marine mammals can be conducted.

The conceptual analytical framework (Figure 3.9-2) presents an overview of how the mid-frequency active sonar sources used during training are assessed to evaluate the potential for marine mammals to be exposed to an acoustic source, the potential for that exposure to result in a physiological effect or behavioral response by an animal, and the assessment of whether that response may result in a consequence that constitutes harassment in accordance with MMPA definitions.

The first step in the conceptual model is to estimate the potential for marine mammals to be exposed to a Navy acoustic source. Three questions are answered in this “acoustic modeling” step:

1. What action will occur? This requires identification of all acoustic sources that would be used in the exercises and the specific outputs of those sources. This information is provided in Appendix A.

2. Where and when will the action occur? The place and season of the action are important to determine which marine mammal species are likely to be present. Species occurrence and density data (Section 3.9.5) are used to determine the subset of marine mammals that may be present when an acoustic source is operational.

3. Predict the underwater acoustic environment that would be encountered. The acoustic environment here refers to environmental factors that influence the propagation of underwater sound. Acoustic parameters influenced by the place, season, and time are described in Appendix F.

4. How many marine mammals are predicted to be exposed to sound from the acoustic sources? Sound propagation models are used to predict the received exposure level from an acoustic source, and these are coupled with species distribution and density data to estimate the accumulated received energy and sound pressure level that might be received at a level that could be considered as potential harassment. Appendix F describes the acoustic modeling and Section 3.9.7.5 present the number of exposure incidents predicted by the modeling.

The next steps in the analytical framework evaluate whether the sound exposures predicted by the acoustic model might cause a response in a marine mammal, and if that response might be considered harassment of the animal. Harassment includes the concepts of potential injury (Level A Harassment) and behavioral disturbance (Level B harassment). The response assessment portion of the analytical framework examines the following question:

1. Which potential acoustic exposures might result in harassment of marine mammals?

The predicted acoustic exposures are first considered within the context of the species biology (e.g., can a marine mammal detect the sound, and is that mammal likely to respond to that sound?). Next, if a response is predicted, is that response potentially ‘harassment’ in accordance with MMPA harassment definitions? For example, if a response to the acoustic exposure has a mode of action that results in a consequence for an individual, such as interruption of feeding, that response or repeated occurrence of that response could be considered “abandonment or significant alteration of natural behavioral patterns,” and therefore the exposure(s) would cause Level B harassment.

The following flow chart (Figure 3.9-2) is a representation of the general analytical framework utilized in applying the specific thresholds discussed in this section. The framework presented in the flow chart is organized from left to right and is compartmentalized according to the phenomena that occur within each. These include the physics of sound propagation (Physics), the potential physiological processes associated with sound exposure (Physiology), the potential behavioral processes that might be affected as a function of sound exposure (Behavior), and the immediate effects these changes may have on functions the animal is engaged in at the time of exposure (Life Function – Proximate). These compartmentalized effects are extended to longer term life functions (Life Function – Ultimate) and into population and species effects. Throughout the flow chart, dotted and solid lines are used to connect related events. Solid lines designate those effects that “will” happen; dotted lines designate those that “might” happen but must be considered (including those hypothesized to occur but for which there is no direct evidence).

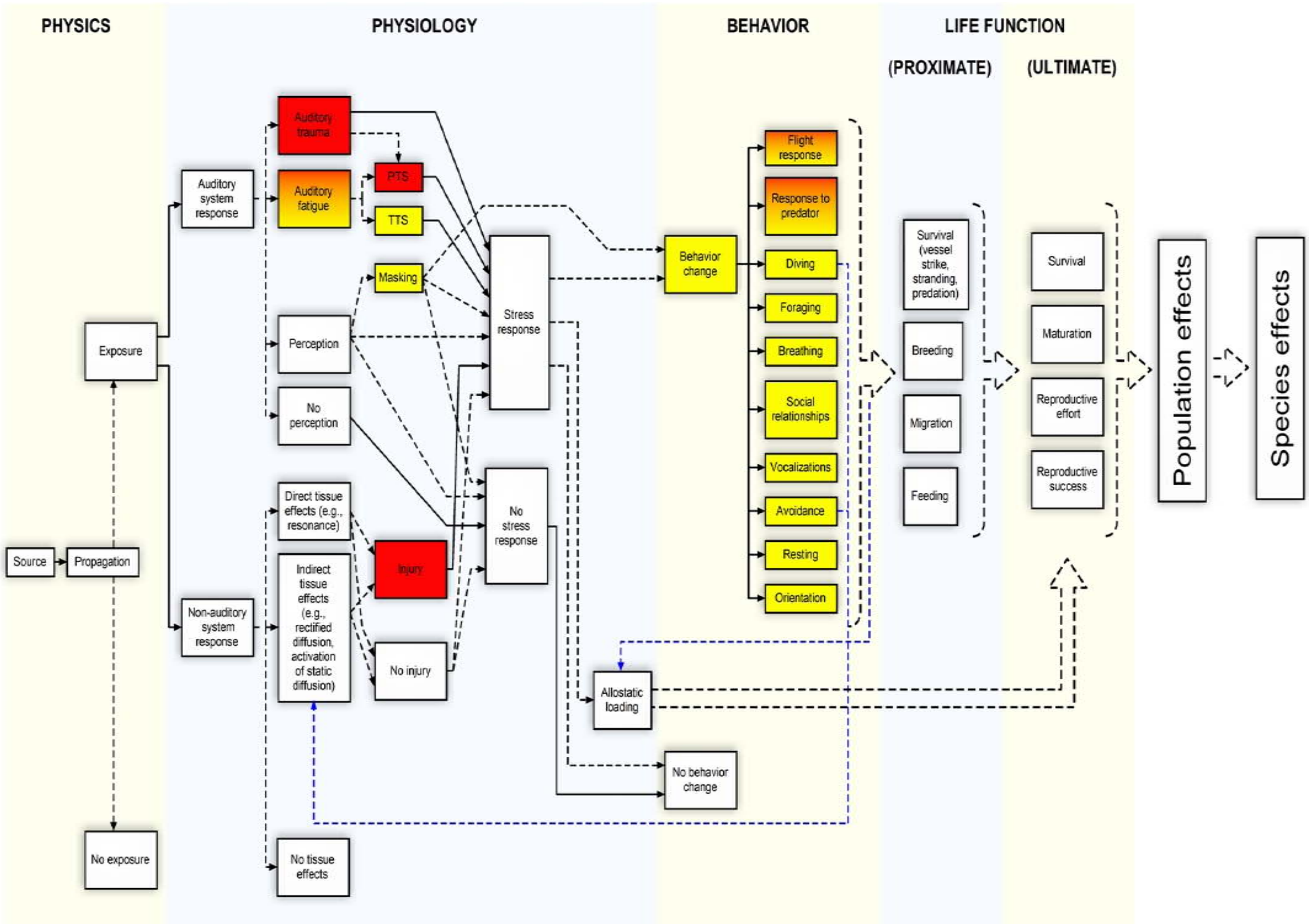

Figure 3.9-2: Conceptual Model for Assessing Effects of MFA Sonar Exposures on Marine Mammals.

Some boxes contained within the flow chart are colored according to how they relate to the definitions of harassment under the Marine Mammal Protection Act (MMPA). Red boxes correspond to events that are injurious. By prior ruling and usage, these events would be considered as Level A harassment under the MMPA. Yellow boxes correspond to events that have the potential to qualify as Level B harassment under the MMPA. Based on prior ruling, the specific instance of TTS is considered as Level B harassment. Boxes that are shaded from red to yellow have the potential for injury and behavioral disturbance. The analytical framework outlined within the flow chart acknowledges that physiological responses must always precede behavioral responses (i.e., there can be no behavioral response without first some physiological effect of the sound) and an organization where each functional block only occurs once and all relevant inputs/outputs flow to/from a single instance.

3.9.7.1.1 Physiology

Potential impacts to the auditory system are assessed by considering the characteristics of the received sound (e.g., amplitude, frequency, duration) and the sensitivity of the exposed animals. Some of these assessments can be numerically based (e.g., TTS, permanent threshold shift [PTS], perception). Others will be necessarily qualitative, due to lack of information, or will need to be extrapolated from other species for which information exists. Potential physiological responses to the sound exposure are ranked in descending order, with the most severe impact (auditory trauma) occurring at the top and the least severe impact occurring at the bottom (the sound is not perceived).

1. Auditory trauma represents direct mechanical injury to hearing related structures, including tympanic membrane rupture, disarticulation of the middle ear ossicles, and trauma to the inner ear structures such as the organ of Corti and the associated hair cells. Auditory trauma is always injurious but could be temporary and not result in PTS. Auditory trauma is always assumed to result in a stress response.

2. Auditory fatigue refers to a loss of hearing sensitivity after sound stimulation. The loss of sensitivity persists after, sometimes long after, the cessation of the sound. The mechanisms responsible for auditory fatigue differ from auditory trauma and would primarily consist of metabolic exhaustion of the hair cells and cochlear tissues. The features of the exposure (e.g., amplitude, frequency, duration, temporal pattern) and the individual animal’s susceptibility would determine the severity of fatigue and whether the effects were temporary (TTS) or permanent (PTS). Auditory fatigue (PTS or TTS) is always assumed to result in a stress response.

3. Sounds with sufficient amplitude and duration to be detected among the background ambient noise are considered to be perceived. This category includes sounds from the threshold of audibility through the normal dynamic range of hearing (i.e., not capable of producing fatigue). To determine whether an animal perceives the sound, the received level, frequency, and duration of the sound are compared to what is known of the species’ hearing sensitivity.

Since audible sounds may interfere with an animal’s ability to detect other sounds at the same time, perceived sounds have the potential to result in auditory masking. Unlike auditory fatigue, which always results in a stress response because the sensory tissues are being stimulated beyond their normal physiological range, masking may or may not result in a stress response, depending on the degree and duration of the masking effect. Masking may also result in a unique circumstance where an animal’s ability to detect other sounds is compromised without the animal’s knowledge. This could conceivably result in sensory impairment and subsequent behavior change; in this case, the change in behavior is the *lack of a response* that would normally be made if sensory impairment did not occur. For this reason, masking also may lead directly to behavior change without first causing a stress response.

The features of perceived sound (e.g., amplitude, duration, temporal pattern) are also used to judge whether the sound exposure is capable of producing a stress response. Factors to consider in this decision include the probability of the animal being naïve or experienced with the sound (i.e., what are the known/unknown consequences of the exposure).

The received level is not of sufficient amplitude, frequency, and duration to be perceptible by the animal. By extension, this does not result in a stress response (not perceived).

Potential impacts to tissues other than those related to the auditory system are assessed by considering the characteristics of the sound (e.g., amplitude, frequency, duration) and the known or estimated response characteristics of nonauditory tissues. Some of these assessments can be numerically based (e.g., exposure required for rectified diffusion). Others will be necessarily qualitative, due to lack of information. Each of the potential responses may or may not result in a stress response.

1. Direct tissue effects – Direct tissue responses to sound stimulation may range from tissue shearing (injury) to mechanical vibration with no resulting injury. Any tissue injury would produce a stress response, whereas noninjurious stimulation may or may not.

2. Indirect tissue effects – Based on the amplitude, frequency, and duration of the sound, it must be assessed whether exposure is sufficient to indirectly affect tissues. For example, the hypothesis that rectified diffusion occurs is based on the idea that bubbles that naturally exist in biological tissues can be stimulated to grow by an acoustic field. Under this hypothesis, one of three things could happen: (1) bubbles grow to the extent that tissue hemorrhage occurs (injury); (2) bubbles develop to the extent that a complement immune response is triggered or nervous tissue is subjected to enough localized pressure that pain or dysfunction occurs (a stress response without injury); or (3) the bubbles are cleared by the lung without negative consequence to the animal. The probability of rectified diffusion, or any other indirect tissue effect, will necessarily be based on what is known about the specific process involved. No tissue effects – The received sound is insufficient to cause either direct mechanical) or indirect effects to tissues. No stress response occurs.

3.9.7.1.2 The Stress Response

The acoustic source is considered a potential stressor if, by its action on the animal, via auditory or nonauditory means, it may produce a stress response in the animal. The term "stress" has taken on an ambiguous meaning in the scientific literature, but with respect to Figure 3.9-2 and the later discussions of allostasis and allostatic loading, the stress response will refer to an increase in energetic expenditure that results from exposure to the stressor and which is predominantly characterized by either the stimulation of the sympathetic nervous system (SNS) or the hypothalamic-pituitary-adrenal (HPA) axis (Reeder and Kramer, 2005). The SNS response to a stressor is immediate and acute and is characterized by the release of the catecholamine neurohormones norepinephrine and epinephrine (i.e., adrenaline). These hormones produce elevations in the heart and respiration rate, increase awareness, and increase the availability of glucose and lipids for energy. The HPA response is ultimately defined by increases in the secretion of the glucocorticoid steroid hormones, predominantly cortisol in mammals. The amount of increase in circulating glucocorticoids above baseline may be an indicator of the overall severity of a stress response (Hennessy et al., 1979). Each component of the stress response is variable in time; e.g., adrenalines are released nearly immediately and are used or cleared by the system quickly, whereas cortisol levels may take long periods of time to return to baseline.

The presence and magnitude of a stress response in an animal depends on a number of factors. These include the animal's life history stage (e.g., neonate, juvenile, adult), the environmental conditions, reproductive or developmental state, and experience with the stressor. Not only will these factors be subject to individual variation, but they will also vary within an individual over time. In considering potential stress responses of marine mammals to acoustic stressors, each of these should be considered. For example, is the acoustic stressor in an area where animals engage in breeding activity? Are animals in the region resident and likely to have experience with the stressor (i.e., repeated exposures)? Is the region a foraging ground or are the animals passing through as transients? What is the ratio of young (naïve) to old (experienced) animals in the population? It is unlikely that all such questions can be answered from empirical data; however, they should be addressed in any qualitative assessment of a potential stress response as based on the available literature.

The stress response may or may not result in a behavioral change**,** depending on the characteristics of the exposed animal. However, provided a stress response occurs, we assume that some contribution is made to the animal's allostatic load. Allostasis is the ability of an animal to maintain stability through change by adjusting its physiology in response to both predictable and unpredictable events (McEwen and Wingfield, 2003). The same hormones associated with the stress response vary naturally throughout an animal's life, providing support for particular life history events (e.g., pregnancy) and predictable environmental conditions (e.g., seasonal changes). The allostatic load is the cumulative cost of allostasis incurred by an animal and is generally characterized with respect to an animal's energetic expenditure. Perturbations to an animal that may occur with the presence of a stressor, either biological (e.g., predator) or anthropogenic (e.g., construction), can contribute to the allostatic load (Wingfield, 2003). Additional costs are cumulative and additions to the allostatic load over time may contribute to reductions in the probability of achieving ultimate life history functions (e.g., survival, maturation, reproductive effort and success) by producing pathophysiological states. The contribution to the allostatic load from a stressor requires estimating the magnitude and duration of the stress response, as well as any secondary contributions that might result from a change in behavior.

If the acoustic source does not produce tissue effects, is not perceived by the animal, or does not produce a stress response by any other means, Figure 3.9-1 assumes that the exposure does not contribute to the allostatic load. Additionally, without a stress response or auditory masking, it is assumed that there can be no behavioral change. Conversely, any immediate effect of exposure that produces an injury (i.e., red boxes on the flow chart in Figure 3.9-1) is assumed to also produce a stress response and contribute to the allostatic load.

3.9.7.1.3 Behavior

Acute stress responses may or may not cause a behavioral reaction. However, all changes in behavior are expected to result from an acute stress response. This expectation is based on the idea that some sort of physiological trigger must exist to change any behavior that is already being performed. The exception to this rule is the case of masking. The presence of a masking sound may not produce a stress response, but may interfere with the animal's ability to detect and discriminate biologically relevant signals. The inability to detect and discriminate biologically relevant signals hinders the potential for normal behavioral responses to auditory cues and is thus considered a behavioral change.

Numerous behavioral changes can occur as a result of stress response, and Figure 3.9-1 lists only those that might be considered the most common types of response for a marine animal. For each potential behavioral change, the magnitude in the change and the severity of the response needs to be estimated. Certain conditions, such as stampeding (i.e., flight response) or a response to a predator, might have a probability of resulting in injury. For example, a flight response, if significant enough, could produce a stranding event. Under the MMPA, such an event would be considered a Level A harassment. Each altered behavior may also have the potential to disrupt biologically significant events (e.g., breeding or nursing) and may need to be qualified as Level B harassment. All behavioral disruptions have the potential to contribute to the allostatic load. This secondary potential is signified by the feedback from the collective behaviors to allostatic loading.

Special considerations are given to the potential for avoidance and disrupted diving patterns. Due to past incidents of beaked whale strandings associated with sonar operations, feedback paths are provided between avoidance and diving and indirect tissue effects. This feedback accounts for the hypothesis that variations in diving behavior and/or avoidance responses can possibly result in nitrogen tissue supersaturation and nitrogen off-gassing, possibly to the point of deleterious vascular bubble formation. Although hypothetical in nature, the potential process is currently popular and hotly debated.

3.9.7.1.4 Life Function

Proximate Life Functions

Proximate life history functions are the functions that the animal is engaged in at the time of acoustic exposure. The disruption of these functions, and the magnitude of the disruption, is something that must be considered in determining how the ultimate life history functions are affected. Consideration of the magnitude of the effect to each of the proximate life history functions is dependent upon the life stage of the animal. For example, an animal on a breeding ground which is sexually immature will suffer relatively little consequence to disruption ofbreeding behavior when compared to an actively displaying adult of prime reproductive age.

Ultimate Life Functions

The ultimate life functions are those that enable an animal to contribute to the population (or stock, or species, etc.). The impact to ultimate life functions will depend on the nature and magnitude of the perturbation to proximate life history functions. Depending on the severity of the response to the stressor, acute perturbations may have nominal to profound impacts on ultimate life functions. For example, unit-level use of sonar by a vessel transiting through an area that is utilized for foraging, but not for breeding, may disrupt feeding by exposed animals for a brief period of time. Because of the brevity of the perturbation, the impact to ultimate life functions may be negligible. By contrast, weekly training over a period of years may have a more substantial impact because the stressor is chronic. Assessment of the magnitude of the stress response from the chronic perturbation would require an understanding of how and whether animals acclimate to a specific, repeated stressor and whether chronic elevations in the stress response (e.g., cortisol levels) produce fitness deficits.

The proximate life functions are loosely ordered in decreasing severity of impact. Mortality (survival) has an immediate effect, in that no future reproductive success is feasible and there is no further addition to the population resulting from reproduction. Severe injuries may also lead to reduced survivorship (longevity) and prolonged alterations in behavior. The latter may further affect an animal’s overall reproductive success and reproductive effort. Disruptions of breeding have an immediate impact on reproductive effort and may impact reproductive success. The magnitude of the effect will depend on the duration of the disruption and the type of behavior change that was provoked. Disruptions to feeding and migration can affect all of the ultimate life functions; however, the impacts to reproductive effort and success are not likely to be as severe or immediate as those incurred by mortality and breeding disruptions.

3.9.7.2 Regulatory Framework

MMPA and ESA prohibit the unauthorized harassment of marine mammals and endangered species, and provide the regulatory processes for authorization for any such harassment that might occur incidental to an otherwise lawful activity. The regulatory framework for estimating potential acoustic effects from SOCAL ASW training activities on cetacean species makes use of the methodology that was developed in cooperation with NOAA for the Navy's *Undersea Warfare Training Range (USWTR) Draft Overseas Environmental Impact Statement/Environmental Impact Statement (OEIS/EIS),* (DoN 2005). Via response comment letter to USWTR received from NMFS January 30, 2006, NMFS concurred with the use of EL for the determination of physiological effects to marine mammals. Therefore, this methodology is used to estimate the annual exposure of marine mammals that may be considered Level A harassment or Level B harassment as a result of temporary, recoverable physiological effects. In addition, the approach for estimating potential acoustic effects from SOCAL training activities on marine mammals makes use of the comments received on the Navy's USWTR Draft OEIS/EIS(DoN 2005) and the *2006 Rim of the Pacific Supplemental Overseas Environmental Assessment* (DoN, 2006). NMFS and other commentators recommended the use of an alternate methodology to evaluate when sound exposures might result in behavioral effects without corresponding physiological effects. As a result of these comments, this document uses a dose function approach to evaluate the potential for behavioral effects (Section 3.9-X). A number of Navy actions and NOAA rulings have helped to qualify possible events deemed as "harassment" under the MMPA. As stated previously, "harassment" under the MMPA includes both potential injury (Level A), and disruptions of natural behavioral patterns to a point where they are abandoned or significantly altered (Level B). NMFS also includes mortality as a possible outcome to consider in addition to Level A and Level B harassment. The acoustic effects analysis and exposure calculations are based on the following premises:

- Harassment that may result from Navy operations described in the SOCAL Range Complex EIS/OEIS is unintentional and incidental to those operations.

- This SOCAL Range Complex EIS/OEIS uses an unambiguous definition of injury as defined in the USWTR Draft OEIS/EIS (DoN 2005), 2006 Rim of the Pacific Supplemental Overseas Environmental Assessment (DON 2006), and in previous rulings (NOAA, 2001; 2002a): injury occurs when any biological tissue is destroyed or lost as a result of the action.

- Behavioral disruption might result in subsequent injury and injury may cause a subsequent behavioral disruption, so Level A and Level B (defined below) harassment categories can overlap and are not necessarily mutually exclusive. However, by prior ruling (National Oceanic and Atmospheric Administration, 2001; 2006b), this SOCAL Range Complex EIS/OEIS analysis assumes that Level A and B do not overlap.

- An individual animal predicted to experience simultaneous multiple injuries, multiple disruptions, or both, is counted as a single take (see National Oceanic and Atmospheric Administration, 2001; 2006b). An animal whose behavior is disrupted by an injury has already been counted as a Level A harassment and will not also be counted as a Level B harassment. Based on the consideration of two different acoustic modeling methodologies to assess the potential for sound exposures that might result in behavioral disturbance, it is possible that the model would count a Level B TTS exposure and a Level B behavioral exposure for the same animal. Although this approach overestimates the potential for behavioral disturbance incidents, it is considered conservative because the actual incidents of disturbance are expected to be lower.

- The acoustic effects analysis is based on primary exposures of the action. Secondary, or indirect, effects, such as susceptibility to predation following injury and injury resulting from disrupted behavior, while possible, can only be reliably predicted in circumstances where the responses have been well documented. Consideration of secondary effects would result in Level A exposures being considered Level B exposures, and vice versa, since Level A exposure (assumed to be Level A harassment and injury) has the potential to disrupt behavior resulting in Level B harassment. In like manner, temporary physiological or behavioral disruption (Level B exposures) could be conjectured to have the potential for injury (Level A). Consideration of secondary effects would lead to circular definitions of exposures. For beaked whales, where a connection between behavioral disruption by mid frequency active sonar and injury to beaked whales is considered a possibility (under specific operational and environmental parameters), secondary effects are considered in the discussion for each species.

3.9.7.3 Physiological Effects

3.9.7.3.1 TTS in Marine Mammals

A number of investigators have measured TTS in marine mammals. These studies measured hearing thresholds in trained marine mammals before and after exposure to intense sounds. Some of the more important data obtained from these studies are onset-TTS levels – exposure levels sufficient to cause a just-measurable amount of TTS, often defined as 6 dB of TTS (for example, Schlundt et al. 2000). The existing cetacean and pinniped TTS data for underwater exposure are summarized in the following bullets.

- Schlundt et al. (2000) reported the results of TTS experiments conducted with bottlenose dolphins and white whales exposed to 1-second tones. This paper also includes a reanalysis of preliminary TTS data released in a technical report by Ridgway et al. (1997). At frequencies of 3, 10, and 20 kHz, SPLs necessary to induce measurable amounts (6 dB or more) of TTS were between 192 and 201 dB re 1 µPa (EL = 192 to 201 dB re 1 µPa2-s). The mean exposure SPL and EL for onset-TTS were 195 dB re 1 µPa and 195 dB re 1 µPa^2-s, respectively. The sound exposure stimuli (tones) and relatively large number of test subjects (five dolphins and two white whales) make the Schlundt et al. (2000) data the most directly relevant TTS information for the scenarios described in the SOCAL Range Complex EIS/OEIS.
- Finneran et al. (2001, 2003, 2005) described TTS experiments conducted with bottlenose dolphins exposed to 3-kHz tones with durations of 1, 2, 4, and 8 seconds. Small amounts of TTS (3 to 6 dB) were observed in one dolphin after exposure to ELs between 190 and 204 dB re 1 µPa^2-s. These results were consistent with the data of Schlundt et al. (2000) and showed that the Schlundt et al. (2000) data were not significantly affected by the masking sound used. These results also confirmed that, for tones with different durations, the amount of TTS is best correlated with the exposure EL rather than the exposure SPL.
- Nachtigall et al. (2003) measured TTS in a bottlenose dolphin exposed to octave-band sound centered at 7.5 kHz. Nachtigall et al. (2003a) reported TTSs of about 11 dB measured 10 to 15 minutes after exposure to 30 to 50 minutes of sound with SPL 179 dB re 1 µPa (EL about 213 dB re µPa^2-s). No TTS was observed after exposure to the same sound at 165 and 171 dB re 1 µPa. Nachtigall et al. (2003b) reported TTSs of around 4 to 8 dB 5 minutes after exposure to 30 to 50 minutes of sound with SPL 160 dB re 1 µPa (EL about 193 to 195 dB re 1 µPa^2-s). The difference in results was attributed to faster post-exposure threshold measurement—TTS may have recovered before being detected by Nachtigall et al. (2003a). These studies showed that, for long-duration exposures, lower sound pressures are required to induce TTS than are required for short-duration tones. These data also confirmed that, for the cetaceans studied, EL is the most appropriate predictor for onset-TTS.

- Finneran et al. (2000, 2002) conducted TTS experiments with dolphins and white whales exposed to impulsive sounds similar to those produced by distant underwater explosions and seismic water guns. These studies showed that, for very short-duration impulsive sounds, higher sound pressures were required to induce TTS than for longer-duration tones.
- Finneran et al. (2007) conducted TTS experiments with bottlenose dolphins exposed to intense 20 kHz fatiguing tone. Behavioral and auditory evoked potentials (using sinusoidal amplitude modulated tones creating auditory steady state response [AASR]) were used to measure TTS. The fatiguing tone was either 16 (mean = 193 re 1µPa, SD = 0.8) or 64 seconds (185-186 re 1µPa) in duration. TTS ranged from 19-33db from behavioral measurements and 40-45dB from ASSR measurements.
- Regarding pinniped TTS data, Kastak et al. (1999, 2005) conducted TTS experiments with three species of pinnipeds, California sea lion, northern elephant seal and a Pacific harbor seal, exposed to continuous underwater sounds at levels of 80 and 95 dB Sensation Level (referenced to the animal's absolute auditory threshold) at 2.5 and 3.5 kHz for up to 50 minutes. Mean TTS shifts of up to 12.2 dB occurred with the harbor seals showing the largest shift of 28.1 dB. Increasing the sound duration had a greater effect on TTS than increasing the sound level from 80 to 95 dB.

In summary, the existing TTS data show that, for the species studied and sounds (non- impulsive) of interest, the following is true:

- The growth and recovery of TTS are analogous to those in land mammals. This means that, as in land mammals, marine mammal TSs depend on the amplitude, duration, frequency content, and temporal pattern of the sound exposure. Threshold shifts will generally increase with the amplitude and duration of sound exposure. For continuous sounds, exposures of equal energy will lead to approximately equal effects (Ward 1997). For intermittent sounds, less TS will occur than from a continuous exposure with the same energy (some recovery will occur between exposures) (Kryter et al. 1965; Ward 1997).
- SPL by itself is not a good predictor of onset-TTS, since the amount of TTS depends on both SPL and duration.
- Exposure Level (EL) is correlated with the amount of TTS and is a good predictor for onset-TTS for single, continuous exposures with different durations. This agrees with human TTS data presented by Ward et al. (1958, 1959).
- An energy flux density level of 195 dB re 1 µPa^2-s is the most appropriate predictor for onset-TTS from a single, continuous exposure.

3.9.7.3.2 Relationship between TTS and PTS

Since marine mammal PTS data do not exist, onset-PTS levels for these animals must be estimated using TTS data and relationships between TTS and PTS. Much of the early human TTS work was directed towards relating TTS2 after 8 hours of sound exposure to the amount of PTS that would exist after years of similar daily exposures (e.g., Kryter et al. 1966). Although it is now acknowledged that susceptibility to PTS cannot be reliably predicted from TTS measurements, TTS data does provide insight into the amount of TS that may be induced without a PTS. Experimental studies of the growth of TTS may also be used to relate changes in exposure level to changes in the amount of TTS induced. Onset-PTS exposure levels may therefore be predicted by:

- Estimating the largest amount of TTS that may be induced without PTS. Exposures causing a TS greater than this value are assumed to cause PTS.
- Estimating the additional exposure, above the onset-TTS exposure, necessary to reach the maximum allowable amount of TTS that, again, may be induced without PTS. This is equivalent to estimating the growth rate of TTS – how much additional TTS is produced by an increase in exposure level.

Experimentally induced TTSs, from short duration sounds (1-8 seconds) in the range of 3.5-20 kHz, in marine mammals have generally been limited to around 2 to 10 dB, well below TSs that result in some PTS. Experiments with terrestrial mammals have used much larger TSs and provide more guidance on how high a TS may rise before some PTS results. Early human TTS studies reported complete recovery of TTSs as high as 50 dB after exposure to broadband sound (Ward, 1960; Ward et al. 1958, 1959). Ward et al. (1959) also reported slower recovery times when TTS2 approached and exceeded 50 dB, suggesting that 50 dB of TTS2 may represent a "critical" TTS. Miller et al. (1963) found PTS in cats after exposures that were only slightly longer in duration than those causing 40 dB of TTS. Kryter et al. (1966) stated: "A TTS2 that approaches or exceeds 40 dB can be taken as a signal that danger to hearing is imminent." These data indicate that TSs up to 40 to 50 dB may be induced without PTS, and that 40 dB is a reasonable upper limit for TS to prevent PTS.

The small amounts of TTS produced in marine mammal studies also limit the applicability of these data to estimates of the growth rate of TTS. Fortunately, data does exist for the growth of TTS in terrestrial mammals. For moderate exposure durations (a few minutes to hours), TTS2 varies with the logarithm of exposure time (Ward et al. 1958, 1959; Quaranta et al. 1998). For shorter exposure durations the growth of TTS with exposure time appears to be less rapid (Miller 1974; Keeler 1976). For very long-duration exposures, increasing the exposure time may fail to produce any additional TTS, a condition known as asymptotic threshold shift (Saunders et al. 1977; Mills et al. 1979).

Ward et al. (1958, 1959) provided detailed information on the growth of TTS in humans. Ward et al. presented the amount of TTS measured after exposure to specific SPLs and durations of broadband sound. Since the relationship between EL, SPL, and duration is known, these same data could be presented in terms of the amount of TTS produced by exposures with different ELs.

An estimate of 1.6 dB TTS2 per dB increase in exposure EL is the upper range of values from Ward et al. (1958, 1959) and gives the most conservative estimate – it predicts a larger amount of TTS from the same exposure compared to the lines with smaller slopes. The difference between onset-TTS (6 dB) and the upper limit of TTS before PTS (40 dB) is 34 dB. To move from onset-TTS to onset-PTS, therefore, requires an increase in EL of 34 dB divided by 1.6 dB/dB, or approximately 21 dB. An estimate of 20 dB between exposures sufficient to cause onset-TTS and those capable of causing onset-PTS is a reasonable approximation.

To summarize:

- In the absence of marine mammal PTS data, onset-PTS exposure levels may be estimated from marine mammal TTS data and PTS/TTS relationships observed in terrestrial mammals. This involves:
- Estimating the largest amount of TTS that may be induced without PTS. Exposures causing a TS greater than this value are assumed to cause PTS.
- Estimating the growth rate of TTS – how much additional TTS is produced by an increase in exposure level.

- A variety of terrestrial mammal data sources point toward 40 dB as a reasonable estimate of the largest amount of TS that may be induced without PTS. A conservative is that continuous-type exposures producing TSs of 40 dB or more always result in some amount of PTS.
- Data from Ward et al. (1958, 1959) reveal a linear relationship between TTS2 and exposure EL. A value of 1.6 dB TTS2 per dB increase in EL is a conservative estimate of how much additional TTS is produced by an increase in exposure level for continuous-type sounds.
- There is a 34 dB TS difference between onset-TTS (6 dB) and onset-PTS (40 dB). The additional exposure above onset-TTS that is required to reach PTS is therefore 34 dB divided by 1.6 dB/dB, or approximately 21 dB.

Exposures with ELs 20 dB above those producing TTS may be assumed to produce a PTS. This number is used as a conservative simplification of the 21 dB number derived above.

3.9.7.3.3 Use of Exposure Levels to Determine Physiological Effects

Effect thresholds are expressed in terms of total received EL. Energy flux density is a measure of the flow of sound energy through an area. Marine and terrestrial mammal data show that, for continuous-type sounds of interest, TTS and PTS are more closely related to the energy in the sound exposure than to the exposure SPL.

The EL for each individual ping is calculated from the following equation:

EL = SPL + 10log10(duration)

The EL includes both the ping SPL and duration. Longer-duration pings and/or higher-SPL pings will have a higher EL.

If an animal is exposed to multiple pings, the energy flux density in each individual ping is summed to calculate the total EL. Since mammalian TS data show less effect from intermittent exposures compared to continuous exposures with the same energy (Ward, 1997), basing the effect thresholds on the total received EL is a conservative approach for treating multiple pings; in reality, some recovery will occur between pings and lessen the effect of a particular exposure.

Therefore, estimates are conservative because recovery is not taken into account – intermittent exposures are considered comparable to continuous exposures.

The total EL depends on the SPL, duration, and number of pings received. The TTS and PTS thresholds do not imply any specific SPL, duration, or number of pings. The SPL and duration of each received ping are used to calculate the total EL and determine whether the received EL meets or exceeds the effect thresholds. For example, the TTS threshold would be reached through any of the following exposures:

- A single ping with SPL = 195 dB re 1 µPa and duration = 1 second.
- A single ping with SPL = 192 dB re 1 µPa and duration = 2 seconds.
- Two pings with SPL = 192 dB re 1 µPa and duration = 1 second.
- Two pings with SPL = 189 dB re 1 µPa and duration = 2 seconds.

Cetaceans predicted to receive a sound exposure with EL of 215 dB re 1 µPa^2-s or greater are assumed to experience PTS and are counted as Level A harassment. Cetaceans predicted to receive a sound exposure with EL greater than or equal to 195 dB re 1 µPa^2-s but less than 215 dB re 1 µPa^2-s are assumed to experience TTS and are counted as Level B harassment.

Unlike cetaceans, the TTS and PTS thresholds used for pinnipeds vary with species. Otariids have thresholds of 206 dB re 1 μPa^2-s for TTS and 226 dB re 1 μPa^2-s for PTS. Northern elephant seals are similar to otariids (TTS = 204 dB re 1 μPa^2-s, PTS = 224 dB re 1 μPa^2-s) but are lower for harbor seals (TTS = 183 dB re 1 μPa^2-s, PTS = 203 dB re 1 μPa^2-s).

The physiological effect thresholds described in this DEIS/DOEIS should not be confused with criteria and thresholds used for the Navy's Surveillance Towed Array Sensor System Low Frequency Active (SURTASS LFA) sonar. SURTASS LFA features pings lasting many tens of seconds. The sonars of concern for use during within the SOCAL Range Complex emit pings lasting a few seconds at most. SURTASS LFA risk functions were expressed in terms of the received "single ping equivalent" SPL. Physiological effect thresholds in this authorization request are expressed in terms of the total received EL. The SURTASS LFA risk function parameters cannot be directly compared to the effect thresholds used in this DEIS/DOEIS. Comparisons must take into account the differences in ping duration, number of pings received, and method of accumulating effects over multiple pings.

3.9.7.3.4 Summary of Physiological Effects Thresholds

PTS and TTS are used as the criteria for physiological effects resulting in injury (Level A harassment) and disturbance (Level B harassment), respectively. Sound exposure thresholds for TTS and PTS are 195 dB re 1 μPa^2-s received EL for TTS and 215 dB re 1 μPa^2-s received EL for PTS. The TTS threshold is primarily based on cetacean TTS data from Schlundt et al. (2000). Since these tests used short-duration tones similar to sonar pings, they are the most directly relevant data. The PTS threshold is based on a 20 dB increase in exposure EL over that required for onset-TTS. The 20 dB value is based on extrapolations from terrestrial mammal data indicating that PTS occurs at 40 dB or more of TS, and that TS growth occurring at a rate of approximately 1.6 dB/dB increase in exposure EL. The application of the model results to estimate marine mammal exposures for each species is discussed in Section 3.9.9. Sound exposure thresholds for onset TTS and PTS are as presented in the following Table 3.9-3:

Table 3.9-3: Summary of Physiological Effects Thresholds for TTS and PTS: Cetaceans and Pinnipeds

Physiological Effects			
Animal	**Criteria**	**Threshold (re 1μPa^2-s)**	**MMPA Effect**
Cetacean	TTS PTS	195 215	Level B Harassment Level A Harassment
Pinnipeds			
Northern Elephant Seal	TTS PTS	204 224	Level B Harassment Level A Harassment
Pacific Harbor Seal	TTS PTS	183 203	Level B Harassment Level A Harassment
California Sea Lion	TTS PTS	206 226	Level B Harassment Level A Harassment
Guadalupe Fur Seal	TTS PTS	226 206	Level B Harassment Level A Harassment
Northern Fur Seal	TTS PTS	206 226	Level B Harassment Level A Harassment

3.9.7.4 Behavioral Effects

Based on available evidence, marine animals are likely to exhibit any of a suite of potential behavioral responses or combinations of behavioral responses upon exposure to sonar transmissions. Potential behavioral responses include, but are not limited to: avoiding exposure or continued exposure; behavioral disturbance (including distress or disruption of social or foraging activity); habituation to the sound; becoming sensitized to the sound; or not responding to the sound.

Existing studies of behavioral effects of human-made sounds in marine environments remain inconclusive, partly because many of those studies have lacked adequate controls, applied only to certain kinds of exposures (which are often different from the exposures being analyzed in the study), and had limited ability to detect behavioral changes that may be significant to the biology of the animals that were being observed. These studies are further complicated by the wide variety of behavioral responses marine mammals exhibit and the fact that those responses can vary significantly by species, individuals, and the context of an exposure. In some circumstances, some individuals will continue normal behavioral activities in the presence of high levels of human-made noise. In other circumstances, the same individual or other individuals may avoid an acoustic source at much lower received levels (Richardson et al. 1995; Wartzok et al. 2003). These differences within and between individuals appear to result from a complex interaction of experience, motivation, and learning that are difficult to quantify and predict.

The National Marine Fisheries Service (NMFS) and other commentators recommended the use of an alternate methodology to evaluate when sound exposures might result in behavioral effects without corresponding physiological effects. Therefore, the Navy and NMFS have developed the Risk-Function approach to estimate potential behavioral effects from mid frequency active sonar. The behavioral response exposures presented in this chapter were estimated using the risk function methodology described below.

3.9.7.4.1 Development of the Risk Function

The Navy and NMFS have developed a dose methodology to assess the probability of Level B behavioral harassment from the effects of MFA and high-frequency active (HFA) sonar on marine mammals. As the regulating and cooperating agency, NMFS presented two methodologies to six scientists (marine mammalogists and acousticians from within and outside the federal government) for an independent review (NMFS 2008). Two scientists, including one from the NMFS Office of Science and Technology, then synthesized the reviews from the six scientists and developed a recommendation.

One of the methodologies was a normal curve fit to a “mean of means” calculated from the mean of: (1) the mean of the lowest received levels from the 3 kHz data that the SPAWAR Systems Center (SSC) classified as altered behavior from Finneran and Schulndt (2004); (2) the estimated mean received level produced by the reconstruction of the USS SHOUP event of May 2003 in which killer whales were exposed to MFA sonar (DoN 2004); and (3) the mean of the five maximum received levels at which Nowacek et al. (2004) observed significantly different responses of right whales to an alert stimuli.

The second methodology was a derivation of a mathematical function used for assessing the percentage of a marine mammal population experiencing the risk of harassment under the MMPA associated with the Navy’s use of the Surveillance Towed Array Sensor System Low-Frequency Active (SURTASS LFA) sonar (DoN 2001). This function is appropriate for application to instances with limited data (Feller 1968), and this methodology is subsequently identified as “the risk function” in this document.

NMFS made the decision to use the risk function and applicable input parameters to estimate the risk of behavioral harassment associated with exposure to MFA sonar. This determination was based on the recommendation of the two NMFS scientists, consideration of the independent reviews from six scientists, and NMFS MMPA regulations affecting the Navy's use of SURTASS LFA sonar (Federal Register [FR] 67:48145-48154, 2002; FR 72: 46846-46893, 2007).

3.9.7.4.2 Applying the Risk Function Methodology

To assess the potential effects on marine mammals associated with active sonar used during training activities, the Navy together with NMFS, as a first step, investigated a series of mathematical models and methodologies that estimate the number of times individuals of the different species of marine mammals might be exposed to MFA sonar at different received levels. The Navy effects analyses assumed that the potential consequences of exposure to MFA sonar on individual animals would be a function of the received sound pressure level (decibels re 1 micropascal [dB re 1 µPa]). These analyses assume that MFA sonar poses no risk, that is, does not constitute harassment to marine mammals if they are exposed to sound pressure levels from the MFA sonar below a certain basement value.

The second step of the assessment procedure requires the Navy and NMFS to identify how marine mammals are likely to respond when they are exposed to active sonar. Marine mammals can experience a variety of responses to sound including sensory impairment (permanent and temporary threshold shifts and acoustic masking), physiological responses (particular stress responses), behavioral responses, social responses that might result in reducing the fitness of individual marine mammals and social responses that would not result in reducing the fitness of individual marine mammals.

Previously, the Navy and NMFS have used acoustic thresholds to identify the number of marine mammals that might experience hearing losses (temporary or permanent) or behavioral harassment upon being exposed to MFA sonar (see Figure 3.9.3, left panel). These acoustic thresholds have been represented by either sound exposure level (related to sound energy, abbreviated as SEL), sound pressure level (SPL), or other metrics such as peak pressure level and acoustic impulse (not considered for sonar in this DEIS/DOEIS). The general approach has been to apply these threshold functions so that a marine mammal is counted as behaviorally harassed or experiencing hearing loss when exposed to received sound levels above a certain threshold and not counted as behaviorally harassed or experiencing hearing loss when exposed to received levels below that threshold. For example, previous Navy EISs, environmental assessments, MMPA take authorization requests, and the MMPA incidental harassment authorization (IHA) for the Navy's 2006 Rim-of-the Pacific (RIMPAC) Major Exercise (FR 71.38710-38712, 2006) used 173 dB re 1 μPa^2-second (sec) as the energy threshold level (i.e., SEL) for Level B behavioral harassment for cetaceans. If the transmitted sonar accumulated energy received by a whale was above 195 dB re 1 μPa^2-sec, then the animal was considered to have experienced a temporary loss in the sensitivity of its hearing. The left panel in Figure 3.9-3 illustrates a typical step-function or threshold that might also relate a sonar exposure to the probability of a response. As this figure illustrates, past Navy/NMFS acoustic thresholds assumed that every marine mammal above a particular received level (for example, to the right of the red vertical line in the figure) would exhibit identical responses to a sonar exposure. This assumed that the responses of marine mammals would not be affected by differences in acoustic conditions; differences between species and populations: differences in gender, age, reproductive status, or social behavior; or the prior experience of the individuals.

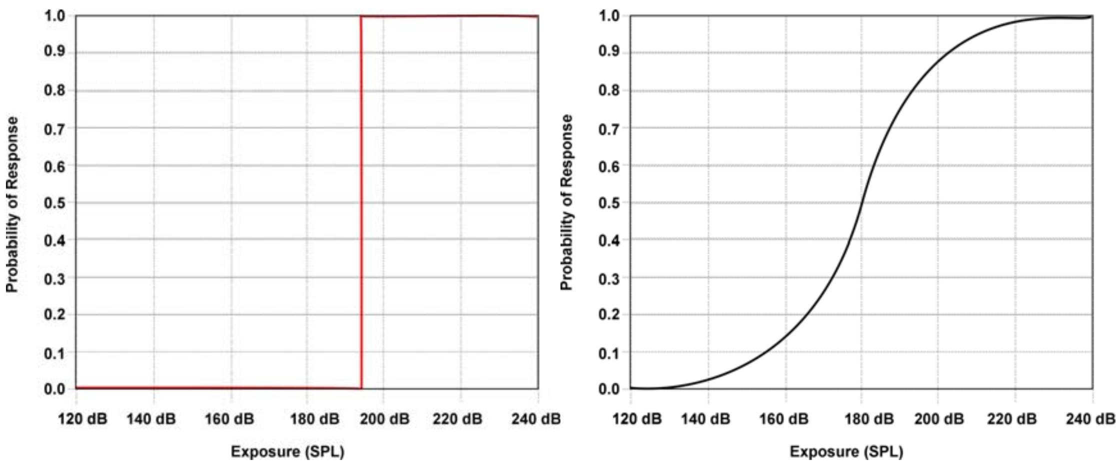

Figure 3.9-3: Typical step function (left) and typical risk continuum-function (right).

In this figure, for the typical step function (left panel) the probability of a response is depicted on the y-axis and received exposure on the x-axis. The right panel illustrates a typical risk continuum-function using the same axes. SPL is "Sound Pressure Level" in decibels referenced to 1 μPa root mean square (rms).

Both the Navy and NMFS agree that the studies of marine mammals in the wild and in experimental settings do not support these assumptions—different species of marine mammals and different individuals of the same species respond differently to sonar exposure. Additionally, there are specific geographic/bathymetric conditions that dictate the response of marine mammals to sonar that suggest that different populations may respond differently to sonar exposure. Further, studies of animal physiology suggest that gender, age, reproductive status, and social behavior, among other variables, probably affect how marine mammals respond to sonar exposures (Wartzok et al. 2003; Southall et al. 2007).

Over the past several years, the Navy and NMFS have worked on developing an MFA sonar acoustic risk function to replace the acoustic thresholds used in the past to estimate the probability of marine mammals being behaviorally harassed by received levels of MFA sonar. The Navy and NMFS will continue to use acoustic thresholds to estimate temporary or permanent threshold shifts using SEL as the appropriate metric. Unlike acoustic thresholds, acoustic risk continuum functions (which are also called "exposure-response functions," "dose-response functions," or "stress-response functions" in other risk assessment contexts) assume that the probability of a response depends first on the "dose" (in this case, the received level of sound) and that the probability of a response increases as the "dose" increases. It is important to note that the probabilities associated with acoustic risk functions do not represent an individual's probability of responding. Rather, the probabilities identify the proportion of an exposed population that is likely to respond to an exposure.

The right panel in Figure 3.9-3 illustrates a typical acoustic risk function that might relate an exposure, as received SPL in dB re 1 μPa, to the probability of a response. As the exposure receive level increases in this figure, the probability of a response increases as well but the relationship between an exposure and a response is "linear" only in the center of the curve (that is, unit increases in exposure would produce unit increases in the probability of a response only in the center of a risk function curve). In the "tails" of an acoustic risk function curve, unit increases in exposure produce smaller increases in the probability of a response. Based on observations of various animals, including humans, the relationship represented by an acoustic risk function is a more robust predictor of the probable behavioral responses of marine mammals to sonar and other acoustic sources.

The Navy and NMFS have previously used the acoustic risk function to estimate the probable responses of marine mammals to acoustic exposures for other training and research programs. Examples of previous application include the Navy Final EISs on the SURTASS LFA sonar (DoN 2001); the North Pacific Acoustic Laboratory experiments conducted off the Island of Kauai (Office of Naval Research 2001), and the Supplemental EIS for SURTASS LFA sonar (DoN 2007a).

The Navy and NMFS used two metrics to estimate the number of marine mammals that could be subject to Level B harassment (behavioral harassment and TTS) as defined by the MMPA, during training exercises. The agencies used acoustic risk functions with the metric of received SPL (dB re 1 µPa) to estimate the number of marine mammals that might be at risk for MMPA Level B behavioral harassment as a result of being exposed to MFA sonar. The agencies will continue to use acoustic thresholds ("step-functions") with the metric of SEL (dB re 1 μPa^2-s) to estimate the number of marine mammals that might be "taken" through sensory impairment (i.e., Level A – PTS and Level B – TTS) as a result of being exposed to MFA sonar.

Although the Navy has not used acoustic risk functions in previous MFA sonar assessments of the potential effects of MFA sonar on marine mammals, risk functions are not new concepts for risk assessments. Common elements are contained in the process used for developing criteria for air, water, radiation, and ambient noise and for assessing the effects of sources of air, water, and noise pollution. The Environmental Protection Agency (EPA) uses dose-functions to develop water quality criteria and to regulate pesticide applications (U.S. EPA 1998); the Nuclear Regulatory Commission (NRC) uses dose-functions to estimate the consequences of radiation exposures (see NRC 1997 and 10 Code of Federal Regulations [C.F.R] § 20.1201); the Centers for Disease Control and Prevention (CDCP) and the Food and Drug Administration (FDA) use dose-functions as part of their assessment methods (for example, see CDCP 2003, U.S. FDA 2001); and the Occupational Safety and Health Administration (OSHA) uses dose-functions to assess the potential effects of noise and chemicals in occupational environments on the health of people working in those environments (for examples, see FR 61:56746-56856, 1996; FR 71:10099-10385, 2006).

The particular acoustic risk function developed by the Navy and NMFS estimates the probability of behavioral responses that NMFS would classify as harassment for the purposes of the MMPA given exposure to specific received levels of MFA sonar. The mathematical function is derived from a solution in Feller (1968) as defined in the SURTASS LFA Sonar Final OEIS/EIS (DoN 2001), and relied on in the Supplemental SURTASS LFA Sonar EIS (DoN 2007a) for the probability of MFA sonar risk for MMPA Level B behavioral harassment with input parameters modified by NMFS for MFA sonar for mysticetes, odontocetes, and pinnipeds.

In order to represent a probability of risk, the function should have a value near zero at very low exposures, and a value near one for very high exposures. One class of functions that satisfies this criterion is cumulative probability distributions, a type of cumulative distribution function. In selecting a particular functional expression for risk, several criteria were identified:

- The function must use parameters to focus discussion on areas of uncertainty;
- The function should contain a limited number of parameters;
- The function should be capable of accurately fitting experimental data; and
- The function should be reasonably convenient for algebraic manipulations.

As described in U.S. Department of the Navy (2001), the mathematical function below is adapted from a solution in Feller (1968).

$$R = \frac{1-\left(\frac{L-B}{K}\right)^{-A}}{1-\left(\frac{L-B}{K}\right)^{-2A}}$$

Where: R = risk (0 – 1.0);

L = Received Level (RL) in dB;

B = basement RL in dB; (120 dB);

K = the RL increment above basement in dB at which there is 50 percent risk;

A = risk transition sharpness parameter (10) (explained in 3.1.5.3).

In order to use this function, the values of the three parameters (B, K, and A) need to be established. The values used in this DEIS/DOEIS analysis are based on three sources of data: TTS experiments conducted at SSC and documented in Finneran, et al. (2001, 2003, and 2005; Finneran and Schlundt, 2004); reconstruction of sound fields produced by the USS SHOUP associated with the behavioral responses of killer whales observed in Haro Strait and documented in Department of Commerce NMFS (2005); DoN (2004); and Fromm (2004a, 2004b); and observations of the behavioral response of North Atlantic right whales exposed to alert stimuli containing mid-frequency components documented in Nowacek et al. (2004). The input parameters, as defined by NMFS, are based on very limited data that represent the best available science at this time.

3.9.7.4.3 Data Sources Used for Risk Function

There is widespread consensus that cetacean response to MFA sound signals needs to be better defined using controlled experiments. Navy is contributing to an ongoing behavioral response study in the Bahamas that is anticipated to provide some initial information on beaked whales, the species identified as the most sensitive to MFA sonar. NMFS is leading this international effort with scientists from various academic institutions and research organizations to conduct studies on how marine mammals respond to underwater sound exposures.

Until additional data is available, NMFS and the Navy have determined that the following three data sets are most applicable for the direct use in developing risk function parameters for MFA/HFA sonar. These data sets represent the only known data that specifically relate altered behavioral responses to exposure to MFA sound sources.

Data from SSC's Controlled Experiments: Most of the observations of the behavioral responses of toothed whales resulted from a series of controlled experiments on bottlenose dolphins and beluga whales conducted by researchers at SSC's facility in San Diego, California (Finneran et al. 2001, 2003, 2005; Finneran and Schlundt 2004; Schlundt et al. 2000). In experimental trials with marine mammals trained to perform tasks when prompted, scientists evaluated whether the marine mammals performed these tasks when exposed to mid-frequency tones. Altered behavior during experimental trials usually involved refusal of animals to return to the site of the sound stimulus. This refusal included what appeared to be deliberate attempts to avoid a sound exposure or to avoid the location of the exposure site during subsequent tests (Schlundt et al. 2000, Finneran et al., 2002). Bottlenose dolphins exposed to 1-sec intense tones exhibited short-term changes in behavior above received sound levels of 178 to 193 dB re 1 μPa rms, and beluga whales did so at received levels of 180 to 196 dB and above.

Finneran and Schlundt (2004) examined behavioral observations recorded by the trainers or test coordinators during the Schlundt et al. (2000) and Finneran et al. (2001, 2003, 2005) experiments featuring 1-second (sec) tones. These included observations from 193 exposure sessions (fatiguing stimulus level > 141 dB re 1µPa) conducted by Schlundt et al. (2000) and 21 exposure sessions conducted by Finneran et al. (2001, 2003, 2005). The observations were made during exposures to sound sources at 0.4 kHz, 3 kHz, 10 kHz, 20 kHz, and 75 kHz. The TTS experiments that supported Finneran and Schlundt (2004) are further explained below:

- Schlundt et al. (2000) provided a detailed summary of the behavioral responses of trained marine mammals during TTS tests conducted at SSC San Diego with 1-sec tones. Schlundt et al. (2000) reported eight individual TTS experiments. Fatiguing stimuli durations were 1-sec; exposure frequencies were 0.4 kHz, 3 kHz, 10 kHz, 20 kHz and 75 kHz. The experiments were conducted in San Diego Bay. Because of the variable ambient noise in the bay, low-level broadband masking noise was used to keep hearing thresholds consistent despite fluctuations in the ambient noise. Schlundt et al. (2000) reported that "behavioral alterations," or deviations from the behaviors the animals being tested had been trained to exhibit, occurred as the animals were exposed to increasing fatiguing stimulus levels.
- Finneran et al. (2001, 2003, 2005) conducted TTS experiments using tones at 3 kHz. The test method was similar to that of Schlundt et al. (2000) except the tests were conducted in a pool with very low ambient noise level (below 50 dB re 1 µPa/hertz [Hz]), and no masking noise was used. Two separate experiments were conducted using 1-sec tones. In the first, fatiguing sound levels were increased from 160 to 201 dB SPL. In the second experiment, fatiguing sound levels between 180 and 200 dB re 1 µPa were randomly presented.

<u>Data from Studies of Baleen (Mysticetes) Whale Responses</u>: The only mysticete data available resulted from a field experiments in which baleen whales (mysticetes) were exposed to a range frequency sound sources from 120 Hz to 4500 Hz (Nowacek et al. 2004). An alert stimulus, with a mid-frequency component, was the only portion of the study used to support the risk function input parameters.

- Nowacek et al. (2004) documented observations of the behavioral response of North Atlantic right whales exposed to alert stimuli containing mid-frequency components. To assess risk factors involved in ship strikes, a multi-sensor acoustic tag was used to measure the responses of whales to passing ships and experimentally tested their responses to controlled sound exposures, which included recordings of ship noise, the social sounds of conspecifics and a signal designed to alert the whales. The alert signal was 18-minutes of exposure consisting of three 2-minute signals played sequentially three times over. The three signals had a 60 percent duty cycle and consisted of: (1) alternating 1-sec pure tones at 500 Hz and 850 Hz; (2) a 2-sec logarithmic down-sweep from 4,500 Hz to 500 Hz; and (3) a pair of low (1,500 Hz)-high (2,000 Hz) sine wave tones amplitude modulated at 120 Hz and each 1-sec long. The purposes of the alert signal were (a) to provoke an action from the whales via the auditory system with disharmonic signals that cover the whales estimated hearing range; (b) to maximize the signal to noise ratio (obtain the largest difference between background noise) and c) to provide localization cues for the whale. Five out of six whales reacted to the signal designed to elicit such behavior. Maximum received levels ranged from 133 to 148 dB re 1µPa.

<u>Observations of Killer Whales in Haro Strait in the Wild</u>: In May 2003, killer whales (*Orcinus orca*) were observed exhibiting behavioral responses while the USS SHOUP was engaged in MFA sonar operations in the Haro Strait in the vicinity of Puget Sound, Washington. Although these observations were made in an uncontrolled environment, the sound field that may have been

associated with the sonar operations had to be estimated, and the behavioral observations were reported for groups of whales, not individual whales, the observations associated with the USS SHOUP provide the only data set available of the behavioral responses of wild, non-captive animal upon exposure to the AN/SQS-53 MFA sonar.

- NMFS (2005), DoN (2004), and Fromm (2004a, 2004b) documented reconstruction of sound fields produced by the USS SHOUP associated with the behavioral response of killer whales observed in Haro Strait. Observations from this reconstruction included an approximate closest approach time which was correlated to a reconstructed estimate of received level at an approximate whale location (which ranged from 150 to 180 dB), with a mean value of 169.3 dB.

3.9.7.4.4 Limitations of the Risk Function Data Sources

There are significant limitations and challenges to any risk function derived to estimate the probability of marine mammal behavioral responses; these are largely attributable to sparse data. Ultimately there should be multiple functions for different marine mammal taxonomic groups, but the current data are insufficient to support them. The goal is unquestionably that risk functions be based on empirical measurement.

The risk function presented here is based on three data sets that NMFS and Navy have determined are the best available science at this time. The Navy and NMFS acknowledge each of these data sets has limitations. However, this risk function, if informed by the limited available data relevant to the MFA sonar application, has the advantages of simplicity and the fact that there is precedent for its application and foundation in marine mammal research.

While NMFS considers all data sets as being weighted equally in the development of the risk function, the Navy believes the SSC San Diego data is the most rigorous and applicable for the following reasons:

- The data represents the only source of information where the researchers had complete control over and ability to quantify the noise exposure conditions.
- The altered behaviors were identifiable due to long term observations of the animals.
- The fatiguing noise consisted of tonal exposures with limited frequencies contained in the MFA sonar bandwidth.

However, the Navy and NMFS do agree that the following are limitations associated with the three data sets used as the basis of the risk function:

- The three data sets represent the responses of only four species: trained bottlenose dolphins and beluga whales, North Atlantic right whales in the wild and killer whales in the wild.
- None of the three data sets represent experiments designed for behavioral observations of animals exposed to MFA sonar.
- The behavioral responses of marine mammals that were observed in the wild are based solely on an estimated received level of sound exposure; they do not take into consideration (due to minimal or no supporting data):
    - Potential relationships between acoustic exposures and specific behavioral activities (e.g., feeding, reproduction, changes in diving behavior, etc.), variables such as bathymetry, or acoustic waveguides; or
    - Differences in individuals, populations, or species, or the prior experiences, reproductive state, hearing sensitivity, or age of the marine mammal.

<u>SSC San Diego Trained Bottlenose Dolphins and Beluga Data Set:</u>

- The animals were trained animals in captivity; therefore, they may be more or less sensitive than cetaceans found in the wild (Domjan 1998).
- The tests were designed to measure TTS, not behavior.
- Because the tests were designed to measure TTS, the animals were exposed to much higher levels of sound than the baseline risk function (only two of the total 193 observations were at levels below 160 dB re 1 μPa^2-s).
- The animals were not exposed in the open ocean but in a shallow bay or pool.

<u>North Atlantic Right Whales in the Wild Data Set:</u>

- The observations of behavioral response were from exposure to alert stimuli that contained mid-frequency components but was not similar to a MFA sonar ping. The alert signal was 18 minutes of exposure consisting of three 2-minute signals played sequentially three times over. The three signals had a 60 percent duty cycle and consisted of: (1) alternating 1-sec pure tones at 500 Hz and 850 Hz; (2) a 2-sec logarithmic down-sweep from 4,500 Hz to 500 Hz; and (3) a pair of low (1,500 Hz)-high (2,000 Hz) sine wave tones amplitude modulated at 120 Hz and each 1-sec long. This 18-minute alert stimuli is in contrast to the average 1-sec ping every 30 sec in a comparatively very narrow frequency band used by military sonar.
- The purpose of the alert signal was, in part, to provoke an action from the whales through an auditory stimulus.

<u>Killer Whales in the Wild Data Set:</u>

- The observations of behavioral harassment were complicated by the fact that there were other sources of harassment in the vicinity (other vessels and their interaction with the animals during the observation).
- The observations were anecdotal and inconsistent. There were no controls during the observation period, with no way to assess the relative magnitude of the any observed response as opposed to baseline conditions.

3.9.7.4.5 Input Parameters for the Risk Function

The values of <u>B</u>, <u>K</u>, and <u>A</u> need to be specified in order to utilize the risk function defined in Section 3.9.7.4.2. The risk continuum function approximates the dose-response function in a manner analogous to pharmacological risk assessment (DoN 2001, Appendix A). In this case, the risk function is combined with the distribution of sound exposure levels to estimate aggregate impact on an exposed population.

<u>Basement Value for Risk—The B Parameter</u>

The <u>B</u> parameter defines the basement value for risk, below which the risk is so low that calculations are impractical. This 120 dB level is taken as the estimate received level (RL) below which the risk of significant change in a biologically important behavior approaches zero for the MFA sonar risk assessment. This level is based on a broad overview of the levels at which multiple species have been reported responding to a variety of sound sources, both mid-frequency and other, was recommended by the scientists, and has been used in other publications. The Navy recognizes that for actual risk of changes in behavior to be zero, the signal-to-noise ratio of the animal must also be zero. However, the present convention of ending the risk calculation at 120 dB for MFA sonar has a negligible impact on the subsequent calculations, because the risk function does not attain appreciable values at received levels that low.

The K Parameter

NMFS and the Navy used the mean of the following values to define the midpoint of the function: (1) the mean of the lowest received levels (185.3 dB) at which individuals responded with altered behavior to 3 kHz tones in the SSC data set; (2) the estimated mean received level value of 169.3 dB produced by the reconstruction of the USS SHOUP incident in which killer whales exposed to MFA sonar (range modeled possible received levels: 150 to 180 dB); and (3) the mean of the 5 maximum received levels at which Nowacek et al. (2004) observed significantly altered responses of right whales to the alert stimuli than to the control (no input signal) is 139.2 dB SPL. The arithmetic mean of these three mean values is 165 dB SPL. The value of K is the difference between the value of B (120 dB SPL) and the 50 percent value of 165 dB SPL; therefore, K=45.

Risk Transition—The A Parameter

The A parameter controls how rapidly risk transitions from low to high values with increasing receive level. As A increases, the slope of the risk function increases. For very large values of A, the risk function can approximate a threshold response or step function. NMFS has recommended that Navy use A=10 as the value for odontocetes, and pinnipeds (Figure 3.1.5.3-1) (NMFS 2008). This is the same value of A that was used for the SURTASS LFA sonar analysis. As stated in the SURTASS LFA Sonar Final OEIS/EIS (DoN 2001), the value of A=10 produces a curve that has a more gradual transition than the curves developed by the analyses of migratory gray whale studies (Malme et al., 1984). The choice of a more gradual slope than the empirical data was consistent with other decisions for the SURTASS LFA Sonar Final OEIS/EIS to make conservative assumptions when extrapolating from other data sets (see Subchapter 1.43 and Appendix D of the SURTASS LFA Sonar EIS [NMFS 2008]).

Based on NMFS' direction, the Navy will use a value of A=8 for mysticetes to allow for greater consideration of potential harassment at the lower received levels based on Nowacek et al., 2004 (Figure 3.1.5.3-2) (NMFS 2008).

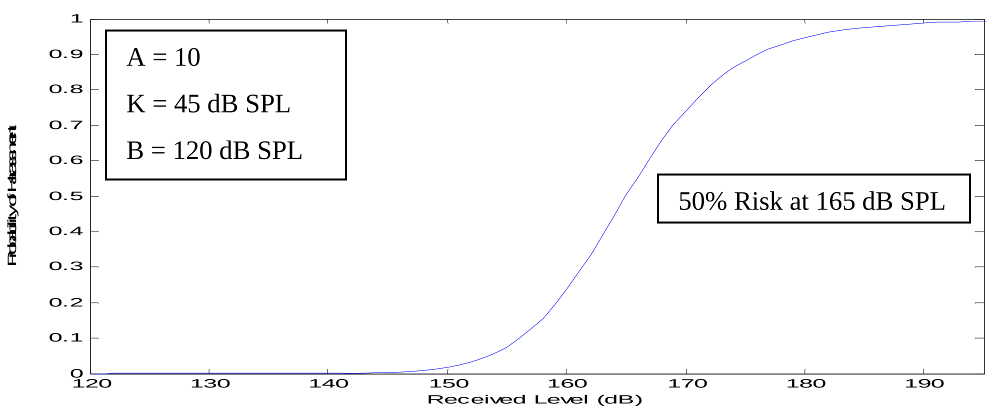

Figure 3.9-4: Risk Function Curve for Odontocetes (Toothed Whales) and Pinnipeds

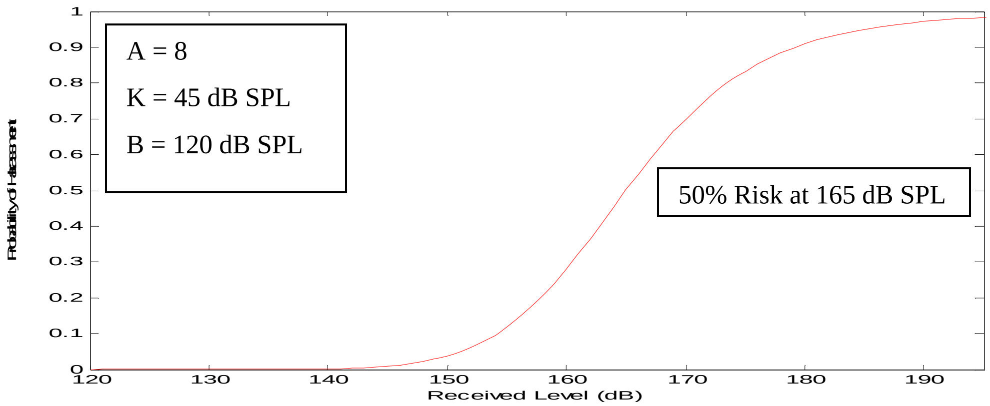

Figure 3.9-5: Risk Function Curve for Mysticetes (Baleen Whales)

3.9.7.4.6 Application of the Risk Function

The risk function is used to estimate the percentage of an exposed population that is likely to exhibit behaviors that would qualify as harassment (as that term is defined by the MMPA applicable to military readiness activities, such as the Navy's testing and training with mid- and high-frequency active sonar) at a given received level of sound. For example, at 165 dB SPL (dB re: 1μPa rms), the risk (or probability) of harassment is defined according to this function as 50 percent, and Navy/NMFS applies that by estimating that 50 percent of the individuals exposed at that received level are likely to respond by exhibiting behavior that NMFS would classify as behavioral harassment. The risk function is not applied to individual animals, only to exposed populations.

The data used to produce the risk function were compiled from four species that had been exposed to sound sources in a variety of different circumstances. As a result, the risk function represents a general relationship between acoustic exposures and behavioral responses that is then applied to specific circumstances. That is, the risk function represents a relationship that is deemed to be generally true, based on the limited, best-available science, but may not be true in specific circumstances. In particular, the risk function, as currently derived, treats the received level as the only variable that is relevant to a marine mammal's behavioral response. However, we know that many other variables—the marine mammal's gender, age, and prior experience; the activity it is engaged in during an exposure event, its distance from a sound source, the number of sound sources, and whether the sound sources are approaching or moving away from the animal—can be critically important in determining whether and how a marine mammal will respond to a sound source (Southall et al. 2007). The data that are currently available do not allow for incorporation of these other variables in the current risk functions; however, the risk function represents the best use of the data that are available.

As more specific and applicable data become available, NMFS can use these data to modify the outputs generated by the risk function to make them more realistic (and ultimately, data may exist to justify the use of additional, alternate, or multi-variate functions). As mentioned above, it is known that the distance from the sound source and whether it is perceived as approaching or moving away can affect the way an animal responds to a sound (Wartzok et al. 2003). Though there are data showing marine mammal responses to sound sources at that *received level*, NMFS does not currently have any data that describe the response of marine mammals to sounds at that *distance* (or to other contextual aspects of the exposure, such as the presence of higher frequency harmonics), much less data that compare responses to similar sound levels at varying distances. However, if data were to become available that suggested animals were less likely to respond (in a manner NMFS would classify as harassment) to certain levels beyond certain distances, or that they were more likely to respond at certain closer distances, Navy will re-evaluate the risk function to try to incorporate any additional variables into the “take” estimates.

Last, pursuant to the MMPA, an applicant is required to estimate the number of animals that will be “taken” by their activities. This estimate informs the analysis that NMFS must perform to determine whether the activity will have a “negligible impact” on the species or stock. Level B (behavioral) harassment occurs at the level of the individual(s) and does not assume any resulting population-level consequences, though there are known avenues through which behavioral disturbance of individuals can result in population-level effects. Alternately, a negligible impact finding is based on the lack of likely adverse effects to annual rates of recruitment or survival (i.e., population-level effects). An estimate of the number of Level B harassment takes, alone, is not enough information on which to base an impact determination. In addition to considering estimates of the number of marine mammals that might be “taken” through harassment, NMFS must consider other factors, such as the nature of any responses (their intensity, duration, etc.), the context of any responses (critical reproductive time or location, migration, etc.), or any of the other variables mentioned in the first paragraph (if known), as well as the number and nature of estimated Level A takes, the number of estimated mortalities, and effects on habitat. For example, in the case of sonar usage in the SOCAL Range Complex, a portion of the animals that are likely to be “taken” through behavioral harassment are expected to be exposed at relatively low received levels (120-140 dB SPL) where the significance of those responses would be reduced because of the distance (25-65 nm) from a sound source. Alternatively, only a relatively very small portion (<5%) of the animals that are expected to be “taken” through behavioral harassment are expected to occur when animals are exposed to higher received levels, such as the onset of TTS (195 dB re 1 μPa^2-s) or higher. Since the modeling does not take into account the reduction of effects resulting from the Navy’s standard mitigation, approximately 25% of all exposures are modeled as having occurred within the 1,000 yard mitigation safety zone where procedures are in place to reduce the received level of animals within this zone. Generally speaking, Navy and NMFS anticipate more severe effects from takes resulting from exposure to higher received levels (though this is in no way a strictly linear relationship throughout species, individuals, or circumstances) and less severe effects from takes resulting from exposure to lower received levels.

It is worth noting that Navy and NMFS would expect an animal exposed to the levels at the bottom of the risk function to exhibit behavioral responses that are less likely to adversely affect the longevity, survival, or reproductive success of the animals that might be exposed, based on received level, and the fact that the exposures will occur in the absence of some of the other contextual variables that would likely be associated with increased severity of effects, such as the proximity of the sound source(s) or the proximity of other vessels, aircraft, submarines, etc. maneuvering in the vicinity of the exercise. NMFS will consider all available information (other variables, etc.), but all else being equal, takes that result from exposure to lower received levels and at greater distances from the exercises would be less likely to contribute to population level effects.

3.9.7.5 Navy Protocols For Acoustic Modeling Analysis of Marine Mammal Exposures

For this DEIS/DOEIS, the acoustic modeling results include additional analysis to account for the model's overestimation of potential effects. Specifically, the model overestimated effects because:

- Acoustic footprints for sonar sources near land are not reduced to account for the land mass where marine mammals would not occur..
- Acoustic footprints for sonar sources were added independently and, therefore, did not account for overlap they would have with other sonar systems used during the same active sonar activity. As a consequence, the area of the total acoustic footprint was larger than the actual acoustic footprint when multiple ships are operating together.
- Acoustic exposures do not reflect implementation of mitigation measures, such as reducing sonar source levels when marine mammals are present.
- Marine mammal densities were averaged across specific active sonar activity areas and, therefore, are evenly distributed without consideration for animal grouping or patchiness.
- Acoustic modeling did not account for limitations of the NMFS-defined refresh rate of 24 hours or less depending on the exercise or activity. This time period represents the amount of time in which individual marine mammals can be harasses no more than once.

Table 3.9-4 provides a summary of the modeling protocols used in the analysis for this DEIS/OEIS.

Table 3.9-4: Navy Protocols Providing for Modeling Quantification of Marine Mammal Exposures

Historical Data	Sonar Positional Reporting System (SPORTS)	Annual active sonar usage data will be obtained from the SPORTS database to determine the number of active sonar hours and the geographic location of those hours for modeling purposes.
Acoustic Parameters	AN/SQS-53 and AN/SQS-56	Model the AN/SQS-53 and the AN/SQS-56 active sonar sources separately to account for the differences in source level, frequency, and exposure effects.
	Submarine Sonar	Submarine active sonar use will be included in effects analysis calculations using the SPORTS database.
Post Modeling Analysis	Land Shadow	For sound sources within the acoustic footprint of land, subtract the land area from the marine mammal exposure calculation.
	Multiple Ships	Correction factors will be used to address overestimates of exposures to marine mammals resulting from multiple counting when there are more than one ship operating in the same vicinity.
	Multiple Exposures	The following refresh rates for SOCAL Range Complex training events will be included to account for multiple exposures: • Unit-level Training, Coordinated Events, and Maintenance – 4 hours • Integrated Anti-submarine Warfare (ASW) Course- – 16 hours • Major Exercises / Major Range Events– 12 hours • Sustainment Training Exercises – 12 hours.

Appendix F provides additional detailed information about the methods applied to estimate acoustic effects of Navy activities in the SOCAL Range Complex on marine Mammals.

3.9.8 Analytical Framework for Assessing Marine Mammal Response to Underwater Detonations

3.9.8.1 Criteria

The criterion for mortality for marine mammals used in the CHURCHILL Final EIS (DoN 2001) is "onset of severe lung injury." This is conservative in that it corresponds to a 1 percent chance of mortal injury, and yet any animal experiencing onset severe lung injury is counted as a lethal exposure.

- The threshold is stated in terms of the Goertner (1982) modified positive impulse with value "indexed to 31 psi-ms.'" Since the Goertner approach depends on propagation, source/animal depths, and animal mass in a complex way, the actual impulse value corresponding to the 31-psi-ms index is a complicated calculation. Again, to be conservative, CHURCHILL used the mass of a calf dolphin (at 12.2 kg), so that the threshold index is 30.5 psi-ms (Table 3.9-5).

Two criteria are used for injury: onset of slight lung hemorrhage and 50 percent eardrum rupture (tympanic membrane [TM] rupture). These criteria are considered indicative of the onset of injury (Table 3.9-5).

- The threshold for onset of slight lung injury is calculated for a small animal (a dolphin calf weighing 27 lb), and is given in terms of the "Goertner modified positive impulse," indexed to 13 psi-ms in the (DoN 2001a). This threshold is conservative since the positive impulse needed to cause injury is proportional to animal mass, and therefore, larger animals require a higher impulse to cause the onset of injury.
- The threshold for TM rupture corresponds to a 50 percent rate of rupture (i.e., 50 percent of animals exposed to the level are expected to suffer TM rupture); this is stated in terms of an EL value of 205 dB re 1 μPa^2-s. The criterion reflects the fact that TM rupture is not necessarily a serious or life-threatening injury, but is a useful index of possible injury that is well correlated with measures of permanent hearing impairment (e.g., Ketten, 1998 indicates a 30 percent incidence of permanent threshold shift [PTS] at the same threshold).

The following criteria is considered for non-injurious harassment temporary threshold shift (TTS), which is a temporary, recoverable, loss of hearing sensitivity (NMFS 2001; DoN 2001a).

- A threshold of 12 pounds per square inch (psi) peak pressure was developed for 10,000 pound charges as part of the CHURCHILL Final EIS (DoN 2001a, [FR70/160, 19 Aug 05; FR 71/226, 24 Nov 06]). It was introduced to provide a more conservative safety zone for TTS when the explosive or the animal approaches the sea surface (for which case the explosive energy is reduced but the peak pressure is not). Navy policy is to use a 23 psi criterion for explosive charges less than 2,000 lb and the 12 psi criterion for explosive charges larger than 2,000 lb. This is below the level of onset of TTS for an odontocete (Finneran et al. 2002). All explosives modeled for the SOCAL Range Complex DEIS/DOEIS are less than 1,500 lbs.

Table 3.9-5: Effects Analysis Criteria for Underwater Detonations

(For explosives < 2000 lbs Net Explosive Weight (NEW), based on CHURCHILL FEIS (DON 2001) and Eglin Air Force Base IHA (NMFS 2005h) and LOA (NMFS 2006a).

	Criterion	Metric	Threshold	Comments	Source
Mortality & Injury	Mortality Onset of extensive lung hemorrhage	Shock Wave Goertner modified positive impulse	30.5 psi-msec*	All marine mammals (dolphin calf)	Goertner 1982
	Slight Injury Onset of slight lung hemorrhage	Shock Wave Goertner modified positive impulse	13.0 psi-msec*	All marine mammals (dolphin calf)	Goertner 1982
	Slight Injury 50% TM Rupture	Shock Wave Energy Flux Density (EFD) for *any single exposure*	205 dB re:1µPa^2-sec	All marine mammals	DoN 2001
Harassment	Temporary Auditory Effects TTS	Noise Exposure greatest EFD in any 1/3-octave band *over all exposures*	182 dB re:1µPa^2-sec	For odontocetes greatest EFD for frequencies ≥100 Hz and for mysticetes ≥10 Hz	NMFS 2005, NMFS 2006a
	Temporary Auditory Effects TTS	Noise Exposure Peak Pressure for *any single exposure*	23 psi	All marine mammals	DoN 2001
Behavioral	Behavioral Modification	Noise Exposure greatest EFD in any 1/3-octave band *over all exposures*	177 dB re:1µPa^2-sec	For odontocetes greatest EFD for frequencies ≥100 Hz and for mysticetes ≥10 Hz	NMFS

Notes:

Goertner, J.F. 1982. Prediction of underwater explosion safe ranges for sea mammals. Naval Surface Weapons Center, White Oak Laboratory, Silver Spring, MD. NSWC/WOL TR-82-188. 25 pp.

DoN. 2001. USS Churchill Shock Trail FEIS- February 2001.

NMFS 2005. Notice of Issuance of an Incidental Harassment Authorization, Incidental to Conducting the Precisions Strike Weapon (PSW) Testing and Training by Eglin Air Force Base in the Gulf of Mexico. Federal Register,70:48675-48691.

NMFS 2006. Incidental Takes of Marine Mammals Incidental to Specified Activities; Naval Explosive Ordnance Disposal School Training Operations at Eglin Air Force Base, Florida, National Oceanic and Atmospheric Administration, National Marine Fisheries Service. Federal Register 71(199):60693-60697

NMFS. Briefed to NMFS for VAST-IMPASS; U.S. Air Force uses 176 dB for permit applications at Eglin Gulf Test and Training Range (EGTTR)

EFD = Energy Flux Density

3.9.8.2 Very Shallow Water Underwater Detonations

Measurements of pressure-wave propagation are available for detonations in deep and shallow water, but only fragmentary data exist for propagation in Very Shallow Water (VSW) near shorelines between the shoreline and 50-foot (ft) depth. The lack of data is due to the complicated nature of the VSW environment as well as to substantial differences between different VSW sites. In VSW, surface- and bottom-boundary effects have more influence on propagation than in deeper water. At the point of detonation, the geometry of the short water column dictates that a charge must be close to one or both of these boundaries. More likely surface blowout can dissipate energy and diminish bubble formation with its attendant oscillation effects while detonations closer to the bottom may have considerable energy absorbed by the bottom as well. Further, as pressure waves propagate laterally through the VSW column, they reflect off surface and bottom boundaries more often over a given distance than in deeper waters and thus, VSW boundaries exert their influence relatively more frequently over that distance. Refraction of the pressure waves, determined by differences in sound velocity at different depths – i.e., the sound velocity profile (SVP) - acts as it does in deeper water, but thermal layering and mixing of layers that determine the SVP may be more complicated and dynamic in VSW. In summary, reliable prediction of pressure wave propagation in all situations requires knowledge of the charge size, type, and position as well as boundary and water column conditions, but in VSW, the relative contributions of these variables may differ considerably from those in deeper waters.

The best mathematical models of underwater explosive-pressure propagation take into account the variables just described. However, the lack of empirical validation data for VSW has allowed the use of less complete models with untested assumptions as well as more complete models with untested assumptions and extreme values of those variables. Occasionally, these practices produced extreme over- and underestimation of propagation and consequent effects on marine mammals, neither of which facilitate realistic, practical regulatory compliance policy. To address the variables of concern and garner an understanding of the affects of underwater detonations, the Navy collected and analyzed empirical data from underwater detonations conducted during training events. Because bottom conditions factor heavily into the amount energy propagating through the water column, explosive tests were conducted at actual ordnance training sites so that, in addition to providing basic data to test theoretical issues, the tests would also provide applied knowledge about the acoustic properties of specific beach approaches in which explosive training and tests are conducted.

The principle objectives of the tests reported in the main body of this report were to measure the pressure waves at various distances seaward of single-charge underwater explosions in VSW and, subsequently evaluate the predictions of existing underwater explosion-propagation models. A model of particular interest is the Reflection and Refraction in Multi-Layered Ocean/Ocean Bottoms with Shear Wave Effects (REFMS), but the test results may be used to evaluate other models of underwater explosive propagation as well. A second objective was to record waveform propagation information for specific single-charge sizes on the specific beach approaches where underwater ordnance training is conducted by Navy Special Warfare (NSW) and Explosive Ordinance Disposal (EOD) personnel in routine underwater ordinance training. The main body of the report deals with single charges of up to 15 lbs on those beach approaches. Additionally, two configurations of multiple larger charges are used on the SCI range for training of NSW personnel. As there are no standard models for multiple-charge detonations, the pressure waves at various distances seaward of these charges were measured. The multiple charge sizes, configurations, locations, empirical measurements, and analyses of these detonations are described in Appendix F.

3.9.9 Environmental Consequences

This section discusses the potential environmental effects associated with the use of active sonar and other Navy operations within the SOCAL Range Complex. In determining the potential environmental consequences, an approach was established to differentiate between significant and non-significant effects. This approach involved using either documented regulatory criteria or the best scientific information available at the time of analysis. Further, the extent of significance was evaluated using the context (e.g., short- versus long-term) of the Proposed Action and the intensity (severity) of the potential effect.

Acoustic Impact Model Process Applicable to All Alternative Discussions

The methodology for analyzing potential impacts from sonar and explosives is presented in Section 3.9.7 and in further detail in Appendix F, which explains the model process in detail, describes how the impact threshold derived from Navy-NMFS consultations are derived, and discusses relative potential impact based on species biology.

The Navy acoustic exposure model process uses a number of inter-related software tools to assess potential exposure of marine mammals to Navy generated underwater sound including sonar and explosions. For sonar, these tools estimate potential impact volumes and areas over a range of thresholds for sonar specific operating modes. Results are based upon extensive pre-computations over the range of acoustic environments that might be encountered in the operating area (Appendix F).

The acoustic model includes four steps used to calculate potential exposures:

1. Identify unique acoustic environments that encompass the operating area. Parameters include depth and seafloor geography, bottom characteristics and sediment type, wind and surface roughness, sound velocity profile, surface duct, sound channel, and convergence zones.

2. Compute transmission loss (TL) data appropriate for each sensor type in each of these acoustic environments. Propagation can be complex depending on a number of environmental parameters listed in step one, as well as sonar operating parameters such as directivity, source level, ping rate, and ping length, and for explosives the amount of explosive material detonated. The standard Navy CASS-GRAB acoustic propagation model is used to resolve complexities for underwater propagation prediction.

3. Use that TL to estimate the total sound energy received at each point in the acoustic environment.

4. Apply this energy to predicted animal density for that area to estimate potential acoustic exposure, with animals distributed in 3-D based on best available science on animal dive profiles.

Model Results Explanation

Acoustic exposures are evaluated based on their potential direct effects on marine mammals, and these effects are then assessed in the context of the species biology and ecology to determine if there is a mode of action that may result in the acoustic exposure warranting consideration as a harassment level effect.

A large body of research on terrestrial animal and human response to airborne sound exists, but results from those studies are not readily extendible to the development of behavioral criteria and thresholds for marine mammals. For example, “annoyance” is one of several criteria used to define impact to humans from exposure to industrial sound sources. Comparable criteria cannot be developed for marine mammals because there is no scientifically acceptable method for determining whether a non-verbal animal is annoyed (NRC 2003). Further, differences in hearing thresholds, dynamic range of the ear, and the typical exposure patterns of interest (e.g., human data tend to focus on 8-hour-long exposures) make extrapolation of human sound exposure standards inappropriate. Behavioral observations of marine mammals exposed to anthropogenic sound sources exists, however, there are few observations and no controlled measurements of behavioral disruption of cetaceans caused by sound sources with frequencies, waveforms, durations, and repetition rates comparable to those employed by the tactical sonars described in this EIS/OEIS (Deecke 2006).

At the present time there is no general scientifically accepted consensus on how to account for behavioral effects on marine mammals exposed to anthropogenic sounds including military sonar and explosions (NRC 2003, NRC 2005). While the first three blocks in Figure 3.9-6 can be easily defined (source, propagation, receiver) the remaining two blocks (perception and behavior) are not well understood given the difficulties in studying marine mammals at sea (NRC 2005). NRC (2005) acknowledges "there is not one case in which data can be integrated into models to demonstrate that noise is causing adverse affects on a marine mammal population."

From: NRC. 2003. Ocean Noise And Marine Mammals. National Research Council of the National Academies. National Academies Press, Washington, DC.

Figure 3.9-6: Required steps needed in order to understand effects or non-effects of underwater sound on marine species.

For purposes of predicting potential acoustic and explosive effects on marine mammals, the U.S Navy uses an acoustic impact model process with numeric criteria agreed upon with the NMFS. While this process is described more completely in Appendix F, there are some caveats necessary to understand in order to put these exposures in context.

For instance, 1) significant scientific uncertainties are implied and carried forward in any analysis using marine mammal density data as a predictor for animal occurrence within a given geographic area; 2) there are limitations to the actual model process based on information available (animal densities, animal depth distributions, animal motion data, impact thresholds, and supporting statistical model); and determination and understanding of what constitutes a significant behavioral effect is still unresolved.

The sources of marine mammal densities used in the SOCAL EIS/OEIS are derived from NMFS broad scale West Coast Surveys. These ship board surveys cover significant distance along the California coast out the extent of the U.S. EEZ. However, although survey design includes statistical placement of survey tracks, the survey itself can only cover so much ocean area and post-survey statistics are used to calculate animal abundances and densities (Barlow and Forney 2007). There is often significant statistical variation inherit within the calculation of the final density values depending on how many sightings were available during a survey.

Occurrence of marine mammals within any geographic area including Southern California is highly variable and strongly correlated to oceanographic conditions, bathymetry, and ecosystem level patterns rather than changes in reproduction success and survival (Forney 2000, Ferguson and Barlow 2001, Benson et al. 2002, Moore et al. 2002, Tynan 2005, Redfern 2006). For some species, distribution may be even more highly influence by relative small scale features over both short and long-term time scales (Balance et al. 2006, Etnoyer et al. 2006, Ferguson et al. 2006, Skov et al. 2007). Unfortunately, the scientific level of understanding of some large scale and most small scale processes thought to influence marine mammal distribution is incomplete.

Given the uncertainties in marine mammal density estimation and localized distributions, the U.S. Navy's acoustic impact models can not currently be use to predict occurrence of marine mammals within specific regions of Southern California. To resolve this issue and allow modeling to precede, animals are "artificially and uniformly distributed" within the modeling provinces described in Appendix F. This process does not account for animals that move into or out of the region based on foraging and migratory patterns, and adds a significant amount of variability to the model predictions.

Results, therefore, from acoustic impact exposure models should be regarded as exceedingly conservative estimates strongly influenced by limited biological data. While numbers generated allow establishment of predicted marine mammal exposures for consultation with NMFS, the short duration and limited geographic extent of most sonar and explosive events does not necessarily mean that these exposures will ever be realized.

Comparison With SOCAL After Action Report Data

From exercise after action reports of major SOCAL exercises in 2007, marine mammal sightings ranged from 289 to 881 animals per event over four events. Approximately, 77 to 96% of these animals were dolphins. From all four exercises, only approximately 226 of 2303 animals were observed during mid-frequency operations and sonar was secured or powered down in all cases upon initial animal sighting and until the animal had departed the vicinity of the ship, or the ship moved from the vicinity of the animal. At no time were any of these animals potentially exposed to SEL of greater than 189 dB, with the exception of two groups of dolphins that closed with a ship to ride the bow wake while MFAS was in use, and one group of four whales observed at 50 yards during MFAS transmission and that could have been exposed to RL of 201 dB. Like other sighting, MFAS was secured when these marine mammals were first observed within 200 yards of the ship. Of interest in this evaluation, even accounting for marine mammal not detected visually, the numbers of animals potentially exposed during 2007 are many orders of magnitude below what was predicted by the SOCAL EIS/OEIS acoustic impact modeling (Tables 3.9-7, 3.9-10, 3.9-13).

Behavioral Responses

Behavioral responses to exposure from mid- and high-frequency active sonar and underwater detonations can range from no observable response to panic, flight and possibly stranding (Figure 3.9-7). The intensity of the behavioral responses exhibited by marine mammals depends on a number of conditions including the age, reproductive condition, experience, behavior (foraging or reproductive), species, received sound level, type of sound (impulse or continuous) and duration of sound (Reviews by Richardson et al., 1995; Wartzok et al. 2004; Cox et al. 2006, Nowacek et al. 2007; Southall et al. 2007). Most behavioral responses may be short term and of little consequence for the animal although certain responses may lead to a stranding or mother-offspring separation. Active sonar exposure is brief as the ship is constantly moving and the animal will likely be moving as well. Generally the louder the sound source the more intense the response although duration is also very important (Southall et al. 2007). According to the Southall et al. (2007) response spectrum, responses from 0-3 are brief and minor, 4-6 have a higher potential to affect foraging, reproduction or survival and 7-9 are likely to affect foraging, reproduction and survival. Mitigation measures would likely prevent animals from being exposed to the loudest sonar sounds that could cause PTS, TTS and more intense behavioral reactions (i.e. 7-9 on the response spectrum. There is little data on the consequences of sound exposure on vital rates of marine mammals. Several studies have shown the effects of chronic noise (either continuous or multiple pulses) on marine mammal presence in an area (e.g. Malme et al. 1984; McCauley et al. 1998; Nowacek et al. 2004)

Even for more cryptic species such as beaked whales, the main determinant of causing a stranding appears to be exposure in a narrow channel with no egress thus animals are exposed for prolonged period rather than just several sonar pings over a several minutes (See section 2.4.3 in Appendix F). There are no narrow channels in the SOCAL Range Complex therefore it is unlikely that mid- or high-frequency active sonar would cause beaked whales to strand.

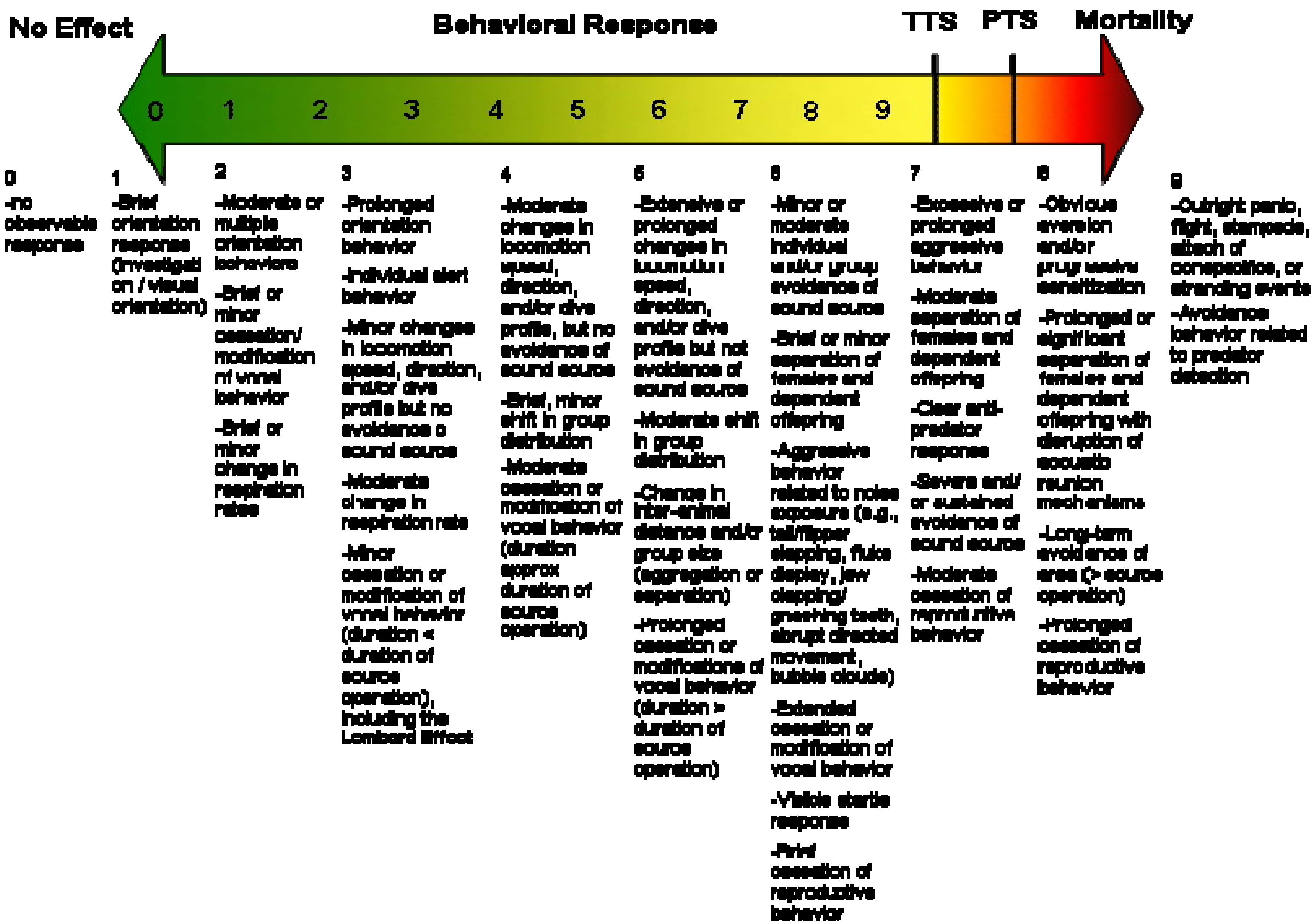

Figure 3.9-7: Marine Mammal Response Spectrum to Anthropogenic Sounds (Numbered severity scale for ranking observed behaviors from Southall et al. 2007.

3.9.9.1 No Action Alternative

3.9.9.1.1 Non-Sonar Acoustic Impacts and Non-Acoustic Impacts

Ship Noise

Increased number of ships operating in the area will result in increased sound from vessel traffic. Marine mammals react to vessel-generated sounds in a variety of ways. Some respond negatively by retreating or engaging in antagonistic responses while other animals ignore the stimulus altogether (Watkins 1986; Terhune and Verboom 1999). Most studies have ascertained the short-term response to vessel sound and vessel traffic (Watkins et al. 1981; Baker et al. 1983; Magalhães et al. 2002); however, the long-term implications of ship sound on marine mammals is largely unknown (NMFS 2007). Anthropogenic sound, especially around regional commercial shipping hubs has increased in the marine environment over the past 50 years (Richardson, et al. 1995; Andrew et al. 2002; NRC 2003; Hildebrand 2004; NRC 2005). This sound increase can be attributed primarily to increases in vessel traffic as well as sound from other human sources (Richardson, et al. 1995; NRC 2005). NRC (2005) has a thorough discussion of both human and natural underwater sound sources.

Given the current ambient sound levels in the Southern California marine environment, the amount of sound contributed by the use of Navy vessels in the proposed exercises is very low. In addition, as opposed to commercial vessels, Navy ships are purposely designed and engineered for the lowest underwater acoustic signature possible given the limits of current naval shipbuilding technology. The goal with ship silencing technology is to limit the amount of sound a Navy vessel radiates that could be used by a potential adversary for detection. Given these factors, it is anticipated that any marine mammals exposed may exhibit either nor reactions or only short-term reactions, and would not suffer any long-term consequences from ship sound. This assessment is also applicable to discussions of Alternatives 1 and 2.

Ship Strikes

Collisions with commercial and Navy ships can cause major wounds and may occasionally cause fatalities to cetaceans. The most vulnerable marine mammals are those that spend extended periods of time at the surface in order to restore oxygen levels within their tissues after deep dives (e.g., sperm whale). In addition, some baleen whales, such as the northern right whale and fin whale swim slowly and seem generally unresponsive to ship sound, making them more susceptible to ship strikes (Nowacek et al. 2004). Smaller marine mammals-for example, Pacific white-side dolphins and common dolphins move quickly throughout the water column and are often seen riding the bow wave of large ships. Marine mammal responses to vessels may include avoidance and changes in dive pattern (NRC 2003).

The Navy has adopted mitigation measures that reduce the potential for collisions with surfaced marine mammals and sea turtles (See Chapter 5). These standard operating procedures include: (1) use of lookouts trained to detect all objects on the surface of the water, including marine mammals; (2) reasonable and prudent actions to avoid the close interaction of Navy assets and marine mammals; and (3) maneuvering to keep away from any observed marine mammal. Based on these standard operating procedures, collisions with marine mammals are not expected. This assessment is also applicable to discussions of Alternatives 1 and 2.

Torpedoes

There is a negligible risk that a marine mammal could be struck by a torpedo during ASW training activities. This conclusion is based on (1) review of torpedo design features, and (2) review of a large number of previous naval exercise ASW torpedo activities. The acoustic homing programs of torpedoes are designed to detect either the mechanical sound signature of the submarine or active sonar returns from its metal hull with large internal air volume interface. The torpedoes are specifically designed to ignore false targets. As a result, their homing logic does not detect or recognize the relatively small air volume associated with the lungs of marine mammals. They do not detect or home to marine mammals. The Navy has conducted exercise torpedo activities since 1968. At least 14,322 exercise torpedo runs have been conducted since 1968. There have been no recorded or reported instances of a marine species strike by an exercise torpedo. Every exercise torpedo activity is monitored acoustically by on-scene range personnel listening to range hydrophones positioned on the ocean floor in the immediate vicinity of the torpedo activity. After each torpedo run, the recovered exercise torpedo is thoroughly inspected for any damage. The torpedoes then go through an extensive production line refurbishment process for re-use. This production line has stringent quality control procedures to ensure that the torpedo will safely and effectively operate during its next run. Since these exercise torpedoes are frequently used against manned Navy submarines, this post activity inspection process is thorough and accurate. Inspection records and quality control documents are prepared for each torpedo run. This post exercise inspection is the basis that supports the conclusion of negligible risk of marine mammal strike. Therefore, there will be no significant impact and no significant harm to marine mammals resulting from interactions with torpedoes during SOCAL activities under the No Action Alternative, Alternative 1, or Alternative 2. The probability of direct strike of torpedoes associated with SOCAL training is negligible and therefore will have no effect on ESA-listed marine mammal species.

Military Expendable Material

Marine mammals are subject to entanglement in expended materials, particularly anything incorporating loops or rings, hooks and lines, or sharp objects. Most documented cases of entanglements occur when whales encounter the vertical lines of fixed fishing gear. This section analyzes the potential effects of expended materials on marine mammals

The Navy endeavors to recover expended training materials. Notwithstanding, it is not possible to recover all training debris, and some may be encountered by marine mammals in the waters of the SOCAL Range Complex. Debris related to military activities that is not recovered generally sinks; the amount that might remain on or near the sea surface is low, and the density of such debris in the SOCAL Range Complex would be very low. Types of training debris that might be encountered include: parachutes of various types (e.g., those employed by personnel or on targets, flares, or sonobuoys); torpedo guidance wires, torpedo “flex hoses;” cable assemblies used to facilitate target recovery; sonobuoys; and Expendable Mobile Acoustic Training Target s (EMATT)

Entanglement in military-related debris was not cited as a source of injury or mortality for any marine mammals recorded in a large marine mammal and sea turtle stranding database for California waters. Range debris is highly unlikely to affect marine mammal species in the SOCAL Range Complex. The following discussion addresses categories of debris.

Sonobuoys. A sonobuoy is approximately 13 centimeters (cm) (5 inches [in]) in diameter, 1 meter (m) (3 feet [ft]) long, and weighs between 6 and 18 kilograms (kg) (14 and 39 pounds [lb]), depending on the type. In addition, aircraft-launched sonobuoys deploy a nylon parachute of varying sizes, ranging from 0.15 to 0.35 square meters (m2) (1.6 to 3.8 square feet [ft2]). The shroud lines range from 0.30 to 0.53 m (12 to 21 in) in length and are made of either cotton polyester with a 13.6-kg (30-lb) breaking strength or nylon with a 45.4-kg (100-lb) breaking strength. All parachutes are weighted with a 0.06-kg (2-ounce) steel material weight, which causes the parachute to sink from the surface within 15 minutes. At water impact, the parachute assembly, battery, and sonobuoy will sink to the ocean floor where they will be buried into its soft sediments or land on the hard bottom where they will eventually be colonized by marine organisms and degrade over time. These components are not expected to float at the water surface or remain suspended within the water column. Over time, the amount of materials will accumulate on the ocean floor. However, the active sonar activities using sonobuoys will not likely occur in the exact same location each time. Additionally, the materials will not likely settle in the same vicinity due to ocean currents.

Parachutes. Aircraft-launched sonobuoys, flares, torpedoes, and EMATTs deploy nylon parachutes of varying sizes. As described above, at water impact, the parachute assembly is expended and sinks, as all of the material is negatively buoyant. Some components are metallic and will sink rapidly. Entanglement and the eventual drowning of a marine mammal in a parachute assembly would be unlikely, since such an event would require the parachute to land directly on an animal, or the animal would have to swim into it before it sinks. The expended material will accumulate on the ocean floor and will be covered by sediments over time, remaining on the ocean floor and reducing the potential for entanglement. If bottom currents are present, the canopy may billow (bulge) and pose an entanglement threat to marine animals with bottom-feeding habits; however, the probability of a marine mammal encountering a submerged parachute assembly and the potential for accidental entanglement in the canopy or suspension lines is considered to be unlikely.

Torpedoes. The Mk-48 will be used during active sonar activities. These devices are approximately 19 ft (580 cm) long and 21 in (53 cm) in diameter. Mk-48 torpedoes when used in a non-detonation exercise mode are typically recovered. An assortment of air launch accessories, all of which consist of non-hazardous materials, would be expended into the marine environment during air launching of Mk-46 or Mk-54 torpedoes, which are lightweight torpedoes. Depending on the type of launch craft used, Mk-46 launch accessories may be comprised of a protective nose cover, suspension bands, air stabilizer, release wire, and propeller baffle (DoN 1996). Mk-54 air launch accessories may be comprised of a nose cap, suspension bands, air stabilizer, sway brace pad, arming wire, and fan stock clip (DoN 1996). Upon completion of an M6-46 EXTORP run, two steel-jacketed lead ballast weights are released to lighten the torpedo, allowing it to rise to the surface for recovery. Each ballast weighs 37 lbs (16.8 kg) and sinks rapidly to the bottom. In addition to the ballasted Mk-46 EXTORPs, Mk-46 REXTORPs launched from maritime patrol aircraft (MPA) must also be ballasted for safety purposes. Ballast weights for these REXTORPs are similarly released to allow for missile recovery. Ballasting the Mk-46 REXTORP for MPA use requires six ballasts, totaling 180 lbs (82 kg) of lead

Torpedo Guidance Wires. Torpedoes are equipped with a single-strand guidance wire, which is laid behind the torpedo as it moves through the water. The guidance wire is a maximum of 0.11 cm (0.043 in) in diameter and composed of a very fine thin-gauge copper-cadmium core with a polyolefin coating. The tensile breaking strength of the wire is a maximum of 19 kg (42 lb) and can be broken by hand. Up to 28 km (15 miles [mi]) of wire is deployed during a run, which will sink to the sea floor at a rate of 0.15 meters per second (m/sec) (0.5 feet per second [ft/sec]). At the end of a training torpedo run, the wire is released from the firing vessel and the torpedo to enable torpedo recovery. The wire sinks rapidly and settles on the ocean floor. Guidance wires are expended with each exercise torpedo launched. DoN (1996) analyzed the potential entanglement effects of torpedo control wires on sea turtles. The Navy analysis concluded that the potential for entanglement effects will be low for the following reasons, which apply also to potential entanglement of marine mammals:

- The guidance wire is a very fine, thin-gauge copper-cadmium core with a polyolefin coating. The tensile breaking strength of the wire is a maximum of 19 kg (42 lb) and can be broken by hand. With the exception of a chance encounter with the guidance wire while it was sinking to the sea floor (at an estimate rate of 0.2 m [0.5 ft] per second), a marine animal would be vulnerable to entanglement only if its diving and feeding patterns place it in contact with the bottom.

- The torpedo control wire is held stationary in the water column by drag forces as it is pulled from the torpedo in a relatively straight line until its length becomes sufficient for it to form a chain-like droop. When the wire is cut or broken, it is relatively straight and the physical characteristics of the wire prevent it from tangling, unlike the monofilament fishing lines and polypropylene ropes identified in the entanglement literatures.

While it is possible that a marine mammal would encounter a torpedo guidance wire as it sinks to the ocean floor, the likelihood of such an event is considered remote, as is the likelihood of entanglement after the wire has descended to and rests upon the ocean floor.

Given the low potential probability of marine mammal entanglement with guidance wires, the potential for any harm or harassment to these species is extremely low. Therefore, there will be no significant impact to marine mammals resulting from interactions with torpedo guidance wire during SOCAL activities under the No Action Alternative, Alternative 1, and Alternative 2. In addition, there will be no significant harm to marine mammals resulting from interactions with torpedo guidance wire during. The torpedo guidance wires associated with SOCAL activities will also have no effect on ESA-listed marine mammal species

Torpedo Flex Hoses. The flex hose protects the torpedo guidance wire and prevents it from forming loops as it leaves the torpedo tube of a submarine. Improved flex hoses or strong flex hoses will be expended during torpedo exercises. DoN (1996) analyzed the potential for the flex hoses to affect sea turtles. This analysis concluded that the potential entanglement effects to marine animals will be insignificant for reasons similar to those stated for the potential entanglement effects of control wires:

- Due to weight, flex hoses will rapidly sing to the bottom upon release. With the exception of a chance encounter with the flex hose while it was sinking to the sea floor, a marine mammal would be vulnerable to entanglement only if its diving and feeding patterns placed it in contact with the bottom.
- Due to its stiffness, the 250-ft-long flex hose will not form loops that could entangle marine mammals.

Therefore, there will be no significant impact to marine mammals resulting from interactions with torpedo flex hoses during AFAST activities within territorial waters under the No Action Alternative, Alternative 1, and Alternative 2. In addition, there will be no significant harm to marine mammals or ESA-listed marine species resulting from interactions with torpedo flex hoses.

EMATT. The Navy uses the EMATT and the MK-30 acoustic training targets (recovered), sonobuoys and exercise torpedoes during ASW sonar training exercises. EMATTs are approximately 5 by 36 inches (in) (12 by 91 centimeters [cm]) and weigh approximately 21 pounds (lbs). EMATTs are much smaller than sonobuoys and ADCs. Given the small sized of EMATTs and coupled with the low probability that an animal would occur at the immediate location of deployment and reconnaissance, provide little potential for a direct strike. Moreover, there is a negligible risk that a marine mammal could be struck by a torpedo during ASW training activities. The acoustic homing programs of torpedoes are designed to detect either the mechanical sound signature of the submarine or active sonar returns from its metal hull with large, internal air volume interface. Their homing logic does not detect or recognize the relatively small air volume associated with the lungs of marine mammals.

Therefore, the probability of direct strike by training target is remote, and there will be no significant impact to marine mammals resulting from interactions with targets, or exercise torpedoes during SOCAL activities under the No Action Alternative, Alternative 1, and

Alternative 2. In addition, there will be no significant harm to marine mammals or ESA-listed marine species from interactions with targets, or exercise torpedoes.

EMATTs, their batteries, parachutes, and other components will scuttle and sink to the ocean floor and will be covered by sediments over time. In addition, the small amount of expended material will be spread over a relatively large area. Due to the small size and low density of the materials, these components are not expected to float at the water surface or remain suspended within the water column. Over time, the amount of materials will accumulate on the ocean floor, but due to ocean currents, the materials will not likely settle in the same vicinity. There will be no significant impact to marine habitat from expended EMATTs or their components.

Other Falling Expendable Material. Marine mammals are widely dispersed in the SOCAL Range Complex, therefore, there is an extremely low probability of injury to a marine mammal from falling debris such as munitions constituents, inert ordnance, or targets. The probability of negative interaction from direct strike, sound, or other energy by expendable material is remote. Therefore, there will be no significant impact to marine mammals resulting from interactions with targets, or exercise torpedoes during SOCAL activities under the No Action Alternative, Alternative 1, and Alternative 2. In addition, there will be no significant harm to marine mammals or ESA-listed marine species from interactions with targets, or exercise torpedoes.

3.9.9.1.2 Summary of Potential Mid- and High Frequency Active Sonar Effects-No Action Alternative

Table 3.9-6 represents the number of No Action Alternative active sonar hours or usage per year for different sonar sources including the SQS-53C, SQS-56C, AQS-22 dipping sonar, SSQ-62 Sonobuoys, and MK-48 torpedoes.

Table 3.9-6: No Action Alternative: Summary of Active Sonar Hours, Number of Sonar Dips, Number of Sonobuoys, and Torpedo Runs

Event	**SQS-53 C Sonar Hours**	**SQS-56 C Sonar Hours**	***Total Sonar Hours***	**AQS-22 Number of Dips**	**SSQ-62 Number of Sonobuoys Deployments**	**MK-48 Number of Torpedo Events**
Major Exercise (8/yr)	927	231	1,158	299	1,999	9
Sustainment Exercise (2/yr)	75	19	94	39	151	3
IAC II (4/yr)	216	55	271	361	453	2
ULT, Coordinated Events and Maintenance	535	133	668	1,712	1,169	62
Total	1,753	438	2,191	2,411	3,773	77

Table 3.9-7 presents estimated marine mammal exposures for potential non injurious (Level B) harassment, as well as potential onset of injury (Level A) to cetaceans and pinnipeds.

Specifically, under this assessment for mid-frequency active sonar, the risk function methodology estimates 83,686 annual exposures that could potentially result in behavioral sub-TTS (Level B Harassment); 16,706 annual exposures that could potentially result in TTS (Level B Harassment); and 26 annual exposures could result in potential injury as PTS (Level A Harassment). No mid-frequency active sonar exposures are predicted to result in any animal mortality.

It should be noted, however, that these exposure modeling results are statistically derived estimates of potential marine mammal sonar exposures without consideration of standard mitigation and monitoring procedures. The caveats to intrepreations of model results are explained previously. It is highly unlikely that a marine mammal would experience any long-term effects because the large SOCAL Range Complex training areas makes individual mammals' repeated or prolonged exposures to high-level sonar signals unlikely. Specifically, mid-frequency active sonars have limited marine mammal exposure ranges and relatively high platform speeds. The number of exposures that exceed the PTS threshold and result in Level A harassment from sonar is eight for six species (blue whale, gray whale, sperm whale, long-beaked common dolphin, short-beaked common dolphin, and Pacific harbor seal). Therefore, long term effects on individuals, populations or stocks are unlikely.

When analyzing the results of the acoustic exposure modeling to provide an estimate of effects, it is important to understand that there are limitations to the ecological data (diving behavior, migration or movement patterns and population dynamics) used in the model, and that the model results must be interpreted within the context of a given species' ecology.

As described previously, this authorization request assumes that short-term non-injurious sound exposure levels predicted to cause TTS or temporary behavioral disruptions qualify as Level B harassment. This approach is overestimating because there is no established scientific correlation between mid-frequency active sonar use and long term abandonment or significant alteration of behavioral patterns in marine mammals.

Because of the time delay between pings, and platform speed, an animal encountering the sonar will accumulate energy for only a few sonar pings over the course of a few minutes. Therefore, exposure to sonar would be a short-term event, minimizing any single animal's exposure to sound levels approaching the harassment thresholds.

The implementation of the mitigation and monitoring procedures as addressed in Section 5 will further minimize the potential for marine mammal exposures to underwater detonations. When reviewing the acoustic exposure modeling results, it is also important to understand that the estimates of marine mammal sound exposures are presented without consideration of standard protective measure operating procedures. Section 5 presents details of the mitigation measures currently used for ASW activities including detection of marine mammals and power down procedures if marine mammals are detected within one of the safety zones. The Navy will work through the MMPA incidental harassment regulatory process to discuss the mitigation measures and their potential to reduce the likelihood for incidental harassment of marine mammals.

Table 3.9-7: No-Action Alternative: Summary of All Annual Sonar Exposures

Species	Level B Sonar Exposures		Level A Sonar Exposures
	Risk Function	TTS	PTS
ESA Species			
Blue whale	463	113	1
Fin whale	101	21	0
Humpback whale	12	2	0
Sei whale	0	0	0
Sperm whale	104	17	1
Guadalupe fur seal	807	285	0
Sea otter	0	0	0
Mysticetes			
Bryde's whale	0	0	0
Gray whale	4,797	901	2
Minke whale	90	26	0
Odontocetes			
Baird's beaked whale	8	2	0
Bottlenose dolphin	853	317	0
Cuvier's beaked whale	288	63	0
Dall's porpoise	419	145	0
Dwarf sperm whale	N/A	N/A	N/A
False killer whale	N/A	N/A	N/A
Killer whale	6	2	0
Long beaked common dolphin	2,255	715	1
Longman's beaked whale	N/A	N/A	N/A
Melon-headed whale	N/A	N/A	N/A
Mesoplodon spp.	86	22	0
Northern right whale dolphin	811	277	0
Pacific white-sided dolphin	756	312	0
Pantropical spotted dolphin	N/A	N/A	N/A
Pygmy killer whale	N/A	N/A	N/A
Pygmy sperm whale	108	27	0
Risso's dolphin	1,968	570	0
Rough-toothed dolphin	N/A	N/A	N/A
Short beaked common dolphin	19,377	6,148	8
Short-finned pilot whale	34	9	0
Spinner dolphin	N/A	N/A	N/A
Striped dolphin	1,401	411	0
Ziphiid whales	65	15	0
Pinnipeds			
Northern elephant seal	599	7	0
Pacific harbor seal	906	6,290	13
California sea lion	46,715	5	0
Northern fur seal	656	5	0
Total	**83,686**	**16,706**	**26**

TTS and PTS Thresholds: Cetaceans TTS = 195 dB re 1 µPa^2-s; PTS = 215 dB, re 1 µPa^2-s
Northern elephant seal TTS = 204 re 1 µPa^2-s, PTS = 224 re 1 µPa^2-s
Harbor seal TTS = 183 re 1 µPa^2-s, PTS = 203 re 1 µPa^2-s.
Otariids TTS = 206 re 1 µPa^2-s, PTS = 226 re 1 µPa^2-s.

N/A: Not applicable – Based on a few historic observations, its habitat preference or overall distribution, a species may occur rarely in the SOCAL Range Complex, but no density estimates were available for modeling exposures..

3.9.9.1.3 Summary of Potential Underwater Detonation Effects

The modeled exposure harassment numbers for all training operations involving explosives are presented by species in Table 3-9-8. The modeling indicates 635 annual exposures to pressure from underwater detonations that could potentially result in TTS (Level B Harassment); 28 annual exposures from pressure from underwater detonations that could cause slight injury (Level A Harassment); and eight exposures that could cause severe injury or mortality.

Training operations involving explosives include Mine Neutralization, Air to Surface Missile Exercise, Surface to Surface Missile Exercise, Bombing Exercise, Sinking Exercise, Surface to Surface Gunnery exercise, and Naval Surface Fire Support. In a SINKEX, weapons are typically fired in order of decreasing range from the source with weapons fired until the target is sunk. Since the target may sink at any time during the exercise, the actual number of weapons used can vary widely. In the representative case, however, all of the ordnances are assumed expended; this represents the worst case of maximum exposure. The sequence of weapons firing for the representative SINKEX is described in the modeling section in Appendix F of this DEIS/OEIS.

These exposure modeling results are estimates of marine mammal underwater detonation sound exposures without considering similar model limitations as discussed in the summary of mid-frequency active sonar sub-section (Section 3.9.1.1.2). In addition, implementation of the mitigation and monitoring procedures as addressed in Section 3.9.10 will further minimize the potential for marine mammal exposures to underwater detonations.

Table 3.9-8: No-Action Annual Underwater Detonation Exposures Summary

Species	Level B Exposures	Level A Exposures	
	TTS 182 dB re 1 μPa²-s /23 psi	50% TM Rupture 205 dB re 1 μPa²-s Slight Lung Injury or 13 psi-ms	Onset Massive Lung Injury or Mortality 31 psi-ms
ESA Species			
Blue whale	1	1	0
Fin whale	0	0	0
Humpback whale	0	0	0
Sei whale	0	0	0
Sperm whale	0	0	0
Guadalupe fur seal	2	0	0
Sea otter	0	0	0
Mysticetes			
Bryde's whale	0	0	0
Gray whale	5	0	0
Minke whale	0	0	0
Odontocetes			
Baird's beaked whale	0	0	0
Bottlenose dolphin	5	0	0
Cuvier's beaked whale	1	0	0
Dall's porpoise	1	0	0
Dwarf sperm whale	N/A	N/A	N/A
False killer whale	N/A	N/A	N/A
Killer whale	0	0	0
Long-beaked common dolphin	20	1	0
Longman's beaked whale	N/A	N/A	N/A
Melon-headed whale	N/A	N/A	N/A
Mesoplodon spp.	0	0	0
Northern right whale dolphin	5	0	0
Pacific white-sided dolphin	5	0	0
Pantropical spotted dolphin	N/A	N/A	N/A
Pygmy killer whale	N/A	N/A	N/A
Pygmy sperm whale	0	0	0
Risso's dolphin	12	1	0
Rough-toothed dolphin	N/A	N/A	N/A
Short-beaked common dolphin	175	9	3
Short-finned pilot whale	0	0	0
Spinner dolphin	N/A	N/A	N/A
Striped dolphin	5	0	0
Ziphiid whale	0	0	0
Pinnipeds			
Northern elephant seal	13	0	0
Pacific harbor seal	19	1	0
California sea lion	333	13	4
Northern fur seal	33	2	1
Total	**635**	**28**	**8**

N/A: Not applicable – Based on a few historic observations, its habitat preference or overall distribution, a species may occur rarely in the SOCAL Range Complex, but no density estimates were available for modeling exposures..

3.9.9.2 Alternative 1

3.9.9.2.1 Non-Acoustic Impacts

Non-acoustic impacts on marine mammals under Alternative 1 would be substantially the same as impacts identified under the No Action Alternative. Under Alternative 1, increased operations would not increase the risk of collisions between Navy ships and marine mammals, given the extensive mitigation measures in effect to avoid such an event. Based on these standard operating procedures, collisions with marine mammals are not expected under Alternative 1. With regard to potential encounters between marine mammals and unrecovered military debris expended on the SOCAL Range Complex: Debris related to military activities that is not recovered generally sinks; the amount that might remain on or near the sea surface is low, and the density of such debris in the SOCAL Range Complex would be very low under Alternative 1 as under the No Action Alternative. Impacts to marine mammals from expended debris are unlikely.

3.9.9.2.2 Summary of Potential Mid and High-Frequency Active Sonar Effects

Table 3.9-9 represents the number of Alternative 1 active sonar hours or usage per year for different sonar sources including the SQS-53C, SQS-56C, AQS-22 dipping sonar, SSQ-62 sonobuoys, and MK-48 torpedo sonar.

Table 3.9-9: Alternative 1: Summary of Active Sonar Hours, Number of Sonar Dips, Number of Sonobuoys, and Torpedo Runs

Event	SQS-53 C Sonar Hours	SQS-56 C Sonar Hours	*Total Sonar Hours*	AQS-22 Number of Dips	SSQ-62 Number of Sonobuoy Deployment	MK-48 Number of Torpedo Events
Major Exercise (8/yr)	986	246	1,232	318	2,127	10
Sustainment Exercise (2/yr)	80	20	100	42	161	3.2
IAC II (4/yr)	230	58	288	384	482	2.4
ULT, Coordinated Events & Maintenance	569	142	711	1,821	1,244	66.4
Total Hours Or Number of Events Or Deployments	**1,865**	**466**	**2,331**	**2,565**	**4,014**	**82**

Table 3.9-10 presents estimated marine mammal exposures for potential non injurious (Level B) harassment, as well as potential onset of injury (Level A) to cetaceans and pinnipeds. Specifically, under this assessment for mid-frequency active sonar, the risk function methodology estimates 89,028 annual exposures that could potentially result in behavioral sub-TTS (Level B Harassment); 17,772 annual exposures that could potentially result in TTS (Level B Harassment); and 28 annual exposures could result in potential injury as PTS (Level A Harassment). No mid-frequency active sonar exposures are predicted to result in any animal mortality.

It should be noted, however, that these exposure modeling results are statistically derived estimates of potential marine mammal sonar exposures without consideration of standard mitigation and monitoring procedures. The caveats to interpretations of model results are described previously. It is highly unlikely that a marine mammal would experience any long-term effects because the large SOCAL Range Complex training areas makes individual mammals' repeated or prolonged exposures to high-level sonar signals unlikely. Specifically, mid-frequency active sonars have limited marine mammal exposure ranges and relatively high platform speeds. The number of exposures that exceed the PTS threshold and result in Level A harassment from sonar is 28 for six species (blue whale, gray whale, long-beaked common dolphin, Pacific harbor seal, short-beaked common dolphin, and sperm whale). Therefore, long term effects on individuals, populations or stocks are unlikely.

When analyzing the results of the acoustic exposure modeling to provide an estimate of effects, it is important to understand that there are limitations to the ecological data (diving behavior, migration or movement patterns and population dynamics) used in the model, and that the model results must be interpreted within the context of a given species' ecology.

As described previously, this analysis assumes that short-term non-injurious sound exposure levels predicted to cause TTS or temporary behavioral disruptions qualify as Level B harassment. This approach is overestimating because there is no established scientific correlation between mid-frequency active sonar use and long term abandonment or significant alteration of behavioral patterns in marine mammals.

Because of the time delay between pings, and platform speed, an animal encountering the sonar will accumulate energy for only a few sonar pings over the course of a few minutes. Therefore, exposure to sonar would be a short-term event, minimizing any single animal's exposure to sound levels approaching the harassment thresholds.

The implementation of the mitigation and monitoring procedures as addressed in Section 3.9.10 will further minimize the potential for marine mammal exposures to underwater detonations. When reviewing the acoustic exposure modeling results, it is also important to understand that the estimates of marine mammal sound exposures are presented without consideration of standard protective measure operating procedures. Section 3.9.10 presents details of the mitigation measures currently used for ASW activities including detection of marine mammals and power down procedures if marine mammals are detected within one of the safety zones. The Navy will work through the MMPA incidental harassment regulatory process to discuss the mitigation measures and their potential to reduce the likelihood for incidental harassment of marine mammals.

Table 3.9-10: Alternative 1 Summary of All Annual Sonar Exposures

Species	Level B Sonar Exposures		Level A Sonar Exposures
	Risk Function	TTS	PTS
ESA Species			
Blue whale	493	120	1
Fin whale	107	22	0
Humpback whale	13	2	0
Sei whale	0	0	0
Sperm whale	111	18	1
Guadalupe fur seal	859	303	0
Sea otter	0	0	0
Mysticetes			
Bryde's whale	0	0	0
Gray whale	5,103	959	2
Minke whale	96	28	0
Odontocetes			
Baird's beaked whale	9	2	0
Bottlenose dolphin	907	337	0
Cuvier's beaked whale	306	67	0
Dall's porpoise	446	154	0
Dwarf sperm whale	N/A	N/A	N/A
False killer whale	N/A	N/A	N/A
Killer whale	6	2	0
Long beaked common dolphin	2,399	761	1
Longman's beaked whale	N/A	N/A	N/A
Melon-headed whale	N/A	N/A	N/A
Mesoplodon spp.	92	23	0
Northern right whale dolphin	863	295	0
Pacific white-sided dolphin	804	332	0
Pantropical spotted dolphin	N/A	N/A	N/A
Pygmy killer whale	N/A	N/A	N/A
Pygmy sperm whale	115	29	0
Risso's dolphin	2,094	606	0
Rough-toothed dolphin	N/A	N/A	N/A
Short beaked common dolphin	20,614	6,540	9
Short-finned pilot whale	36	10	0
Spinner dolphin	N/A	N/A	N/A
Striped dolphin	1,490	437	0
Ziphiid whales	69	16	0
Pinnipeds			
Northern elephant seal	637	7	0
Pacific harbor seal	964	6,692	14
California sea lion	49,697	5	0
Northern fur seal	698	5	0
Total	**89,028**	**17,772**	**28**

TTS and PTS Thresholds: Cetaceans TTS = 195 dB re 1 μPa^2-s; PTS = 215 dB, re 1 μPa^2-s
Northern elephant seal TTS = 204 re 1 μPa^2-s, PTS = 224 re 1 μPa^2-s
Harbor seal TTS = 183 re 1 μPa^2-s, PTS = 203 re 1 μPa^2-s.
Otariids TTS = 206 re 1 μPa^2-s, PTS = 226 re 1 μPa^2-s.

N/A: Not applicable – Based on a few historic observations, its habitat preference or overall distribution, a species may occur rarely in the SOCAL Range Complex, but no density estimates were available for modeling exposures.

Acoustically Mediated Bubble Growth

One suggested cause of injury to marine mammals is rectified diffusion, which is the process of increasing the size of a bubble by exposing it to a sound field (Crum and Mao 1996). This process is facilitated if the environment in which the ensonified bubbles exist is supersaturated with a gas, such as nitrogen, which makes up approximately 78 percent of air (remainder of air is about 21 percent oxygen with some carbon dioxide). Repetitive diving by marine mammals can cause the blood and some tissues to accumulate gas to a greater degree than is supported by the surrounding environmental pressure (Ridgway and Howard 1979). Deeper and longer dives of some marine mammals (for example, beaked whales) are theoretically predicted to induce greater supersaturation (Houser et al. 2001). Conversely, studies have shown that marine. mammal lung structure (both pinnipeds and cetaceans) facilitates collapse of the lungs at depths below approximately 162 ft (50m) (Kooyman et al. 1970). Collapse of the lungs would force air into the non-air-exchanging areas of the lungs (into the bronchioles away from the alveoli) thus significantly decreasing nitrogen diffusion into the body. Deep-diving pinnipeds such as the northern elephant (*Mirounga angustirostris*) and Weddell seals (Leptonychotes weddellii) typically exhale before long deep dives, further reducing air volume in the lungs (Kooyman et al. 1970). If rectified diffusion were possible in marine mammals exposed to high-level sound, conditions of tissue supersaturation could theoretically speed the rate and increase the size of bubble growth. Subsequent effects due to tissue trauma and emboli would presumably mirror those observed in humans suffering from decompression sickness. It is unlikely that the short duration of sonar pings will be long enough to drive bubble growth to any substantial size, if such a phenomenon occurs. However, an alternative but related hypothesis has also been suggested: stable bubbles could be destabilized by high-level sound exposures such that bubble growth then occurs through static diffusion of gas out of the tissues. In such a scenario, the marine mammal would need to be in a gas-supersaturated state for a long enough period of time for bubbles to become of a problematic size.

Decompression Sickness

Another hypothesis suggests that rapid ascent to the surface following exposure to a startling sound might produce tissue gas saturation sufficient for the evolution of nitrogen bubbles (Jepson et al., 2003). In this scenario, the rate of ascent would need to be sufficiently rapid to compromise behavioral or physiological protections against nitrogen bubble formation. Cox et al. (2006), with experts in the field of marine mammal behavior, diving, physiology, respiration physiology, pathology, anatomy, and bioacoustics considered this to be a plausible hypothesis that requires further investigation. Conversely, Fahlman et al. (2006) suggested that diving bradycardia (reduction in heart rate and circulation to the tissues), lung collapse, and slow ascent rates would reduce nitrogen uptake and thus reduce the risk of decompression sickness by 50 percent in models of marine mammals. Zimmer and Tyack (2007) suggest that beaked whales avoid sonar sound by swimming deeper than 25 m and shallower than the depth of alveolar collapse. This avoidance mechanism continues until the sound no longer creates the response or the animal enters shallow water where it can no longer dive in this pattern. The evidence would support decompression sickness and is consistent with previous studies on avoidance, for example with ship noise (Zimmer and Tyack 2007). Recent information on the diving profiles of Cuvier's (*Ziphius cavirostris*) and Blainvilles's (*Mesoplodon densirostris*) beaked whales (Baird et al. 2006) and in the Ligurian Sea in Italy (Tyack et al. 2006) showed that while these species do dive deeply (regularly exceed depths of 800 meters) and for long periods (48-68 minutes), they have significantly slower ascent rates than descent rates. This fits well with Fahlman et al. (2006) model of deep and long duration divers that would have slower ascent rates to reduce nitrogen saturation and reduce the risk of decompression sickness. Therefore, if nitrogen saturation remains low, then a rapid ascent in response to sonar should not cause decompression sickness. Currently it is not known if beaked whales rapidly ascend in response to sonar or other disturbances. It may be that deep diving animals would be better protected diving to depth to avoid predators, such as killer whales, rather then ascending to the surface where they may be more susceptible to predators.

Although theoretical predictions suggest the possibility for acoustically mediated bubble growth, there is considerable disagreement among scientists as to its likelihood (Piantadosi and Thalmann 2004; Evans and Miller 2004). To date, ELs predicted to cause in vivo bubble formation within diving cetaceans have not been evaluated (NOAA 2002). Further, although it has been argued that traumas from recent beaked whale strandings are consistent with gas emboli and bubble-induced tissue separations (Jepson et al. 2003), there is no conclusive evidence of this and complicating factors are associated with introduction of gas into the venous system during necropsy. Because evidence supporting it is debatable, no marine mammals addressed in this EIS/OEIS are given special treatment due to the possibility for acoustically mediated bubble growth. Beaked whales are, however, assessed differently from other species to account for factors that may have contributed to prior beaked whale strandings.

Resonance

Another suggested cause of injury in marine mammals is air cavity resonance due to sonar exposure. Resonance is a phenomenon that exists when an object is vibrated at a frequency near its natural frequency of vibration—the particular frequency at which the object vibrates most readily. The size and geometry of an air cavity determine the frequency at which the cavity will resonate. Displacement of the cavity boundaries during resonance has been suggested as a cause of injury. Large displacements have the potential to tear tissues that surround the air space (for example, lung tissue).Understanding resonant frequencies and the susceptibility of marine mammal air cavities to resonance is important in determining whether certain sonars have the potential to affect different cavities in different species. In 2002, NMFS convened a panel of government and private scientists to address this issue (NOAA 2002). They modeled and evaluated the likelihood that U.S. Navy mid-frequency active sonar caused resonance effects in beaked whales that eventually led to their stranding (Department of Commerce and DON 2001). The conclusions of that group were that resonance in air-filled structures the frequencies at which resonance were predicted to occur were below the frequencies utilized by the sonar systems employed. Furthermore, air cavity vibrations due to the resonance effect were not considered to be of sufficient amplitude to cause tissue damage. The SOCAL EIS/OEIS assumes that similar phenomenon will not be problematic in other cetacean species.

Likelihood of Masking

Natural and artificial sounds can disrupt behavior by masking, or interfering with an animal's ability to hear other sounds. Masking occurs when the receipt of a sound is interfered with by a second sound at similar frequencies and at similar or higher levels. If the second sound were artificial, it could be potentially harassing if it disrupted hearing-related behavior such as communications or echolocation. It is important to distinguish TTS and PTS, which persist after the sound exposure, from masking, which occurs during the sound exposure. Historically, principal masking concerns have been with prevailing background noise levels from natural and man-made sources (for example, Richardson et al., 1995). Dominant examples of the latter are the accumulated sound from merchant ships and sound of seismic surveys. Both cover a wide frequency band and are long in duration. The majority of proposed SOCAL activities are away from harbors or heavily traveled shipping lanes. The loudest mid-frequency underwater sounds in the Proposed Action area are those produced by hull-mounted mid-frequency active tactical sonar. The sonar signals are likely within the audible range of some cetaceans, but are very limited in the temporal and frequency domains. In particular, the pulse lengths are short, the duty cycle low, and these hull-mounted mid-frequency active tactical sonars transmit within a narrow band of frequencies (typically less than one-third octave). For the reasons outlined above, the chance of sonar operations causing masking effects is considered negligible

Likelihood of Prolonged Exposure

ASW activities would not result in prolonged exposure because the vessels are constantly moving, and the flow of the activity when training occurs reduces the potential for prolonged exposure. The implementation of the protective measures described in Section 5 would further reduce the likelihood of any prolonged exposure.

Potential for Long-Term Effects

Some training activities will be conducted in the same general areas, so marine mammal populations could be exposed to repeated activities over time. However, as described earlier, the acoustic analyses assume that short-term noninjurious SELs predicted to cause TTS or temporary behavioral disruptions qualify as Level B harassment. Application of this criterion assumes an effect even though it is highly unlikely that all behavioral disruptions or instances of TTS will result in long-term significant effects.

3.9.9.2.3 Summary of Potential Underwater Detonation Effects

The modeled exposure harassment numbers for all training operations involving explosives are presented by species in Table 3-9-8. The modeling indicates 742 annual exposures to pressure from underwater detonations that could potentially result in TTS (Level B Harassment); 29 annual exposures from pressure from underwater detonations that could cause slight injury (Level A Harassment); and 10 exposures that could cause severe injury or mortality.

Training operations involving explosives include Mine Neutralization, Air to Surface Missile Exercise, Surface to Surface Missile Exercise, Bombing Exercise, Sinking Exercise, Surface to Surface Gunnery exercise, and Naval Surface Fire Support. In a SINKEX, weapons are typically fired in order of decreasing range from the source with weapons fired until the target is sunk. Since the target may sink at any time during the exercise, the actual number of weapons used can vary widely. In the representative case, however, all of the ordnances are assumed expended; this represents the worst case of maximum exposure. The sequence of weapons firing for the representative SINKEX is described in the modeling section in Appendix F.

These exposure modeling results are estimates of marine mammal underwater detonation sound exposures without considering similar model limitations as discussed in the summary of mid-frequency active sonar sub-section (Section 3.9.1.1.2). In addition, implementation of the mitigation and monitoring procedures will further minimize the potential for marine mammal exposures to underwater detonations.

Table 3.9-11: Alternative 1 Annual Underwater Detonation Exposures Summary

Species	Level B Exposures	Level A Exposures	
	TTS 182 dB re 1 μPa²-s /23 psi	50% TM Rupture 205 dB re 1 μPa²-s or Slight Lung Injury 13 psi-ms	Onset Massive Lung Injury or Mortality 31 psi-ms
ESA Species			
Blue whale	2	0	0
Fin whale	1	0	0
Humpback whale	0	0	0
Sei whale	0	0	0
Sperm whale	1	0	0
Guadalupe fur seal	2	0	0
Sea otter	0	0	0
Mysticetes			
Bryde's whale	0	0	0
Gray whale	6	0	0
Minke whale	0	0	0
Odontocetes			
Baird's beaked whale	0	0	0
Bottlenose dolphin	6	0	0
Cuvier's beaked whale	1	0	0
Dall's porpoise	2	0	0
Dwarf sperm whale	N/A	N/A	N/A
False killer whale	N/A	N/A	N/A
Killer whale	0	0	0
Long-beaked common dolphin	24	1	0
Longman's beaked whale	N/A	N/A	N/A
Melon-headed whale	N/A	N/A	N/A
Mesoplodon spp.	0	0	0
Northern right whale dolphin	6	0	0
Pacific white-sided dolphin	6	0	0
Pantropical spotted dolphin	N/A	N/A	N/A
Pygmy killer whale	N/A	N/A	N/A
Pygmy sperm whale	1	0	0
Risso's dolphin	14	1	0
Rough-toothed dolphin	N/A	N/A	N/A
Short-beaked common dolphin	202	10	4
Short-finned pilot whale	0	0	0
Spinner dolphin	N/A	N/A	N/A
Striped dolphin	5	0	0
Ziphiid whale	0	0	0
Pinnipeds			
Northern elephant seal	15	0	0
Pacific harbor seal	22	1	0
California sea lion	388	14	5
Northern fur seal	38	2	1
Total	**742**	**29**	**10**

N/A: Not applicable – Based on a few historic observations, its habitat preference or overall distribution, a species may occur rarely in the SOCAL Range Complex, but no density estimates were available for modeling exposures

3.9.9.3 Alternative 2

3.9.9.3.1 Non-Acoustic Impacts

Shallow Water Training Range (SWTR) Installation

Once underway during array installations, the larger project vessels would move very slowly during cable installment activities (0 to 2 knots [0 to 3.7 km per hour]), and would not pose a collision threat to marine mammals expected to be present in the vicinity. Entanglement of marine species is not likely because the rigidity of the cable that is designed to lay extended on the sea floor vice coil easily. Anchor and cable lines would be taut, posing no risk of entanglement or interaction with marine mammals that may be swimming in the area. Once installed on the seabed, the new cable and communications instruments would be equivalent to other hard structures on the seabed, again posing no risk of affecting on marine mammals.

Shallow Water Minefield Installation

Establishment of a proposed shallow water minefield at Tanner Bank would be highly unlikely to affect marine mammals. Mine shapes resting on the sea floor pose no risk of entanglement or interaction with marine mammals that may be swimming in the area. Moored mine shapes pose a negligible risk of entanglement or interaction with marine mammals.

Other Non-Acoustic Impacts

Non-acoustic impacts on marine mammals under Alternative 2 would be substantially the same as impacts identified under the No Action Alternative. Under Alternative 2, increased operations would not increase the risk of collisions between Navy ships and marine mammals, given the extensive mitigation measures in effect to avoid such an event. Based on these standard operating procedures, collisions with marine mammals are not expected under Alternative 2. With regard to potential encounters between marine mammals and unrecovered military debris expended on the SOCAL Range Complex: Debris related to military activities that is not recovered generally sinks; the amount that might remain on or near the sea surface is low, and the density of such debris in the SOCAL Range Complex would be very low under Alternative 2 as under the No Action Alternative. Impacts to marine mammals from expended debris are unlikely.

3.9.9.3.2 Summary of Potential Mid- and High-Frequency Active Sonar Effects

Table 3.9-12 represents the number of Alternative 2 active sonar hours or usage per year for different sonar sources including the SQS-53C, SQS-56C,, AQS-22 dipping sonar, SSQ-62 Sonobuoys, and MK-48 torpedo sonar.

Table 3.9-12: Alternative 2: Summary of Active Sonar Hours, Number of Sonar Dips, Number of Sonobuoys, and Torpedo Runs

Event	SQS-53 C Sonar Hours	SQS-56 C Sonar Hours	*Total Sonar Hours*	AQS-22 Number of Dips	SSQ-62 Number of Sonobuoy Deployments	MK-48 Number of Torpedo Events
Major Exercise (8/yr)	1,045	261	1,306	337	2,255	11
Sustainment Exercise (2/yr)	85	21	106	45	171	3
IAC II (4/yr)	244	61	305	407	511	3
ULT, Coordinated Events & Maintenance	603	151	754	1,930	1319	70
Total Hours Or Number Of Events Or Deployments	1,977	494	2,471	2,719	4,255	87

Table 3.9-13 presents estimated marine mammal exposures for potential non injurious (Level B) harassment, as well as potential onset of injury (Level A) to cetaceans and pinnipeds. Specifically, under this assessment for mid-frequency active sonar, the risk function methodology estimates 94,370 annual exposures that could potentially result in behavioral sub-TTS (Level B Harassment); 18,838 annual exposures that could potentially result in TTS (Level B Harassment); and 30 annual exposures could result in potential injury as PTS (Level A Harassment). No mid-frequency active sonar exposures are predicted to result in any animal mortality.

It should be noted, however, that these exposure modeling results are statistically derived estimates of potential marine mammal sonar exposures without consideration of standard mitigation and monitoring procedures. The caveats to interpretations of model results are described previously. It is highly unlikely that a marine mammal would experience any long-term effects because the large SOCAL Range Complex training areas makes individual mammals' repeated or prolonged exposures to high-level sonar signals unlikely. Specifically, mid-frequency active sonars have limited marine mammal exposure ranges and relatively high platform speeds. The number of exposures that exceed the PTS threshold and result in Level A harassment from sonar is 28 for six species (blue whale, gray whale, long-beaked common dolphin, Pacific harbor seal, short-beaked common dolphin, and sperm whale). Therefore, long term effects on individuals, populations or stocks are unlikely.

When analyzing the results of the acoustic exposure modeling to provide an estimate of effects, it is important to understand that there are limitations to the ecological data (diving behavior, migration or movement patterns and population dynamics) used in the model, and that the model results must be interpreted within the context of a given species' ecology.

As described previously, this analysis assumes that short-term non-injurious sound exposure levels predicted to cause TTS or temporary behavioral disruptions qualify as Level B harassment. This approach is overestimating because there is no established scientific correlation between mid-frequency active sonar use and long term abandonment or significant alteration of behavioral patterns in marine mammals.

Because of the time delay between pings, and platform speed, an animal encountering the sonar will accumulate energy for only a few sonar pings over the course of a few minutes. Therefore, exposure to sonar would be a short-term event, minimizing any single animal's exposure to sound levels approaching the harassment thresholds.

The implementation of the mitigation and monitoring procedures as addressed in Section 3.9.10 will further minimize the potential for marine mammal exposures to underwater detonations. When reviewing the acoustic exposure modeling results, it is also important to understand that the estimates of marine mammal sound exposures are presented without consideration of standard protective measure operating procedures. Section 3.9.10 presents details of the mitigation measures currently used for ASW activities including detection of marine mammals and power down procedures if marine mammals are detected within one of the safety zones. The Navy will work through the MMPA incidental harassment regulatory process to discuss the mitigation measures and their potential to reduce the likelihood for incidental harassment of marine mammals.

Table 3.9-13: Alternative 2 Summary of All Annual Sonar Exposures

Species	Level B Sonar Exposures		Level A Sonar Exposures
	Risk Function	TTS	PTS
ESA Species			
Blue whale	523	127	1
Fin whale	113	23	0
Humpback whale	14	2	0
Sei whale	0	0	0
Sperm whale	118	19	1
Guadalupe fur seal	911	321	0
Sea otter	N/A	N/A	N/A
Mysticetes			
Bryde's whale	0	0	0
Gray whale	5,409	1,017	2
Minke whale	102	30	0
Odontocetes			
Baird's beaked whale	10	2	0
Bottlenose dolphin	961	357	0
Cuvier's beaked whale	324	71	0
Dall's porpoise	473	163	0
Dwarf sperm whale	N/A	N/A	N/A
False killer whale	N/A	N/A	N/A
Killer whale	6	2	0
Long beaked common dolphin	2,543	807	1
Longman's beaked whale	N/A	N/A	N/A
Melon-headed whale	N/A	N/A	N/A
Mesoplodon spp.	98	24	0
Northern right whale dolphin	915	313	0
Pacific white-sided dolphin	852	352	0
Pantropical spotted dolphin	N/A	N/A	N/A
Pygmy killer whale	N/A	N/A	N/A
Pygmy sperm whale	122	31	0
Risso's dolphin	2,220	642	0
Rough-toothed dolphin	N/A	N/A	N/A
Short beaked common dolphin	21,851	6,932	10
Short-finned pilot whale	38	11	0
Spinner dolphin	N/A	N/A	N/A
Striped dolphin	1,579	463	0
Ziphiid whales	73	17	0
Pinnipeds			
Northern elephant seal	675	7	0
Pacific harbor seal	1,022	7,094	15
California sea lion	52,679	5	0
Northern fur seal	740	5	0
Total	**94,370**	**18,838**	**30**

TTS and PTS Thresholds: Cetaceans TTS = 195 dB re 1 μPa^2-s; PTS = 215 dB, re 1 μPa^2-s
Northern elephant seal TTS = 204 re 1 μPa^2-s, PTS = 224 re 1 μPa^2-s
Harbor seal TTS = 183 re 1 μPa^2-s, PTS = 203 re 1 μPa^2-s.
Otariids TTS = 206 re 1 μPa^2-s, PTS = 226 re 1 μPa^2-s.

N/A: Not applicable – Based on a few historic observations, its habitat preference or overall distribution, a species may occur rarely in the SOCAL Range Complex, but no density estimates were available for modeling exposures.

3.9.9.3.3 Summary of Potential Underwater Detonation Effects

The modeled exposure harassment numbers for all training operations involving explosives are presented by species in Table 3-9-13. The modeling indicates 817 annual exposures to pressure from underwater detonations that could potentially result in TTS (Level B Harassment); 36 annual exposures from pressure from underwater detonations that could cause slight injury (Level A Harassment); and 12 exposures that could cause severe injury or mortality.

Training operations involving explosives include Mine Neutralization, Air to Surface Missile Exercise, Surface to Surface Missile Exercise, Bombing Exercise, Sinking Exercise, Surface to Surface Gunnery exercise, and Naval Surface Fire Support. In a SINKEX, weapons are typically fired in order of decreasing range from the source with weapons fired until the target is sunk. Since the target may sink at any time during the exercise, the actual number of weapons used can vary widely. In the representative case, however, all of the ordnances are assumed expended; this represents the worst case of maximum exposure. The sequence of weapons firing for the representative SINKEX is described in the modeling section in Appendix F.

These exposure modeling results are estimates of marine mammal underwater detonation sound exposures without considering similar model limitations as discussed in the summary of mid-frequency active sonar sub-section (Section 3.9.1.1.2). In addition, implementation of the mitigation and monitoring procedures will further minimize the potential for marine mammal exposures to underwater detonations.

Table 3.9-14: Alternative 2 Annual Underwater Detonation Exposures Summary

Species	Level B Exposures	Level A Exposures	
	TTS 182 dB/23 psi	50% TM Rupture 205 dB or Slight Lung Injury 13 psi-ms	Onset Massive Lung Injury or Mortality 31 psi-ms
ESA Species			
Blue whale	2	1	0
Fin whale	1	0	0
Humpback whale	0	0	0
Sei whale	0	0	0
Sperm whale	1	0	0
Guadalupe fur seal	2	1	0
Sea otter	0	0	0
Mysticetes			
Bryde's whale	0	0	0
Gray whale	7	0	0
Minke whale	0	0	0
Odontocetes			
Baird's beaked whale	0	0	0
Bottlenose dolphin	6	0	0
Cuvier's beaked whale	2	0	0
Dall's porpoise	2	0	0
Dwarf sperm whale	N/A	N/A	N/A
False killer whale	N/A	N/A	N/A
Killer whale	0	0	0
Long-beaked common dolphin	26	1	1
Longman's beaked whale	N/A	N/A	N/A
Melon-headed whale	N/A	N/A	N/A
Mesoplodon spp.	0	0	0
Northern right whale dolphin	6	0	0
Pacific white-sided dolphin	6	0	0
Pantropical spotted dolphin	N/A	N/A	N/A
Pygmy killer whale	N/A	N/A	N/A
Pygmy sperm whale	1	0	0
Risso's dolphin	15	1	0
Rough-toothed dolphin	N/A	N/A	N/A
Short-beaked common dolphin	227	12	4
Short-finned pilot whale	0	0	0
Spinner dolphin	N/A	N/A	N/A
Striped dolphin	6	0	0
Ziphiid whale	0	0	0
Pinnipeds			
Northern elephant seal	17	0	0
Pacific harbor seal	24	1	0
California sea lion	424	16	6
Northern fur seal	42	3	1
Total	**817**	**36**	**12**

N/A: Not applicable – Based on a few historic observations, its habitat preference or overall distribution, a species may occur rarely in the SOCAL Range Complex, but no density estimates were available for modeling exposures.

3.9.10 Mitigation Measures

The Navy has implemented a comprehensive suite of mitigation measures reduce impacts to marine mammals that might result from Navy training and RDT&E activities in the SOCAL Range Complex. In order to make the findings necessary to issue a Letter of Authorization (LOA) under the Marine Mammal Protection Act (MMPA), it may be necessary for National Marine Fisheries Service (NMFS) to require additional mitigation or monitoring measures beyond those addressed in this Draft Environmental Impact Statement (EIS)/ Overseas Environmental Impact Statement (OEIS). These measures could include measures considered, but eliminated in this EIS/OEIS, or as yet undeveloped measures. The public will have an opportunity, through the MMPA process, both to provide information to NMFS in the comment period following NMFS' Notice of Receipt of the application for an LOA, and to review any additional mitigation or monitoring measures that NMFS might propose in the comment period at the proposed rule stage. The final suite of measures developed as a result of the MMPA process would be identified and analyzed in the Final EIS/OEIS.

Effective training in the SOCAL Range Complex dictates that ship, submarine, and aircraft participants utilize their sensors and exercise weapons to their optimum capabilities as required by the mission. This section is a comprehensive list of mitigation measures that would be utilized for training activities analyzed in the SOCAL EIS/OEIS in order to minimize potential for impacts on marine mammals and sea turtles in the SOCAL Range Complex.

This section includes mitigation measures that are followed for all types of exercises; those that are associated with a particular type of training event; and those that apply generally to all Navy training at sea. For major exercises, the applicable mitigation measures are incorporated into a naval message which is disseminated to all of the units participating in the exercise or training event and applicable responsible commands. Appropriate measures are also provided to non-Navy participants (other DoD and allied forces) as information in order to ensure their use by these participants.

3.9.10.1 General Maritime Measures

3.9.10.1.1 Personnel Training – Lookouts

The use of shipboard lookouts is a critical component of all Navy protective measures. Navy shipboard lookouts are highly qualified and experienced observers of the marine environment. Their duties require that they report all objects sighted in the water to the officer of the deck (OOD) (e.g., trash, a periscope, marine mammals, sea turtles) and all disturbances (e.g., surface disturbance, discoloration) that may be indicative of a threat to the vessel and its crew. There are personnel serving as lookouts on station at all times (day and night) when a ship or surfaced submarine is moving through the water.

- All commanding officers (COs), executive officers (XOs), lookouts, OODs, junior OODs (JOODs), maritime patrol aircraft aircrews, and Anti-submarine Warfare (ASW)/Mine Warfare (MIW) helicopter crews will complete the NMFS-approved Marine Species Awareness Training (MSAT) by viewing the U.S. Navy MSAT digital versatile disk (DVD). MSAT may also be viewed on-line at https://mmrc.tecquest.net. All bridge lookouts will complete both parts one and two of the MSAT; part two is optional for other personnel. This training addresses the lookout’s role in environmental protection, laws governing the protection of marine species, Navy stewardship commitments and general observation information to aid in avoiding interactions with marine species.

- Navy lookouts will undertake extensive training in order to qualify as a watchstander in accordance with the Lookout Training Handbook (Naval Education and Training Command [NAVEDTRA] 12968-B).
- Lookout training will include on-the-job instruction under the supervision of a qualified, experienced lookout. Following successful completion of this supervised training period, lookouts will complete the Personal Qualification Standard Program, certifying that they have demonstrated the necessary skills (such as detection and reporting of partially submerged objects). Personnel being trained as lookouts can be counted among those listed below as long as supervisors monitor their progress and performance.
- Lookouts will be trained in the most effective means to ensure quick and effective communication within the command structure in order to facilitate implementation of protective measures if marine species are spotted.

3.9.10.1.2 Operating Procedures & Collision Avoidance

- Prior to major exercises, a Letter of Instruction, Mitigation Measures Message or Environmental Annex to the Operational Order will be issued to further disseminate the personnel training requirement and general marine species protective measures.
- COs will make use of marine species detection cues and information to limit interaction with marine species to the maximum extent possible consistent with safety of the ship.
- While underway, surface vessels will have at least two lookouts with binoculars; surfaced submarines will have at least one lookout with binoculars. Lookouts already posted for safety of navigation and man-overboard precautions may be used to fill this requirement. As part of their regular duties, lookouts will watch for and report to the OOD the presence of marine mammals and sea turtles.
- On surface vessels equipped with a multi-function active sensor, pedestal mounted “Big Eye” (20x10) binoculars will be properly installed and in good working order to assist in the detection of marine mammals and sea turtles in the vicinity of the vessel.
- Personnel on lookout will employ visual search procedures employing a scanning methodology in accordance with the Lookout Training Handbook (NAVEDTRA 12968-B).
- After sunset and prior to sunrise, lookouts will employ Night Lookouts Techniques in accordance with the Lookout Training Handbook. (NAVEDTRA 12968-B)
- While in transit, naval vessels will be alert at all times, use extreme caution, and proceed at a “safe speed” so that the vessel can take proper and effective action to avoid a collision with any marine animal and can be stopped within a distance appropriate to the prevailing circumstances and conditions.
- When whales have been sighted in the area, Navy vessels will increase vigilance and take reasonable and practicable actions to avoid collisions and activities that might result in close interaction of naval assets and marine mammals. Actions may include changing speed and/or direction and are dictated by environmental and other conditions (e.g., safety, weather).
- Naval vessels will maneuver to keep at least 460 m (1,500 ft) away from any observed whale and avoid approaching whales head-on. This requirement does not apply if a vessel’s safety is threatened, such as when change of course will create an imminent and serious threat to a person, vessel, or aircraft, and to the extent vessels are restricted in

their ability to maneuver. Restricted maneuverability includes, but is not limited to, situations when vessels are engaged in dredging, submerged operations, launching and recovering aircraft or landing craft, minesweeping operations, replenishment while underway and towing operations that severely restrict a vessel's ability to deviate course. Vessels will take reasonable steps to alert other vessels in the vicinity of the whale.

- Where feasible and consistent with mission and safety, vessels will avoid closing to within 200-yd of sea turtles and marine mammals other than whales (whales addressed above).
- Floating weeds and kelp, algal mats, clusters of seabirds, and jellyfish are good indicators of sea turtles and marine mammals. Therefore, increased vigilance in watching for sea turtles and marine mammals will be taken where these are present.
- Navy aircraft participating in exercises at sea will conduct and maintain, when operationally feasible and safe, surveillance for marine species of concern as long as it does not violate safety constraints or interfere with the accomplishment of primary operational duties. Marine mammal detections will be immediately reported to assigned Aircraft Control Unit for further dissemination to ships in the vicinity of the marine species as appropriate where it is reasonable to conclude that the course of the ship will likely result in a closing of the distance to the detected marine mammal.
- All vessels will maintain logs and records documenting training operations should they be required for event reconstruction purposes. Logs and records will be kept for a period of 30 days following completion of a major training exercise.

3.9.10.2 Measures for Specific Training Events

3.9.10.2.1 Mid-Frequency Active Sonar Operations

General Maritime Mitigation Measures: Personnel Training

- All lookouts onboard platforms involved in ASW training events will review the NMFS-approved Marine Species Awareness Training material prior to use of mid-frequency active sonar.
- All COs, XOs, and officers standing watch on the bridge will have reviewed the Marine Species Awareness Training material prior to a training event employing the use of mid-frequency active sonar.
- Navy lookouts will undertake extensive training in order to qualify as a watchstander in accordance with the Lookout Training Handbook (Naval Educational Training [NAVEDTRA], 12968-B).
- Lookout training will include on-the-job instruction under the supervision of a qualified, experienced watchstander. Following successful completion of this supervised training period, lookouts will complete the Personal Qualification Standard program, certifying that they have demonstrated the necessary skills (such as detection and reporting of partially submerged objects). This does not forbid personnel being trained as lookouts from being counted as those listed in previous measures so long as supervisors monitor their progress and performance.
- Lookouts will be trained in the most effective means to ensure quick and effective communication within the command structure in order to facilitate implementation of mitigation measures if marine species are spotted.

General Maritime Mitigation Measures: Lookout and Watchstander Responsibilities

- On the bridge of surface ships, there will always be at least three people on watch whose duties include observing the water surface around the vessel.

- All surface ships participating in ASW training events will, in addition to the three personnel on watch noted previously, have at all times during the exercise at least two additional personnel on watch as marine mammal lookouts.
- Personnel on lookout and officers on watch on the bridge will have at least one set of binoculars available for each person to aid in the detection of marine mammals.
- On surface vessels equipped with mid-frequency active sonar, pedestal mounted “Big Eye” (20x110) binoculars will be present and in good working order to assist in the detection of marine mammals in the vicinity of the vessel.
- Personnel on lookout will employ visual search procedures employing a scanning methodology in accordance with the Lookout Training Handbook (NAVEDTRA 12968-B).
- After sunset and prior to sunrise, lookouts will employ Night Lookouts Techniques in accordance with the Lookout Training Handbook.
- Personnel on lookout will be responsible for reporting all objects or anomalies sighted in the water (regardless of the distance from the vessel) to the Officer of the Deck, since any object or disturbance (e.g., trash, periscope, surface disturbance, discoloration) in the water may be indicative of a threat to the vessel and its crew or indicative of a marine species that may need to be avoided as warranted.

Operating Procedures

- A Letter of Instruction, Mitigation Measures Message, or Environmental Annex to the Operational Order will be issued prior to the exercise to further disseminate the personnel training requirement and general marine mammal mitigation measures.
- COs will make use of marine species detection cues and information to limit interaction with marine species to the maximum extent possible consistent with safety of the ship.
- All personnel engaged in passive acoustic sonar operation (including aircraft, surface ships, or submarines) will monitor for marine mammal vocalizations and report the detection of any marine mammal to the appropriate watch station for dissemination and appropriate action.
- During mid-frequency active sonar operations, personnel will utilize all available sensor and optical systems (such as night vision goggles) to aid in the detection of marine mammals.
- Navy aircraft participating in exercises at sea will conduct and maintain, when operationally feasible and safe, surveillance for marine species of concern as long as it does not violate safety constraints or interfere with the accomplishment of primary operational duties.
- Aircraft with deployed sonobuoys will use only the passive capability of sonobuoys when marine mammals are detected within 200 yds (183 m) of the sonobuoy.
- Marine mammal detections will be immediately reported to assigned Aircraft Control Unit for further dissemination to ships in the vicinity of the marine species as appropriate where it is reasonable to conclude that the course of the ship will likely result in a closing of the distance to the detected marine mammal.
- Safety Zones—When marine mammals are detected by any means (aircraft, shipboard lookout, or acoustically) within 1,000 yds (914 m) of the sonar dome (the bow), the ship or submarine will limit active transmission levels to at least 6 decibels (dB) below normal

operating levels. (A 6 dB reduction equates to a 75 percent power reduction. The reason is that decibel levels are on a logarithmic scale, not a linear scale. Thus, a 6 dB reduction results in a power level only 25 percent of the original power.)

- Ships and submarines will continue to limit maximum transmission levels by this 6-dB factor until the animal has been seen to leave the area, has not been detected for 30 minutes, or the vessel has transited more than 2,000 yds (1829 m) beyond the location of the last detection.
- Should a marine mammal be detected within or closing to inside 500 yds (457 m) of the sonar dome, active sonar transmissions will be limited to at least 10 dB below the equipment's normal operating level. (A 10 dB reduction equates to a 90 percent power reduction from normal operating levels.) Ships and submarines will continue to limit maximum ping levels by this 10-dB factor until the animal has been seen to leave the area, has not been detected for 30 minutes, or the vessel has transited more than 2,000 yds (457 m) beyond the location of the last detection.
- Should the marine mammal be detected within or closing to inside 200 yds (183 m) of the sonar dome, active sonar transmissions will cease. Sonar will not resume until the animal has been seen to leave the area, has not been detected for 30 minutes, or the vessel has transited more than 2,000 yds (457 m) beyond the location of the last detection.
- Special conditions applicable for dolphins and porpoises only: If, after conducting an initial maneuver to avoid close quarters with dolphins or porpoises, the OOD concludes that dolphins or porpoises are deliberately closing to ride the vessel's bow wave, no further mitigation actions are necessary while the dolphins or porpoises continue to exhibit bow wave riding behavior.
- If the need for power-down should arise as detailed in “Safety Zones” above, the Navy shall follow the requirements as though they were operating at 235 dB—the normal operating level (i.e., the first power-down will be to 229 dB, regardless of at what level above 235 sonar was being operated).

- Prior to start up or restart of active sonar, operators will check that the Safety Zone radius around the sound source is clear of marine mammals.
- Sonar levels (generally)—Navy will operate sonar at the lowest practicable level, not to exceed 235 dB, except as required to meet tactical training objectives.
- Helicopters shall observe/survey the vicinity of an ASW training event for 10 minutes before the first deployment of active (dipping) sonar in the water.
- Helicopters shall not dip their sonar within 200 yds (183 m) of a marine mammal and shall cease pinging if a marine mammal closes within 200 yds (183 m) after pinging has begun.
- Submarine sonar operators will review detection indicators of close-aboard marine mammals prior to the commencement of ASW training events involving active mid-frequency sonar.
- Increased vigilance during ASW training events with tactical active sonar when critical conditions are present.

Based on lessons learned from strandings in Bahamas 2000, Madeiras 2000, Canaries 2002 and Spain 2006, beaked whales are of particular concern since they have been associated with mid-frequency active sonar operations. The Navy should avoid planning Major ASW Training Exercises with mid-frequency active sonar in areas where they will encounter conditions which, in their aggregate, may contribute to a marine mammal stranding event.

The conditions to be considered during exercise planning include:

- Areas of at least 1,000-meter depth near a shoreline where there is a rapid change in bathymetry on the order of 1,000-6,000 yds (914-5486 m) occurring across a relatively short horizontal distance (e.g., 5 nautical miles [nm]).
- Cases for which multiple ships or submarines (≥ 3) operating mid-frequency active sonar in the same area over extended periods of time (≥ 6 hours) in close proximity (≤ 10 nm apart).
- An area surrounded by land masses, separated by less than 35 nm and at least 10 nm in length, or an embayment, wherein operations involving multiple ships/subs (≥ 3) employing mid-frequency active sonar near land may produce sound directed toward the channel or embayment that may cut off the lines of egress for marine mammals.
- Though not as dominant a condition as bathymetric features, the historical presence of a significant surface duct (i.e., a mixed layer of constant water temperature extending from the sea surface to 100 or more feet [ft]).

If the Major Range Event is to occur in an area where the above conditions exist in their aggregate, these conditions must be fully analyzed in environmental planning documentation. The Navy will increase vigilance by undertaking the following additional mitigation measure:

- A dedicated aircraft (Navy asset or contracted aircraft) will undertake reconnaissance of the embayment or channel ahead of the exercise participants to detect marine mammals that may be in the area exposed to active sonar. Where practical, advance survey should occur within about 2 hours prior to mid-frequency active sonar use and periodic surveillance should continue for the duration of the exercise. Any unusual conditions (e.g., presence of sensitive species, groups of species milling out of habitat, and any stranded animals) shall be reported to the Office in Tactical Command, who should give consideration to delaying, suspending, or altering the exercise.
- All safety zone power down requirements described above will apply.
- The post-exercise report must include specific reference to any event conducted in areas where the above conditions exist, with exact location and time/duration of the event, and noting results of surveys conducted.

3.9.10.2.2 Surface-to-Surface Gunnery (5-inch, 76 mm, 20 mm, 25 mm and 30 mm explosive rounds)

- Lookouts will visually survey for floating weeds and kelp, and algal mats which may be inhabited by immature sea turtles in the target area. Intended impact shall not be within 600 yds (585 m) of known or observed floating weeds and kelp, and algal mats.
- For exercises using targets towed by a vessel or aircraft, target-towing vessels/aircraft shall maintain a trained lookout for marine mammals and sea turtles. If a marine mammal or sea turtle is sighted in the vicinity, the tow aircraft/vessel will immediately notify the firing vessel, which will suspend the exercise until the area is clear.
- A 600 yard radius buffer zone will be established around the intended target.

- From the intended firing position, trained lookouts will survey the buffer zone for marine mammals and sea turtles prior to commencement and during the exercise as long as practicable. Due to the distance between the firing position and the buffer zone, lookouts are only expected to visually detect breaching whales, whale blows, and large pods of dolphins and porpoises.
- The exercise will be conducted only when the buffer zone is visible and marine mammals and sea turtles are not detected within it.

3.9.10.2.3 Surface-to-Surface Gunnery (non-explosive rounds)

- Lookouts will visually survey for floating weeds and kelp, and algal mats which may be inhabited by immature sea turtles in the target area. Intended impact will not be within 200 yds (183 m) of known or observed floating weeds and kelp, and algal mats.
- A 200 yd (183 m) radius buffer zone will be established around the intended target.
- From the intended firing position, trained lookouts will survey the buffer zone for marine mammals and sea turtles prior to commencement and during the exercise as long as practicable. Due to the distance between the firing position and the buffer zone, lookouts are only expected to visually detect breaching whales, whale blows, and large pods of dolphins and porpoises.
- If applicable, target towing vessels will maintain a lookout. If a marine mammal or sea turtle is sighted in the vicinity of the exercise, the tow vessel will immediately notify the firing vessel in order to secure gunnery firing until the area is clear.
- The exercise will be conducted only when the buffer zone is visible and marine mammals and sea turtles are not detected within the target area and the buffer zone.

3.9.10.2.4 Surface-to-Air Gunnery (explosive and non-explosive rounds)

- Vessels will orient the geometry of gunnery exercises in order to prevent debris from falling in the area of sighted marine mammals, sea turtles, algal mats, and floating kelp.
- Vessels will expedite the recovery of any parachute deploying aerial targets to reduce the potential for entanglement of marine mammals and sea turtles.
- Target towing aircraft shall maintain a lookout. If a marine mammal or sea turtle is sighted in the vicinity of the exercise, the tow aircraft will immediately notify the firing vessel in order to secure gunnery firing until the area is clear.

3.9.10.2.5 Air-to-Surface Gunnery (explosive and non-explosive rounds)

- If surface vessels are involved, lookouts will visually survey for floating kelp, which may be inhabited by immature sea turtles, in the target area. Impact should not occur within 200 yds (183 m) of known or observed floating weeds and kelp or algal mats.
- A 200 yd (183 m) radius buffer zone will be established around the intended target.
- If surface vessels are involved, lookout(s) will visually survey the buffer zone for marine mammals and sea turtles prior to and during the exercise.
- Aerial surveillance of the buffer zone for marine mammals and sea turtles will be conducted prior to commencement of the exercise. Aerial surveillance altitude of 500 feet to 1,500 feet (ft) (152 - 456 m) is optimum. Aircraft crew/pilot will maintain visual watch during exercises. Release of ordnance through cloud cover is prohibited: aircraft must be able to actually see ordnance impact areas.

- The exercise will be conducted only if marine mammals and sea turtles are not visible within the buffer zone.

3.9.10.2.6 Small Arms Training - (grenades, explosive and non-explosive rounds)

- Lookouts will visually survey for floating weeds or kelp, algal mats, marine mammals, and sea turtles. Weapons will not be fired in the direction of known or observed floating weeds or kelp, algal mats, marine mammals, sea turtles.

3.9.10.2.7 Air-to-Surface At-Sea Bombing Exercises (explosive bombs and cluster munitions, rockets)

- If surface vessels are involved, trained lookouts will survey for floating kelp, which may be inhabited by immature sea turtles. Ordnance shall not be targeted to impact within 1,000 yds (914 m) of known or observed floating kelp, sea turtles, or marine mammals.
- A buffer zone of 1,000 yd (914 m) radius will be established around the intended target.
- Aircraft will visually survey the target and buffer zone for marine mammals and sea turtles prior to and during the exercise. The survey of the impact area will be made by flying at 1,500 feet or lower, if safe to do so, and at the slowest safe speed. Release of ordnance through cloud cover is prohibited: aircraft must be able to actually see ordnance impact areas. Survey aircraft should employ most effective search tactics and capabilities.
- The exercises will be conducted only if marine mammals and sea turtles are not visible within the buffer zone.

3.9.10.2.8 Air-to-Surface At-Sea Bombing Exercises (non-explosive bombs and cluster munitions, rockets)

- If surface vessels are involved, trained lookouts will survey for floating kelp, which may be inhabited by immature sea turtles, and for sea turtles and marine mammals. Ordnance shall not be targeted to impact within 1,000 yds (914 m) of known or observed floating kelp, sea turtles, or marine mammals.
- A 1,000 yd (914 m) radius buffer zone will be established around the intended target.
- Aircraft will visually survey the target and buffer zone for marine mammals and sea turtles prior to and during the exercise. The survey of the impact area will be made by flying at 1,500 ft (152 m) or lower, if safe to do so, and at the slowest safe speed. Release of ordnance through cloud cover is prohibited: aircraft must be able to actually see ordnance impact areas. Survey aircraft should employ most effective search tactics and capabilities.
- The exercise will be conducted only if marine mammals and sea turtles are not visible within the buffer zone.

3.9.10.2.9 Air-to-Surface Missile Exercises (explosive and non-explosive)

- Ordnance shall not be targeted to impact within 1,800 yds (1646 m) of known or observed floating kelp, which may be inhabited by immature sea turtles, or coral reefs.
- Aircraft will visually survey the target area for marine mammals and sea turtles. Visual inspection of the target area will be made by flying at 1,500 (457 m) feet or lower, if safe to do so, and at slowest safe speed. Firing or range clearance aircraft must be able to actually see ordnance impact areas. Explosive ordnance shall not be targeted to impact within 1,800 yds (1646 m) of sighted marine mammals and sea turtles.

3.9.10.2.9.1 Underwater Detonations (up to 20-lb charges)

To ensure protection of marine mammals and sea turtles during underwater detonation training, the operating area must be determined to be clear of marine mammals and sea turtles prior to detonation. Implementation of the following mitigation measures continue to ensure that marine mammals would not be exposed to temporary threshold shift (TTS), permanent threshold shift (PTS), or injury from physical contact with training mine shapes during Major Exercises.

Exclusion Zones

All Mine Warfare and Mine Countermeasures Operations involving the use of explosive charges must include exclusion zones for marine mammals and sea turtles to prevent physical and/or acoustic effects to those species. These exclusion zones shall extend in a 700-yard arc radius around the detonation site.

Pre-Exercise Surveys

For Demolition and Ship Mine Countermeasures Operations, pre-exercise survey shall be conducted within 30 minutes prior to the commencement of the scheduled explosive event. The survey may be conducted from the surface, by divers, and/or from the air, and personnel shall be alert to the presence of any marine mammal or sea turtle. Should such an animal be present within the survey area, the exercise shall be paused until the animal voluntarily leaves the area. The Navy will suspend detonation exercises and ensure the area is clear for a full 30 minutes prior to detonation. Personnel will record any protected species marine mammal and sea turtle observations during the exercise as well as measures taken if species are detected within the exclusion zone.

Post-Exercise Surveys

Surveys within the same radius shall also be conducted within 30 minutes after the completion of the explosive event.

Reporting

If there is evidence that a marine mammal or sea turtle may have been stranded, injured or killed by the action, Navy training activities will be immediately suspended and the situation immediately reported by the participating unit to the Officer in Charge of the Exercise (OCE), who will follow Navy procedures for reporting the incident to Commander, Pacific Fleet, Commander, Navy Region Southwest, Environmental Director, and the chain-of-command.

3.9.10.2.10 Mining Operations

Mining Operations involve aerial drops of inert training shapes on target points. Aircrews are scored for their ability to accurately hit the target points. This operation does not involve live ordnance. The probability of a marine species being in the exact spot in the ocean where an inert object is dropped is remote. However, as a conservative measure, initial target points will be briefly surveyed prior to inert ordnance release from an aircraft to ensure the intended drop area is clear of marine mammals and sea turtles. To the extent feasible, the Navy shall retrieve inert mine shapes dropped during Mining Operations.

3.9.10.2.11 Sink Exercise

The selection of sites suitable for Sink Exercises (SINKEXs) involves a balance of operational suitability, requirements established under the Marine Protection, Research and Sanctuaries Act

(MPRSA) permit granted to the Navy (40 Code of Federal Regulations § 229.2), and the identification of areas with a low likelihood of encountering Endangered Species Act (ESA) listed species. To meet operational suitability criteria, locations must be within a reasonable distance of the target vessels' originating location. The locations should also be close to active military bases to allow participating assets access to shore facilities. For safety purposes, these locations should also be in areas that are not generally used by non-military air or watercraft. The MPRSA permit requires vessels to be sunk in waters which are at least 1,000 fathoms (3,000 yds / 2742 m)) deep and at least 50 nm from land.

In general, most listed species prefer areas with strong bathymetric gradients and oceanographic fronts for significant biological activity such as feeding and reproduction. Typical locations include the continental shelf and shelf-edge.

SINKEX Range Clearance Plan

The Navy has developed range clearance procedures to maximize the probability of sighting any ships or protected species in the vicinity of an exercise, which are as follows:

- All weapons firing would be conducted during the period 1 hour after official sunrise to 30 minutes before official sunset.
- Extensive range clearance operations would be conducted in the hours prior to commencement of the exercise, ensuring that no shipping is located within the hazard range of the longest-range weapon being fired for that event.
- Prior to conducting the exercise, remotely sensed sea surface temperature maps would be reviewed. SINKEX would not be conducted within areas where strong temperature discontinuities are present, thereby indicating the existence of oceanographic fronts. These areas would be avoided because concentrations of some listed species, or their prey, are known to be associated with these oceanographic features.
- An exclusion zone with a radius of 1.0 nm would be established around each target. This exclusion zone is based on calculations using a 990-pound (lb) H6 net explosive weight high explosive source detonated 5 ft below the surface of the water, which yields a distance of 0.85 nm (cold season) and 0.89 nm (warm season) beyond which the received level is below the 182 decibels (dB) re: 1 micropascal squared-seconds (µPa2-s) threshold established for the WINSTON S. CHURCHILL (DDG 81) shock trials (U.S. Navy, 2001). An additional buffer of 0.5 nm would be added to account for errors, target drift, and animal movements. Additionally, a safety zone, which extends from the exclusion zone at 1.0 nm out an additional 0.5 nm, would be surveyed. Together, the zones extend out 2 nm from the target.
- A series of surveillance over-flights would be conducted within the exclusion and the safety zones, prior to and during the exercise, when feasible. Survey protocol would be as follows:
    - Overflights within the exclusion zone would be conducted in a manner that optimizes the surface area of the water observed. This may be accomplished through the use of the Navy's Search and Rescue Tactical Aid, which provides the best search altitude, ground speed, and track spacing for the discovery of small, possibly dark objects in the water based on the environmental conditions of the day. These environmental conditions include the angle of sun inclination, amount of daylight, cloud cover, visibility, and sea state.

  - All visual surveillance activities would be conducted by Navy personnel trained in visual surveillance. At least one member of the mitigation team would have completed the Navy's marine mammal training program for lookouts.
  - In addition to the overflights, the exclusion zone would be monitored by passive acoustic means, when assets are available. This passive acoustic monitoring would be maintained throughout the exercise. Potential assets include sonobuoys, which can be utilized to detect any vocalizing marine mammals (particularly sperm whales) in the vicinity of the exercise. The sonobuoys would be re-seeded as necessary throughout the exercise. Additionally, passive sonar onboard submarines may be utilized to detect any vocalizing marine mammals in the area. The OCE would be informed of any aural detection of marine mammals and would include this information in the determination of when it is safe to commence the exercise.
  - On each day of the exercise, aerial surveillance of the exclusion and safety zones would commence 2 hours prior to the first firing.
  - The results of all visual, aerial, and acoustic searches would be reported immediately to the OCE. No weapons launches or firing would commence until the OCE declares the safety and exclusion zones free of marine mammals and threatened and endangered species.
  - If a protected species observed within the exclusion zone is diving, firing would be delayed until the animal is re-sighted outside the exclusion zone, or 30 minutes have elapsed. After 30 minutes, if the animal has not been re-sighted it would be assumed to have left the exclusion zone. This is based on a typical dive time of 30 minutes for traveling listed species of concern. The OCE would determine if the listed species is in danger of being adversely affected by commencement of the exercise.
  - During breaks in the exercise of 30 minutes or more, the exclusion zone would again be surveyed for any protected species. If protected species are sighted within the exclusion zone, the OCE would be notified, and the procedure described above would be followed.
  - Upon sinking of the vessel, a final surveillance of the exclusion zone would be monitored for 2 hours, or until sunset, to verify that no listed species were harmed.

- Aerial surveillance would be conducted using helicopters or other aircraft based on necessity and availability. The Navy has several types of aircraft capable of performing this task; however, not all types are available for every exercise. For each exercise, the available asset best suited for identifying objects on and near the surface of the ocean would be used. These aircraft would be capable of flying at the slow safe speeds necessary to enable viewing of marine vertebrates with unobstructed, or minimally obstructed, downward and outward visibility. The exclusion and safety zone surveys may be cancelled in the event that a mechanical problem, emergency search and rescue, or other similar and unexpected event preempts the use of one of the aircraft onsite for the exercise.
- Every attempt would be made to conduct the exercise in sea states that are ideal for marine mammal sighting, Beaufort Sea State 3 or less. In the event of a 4 or above, survey efforts would be increased within the zones. This would be accomplished through the use of an additional aircraft, if available, and conducting tight search patterns.

- The exercise would not be conducted unless the exclusion zone could be adequately monitored visually.
- In the unlikely event that any listed species are observed to be harmed in the area, a detailed description of the animal would be taken, the location noted, and if possible, photos taken. This information would be provided to NOAA Fisheries via the Navy's regional environmental coordinator for purposes of identification.
- An after action report detailing the exercise's time line, the time the surveys commenced and terminated, amount, and types of all ordnance expended, and the results of survey efforts for each event would be submitted to NOAA Fisheries.

3.9.10.2.11.1 Mitigation Measures Related to Explosive Source Sonobuoys (AN/SSQ-110A)

- Crews will conduct visual reconnaissance of the drop area prior to laying their intended sonobuoy pattern. This search should be conducted below 457 m (500 yd) at a slow speed, if operationally feasible and weather conditions permit. In dual aircraft operations, crews are allowed to conduct coordinated area clearances.
- Crews shall conduct a minimum of 30 minutes of visual and aural monitoring of the search area prior to commanding the first post detonation. This 30-minute observation period may include pattern deployment time.
- For any part of the briefed pattern where a post (source/receiver sonobuoy pair) will be deployed within 914 m (1,000 yd) of observed marine mammal activity, deploy the receiver ONLY and monitor while conducting a visual search. When marine mammals are no longer detected within 914 m (1,000 yd) of the intended post position, co-locate the explosive source sonobuoy (AN/SSQ-110A) (source) with the receiver.
- When able, crews will conduct continuous visual and aural monitoring of marine mammal activity. This is to include monitoring of own-aircraft sensors from first sensor placement to checking off station and out of RF range of these sensors.
- Aural Detection:
  - If the presence of marine mammals is detected aurally, then that should cue the aircrew to increase the diligence of their visual surveillance. Subsequently, if no marine mammals are visually detected, then the crew may continue multi-static active search.
- Visual Detection:
  - If marine mammals are visually detected within 914 m (1,000 yd) of the explosive source sonobuoy (AN/SSQ-110A) intended for use, then that payload shall not be detonated. Aircrews may utilize this post once the marine mammals have not been re-sighted for 10 minutes, or are observed to have moved outside the 914 m (1,000 yd) safety buffer.
  - Aircrews may shift their multi-static active search to another post, where marine mammals are outside the 914 m (1,000 yd) safety buffer.
- Aircrews shall make every attempt to manually detonate the unexploded charges at each post in the pattern prior to departing the operations area by using the "Payload 1 Release" command followed by the "Payload 2 Release" command. Aircrews shall refrain from using the "Scuttle" command when two payloads remain at a given post. Aircrews will

ensure that a 914 m (1,000 yd) safety buffer, visually clear of marine mammals, is maintained around each post as is done during active search operations.

- Aircrews shall only leave posts with unexploded charges in the event of a sonobuoy malfunction, an aircraft system malfunction, or when an aircraft must immediately depart the area due to issues such as fuel constraints, inclement weather, and in-flight emergencies. In these cases, the sonobuoy will self-scuttle using the secondary or tertiary method.
- Ensure all payloads are accounted for. Explosive source sonobuoys (AN/SSQ-110A) that can not be scuttled shall be reported as unexploded ordnance via voice communications while airborne, then upon landing via naval message.
- Mammal monitoring shall continue until out of own-aircraft sensor range.

3.9.10.3 Conservation Measures

3.9.10.3.1 SOCAL Marine Species Monitoring Plan

The Navy is developing a Marine Species Monitoring Plan (MSMP) that provides recommendations for site-specific monitoring for MMPA and ESA listed species (primarily marine mammals) within the SOCAL Range Complex, including during training. The primary goals of monitoring are to evaluate trends in marine species distribution and abundance in order to assess potential population effects from Navy training activities and determine the effectiveness of the Navy's mitigation measures. The information gained from the monitoring will also allow the Navy to evaluate the models used to predict effects to marine mammals.

By using a combination of monitoring techniques or tools appropriate for the species of concern, type of Navy activities conducted, sea state conditions, and the size of the Range Complex, the detection, localization, and observation of marine mammals and sea turtles can be maximized. The following available monitoring techniques and tools are described in this monitoring plan for monitoring for range events (several days or weeks) and monitoring of population effects such as abundance and distribution (months or years):

- Visual Observations – Vessel-, Aerial- and Shore-based Surveys (for marine mammals and sea turtles) will provide data on population trends (abundance, distribution, and presence) and response of marine species to Navy training activities. Navy lookouts will also record observations of detected marine mammals from Navy ships during appropriate training and test events.

- Acoustic Monitoring – Passive Acoustic Monitoring possibly using towed hydrophone arrays, Autonomous Acoustic Recording buoys and U.S. Navy Instrument Acoustic Range (for marine mammals only) may provide presence/absence data on cryptic species that are difficult to detect visually (beaked whales and minke whales) that could address long term population trends and response to Navy training exercises.

- Tagging – Tagging marine mammals with instruments to measure their dive depth and duration, determine location and record the received level of natural and anthropogenic sounds.

- Additional Methods – Oceanographic Observations and Other Environmental Factors will be obtained during ship-based surveys and satellite remote sensing data. Oceanographic data is important factor that influences the abundance and distribution of prey items and therefore the distribution and movements of marine mammals.

The monitoring plan will be reviewed annually by Navy biologists to determine the effectiveness of the monitoring elements and to consider any new monitoring tools or techniques that may have become available.

3.9.10.3.2 Research

The Navy provides a significant amount of funding and support to marine research. The agency provides nearly 10 million dollars annually to universities, research institutions, federal laboratories, private companies, and independent researchers around the world to study marine mammals. The U.S. Navy sponsors seventy percent of all U.S. research concerning the effects of human-generated sound on marine mammals and 50 percent of such research conducted worldwide. Major topics of Navy-supported research include the following:

- Better understanding of marine species distribution and important habitat areas,
- Developing methods to detect and monitor marine species before and during training,
- Understanding the effects of sound on marine mammals, sea turtles, fish, and birds, and
- Developing tools to model and estimate potential effects of sound.

This research is directly applicable to Fleet training activities, particularly with respect to the investigations of the potential effects of underwater noise sources on marine mammals and other protected species. Proposed training activities employ sonar and underwater explosives, which introduce sound into the marine environment.

The Marine Life Sciences Division of the Office of Naval Research currently coordinates six programs that examine the marine environment and are devoted solely to studying the effects of noise and/or the implementation of technology tools that will assist the Navy in studying and tracking marine mammals. The six programs are as follows:

- Environmental Consequences of Underwater Sound,
- Non-Auditory Biological Effects of Sound on Marine Mammals,
- Effects of Sound on the Marine Environment,
- Sensors and Models for Marine Environmental Monitoring,
- Effects of Sound on Hearing of Marine Animals, and
- Passive Acoustic Detection, Classification, and Tracking of Marine Mammals.

The Navy has also developed the technical reports referenced within this document, which include the Marine Resource Assessments and the Navy OPAREA Density Estimates (NODE) reports. Furthermore, research cruises by the National Marine Fisheries Service (NMFS) and by academic institutions have received funding from the U.S. Navy.

The Navy has sponsored several workshops to evaluate the current state of knowledge and potential for future acoustic monitoring of marine mammals. The workshops brought together acoustic experts and marine biologists from the Navy and other research organizations to present data and information on current acoustic monitoring research efforts and to evaluate the potential for incorporating similar technology and methods on instrumented ranges. However, acoustic detection, identification, localization, and tracking of individual animals still requires a significant amount of research effort to be considered a reliable method for marine mammal monitoring. The Navy supports research efforts on acoustic monitoring and will continue to investigate the feasibility of passive acoustics as a potential mitigation and monitoring tool.

Overall, the Navy will continue to fund ongoing marine mammal research, and is planning to coordinate long term monitoring/studies of marine mammals on various established ranges and operating areas. The Navy will continue to research and contribute to university/external research to improve the state of the science regarding marine species biology and acoustic effects. These efforts include mitigation and monitoring programs; data sharing with NMFS and via the literature for research and development efforts; and future research as described previously.

3.9.10.4 Coordination and Reporting

The Navy will coordinate with the local NMFS Stranding Coordinator for any unusual marine mammal behavior and any stranding, beached live/dead or floating marine mammals that may occur coincident with Navy training activities.

3.9.10.5 Alternative Mitigation Measures Considered but Eliminated

As described in Chapter 3, Section 3.9 and Appendix F, the vast majority of estimated sound exposures of marine mammals during proposed active sonar activities would not cause injury. Potential acoustic effects on marine mammals would be further reduced by the mitigation measures described above. Therefore, the Navy concludes the proposed action and mitigation measures would achieve the least practical adverse impact on species or stocks of marine mammals.

A determination of “least practicable adverse impacts” includes consideration of personnel safety, practicality of implementation, and impact on the effectiveness of the military readiness activity in consultation with the DoD. Therefore, the following additional mitigation measures were analyzed and eliminated from further consideration:

- Reduction of training. The requirements for training have been developed through many years of iteration to ensure sailors achieve levels of readiness to ensure they are prepared to properly respond to the many contingencies that may occur during an actual mission. These training requirements are designed provide the experience needed to ensure sailors are properly prepared for operational success. There is no extra training built in to the plan, as this would not be an efficient use of the resources needed to support the training (e.g. fuel, time). Therefore, any reduction of training would not allow sailors to achieve satisfactory levels of readiness needed to accomplish their mission.
- Use of ramp-up to attempt to clear the range prior to the conduct of exercises. Ramp-up procedures, (slowly increasing the sound in the water to necessary levels), are not a viable alternative for training exercises because the ramp-up would alert opponents to the participants’ presence. This affects the realism of training in that the target submarine would be able to detect the searching unit prior to themselves being detected, enabling them to take evasive measures. This would insert a significant anomaly to the training, affecting its realism and effectiveness. Though ramp-up procedures have been used in testing, the procedure is not effective in training sailors to react to tactical situations, as it provides an unrealistic advantage by alerting the target. Using these procedures would not allow the Navy to conduct realistic training, thus adversely impacting the effectiveness of the military readiness activity.
- Visual monitoring using third-party observers from air or surface platforms, in addition to the existing Navy-trained lookouts.
    - The use of third-party observers would compromise security due to the requirement to provide advance notification of specific times/locations of Navy platforms.

- Reliance on the availability of third-party personnel would also impact training flexibility, thus adversely affecting training effectiveness.
- The presence of other aircraft in the vicinity of naval exercises would raise safety concerns for both the commercial observers and naval aircraft.
- Use of Navy observers is the most effective means to ensure quick and effective implementation of mitigation measures if marine species are spotted. A critical skill set of effective Navy training is communication. Navy lookouts are trained to act swiftly and decisively to ensure that appropriate actions are taken.
- Use of third-party observers is not necessary because Navy personnel are extensively trained in spotting items on or near the water surface. Navy spotters receive more hours of training, and use their spotting skills more frequently, than many third-party trained personnel.
- Crew members participating in training activities involving aerial assets have been specifically trained to detect objects in the water. The crew's ability to sight from both surface and aerial platforms provides excellent survey capabilities using the Navy's existing exercise assets.
- Security clearance issues would have to be overcome to allow non-Navy observers onboard exercise participants.
- Some training events will span one or more 24-hour periods, with operations underway continuously in that timeframe. It is not feasible to maintain non-Navy surveillance of these operations, given the number of non-Navy observers that would be required onboard.
- Surface ships having active mid-frequency sonar have limited berthing capacity. As exercise planning includes careful consideration of this limited capacity in the placement of exercise controllers, data collection personnel, and Afloat Training Group personnel on ships involved in the exercise. Inclusion of non-Navy observers onboard these ships would require that in some cases there would be no additional berthing space for essential Navy personnel required to fully evaluate and efficiently use the training opportunity to accomplish the exercise objectives.
- Contiguous ASW events may cover many hundreds of square miles. The number of civilian ships and/or aircraft required to monitor the area of these events would be considerable. It is, thus, not feasible to survey or monitor the large exercise areas in the time required ensuring these areas are devoid of marine mammals. In addition, marine mammals may move into or out of an area, if surveyed before an event, or an animal could move into an area after an exercise took place. Given that there are no adequate controls to account for these or other possibilities and there are no identified research objectives, there is no utility to performing either a before or an after the event survey of an exercise area.
- Survey during an event raises safety issues with multiple, slow civilian aircraft operating in the same airspace as military aircraft engaged in combat training activities. In addition, most of the training events take place far from land, limiting both the time available for civilian aircraft to be in the exercise area and presenting a concern should aircraft mechanical problems arise.
- Scheduling civilian vessels or aircraft to coincide with training events would impact training effectiveness, since exercise event timetables cannot be precisely

fixed and are instead based on the free-flow development of tactical situations. Waiting for civilian aircraft or vessels to complete surveys, refuel, or be on station would slow the unceasing progress of the exercise and impact the effectiveness of the military readiness activity.

- Multiple simultaneous training events continue for extended periods. There are not enough qualified third-party personnel to accomplish the monitoring task.

- Reducing or securing power during the following conditions.
  - Low-visibility / night training: ASW can require a significant amount of time to develop the "tactical picture," or an understanding of the battle space such as area searched or unsearched, identifying false contacts, understanding the water conditions, etc. Reducing or securing power in low-visibility conditions would affect a commander's ability to develop this tactical picture and would not provide realistic training.
  - Strong surface duct: The complexity of ASW requires the most realistic training possible for the effectiveness and safety of the sailors. Reducing power in strong surface duct conditions would not provide this training realism because the unit would be operating differently than it would in a combat scenario, reducing training effectiveness and the crew's ability. Additionally, water conditions may change rapidly, resulting in continually changing mitigation requirements, resulting in a focus on mitigation versus training.
- Vessel speed: Establish and implement a set vessel speed.
  - Navy personnel are required to use caution and operate at a slow, safe speed consistent with mission and safety. Ships and submarines need to be able to react to changing tactical situations in training as they would in actual combat. Placing arbitrary speed restrictions would not allow them to properly react to these situations, resulting in decreased training effectiveness and reduction the crew proficiency.
- Increasing power down and shut down zones:
  - The current power down zones of 457 and 914 m (500 and 1,000 yd), as well as the 183 m (200 yd) shut down zone were developed to minimize exposing marine mammals to sound levels that could cause temporary threshold shift (TTS) or permanent threshold shift (PTS), levels that are supported by the scientific community. Implementation of the safety zones discussed above will prevent exposure to sound levels greater than 195 dB re 1μPa for animals sighted. The safety range the Navy has developed is also within a range sailors can realistically maintain situational awareness and achieve visually during most conditions at sea.
  - Although the three action alternatives were developed using marine mammal density data and areas believed to provide habitat features conducive to marine mammals, not all such areas could be avoided. ASW requires large areas of ocean space to provide realistic and meaningful training to the sailors. These areas were considered to the maximum extent practicable while ensuring Navy's ability to properly train its forces in accordance with federal law. Avoiding any area that has the potential for marine mammal populations is impractical and would impact the effectiveness of the military readiness activity.

- Using active sonar with output levels as low as possible consistent with mission requirements and use of active sonar only when necessary.
  - Operators of sonar equipment are always cognizant of the environmental variables affecting sound propagation. In this regard, the sonar equipment power levels are always set consistent with mission requirements.
  - Active sonar is only used when required by the mission since it has the potential to alert opposing forces to the sonar platform's presence. Passive sonar and all other sensors are used in concert with active sonar to the maximum extent practicable when available and when required by the mission.

3.9.11 Summary of Effects by Alternative

Modeled effects of Navy activities on marine mammals, as identified in this section, do not account for reductions in potential impacts through application of the extensive mitigation measures detailed in Section 3.9.10.

3.9.11.1 Potential Non-Acoustic Impacts

Impacts to marine mammals from Navy activities in the SOCAL Range Complex may result from non-acoustic sources including ship collisions, entanglement or falling debris. Impacts from these sources are inherently unpredictable; however, impacts from such sources are considered unlikely, would not result in any death or injury to any marine mammal species and would have negligible impact, if any, on annual survival, recruitment, and birth rates.

3.9.11.2 Potential Mid- and High Frequency Active Sonar Effects

No Action Alternative-The risk function methodology estimates 83,686 annual exposures to mid- and high-frequency active sonar that could result in a behavioral change (Level B harassment), 16,706 could result in TTS (Level B Harassment). Twenty-six annual exposures could result in injury as PTS. The modeled sonar exposure numbers by species are presented in Table 3.9-7. These exposure modeling results are estimates of marine mammal sonar exposures without consideration of standard mitigation and monitoring procedures.

Alternative 1-The risk function methodology estimates 89,028 annual exposures to mid-and high -frequency active sonar that could result in a behavioral change, 17,772 could result in TTS (Level B Harassment). Twenty-eight annual exposures could result in injury as PTS. The modeled sonar exposure numbers by species are presented in Table 3.9-10.

Alternative 2-The risk function methodology estimates 94,370 annual exposures to mid-and high-frequency active sonar that could result in a behavioral change, 18,838 could result in TTS (Level B Harassment). Thirty annual exposures could result in injury as PTS. The modeled sonar exposure numbers by species are presented in Table 3.9-13.

3.9.11.3 Potential Underwater Detonation Effects

No Action Alternative-Modeling estimates 635 annual exposures to pressure from underwater detonations could result in TTS (Level B Harassment). Twenty-eight annual exposures could result in slight injury. Eight annual exposures could result in severe injury or mortality. The modeled explosive exposure numbers by species are presented in Table 3.9-8

Alternative 1-Modeling estimates 742 annual exposures to pressure from underwater detonations could result in TTS (Level B Harassment). Twenty-nine annual exposures could result in slight injury. Ten annual exposures could result in severe injury or mortality. The modeled explosive exposure numbers by species are presented in Table 3.9-11.

Alternative 2-Modeling estimates 817 annual exposures to pressure from underwater detonations could result in TTS (Level B Harassment). Thirty-six annual exposures could result in slight injury. Twelve annual exposures could result in severe injury or mortality. The modeled explosive exposure numbers by species are presented in Table 3.9-14.

3.9.11.4 Statement Regarding Potential Mortality of Marine Mammals

Without consideration of mitigation measures for underwater detonations, the modeling results from the SOCAL Range Complex analysis predict underwater detonations could cause mortality to long-and short-beaked common dolphins, northern fur seals, and California sea lions (12 mortalities total are predicted). However, given range clearance procedures with long set-up times, standard mitigation measures presented in Section 3.10 and again in Chapter 5, and the likelihood that these species can be readily detected, Level A exposures and mortally are unlikely to occur. In light of the modeled results, however, the Navy will request authorization for take, by mortality, of long-and short-beaked common dolphins, northern fur seals, and California sea lions.

The history of Navy activities in the southern California and analysis in this document indicate that military readiness activities are not expected to result in any sonar–induced Level A injury or mortalities to marine mammals.

Evidence from five beaked whale strandings, all of which have taken place outside or the SOCAL Range Complex, and have occurred over approximately a decade, suggests that the exposure of beaked whales to MFA sonar in the presence of certain conditions (e.g., multiple units using tactical sonar, steep bathymetry, constricted channels, strong surface ducts, etc.) may result in strandings, potentially leading to mortality. Although these physical factors believed to contribute to the likelihood of beaked whale strandings are not present, in the aggregate, in the SOCAL Range Complex, scientific uncertainty exists regarding what other factors, or combination of factors, may contribute to beaked whale strandings. Accordingly, to allow for scientific uncertainty regarding contributing causes of beaked whale strandings and the exact mechanisms of the physical effects, the Navy will also request authorization for take, by mortality, of the beaked whale species present in Southern California.

Table 3.9-15 presents a summary of effects and mitigation measures for the No Action, Alternative 1, and Alternative 2.

Table 3.9-15: Summary of Marine Mammal Effects

Alternative	NEPA (On-Land and U.S. Territorial Waters)	EO 12114 (Non-U.S. Territorial Waters)
No Action Alternative	• Potential effects of active sonar on marine mammals are as summarized in section 3.9.11.2. • Potential effects on marine mammals associated with underwater detonations are as summarized in section 3.9.11.3. • Non-acoustic effects on marine mammals are unlikely due to implementation of mitigation measures .	• Potential effects of active sonar on marine mammals are as summarized in section 3.9.11.2. • Potential effects on marine mammals associated with underwater detonations are as summarized in section 3.9.11.3. • Non-acoustic effects on marine mammals are unlikely due to implementation of mitigation measures
Alternative 1	• Potential effects of active sonar on marine mammals are as summarized in section 3.9.11.2. • Potential effects on marine mammals associated with underwater detonations are as summarized in section 3.9.11.3. • Non-acoustic effects on marine mammals are unlikely due to implementation of mitigation measures	• Potential effects of active sonar on marine mammals are as summarized in section 3.9.11.2. • Potential effects on marine mammals associated with underwater detonations are as summarized in section 3.9.11.3. • Non-acoustic effects on marine mammals are unlikely due to implementation of mitigation measures
Alternative 2 (Preferred Alternative)	• Potential effects of active sonar on marine mammals are as summarized in section 3.9.11.2. • Potential effects on marine mammals associated with underwater detonations are as summarized in section 3.9.11.3. • Non-acoustic effects on marine mammals are unlikely due to implementation of mitigation measures	• Potential effects of active sonar on marine mammals are as summarized in section 3.9.11.2. • Potential effects on marine mammals associated with underwater detonations are as summarized in section 3.9.11.3. • Non-acoustic effects on marine mammals are unlikely due to implementation of mitigation measures
Mitigation	• The extensive mitigation measures are described in Section 3.9-10.	• The extensive mitigation measures are described in Section 3.9-10.

Table 3.9-15: Summary of Marine Mammal Effects

Alternative	NEPA (On-Land and U.S. Territorial Waters)	EO 12114 (Non-U.S. Territorial Waters)
No Action Alternative	• Potential effects of active sonar on marine mammals are as summarized in section 3.9.11.2. • Potential effects on marine mammals associated with underwater detonations are as summarized in section 3.9.11.3. • Non-acoustic effects on marine mammals are unlikely due to implementation of mitigation measures .	• Potential effects of active sonar on marine mammals are as summarized in section 3.9.11.2. • Potential effects on marine mammals associated with underwater detonations are as summarized in section 3.9.11.3. • Non-acoustic effects on marine mammals are unlikely due to implementation of mitigation measures
Alternative 1	• Potential effects of active sonar on marine mammals are as summarized in section 3.9.11.2. • Potential effects on marine mammals associated with underwater detonations are as summarized in section 3.9.11.3. • Non-acoustic effects on marine mammals are unlikely due to implementation of mitigation measures	• Potential effects of active sonar on marine mammals are as summarized in section 3.9.11.2. • Potential effects on marine mammals associated with underwater detonations are as summarized in section 3.9.11.3. • Non-acoustic effects on marine mammals are unlikely due to implementation of mitigation measures
Alternative 2 (Preferred Alternative)	• Potential effects of active sonar on marine mammals are as summarized in section 3.9.11.2. • Potential effects on marine mammals associated with underwater detonations are as summarized in section 3.9.11.3. • Non-acoustic effects on marine mammals are unlikely due to implementation of mitigation measures	• Potential effects of active sonar on marine mammals are as summarized in section 3.9.11.2. • Potential effects on marine mammals associated with underwater detonations are as summarized in section 3.9.11.3. • Non-acoustic effects on marine mammals are unlikely due to implementation of mitigation measures
Mitigation	• The extensive mitigation measures are described in Section 3.9-10.	• The extensive mitigation measures are described in Section 3.9-10.

3.10 Sea Birds

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3.10 SEA BIRDS

3.10.1 Affected Environment

The Southern California (SOCAL) Range Complex covers a geographic area located in the center of the California current. One of the world's richest marine ecosystems, the California current flows from southern British Columbia, Canada, to Baja California Sur, Mexico. The abundant food in the California current, resulting from high ocean primary productivity, attracts millions of seabirds that breed and/or migrate throughout the region annually, with non-breeders outnumbering breeders year-round, two to one (Mills et al. 2005). The biological importance of the California current extends to all marine ecosystems from primary production to marine mammals and is the basis of the diversity of the southern California marine region.

Due to the mobility of birds, their ranges are not restricted to jurisdictions or boundaries. Populations of birds contained within the SOCAL Range Complex are not accurately documented; however, the importance of the Southern California Bight (SCB) area for both breeding and migratory species has been well established. Currently, more than 195 species of birds use coastal or offshore aquatic habitats in the SCB; that is, the area of the Pacific Ocean lying between Point Conception on the Santa Barbara County coast to a point shortly south of the United States/Mexico border (Dailey et al. 1993). A variety of seabirds use this southern California coastal region for breeding and wintering. For certain seabird species, the area south of Point Conception, California, is the northern or southern perimeter of breeding and/or migratory ranges.

Coastal habitats and productive offshore waters are important nesting and foraging areas for breeding and migratory seabirds; as pressures on habitats increased, cumulative effects of incremental habitat degradation became noticeable on resources used by seabirds in the latter part of the 20th century. Habitat loss, coupled with pollution and related fisheries impacts, has reduced several seabird populations to vulnerable levels.

Many of the SCB seabird populations roost on islands and offshore rocks around the Channel Islands. The Channel Islands offer nesting sites to seabird species, some of which have extremely scarce suitable habitat elsewhere in southern California. These islands' positions offshore makes them readily available to ocean birds, and predator and human disturbance is less than on the mainland. The southern Channel Islands (San Clemente, Santa Catalina, and Santa Barbara) provide vital habitat to nesting and migratory seabirds. However, the northern Channel Islands (San Miguel, Santa Rosa, Santa Cruz, San Nicolas, and Anacapa) contain the majority of seabird breeding colonies considered sensitive. Population status of breeding seabirds on the west coast has been measured primarily through the determination of, and trends in, population size based on counts of birds and nests at nesting colonies (Sowls et al. 1980).

A variety of seabirds are known to occur within the SOCAL Range Complex with the most numerous groups being shearwaters, storm petrels, phalaropes, gulls, terns and auklets. Several seabird species are considered particularly important here because of their large population numbers, their limited ranges, the rapid decrease in populations, or their use of critical or unique habitats (Dailey et al. 1993).

Of the 48 seabird species known to occur within the SOCAL Range Complex, several are under the listing authority of the Endangered Species Act (ESA) (Table 3.10-1). Of the species provided protection under the ESA, three are listed as federally endangered (California brown pelican, California least tern, and short-tailed albatross), one is federally threatened (marble murrelet), and one is a candidate for listing (Xantus's murrelet). Additional seabirds identified as species of concern by the State of California, United States Fish and Wildlife Service (USFWS), and the Audubon Society include several species of tern, auklet, and murrelet, among others. All seabirds occurring within the SOCAL Range Complex are afforded protection under the Migratory Bird Treaty Act (MBTA). The 1988 amendment to the Fish and Wildlife Conservation Act mandated the USFWS to "identify species, subspecies, and populations of all migratory non-game birds that, without additional conservation actions, are likely to become candidates for listing under the Endangered Species Act of 1973." These species, subspecies, and populations are called Birds of Conservation Concern.

3.10.1.1 Migratory Bird Treaty Act

The MBTA of 1918 (16 U.S.C. 703 et seq.) and the Migratory Bird Conservation Act (16 U.S.C. 715–715d, 715e, 715f–715r) of 18 Feb 29, (45 Stat. 1222) are the primary legislation in the United States established to conserve migratory birds. These statutes implement the United States' commitment to four bilateral treaties, or conventions, for the protection of a shared migratory bird resource. Current treaties are with the countries of Great Britain, Mexico, Canada, Japan, and the Soviet Union. The MBTA prohibits the taking, killing, or possessing of migratory birds or the parts, nests, or eggs of such birds, unless permitted by regulation. The species of birds protected by the MBTA appears in Title 50, Section 10.13 of the Code of Federal Regulations (50 C.F.R. 10.13) and represents almost all avian families found in North America. In general, there are only three species that are not protected by the MBTA and they include the rock pigeon (*Columba livia*), European starling (*Sturnus vulgaris*), and house sparrow (*Passer domesticus*). On December 2, 2003, the President signed the 2003 National Defense Authorization Act. The Act provides that the Secretary of the Interior shall exercise his/her authority under the MBTA to prescribe regulations to exempt the Armed Forces from the incidental taking of migratory birds during military readiness activities authorized by the Secretary of Defense. Take under the MBTA is defined to be unlawful at any time, by any means or in any manner, to pursue, hunt, take, capture, kill, attempt to take, capture, or kill, possess, offer for sale, sell, offer to barter, barter, offer to purchase, purchase, deliver for shipment, ship, export, import, cause to be shipped, exported, or imported, deliver for transportation, transport or cause to be transported, carry or cause to be carried, or receive for shipment, transportation, carriage, or export, any migratory bird, any part, nest, or eggs of any such bird, or any product, whether or not manufactured, which consists, or is composed in whole or part, of any such bird or any part, nest, or egg thereof, included in the terms of the conventions between the United States and Great Britain for the protection of migratory birds concluded August 16, 1916 (39 Stat. 1702), the United States and Mexico for the protection of migratory birds and game mammals concluded February 7, 1936, the United States and the Government of Japan for the protection of migratory birds and birds in danger of extinction, and their environment concluded March 4, 1972 and the convention between the United States and the Union of Soviet Socialist Republics for the conservation of migratory birds and their environments concluded November 19, 1976.

Congress defined military readiness activities as all training and operations of the Armed Forces that relate to combat and the adequate and realistic testing of military equipment, vehicles, weapons, and sensors for proper operation and suitability for combat use. Congress further provided that military readiness activities do not include: (A) the routine operation of installation operating support functions, such as administrative offices, military exchanges, commissaries, water treatment facilities, storage facilities, schools, housing, motor pools, laundries, morale, welfare, and recreation activities, shops, and mess halls: (B) the operation of industrial activities; or (C) the construction of demolition of facilities used for a purpose described in (A) and (B).

The final rule authorizing the Department of Defense to take migratory birds during military readiness activities was published in the Federal Register on February 28, 2007. The regulation can be found at 50 C.F.R. Part 21. The regulation provides that the Armed Forces must confer and cooperate with the USFWS on the development and implementation of conservation measures to minimize or mitigate adverse effects of a military readiness activity if it determines that such activity may have a “significant adverse effect” on a population of a migratory bird species.

The requirement to confer with the USFWS is triggered by a determination that the military readiness activity in question will have a “significant adverse effect” on a population of migratory bird species. An activity has a significant adverse effect if, over a reasonable period of time, it diminishes the capacity of a population of a migratory bird species to maintain genetic diversity, to reproduce, and to function effectively in its native ecosystem. A population is defined as “a group of distinct, coexisting, same species, whose breeding site fidelity, migration routes, and wintering areas are temporally and spatially stable, sufficient distinct geographically (at some point of the year), and adequately described so that the population can be effectively monitored to discern changes in its status.

Migratory bird conservation relative to non-military readiness activities is addressed separately in a Memorandum of Understanding developed in accordance with Executive Order 13186, signed January 10, 2001, “Responsibilities of Federal Agencies to Protect Migratory Birds”. The Memorandum of Understanding between Department of Defense (DoD) and the USFWS was signed on July 31 2006. DoD responsibilities discussed in the Memorandum of Understanding include, but are not limited to:

(1) Obtaining permits for import and export, banding, scientific collection, taxidermy, special purposes, falconry, raptor propagation, and depredation activities;
(2) Encouraging incorporation of comprehensive migratory bird management objectives in the planning of Department of Defense planning documents;
(3) Incorporating conservation measures addressed in Regional or State Bird Conservation Plans in Integrated Natural Resource Management Plans;
(4) Managing military lands and activities other than military readiness in a manner that supports migratory bird conservation;
(5) Avoiding or minimizing impacts to migratory birds, including incidental take and the pollution or detrimental alteration of the environments used by migratory birds;
(6) Developing, striving to implement, and periodically evaluating conservation measures for management actions to avoid or minimize incidental take of migratory birds, and, if necessary, conferring with the Service on revisions to these conservation measures.

A number of species covered by the MBTA are found within the SOCAL Range Complex, including various shearwaters, storm petrels, phalaropes, gulls, terns, and auklets. A number of the species covered under the MBTA are also federally and/or state-listed as threatened or endangered. All seabird species found within the SOCAL Range Complex are covered by the MBTA (Table 3.10.1).

3.10.1.2 Existing Conditions

3.10.1.2.1 Natural History and Status of Seabird Groups

Shearwaters (Procellariidae)

Shearwaters are medium-sized, long-winged seabirds most common in temperate and cold waters. Shearwaters come to islands and coastal cliffs to breed. They are nocturnal at the colonial breeding sites, preferring moonless nights to minimize predation. Outside of the breeding season, they are pelagic (frequent the open waters) and most are long-distance migrants. They feed on fish, squid, and similar oceanic food. Numbers of shearwaters have been reduced due to predation by introduced species to islands, such as rats and cats. Some loss of birds also occurs from entanglement in fishing gear.

Strictly visitors, shearwaters have not been recorded to breed within the SOCAL Range Complex. Shearwaters primarily utilize offshore and coastal waters of the SOCAL Range Complex for foraging and are typically concentrated along upwelling boundaries and other water mass convergence areas.

Storm-petrels (Hydrobatidae)

Storm-petrels are the smallest of seabirds and feed on planktonic crustaceans and small fish picked from the surface, typically while hovering. Storm-petrels have a cosmopolitan distribution, found in all oceans. They are strictly pelagic, coming to land only when breeding. In the case of most species, little is known of their behavior and distribution at sea. Storm-petrels nest in colonies on remote islands. Nesting sites are attended nocturnally to avoid predators (Bretagnolle 1990). Petrels typically show a high degree of tenacity to the same nest from year to year; once pairs are established, they would likely continue to breed at the same sites. Several species of storm-petrel are threatened by human activities (IUCN 2006).

Leach's storm-petrels (*Oceanodroma leucorhoa*) are known to breed only on Santa Barbara Island within the SOCAL Range Complex. Approximately 12,500 individuals currently reside in California, primarily on the central coast. Population trends are currently unknown (USFWS 2005a). They have declined in northern California because of the loss of burrow-nesting habitats due to soil erosion and defoliation by nesting cormorants (Carter et al. 1992). Approximately 200 breeding individuals were estimated to occur on Santa Barbara Island in 1992 (Carter et al. 1992).

Black storm-petrels (*Oceanodroma melania*) have a limited breeding range from the Channel Islands, California, to the Gulf of California and off the west coast of Baja, Mexico (Ainley and Everett 2001). The SOCAL Range Complex supports only isolated breeding colonies of black storm-petrels on Santa Barbara and San Clemente Island with larger colonies occurring on Anacapa, Santa Cruz, and San Miguel Island (Carter et al. 1992). Approximately 300 individuals breed on Santa Barbara Island, and associated Sutil Island, California and breeding individuals have been intermittently sited on San Clemente (Carter et al. 1992). The largest breeding colony of black storm-petrels nests on San Benito Island, Mexico.

The ashy storm-petrel (*Oceanodroma homochroa*) is a globally rare seabird species that is endemic to the California islands. In the SOCAL Range Complex area, the ashy storm-petrel is known to breed on Santa Catalina, Santa Barbara and San Clemente Island. The majority of the ashy storm-petrel population breeds in coastal and island areas of central and southern California (McChesney et al. 2000, Ainley et al. 1995). The breeding population has been estimated at 5,200-10,000 individuals, with about half on the South Farallon Islands and half in the Channel Islands. Fewer than 50 breeding individuals were present on Catalina and San Clemente Island in 1999 (Nur et al. 1999), though hundreds are suspected (Carter pers. Comm.). Nearly 1500 breeding individuals were documented on Santa Barbara Island in 1992 (Carter et al. 1992) and 2,252 breeding birds or about 1,126 nests in 1996 (Carter, unpubl. data).

Phalaropes (Scolopacidae)

The red-necked phalarope (*Phalaropus lobatus*) and the red phalarope (*Phalaropus fulicaria*) breed circumpolarly in the low Arctic or Subarctic. These species winter at sea, mostly in tropical waters. Large numbers migrate south along the Califorina coast (probably most of arctic breeding population) and winter (Oct–Mar) off the west coast of South America, as far south as coastal Chile; largest numbers reported from Humboldt Current off Peru (Murphy 1936). Phalaropes are common on an irregular basis in winter off the Pacific coast of southern Mexico, from Colima south to El Salvador (Howell and Webb 1995). The red-necked phalarope has a large global population estimated to be 3,500,000 individuals (Wetlands International 2002). Global population trends have not been quantified, but the species is not believed to approach the thresholds for the population decline criterion of the IUCN Red List (i.e., declining more than 30 percent in 10 years or 3 generations).

Pelicans (Pelecanidae)

The California brown pelican (*Pelecanus occidentalis californicus)* is listed as federally endangered under the ESA. It is one of two subspecies of brown pelicans residing in the United States and breeds along the Pacific coast from the Channel Islands to Mexico. Their number has increased recently at the two primary nesting colonies in the Channel Islands (West Anacapa and Santa Barbara Island) in southern California following severe pre-1975 declines primarily due to eggshell thinning from marine pollutants (Anderson et al. 1975; Anderson and Gress 1983; Carter et al. 1992; USFWS 2007). Breeding success is still low and limited recovery may involve immigration of birds out of Mexico. Although California populations have recovered substantially from previous declines, they continue to show inter-annual variation in productivity as related to prey availability (Anderson et al. 1982). Approximately 12,000 brown pelicans breed in southern California and this represents nearly 12 percent of the western subspecies (Kushlan et al. 2002). The SOCAL Range Complex provides extensive breeding and foraging territory for the California brown pelican including a large breeding population on Santa Barbara Island.

In May 2006, during surveys sponsored by the California Department of Fish and Game, 43 pelican nests were discovered on Prince Island near San Miguel Island. This is the first pelican nesting activity recorded at this location since 1939 (CDFG 2006). In 2006, a nesting colony was found, for the first time, on Middle Anacapa Island and breeders were observed on East Anacapa for the second time since 1928 (California Institute of Environmental Studies through the UCSC website http://currents.ucsc.edu/05-06/06-12/pelicans.asp). Breeding populations on Santa Barbara and Anacapa Islands have increased annually since 2000 and are approaching 7,000 breeding pairs (CHIS 2005 unpublished). The Department of the Navy has conducted long term monitoring on San Nicolas Island tracking population trends and roosting habitat, approximately 5,000 birds currently roost on the island (Capitolo et al. 2007).

A petition to de-list the California brown pelican from the list of endangered or threatened species under the ESA was recorded in December 2005 and resulted in the initiation of a 5-Year Review of the status of the species. According to the USFWS, “the population has remained stable for at least 20 years within its entire range” (USFWS 2007). On the basis of evidence amassed during recent years and examined during the 5-Year Review, the USFWS recommended de-listing the species throughout its entire range. This species is further discussed in the Federally Threatened and Endangered Species section.

Albatross (Diomedeidae)

All the albatross species potentially occurring within the SOCAL Range Complex are considered vagrant migrants and are rarely documented more than once per year (Burr 2007).

The Laysan albatross (*Phoebastria immutabilis*) has a wide range across the north Pacific. Its main breeding colonies are in the Northwestern Leeward Islands of the Hawaiian Archipelago. When away from breeding areas, they range widely from Japan to Alaska, and south to California, usually far offshore.

Short-tailed albatross (*Phoebastria albatrus*) breed on Torishima, an island owned and administered by Japan. The short-tailed albatross’ range overlaps with the black-footed and Laysan albatross’ covering most of the northwestern and northeastern Pacific Ocean. The world population of short-tailed albatross is currently estimated at 2,000 birds (USFWS 2005b). Short-tailed albatross status is discussed more completely in the Federally Threatened and Endangered Species section.

Black-footed albatross (*Phoebastria nigripes*) were found in large numbers in the SCB before this century, but because of the destruction of its colonies in the mid-Pacific its numbers have deceased dramatically worldwide as well as in coastal California (Dailey et al. 1993). Black-footed albatross usually remain at least 20-30 km (10.8 – 16.2 nm) offshore during the non-breeding months (July - November). During these months birds are distributed throughout the northwestern and northeastern Pacific. In 2000, there were an estimated 278,000 black-footed albatross, the majority of which nested on remote islands and atolls in the Hawaiian archipelago. Because of their propensity for scavenging behind ships, black-footed albatross are often unintended victims of commercial long line fisheries in the Pacific.

Cormorants (Phalacrocoracidae)

Cormorants are considered coastal rather than oceanic birds, and some have colonized inland waters. Cormorants are colonial nesters, using trees, rocky islets, or cliffs. They range around the world, except for the central Pacific islands, and are primarily fish eaters. All three species occurring within the SOCAL Range Complex have significant breeding populations within the Channel Islands located on rocky headlands and isolated offshore rocks.

The double-crested cormorant is the most numerous and most widely distributed species of the six North American cormorants. In the United States and Canada, it is the only cormorant to occur in large numbers in the interior as well as on the coasts, and it is more frequently cited than the others as conflicting with human interests in fisheries. Double-crested cormorants (*Phalacrocorax auritus*) have increased dramatically in coastal regions of California and Oregon because of reduced human disturbance, reduced levels of marine pollutants in southern California, and recent use of artificial nesting areas in San Francisco Bay and Columbia River estuaries (Gress et al. 1973; Carter et al. 1992). The Pacific population breeds between southern British Columbia and Sinaloa, Mexico. In these coastal areas, the double-crested cormorant is generally outnumbered by other cormorants.The southern California population has still not recovered to historic levels (Weseloh et al. 1999). The breeding population of double-crested cormorants was estimated to be 1191 individuals on Santa Barbara Island, in 1991 (Carter et al. 1992). Historic records of breeding colonies on Santa Catalina Island have been cited but no confirmed colonies are currently documented.

Populations of both pelagic cormorants (*Phalacrocorax pelagicus*) and Brandt's cormorants (*Phalacrocorax penicillatus*) appear stable although comprehensive surveys of their entire range are lacking. The pelagic cormorant, the smallest and most widely distributed of six cormorant species inhabiting the North Pacific, ranges from the Arctic waters of the Chukchi and Bering Seas south through temperate waters along the North American Pacific Coast to Baja California and along the Asian coast to southern China. The North American population totals about 130,000 birds, the majority of which occur in Alaska. Local populations often fluctuate considerably because of movement among breeding sites (Hobson 1997). The breeding population of pelagic cormorants within the SOCAL Range Complex was estimated to be 46 individuals on Santa Barbara Island, in 1991.

Brandt's cormorant is endemic to North America, where it occurs only in marine and estuarine environments. It breeds along the West Coast of North America, reaching Alaska in the north and Mexico in the south. In the main part of its range, from California to Washington, its life history and populations are tied to the rich upwelling associated with the California Current (Wallace and Wallace 1998). In the nonbreeding season, when the effects of this current diminish, populations redistribute along the coast in concert with changing water and feeding conditions. Current breeding populations within the SOCAL Range Complex occur on San Nicolas Island and Santa Barbara Island. The most current population estimate for SBI is 288 breeding individuals in 1991.

San Nicolas Island has one of the largest breeding colonies in California estimated at 5000 breeding pairs in 2006 (Capitolo et al. 2007).

Overall, numbers of cormorants have increased in southern California, but regional populations have suffered from gill net and oil-spill mortality as well as human disturbance at several colonies. Pacific coast colonies fluctuate annually, with low reproduction and population numbers influenced by El Niño events (Ainley and Boekelheide 1990). Worldwide populations of all three cormorant species range in the millions (IUCN 2006).

Gulls, terns, and skimmers (Laridae)

Most gulls are ground-nesting carnivores which will take live food or scavenge opportunistically. The only nesting gull within the SOCAL Range Complex is the western gull (*Larus occidentalis*). The western gull is a large white-headed gull that inhabits the Pacific Coast of North America, breeding from central Baja California north to Washington. In winter, this gull may be found throughout its breeding range, north to Vancouver Island, south into Baja California, and in adjacent offshore waters of these areas. Although a familiar and well-known species on the Pacific Coast, the western gull is limited in distribution and has a smaller population size than most other North American gulls, with a total population of only about 40,000 pairs nesting at fewer than 200 colony sites (Pierotti and Annett 1995). Numbers have increased, especially in California, probably because of the bird's use of human and fishing refuse and reduced human disturbance (USFWS 2005a). Numbers have reached saturation at the world's largest colony at the South Farallon Islands, California (Ainley et al. 1994) and expansion is occurring at other major colonies in central and southern California (Carter et al. 1992). Western gulls have been documented breeding at various levels on each of the four islands within the SOCAL Range Complex. Santa Barbara Island and San Nicolas Island sustain the largest colonies estimated to number 7,678 and 6,038 breeding individuals respectively, in 1991 (Carter et al. 1992). Western gulls are known predators of eggs and fledglings of other seabird species and may limit the ability of certain sensitive species, such as the ashy storm petrel and the Xantus's murrelet, from recolonizing historic breeding areas.

Similar population trends exist for other year-round resident gulls, including the ring-billed gull (*Larus delawarensis*) and California gull (*Larus californicus*). Population statuses of gulls primarily utilizing inland areas of North America for breeding and wintering are not well documented within the SOCAL Range Complex.

Several gull species such as Bonaparte's gull (*Larus philadelphia*), Heermann's gull (*Larus heermanni*), mew gull (L*arus canus*), herring gull (*Larus argentatus*), and glaucous-winged gull (*Larus glaucescens*) are transient and opportunistic, foraging in a variety of habitats spanning coastal areas and the open ocean.

Jaegers are arctic and boreal sea bird members of the gull family of the genus *Stercorarius* that harass smaller birds and snatch the food they drop. Jaegers winter in productive regions of tropical and subtropical oceans and concentrate over upwellings and boundaries of currents. They may be seen around large fishing vessels.

Three species of jaegers occur within the SOCAL Range Complex and are primarily observed offshore. The pomarine jaeger (*Stercorarius pomarinus*) winters at sea in the tropical oceans and is a fairly common pelagic migratory visitor of the SOCAL Range Complex. Parasitic jaegers (*Stercorarius parasiticus*) are more often found nearer shore and in estuaries compared to other jaegers. They spend most of the year on the ocean within a few miles of land. In the Pacific, parasitic jaegers winter at sea from southern California to southern Chile and Australia (Birdweb 2005). The long-tailed jaeger (*Stercorarius longicaudus)* is a migrant, wintering in the south Atlantic and Pacific.

Low thousands of Caspian, Forster's, least, elegant terns (*Sterna caspia*, *S. forsteri*, *S. antillarum*, *S. elegans*) and black skimmers (*Rynchops niger*) now occur in the SCB region. Their numbers have increased, especially along the southern California coast, due to colony protection and use of artificial nesting sites (Speich and Wahl 1989; Carter et al. 1992). Increasing numbers (< 100 breeding birds) of gull-billed and royal terns (*S. nilotica* and *S. maxima*) recently colonized the southern California coast, although gull-billed terns have nested inland at the Salton Sea for a few decades.

Elegant terns (*Sterna elegans)* breed on islands in the Gulf of California (90 percent of the known population on Isla Rasa), along the west coast of Baja California, and near San Diego, California (Audubon 2005). No breeding colonies exist within the boundaries of the SOCAL Range Complex. Individuals within the range complex utilize coastal waters for foraging or migrating. Post-breeding birds commonly occur north to the central California, Oregon, and Washington coast from midsummer through fall. They are seen only on the coast, frequenting estuaries and beaches along the California coast in summer and fall. They forage on a variety of different schooling fish, with northern anchovy being their most important prey item. Threats to current populations consist of urban development, disturbance at breeding colonies and roost sites, and the introduction of non-native mammalian predators. There is no population trend data for this species.

Gull-billed terns (*Sterna nilotica*) breed along the Atlantic Coast from New Jersey to Florida, along the Gulf Coast from Florida to Mexico, and locally in southern California in San Diego Bay and at the Salton Sea. San Diego County’s first gull-billed tern showed up in south San Diego Bay in 1985, and the species began nesting in the south bay two years later (Unitt 2004). It has nested there annually since, the population growing to 32-37 pairs by 2003 (Unitt 2004). Today the species is limited by the availability of suitable undisturbed habitat, winter food, flooding, predation, and human disturbance. These terns seem both less tolerant of disturbance and less faithful to nest sites than most other tern species (Audubon 2005). This species is capable of exploiting locally abundant prey including many kinds of terrestrial and aquatic species. Specific prey preferences include invertebrates and worms in plowed fields, fish, and crustaceans. The gull-billed tern primarily forages in estuarine and nearshore waters. The California population is under 200 pairs, and the future of the colony at the Salton Sea is unclear giving the current status of the habitat (Unitt 2004).

California least terns (*Sterna antillarum browni*) traditionally frequent isolated sandy beaches close to estuaries and coastal embayments for nesting sites. Today few beaches are utilized by this species with the majority of nesting areas occurring on manufactured (inadvertently and intentionally) substrates or fills within bays and estuaries. This exclusive fish-eater typically feeds on topsmelt, northern anchovy, and jacksmelt. Feeding is carried out both in the calm waters of narrow estuaries or large bays and for a short distance (i.e., usually within 3 kilometers [1.62 nm] off beaches in the open ocean; USFWS 2006). At the time of endangered species designation the least tern breeding population was estimated to be about 600 pairs. The statewide breeding population has increased considerably within the last 5 years and has exceeded 4,500 pairs since 2000. California least tern status is discussed more completely in the Federally Threatened and Endangered Species section.

Black skimmers (*Rynchops niger)* are considered rare within the SOCAL Range Complex. They are not known to breed within the Range Complex and only transit through small portions of the SOCAL Range Complex during migrations and occasional foraging. Unrecorded in California prior to 1962, black skimmers are documented to breed in coastal and inland areas of California. The western population breeds from southern California (inland at the Salton Sea, along coasts in San Diego and Orange counties) south to Nayarit, Mexico (AOU 1983). The species utilizes primarily estuaries and coastal lagoons for foraging and breeding. Their limited breeding range in southern California occurs at only three to four colonies and has resulted in the black skimmer being listed as a bird species of special concern in California. During the last three decades, black skimmers have become increasingly common along the southern California coast.

Alcids (Alcidae)

Alcids are marine birds with a stout bill, short wings and tail, webbed feet, a large head and heavy body, and thick, compact plumage. Confined to the northern parts of the Northern Hemisphere, alcids include auklets, guillemots, murres, and puffins. True seabirds, they come to land to breed in large colonies and then disperse to the open ocean for most of their lives. Important southern breeding colonies historically occurred on the Channel Islands of California, and continue to exist at mostly unknown levels. Current population levels of various alcids known to occur within the SOCAL Range Complex are not comprehensive.

The pigeon guillemot (*Cepphus columba*) is found along rocky coastlines between Alaska and California. This alcid nests in burrows or in rock cavities, mostly on small islands that provide protection from predators; small colonies often form, although this bird does nest as isolated pairs. A significant population and new nesting areas have been found recently in southern California, although higher numbers may reflect both better survey techniques and population increases (Carter et al. 1992). Unlike other alcids that fly 60 to 100 kilometers (32 to 54 nm) out to sea to find fish schools, the pigeon guillemot stays close to the rocky coast and searches for fish prey in relatively shallow waters and within approximately 10 kilometers (5.4 nm) of their nest. The estimated population of this species is about 235,000, with the largest breeding concentrations on Farallon Island, California, and in the Chukot Peninsula, Siberia; about 2,200 birds at each locale. Pigeon guillemot populations have remained stable overall, but major fluctuations have occurred in response to El Niño events at the south Farallon Islands and on the Oregon coast (Hodder and Graybill 1985; Ainley and Boekelheide 1990). The most current population estimate for the SOCAL Range Complex is 284 breeding individuals at Santa Barbara Island (Carter et al. 1992). Its widespread distribution along most north Pacific coastlines significantly decreases this species' vulnerability at the population level.

Cassin's auklets (*Ptychoramphus aleuticus*) breed from the western Aleutians to central Baja California, Mexico (Gaston and Jones 1998). Current global populations are in the millions with the majority of the breeding populations centered on Vancouver Island, Canada. Nesting has recently extended to the Channel Islands (Carter et al. 1992). Post nesting dispersal is variable, with the southern California population mostly resident (USFWS 2005a). Cassin's auklet populations in California have declined and several historic colonies have disappeared altogether, mainly from predation (Manuwal and Thorensen 1993). Individuals usually breed at same nest site in successive years (87% of cases; Nelson 1991). The most recent population estimate for the SOCAL Range Complex is 156 breeding individuals on Santa Barbara Island (Carter et al. 1992). Availability of suitable nest sites directly limits the size of breeding populations, but food supply is probably the main factor influencing total population size (Emms and Verbeek 1989; Ainley and Boekelheide 1990). Overall, it is unclear what is the relative importance of nest-site availability and summer and winter food supply is in regulating total population size

Tufted puffins (*Fratercula cirrhata*) can be found throughout the northern Pacific Ocean. They have recently recolonized southern California where they have not nested since the early 1900s (Carter et al. 1992). The largest tufted puffin populations occur along the west coast of the Olympic Peninsula (Speich and Wahl 1989), but their status there is not well known. Several million of these charismatic birds live in the north Pacific, from California to Japan. However, populations in California and Japan are in long-term decline, and no colonies outside of Alaska contain more than 10,000 birds (USGS 2005). Total world colony population estimate is

2,970,000 birds, of which 82% (2,440,000) breed in North America, only a small proportion of the North American population in California (0.01%; Piatt and Kitayski 2002).

Common murres (*Uria aalge*) are circumpolar and number in the millions worldwide. Primarily utilizing California offshore waters for feeding, common murres breed on open ledges and rocky cliffs of exposed coastline (Sibley 2000). Common murres are the dominant member of the breeding seabird community on the west coast but they have declined substantially in central California and Washington because of the combined effects of high mortality from gillnet fishing, oil spills, and poor reproduction during intense El Niño events (USGS 2005). The estimated world breeding population is 13 to 20.7 million birds. No documented breeding colonies have been cited within the SOCAL Range Complex or south of Point Conception, California.

Craveri's murrelet (*Synthliboramphus craveri*) is a small seabird, closely related to the Xantus' murrelet. Craveri's murrelet breeds on offshore islands in both the Pacific Ocean and the Gulf of California off the Baja peninsula of Mexico, but is not documented on the southern Channel Islands. It wanders fairly regularly as far as central California, primarily during post-breeding dispersal. Craveri's murrelet breeding colonies are threatened by predators introduced to its breeding colonies, oil spills, and tanker traffic. Increasing tourism development and commercial fishing fleets also further threaten the species. With an estimated population of 6,000-10,000 breeding pairs, its population is listed as a species of high concern (Birdlife 2006). Very little information is available on breeding colony locations and population trends.

Marbled murrelet *(Brachyramphus marmoratus)* populations range along the Pacific coast from southern Alaska to central California**.** This species can also be found wintering south of its breeding range, along the coast of southern California to extreme northwestern Baja California. Its populations have declined substantially throughout the region largely because of the direct loss of most (90-95 percent) of old-growth forest-nesting habitat to large-scale logging since the mid-1800s (Carter and Morrison 1992). Marbled murrelets appear to have very low reproductive rates (based on nests examined and at-sea counts of juveniles), probably because of high avian nest predation in fragmented forests and possibly lower breeding success during intense El Niño events. This species is discussed in depth in the Federally Threatened and Endangered Species section.

Xantus's murrelet (*Synthliboramphus hypoleucus*) populations persist in very low numbers throughout their range of which 2,000-5,000 of the breeding birds are documented in southern California. A significant portion of the small world population of this species nests in southern California, while the remainder nests on the northwest coast of Baja California, Mexico. Although more careful surveys are needed on the Baja California islands, available data indicate that the world population of Xantus's murrelet is much lower than estimated in recent reports (e.g., 16,000–30,000 by Springer et al. 1993). Numbers breeding in the largest colony at Santa Barbara Island probably have declined between the mid-1970s and 1991 (Carter et al. 1992). The decline may have occurred because of many factors, including census differences. Larger numbers of nesting birds are now suspected in southern California. The most recent population estimates for the SOCAL Range Complex are 1,544 breeding individuals at Santa Barbara Island (Carter et al. 1992). One breeding individual was sighted at San Clemente Island near Seal Rock on the west shore in the mid-1990s (Carter et al. 1992). Xantus's murrelet is discussed in detail in the Federally Threatened and Endangered Species section.

Rhinoceros auklets (*Cerorhinca monocerata*), a medium-sized auk, closely related to the puffins (*Fratercula*), breeds along the Pacific coast of North America from the Aleutian Islands, Alaska, south to southern California (Gaston and Dechesne 1996). Most of the North American population breeds on a small number of islands in British Columbia and adjacent parts of Washington and southeast Alaska (Gaston and Dechesne 1996). Current status of southern

California breeding population is not well known and is likely restricted to the northern Channel Islands. Population estimates are generally unreliable because of the difficulty in establishing burrow occupancy where burrows are long and nest chambers difficult to access. World population estimates are about 1 million breeding birds, this implies 1–2 million, including pre-breeders (Byrd et al. 1993). California numbers remain low; the most recent counts estimate approximately 1,700 individuals now breeding in California (Carter et al. 1992). During the non-breeding season, it ranges widely at sea from southern Alaska south to southern California and southern Japan. Concentration of population in a few large colonies suggests that population may be limited by availability of suitable colony sites. Competition for burrows with puffins may also be limiting in places and has been suggested as an important factor in determining populations and behavior at Farallon Island, California (Ainley et al. 1990a)

Loons (Gaviidae)

All living species of loons are members of one genus (*Gavia*) in a family (*Gaviidae*), and order (*Gaviiformes*) of their own. All three species of loons known to occur within the SOCAL Range Complex are migratory visitors and breed in northern latitudes. Red-throated loons (*Gavia stellata*) have a large range, with an estimated global extent of occurrence of 10,000,000 km^2 (54,000 nm^2). A large global population is estimated to be 490,000-1,500,000 individuals (Birdlife International 2004a). Common loons (*Gavia immer)* have a global population estimated to be 580,000 individuals (Birdlife International 2004b). Arctic loons (*Gavial arctica)* have a global population estimated to be 130,000–2,000,000 individuals (Birdlife International 2004b). Global population trends have not been quantified, but the species is not believed to approach the thresholds for the population decline criterion.

Scoters (Anatidae)

Scoters are large, mostly black or dark gray sea ducks. Scoters spend the non-breeding part of the year in large rafts on the ocean or in open bays and inlets. They forage almost exclusively by diving, taking prey from the ocean floor and also taking mussels from man-made structures. Surf scoters nest on freshwater lakes and wetlands in the Arctic, in sparsely forested and semi-open regions. They winter in open coastal environments, favoring shallow bays and estuaries with rocky substrates. Continent-wide, surf scoters may have gone through a serious decline early in the 20th century but now appear to be numerous with a stable population. There is evidence of a long-term decline in the west, and large die-offs were observed in the early 1990s at coastal reefs in southeastern Alaska. The cause of these die-offs is unknown, but pesticides or other contaminants are the suspected cause. The population is vulnerable to oil spills on the wintering grounds and disturbance and habitat destruction as a result of oil drilling on breeding grounds.

Table 3.10-1: Seabirds Known to Occur in the SOCAL Range Complex

Common Name	Genus species	Status
red-throated loon	*Gavia stellata*	
arctic loon	*Gavial arctica*	
common loon	*Gavia immer*	
short-tailed albatross	*Phoebastria albatrus*	*FE*
Laysan albatross	*Phoebastria immutabilis*	
black-footed albatross	*Phoebastria nigripes*	*BCC*
pink-footed shearwater	*Puffinus creatopus*	
sooty shearwater	*Puffinus ariseus*	
black-vented shearwater	*Puffinus opisthomelas*	
leach’s storm-petrel	*Oceanodroma leucorhoa*	
ashy storm-petrel	*Oceanodroma homochroa*	*BCC*

Common Name	Genus species	Status
black storm-petrel	*Oceanodroma melania*	
least strom-petrel	*Oceanodroma microsoma*	
California brown pelican	*Pelecanus occidentalis californicus*	*CE, FE*
double-crested cormorant	*Phalacrocorax auritus*	
Brandt's cormorant	*Phalacrocorax penicillatus*	
pelagic cormorant	*Phalacrocorax pelagicus*	
surf scoter	*Melanitta perspicillata*	
white-winged scoter	*Melanitta fusca*	
red-necked phalarope	*Phalaropus lobatus*	
red phalarope	*Phalaropus fulicaria*	
pomarine jaeger	*Stercorarius pomarinus*	
parasitic jaeger	*Stercorarius parasiticus*	
long-tailed jaeger	*Stercorarius longicaudus*	
Bonaparte's gull	*Lanus philadelphia*	
Heermann's gull	*Lanus heermanni*	
mew gull	*Lanus canus*	
ring-billed gull	*Lanus delawarensis*	
California gull	*Lanus californicus*	
herring gull	*Lanus argentatus*	
western gull	*Lanus occidentalis*	
glaucous-winged gull	*Lanus glaucescens*	
black-legged kittiwake	*Rissa tridactyla*	
Caspian tern	*Sterna caspia*	
common tern	*Sterna hirundo*	
elegant tern	*Sterna elegans*	*BCC*
gull-billed tern	*Sterna nilotica*	*BCC*
royal tern	*Sterna maxima*	
arctic tern	*Sterna paradisaea*	
Forster's tern	*Sterna forsteri*	
California least tern	*Sterna antillarum browni*	*CE, FE*
black skimmer	*Rynchops niger*	*BCC*
pigeon guillemot	*Cepphus columba*	
Xantus's murrelet	*Synthliboramphus hypoleucus*	*BCC*
Craveri's murrelet	*Synthliboramphus craveri*	
marbled murrelet	*Brachyramphus marmoratus*	*CE, FT*
Cassin's auklet	*Ptychoramphus aleuticus*	*BCC*
rhinoceros auklet	*Cerorhinca monocerata*	
BCC – Bird of Conservation Concern, 2002, **FE** – Federally Endangered, **FT** – Federally Threatened **CE** – California Endangered		

(Adapted from Dailey et al. 1993 with additions)

3.10.1.2.2 Birds of Conservation Concern

Birds of Conservation Concern (BCC) listed in this section are seabirds found in the SOCAL Range Complex that are protected under the MBTA and identified by the USFWS as warranting additional recognition as species of concern by conservation associations and state and federal agencies. Of the 7 species listed as BCC (Table 3.10-2), three have active breeding populations within the SOCAL Range Complex (ashy storm-petrel, Xantus's murrelet, and Cassin's auklet), one is a vagrant migrant (black-footed albatross), and three utilize primarily bay and estuarine habitat adjacent to the SOCAL Range Complex (elegant tern, gull-billed tern, and black skimmer).

Table 3.10-2: U.S. Fish and Wildlife Service, Birds of Conservation Concern (2002) Known to Occur in the SOCAL Range Complex.

Common Name	Scientific Name	Range Complex Use
black-footed albatross	*Phoebastria nigripes*	Migrant
elegant tern	*Sterna elegans*	Limited Foraging
gull-billed tern	*Sterna nilotica*	Limited Foraging
black skimmer	*Rynchops niger*	Limited Foraging
Xantus's murrelet	*Synthliboramphus hypoleucus*	Breeding
Cassin's auklet	*Ptychoramphus aleuticus*	Breeding
ashy storm-petrel	*Oceanodroma homochroa*	Breeding

The ashy storm petrel, Xantus's murrelet and the Cassin's auklet have well-documented, important, isolated breeding populations on Santa Barbara Island. Breeding populations on San Clemente Island and Santa Catalina Island have not been accurately enumerated since (Carter et al. 1992), and their current status remains unknown as of the date of this research. The species' breeding populations within the SOCAL Range Complex represent important subpopulations of relatively small global populations, providing a species-wide avoidance of potential mortalities at breeding colonies located elsewhere. All three of these seabird species occupy similar habitat and utilize similar breeding, foraging, and prey avoidance techniques.

The presence of floating populations of ashy storm-petrels suggests that availability of nesting space limits the size of breeding populations. Nesting islands are limited in number, and densely nesting gulls and auklets and other factors may limit further the availability of storm-petrel nesting habitat. Storm-petrels are sensitive to disturbance, including that generated by researchers, especially during the incubation period (Ainley et al. 1990). All known nesting sites in the United States (and one site in Mexico) are protected from development and incursions by humans. The large number of sites and their protected designation may lend some measure of protection to the species. Whether the now densely nesting gulls at most of these sites, and introduced rodents at some (e.g., the Farallon Island) (Ainley and Boekelheide 1990), interfere with population stability of storm-petrels to a significant degree is not known. Introduced mammalian predators remain a significant concern at many of the island breeding colonies.

The world population of Xantus's murrelets is concentrated in 4 major breeding colonies. Santa Barbara Island and Islas Los Coronados support the great majority of *S. h. scrippsi* in southern California and northern Baja California. Most Xantus's murrelets off the Baja California coast breed on Isla San Benito (*S. h. scrippsi*) and Isla Guadalupe (*S. h. hypoleucus*) (Everett and Anderson 1991). The species has been extirpated on some of the Baja California islands by introduced cats and other predators, and it is threatened on other islands. Although the colony at Santa Barbara Island has maintained numbers in the low thousands since the mid-1970s, it is very localized and subject to several threats, including oil spills and other pollution as well as avian and mammalian predation. Xantus's murrelets are discussed further in the Federally Threatened, Endangered, and Candidate Species section.

Cassin's auklets breed on islands from middle Baja California to the Aleutian Islands, Alaska. The current worldwide population is estimated between 3 and 4 million breeding birds centered at British Columbia, Canada (Sowls et al. 1980). Less than 4 percent of the world population breeds in California. The majority of breeding birds in California (105,000) are on south Farallon Island. San Miguel Island supports an estimated population of nearly 20,000 breeding birds and additional small isolated colonies are thought to exist at Santa Cruz Island and Anacapa Island. Santa Barbara Island supports the only breeding colony within the SOCAL Range Complex and its population was estimated to be 156 breeding individuals in 1992 (Carter et al. 1992). Crevice nesting and nocturnal foragers, Cassin's auklets are susceptible to predation by gulls, raptors, ravens, and mammals. The California populations are thought to be sedentary while northern populations migrate as far south as northern Baja Mexico during winter months. Populations are regulated by predation, food availability, and territorial behavior. Land based conditions including erosion, exotic mammal predation, and poor burrowing soil are the greatest factors limiting breeding habitat expansion or recolonization of historic colony sites.

The black-footed albatross is considered rare among coastal waters of California and most commonly occurs far offshore foraging for prey species along debris lines and current interfaces. In summer (i.e. non-breeding season) individuals appear to disperse widely throughout the historical range of the temperate and sub arctic North Pacific Ocean (Sanger 1972), with observations concentrated in the northern Gulf of Alaska, Aleutian Islands, and Bering Sea (McDermond and Morgan 1993).

The elegant tern, gull-billed tern, and black skimmer depend on inland lakes and coastal estuary and bay habitat for nesting and foraging. All three species have isolated active breeding colonies in various southern California mainland lakes, bays and estuaries and are considered stable, if not increasing in population size, within areas adjacent to the SOCAL Range Complex. The SOCAL Range Complex does not encompass the breeding habitat utilized by these species and provides only migratory and foraging habitat on a limited basis.

3.10.1.2.3 Federally Threatened, Endangered and Candidate Species

Information is presented below on federally listed species known to occur within the SOCAL Range Complex. Federally listed species are the short-tailed albatross, marbled murrelet, California brown pelican, and California least tern (Table 3.10-3).

Table 3.10-3: Federally Listed Seabird Species Known to Occur in the SOCAL Range Complex.

Common Name	Scientific Name	Federal Status	Range Complex Use
short-tailed albatross	*Phoebastria albatrus*	Endangered	Migrant
marbled murrelet	*Brachyramphus marmoratus marmoratus*	Threatened	Limited Foraging
Xantus's murrelet	*Synthliboramphus hypoleucus*	Candidate [1]	Breeding
California brown pelican	*Pelecanus occidentalis californicus*	Endangered	Breeding
California least tern	*Sterna antillarum browni*	Endangered	Limited Foraging

[1] This candidate species may be considered for federal listing in the near future. The California Fish and Game Commission has determined that the Xantus's murrelet should be listed as a threatened species under the California Endangered Species Act (CESA). As part of the normal listing process, this decision is currently under review by the California Office of Administrative Law (CDFG 2005a).

Short-tailed albatross (Phoebastria albatrus)

The short-tailed albatross is one of the world's rarest albatross. It is listed as endangered under the ESA. No critical habitat is designated for this species (USFWS 2000). Currently, an albatross recovery program is taking place at Midway Atoll, where scientists hope to establish a viable colony. Recent breeding success has been reported at Midway (NPS unpublished data). The short-tailed albatross nests on isolated, windswept, offshore islands that have restricted human access (USFWS 2000). Birds at Japanese breeding sites use steep land characterized by soils that contain loose volcanic ash for nesting. Plants help stabilize the soil around the nest, provide protection from weather, and minimize mutual interference between nesting pairs. Foraging occurs over open offshore ocean waters. Very little is known of its marine habitat requirements.

The short-tailed albatross disperses throughout the North Pacific when it is not breeding. Historic records indicate frequent use of nearshore and coastal waters in the eastern North Pacific, including California (COSEWIC 2003). This species is highly mobile with a large marine range that is currently known to extend from Siberia south to the China coast and from the Bering Sea and Gulf of Alaska south to Baja California, Mexico, including the northwestern Hawaiian Islands (Farrand 1983; Roberson 2000; COSEWIC 2003). Current sightings in the eastern North Pacific are mainly concentrated off the shores of Alaska and British Columbia. As gradual recovery of the population began after 1950, sporadic sightings (11 from 1977 to 2002) were recorded off of California (Unitt 2004).

Based on the number of sightings during the past 25 years, the short-tailed albatross is incidental off the coast of southern California. Roberson (2000) reported a sighting approximately 144.8 km (78.2 nm) west of the San Diego area, seaward of the SOCAL Range Complex. McCaskie and Garrett (2002) reported a sighting near Santa Barbara Island. Sightings of short-tailed albatross have the potential to increase in frequency if the population continues to recover.

Marbled murrelet (*Brachyramphus marmoratus*)

The marbled murrelet is listed as a threatened species under the ESA and is considered endangered by the State of California. Critical habitat for the marbled murrelet has been designated at sites from central California near Santa Cruz and San Francisco and north to Oregon (USFWS 1997).

Marbled murrelets are unique among alcids in their use of old growth forest stands near the coastline for nesting. Stands of 500 acres (2 km^2) or larger appear to be preferred (USFWS 1997). Large trees with a moderate to high canopy closure generally characterize these forests (Singer et al. 1991; USFWS 1997). Stand size is an important factor for this species since it uses trees with large branches or deformities for nest platforms. Marbled murrelets are generally found foraging in nearshore waters, mainly within 1 to 2 km (0.53 to 1.08 nm) of the shore (Kuletz and Marks 1997; USFWS 1997).

The marbled murrelet occurs only in the north Pacific. It ranges from Attu and other islands of the Aleutian archipelago across southern Alaska and south as far as Santa Cruz County in central California (USFWS 1997). Nesting occurs from the Aleutian Islands of Alaska south through British Columbia, Washington, Oregon, and into central California. The marbled murrelet is more likely to occur in northern California than in southern or central California due to its dependence on old-growth timber for nesting. The closest documented nesting site to the SOCAL Range Complex is Half Moon Bay, located in Santa Cruz County, California (CDFG 2005a). This site is located about 370 km (200 nm) north of the northernmost boundary of the SOCAL Range Complex. The species' wintering range is poorly documented but includes most of the Pacific coast marine area used in the breeding season, and extends south into southern California (Nelson 1997). The normal winter, spring, summer, and fall ranges for the marbled murrelet occur within 2 km (1.08 nm) of the coast north of the Santa Barbara County line. The marbled murrelet is considered rare along the coast from the Santa Barbara County line south to the border with Mexico and is considered to be incidental from the United States/Mexico border south along the Mexico coastline. Within the SOCAL Range Complex, occasional sightings have been reported along the coast in San Diego County. All sightings were during late fall, winter, or early spring.

Xantus's murrelet (*Synthliboramphus hypoleucus*)

Both subspecies of Xantus's murrelet are designated federal candidate species to be considered for listing under the ESA. The listing of Xantus's murrelet as a threatened species by the California Fish and Game Commission is being considered. Xantus's murrelet breeding season is from December through January and the nesting season is February through June. Xantus's murrelet nests on islands, utilizing crevices and caves less than 20 centimeters in height, as well as areas under boulders (Murray et al. 1983). It has also been known to use shrubby vegetation, cliffs, and sites on steep slopes adjacent to the sea. Xantus's murrelets are nocturnal birds, limiting all land-based activities except incubation, to hours of darkness (Murray et al. 1983). During the breeding and nesting season, Xantus's murrelets forage in waters surrounding the nesting island.

The known breeding range is from San Miguel Island, California, to San Benito Island, Baja California, Mexico. Breeding and nesting have been documented on islands within the SOCAL Range Complex. Breeding Xantus's murrelets were found up to 18 km (9.72 nm) from Santa Barbara Island. They have been observed over the open ocean within the SOCAL Range Complex and have been reported off of Newport Beach, La Jolla, and San Diego. They are known to nest at Cat Canyon and Sutil Island on Santa Barbara Island, Landing Cove on Santa Catalina Island, and at Seal Cove and China Point on San Clemente Island.

The largest Xantus's breeding colony in southern California is at Santa Barbara Island (Murray et al. 1983; Burkett et al. 2003) and is considered the largest and most important breeding colony in California. Surveys were conducted from 1991 to 1996 at Cat Canyon (southern tip of the island) and on the nature trails south of the landing cove (northeastern part of the island). The population was estimated to range from 2,000 to 4,000 birds in 1980; fewer than 2,000 were estimated in 1992 (CDFG 2003). Additional surveys performed from 1991 to 1997 place the population estimate at 2,252 breeding individuals or about 1,126 nests during this period (Carter unpublished data). The highest numbers of individuals during at sea surveys were found between 2 to 14 km (1.08 to 7.6 nm) from the island. The number of individuals is also noticeably higher over shelf waters ranging from 40 to 100 meters in depth. The highest numbers of Xantus's murrelets are seen close to Santa Barbara Island in the early morning hours. As the day progresses the number of individuals becomes more evenly distributed further from the island. Xantus's murrelets have been known to use sea stacks (offshore rock outcrops) on the island for roosting and as a take-off point for foraging.

Two confirmed nesting sites for this species are known on San Clemente Island: Seal Cove and China Cove. In 1992, 20 individuals were documented during the breeding season on San Clemente Island (Carter el al. 1992). Additional sightings and nests exist on San Miguel, Santa Cruz, and Anacapa Islands northwest of the SOCAL Range Complex.

During the non-breeding season (June through December), most Xantus's murrelets occur offshore in the warm pelagic waters of the California current. Non-breeding distribution for this species ranges from the waters of southern British Columbia, Canada, to Baja California, Mexico. During systematic coastal aerial surveys the highest numbers of murrelets, Xantus's and probably smaller numbers of Craveri's murrelets (*Synthliboramphus craveri*) were found between 20 to 100 km (10.8 to 54 nm) offshore (Briggs et al. 1987). This offshore limit of the species' distribution might not reflect its actual distribution, since very few offshore surveys have been conducted for this species (Drost and Lewis 1995).

The number of suitable, predator-free nesting islands is the major factor limiting the world population of Xantus's murrelet. Several former nesting islands currently support few or no murrelets because of introduced predators. Moreover, on some of the large islands (e.g., Isla Guadalupe) introduced predators have restricted the murrelets to small, predator-free islets offshore, where nesting birds appear to be very crowded (Green and Arnold 1939, Jehl and Bond 1975). Prey availability may limit recruitment at times; delayed nesting and reduced nesting effort in some years have been linked to lower populations of prey (anchovies) in area waters (Hunt and Butler 1980). Even though barn owl predation on murrelets at Santa Barbara Island may be high, there is no evident effect on long-term population size; numbers in years following heavy predation are not significantly different from numbers in years following light predation (Drost 1989). Thus suitable, undisturbed, predator-free offshore island habitat remains the cornerstone to sustained populations of this species.

California brown pelican (*Pelecanus occidentalis californicus*)

The brown pelican is one of two pelican species found in North America. The California brown pelican is one of six recognized subspecies of brown pelican. The California brown pelican is listed as endangered under the ESA and by the State of California. There is no designated critical habitat for the California brown pelican (USFWS 1983).

The California brown pelican is found in estuarine, marine subtidal, and marine pelagic waters along the California coast. In southern California, the brown pelican is common along the coast from June to October, especially within 30 km (16.2 nm) of the shore (Briggs et al. 1981). The California brown pelican usually breeds on small coastal islands within 30 to 50 km (16.2 to 27 nm) of a consistent and adequate food supply. Nesting occurs on the middle or upper parts of steep rocky slopes of small islands off California and Baja California. Foraging occurs in shallow waters within 20 km (10.8 nm) of nesting islands during breeding season and up to 75 km (40.5) from the closest land during the non-breeding season.

Four breeding populations of California brown pelican have been identified: (1) SCB, (2) the lower west coast of Baja California, (3) the Gulf of California, and (4) the coastal estuaries along the western Mexico mainland coast south to Colima. The SCB population consists of breeding birds on the Channel Islands (West Anacapa Island and Santa Barbara Island) and several islands off Baja California (Middle Los Coronados Island and North Los Coronados Island) (USFWS 1983). Recently, additional breeding populations have been observed at Prince Island, Middle Anacapa, and East Anacapa (UCSC http://currents.ucsc.edu/05-06/06-12/pelicans.asp). Brown pelicans are present at nesting islands from March to early August. In general, the brown pelican in California migrates northward in July or August after breeding and returns in December or January to breed (Shields 2002). Some individuals are present year-round in central and southern California, which is also part of its winter range. Non-breeding California brown pelicans range northward along the Pacific Coast from the Gulf of California to southern British Columbia (Johnsgard 1993).

Along the coast and on some islands, the brown pelican is a year-round resident. It is frequently seen in the open ocean within the SOCAL Range Complex. Several California brown pelican colonies occur within or near the SOCAL Range Complex with the largest breeding colony located on Santa Barbara Island, approximately 3,000 breeding pairs (CHIS unpublished data). Brown pelicans are commonly seen roosting year-round at San Clemente Island, Santa Catalina Island, and San Nicolas Island; however, there are no breeding records. Brown pelicans use sea stacks at San Clemente Island for roosting and foraging. Aerial surveys conducted in 1992 and 1993 documented 92 and 358 roosting brown pelicans, respectively (DoN 2002a). California brown pelican day-roosting areas are scattered along the coastline, particularly along the eastern end of San Nicolas Island (DoN 2002b). Nearly 5,000 California brown pelicans roost on San Nicolas Island (Capitolo et al. 2007). Brown pelican numbers increase in the SOCAL OPAREA during the summer as breeders from the Baja California population migrate north after nesting. Numbers off of San Diego peak from August to October and then decline from November on as some brown pelicans continue south to winter along the Mexico coast (Unitt 2004).

California least tern (*Sterna antillarum browni*)

The California least tern is listed as endangered under the ESA and by the State of California. No critical habitat is designated for this species.

California least terns are neotropical migratory birds, spending the breeding season (April through August) along the central and southern California coast, as well as along the west and southwestern coast of Mexico. The California least tern historically nested on coastal beaches of Monterey, California, to Cabo San Lucas, Baja California. Nesting is currently limited to San Francisco Bay and areas along the central and southern California coast from San Luis Obispo County to San Diego County (Massey and Fancher 1989).

The preferred nesting habitat for the California least tern consists of beaches, dunes, sand bars, and spits on the ocean shore (USFWS 1985). The California least tern nests in areas generally free of vegetation above the high tide mark (some nests have potential between the high tide and high-high tide mark). Colony sites are often located in the vicinity of estuaries, lagoons, rivers, or the seacoast (USFWS 1985). This species also nests in human-modified areas including agricultural fields, parking lots, bare land at airports, and gravel rooftops (Thompson et al. 1997). If atypical nesting sites are used, they are almost always adjacent to a bay, estuary, or the ocean (Burr 2007). Atwood and Minsky (1983) noted that, prior to the species decline, at least 82 percent of known California nesting sites were located within 2 km (1.08 nm) of a river mouth or estuarine habitat.

Foraging habitats include nearshore ocean waters, river mouths, salt marshes, marinas, river channels, lakes, and ponds (Thompson et al. 1997). The presence of eelgrass is important for several small fish that are prey species of the least tern (DoN 2002c). Foraging activity occurs within 5 km (2.7 nm) of the shore, with most activity in water less than 18 meters deep. Researchers report that the California least tern in coastal colonies foraged up to 6 km (3.2 nm) from shore; however, up to 75 percent of foraging occurred within 1.2 km (0.65 nm) of nesting areas in southern California (Atwood and Minsky 1983). Areas used for foraging will often vary from year to year, depending upon stage of breeding and prey species availability.

Foraging activity changes during the breeding/nesting season. During courting and incubation of eggs, California least terns forage farther from the nest site over open/deep water. When the chicks hatch, foraging takes place in nearshore/shallow water habitat. Foraging time and peak foraging behavior occur from the end of May through mid-July after chick hatching. Foraging behavior adjacent to Naval facilities structures was studied in San Diego Bay in 2002 (DoN 2002d); this study focused on determining foraging activity in areas adjacent to Naval facility piers and in open water. The study did not find a definitive pattern of foraging between piers (0 to 10 meters from the pier) and open water (>75 meters from pier), but did verify changes in foraging activity previously discussed for the California least tern. Foraging activity was highest in mid-July and was located near the two largest colonies (DoN 2002d). In San Diego County, Unitt (2004) reports that some birds forage at inland locations during the middle of the breeding season, more birds forage inland in northern than southern San Diego County, and that more California least terns go inland to forage after the young have fledged in late July and August.

Migration routes and wintering range for the California least tern are not well known. During spring (late April and early May), Howell and Engel (1993) reported sighting least terns 2 to 30 km (1.08 to 16.2 nm) offshore of western Mexico, with the majority sighted less than 18 km (9.7 nm) offshore. Specific spring/fall distribution data offshore of southern California or fall distribution data off western Baja California, Mexico, was not found. During late summer and fall, migrating California least terns often concentrate in coastal lagoons (CDFG 1998). Fall migration begins in August, with most terns leaving California by September. Late migration may occur with some individuals lingering until October (CDFG 1998). The terns migrate along the coast to their wintering grounds south of the United States.

It is thought that the California least tern winters along the Pacific coast of Central America (USMC 2001). Unitt (2004) reports that California least terns banded in San Diego Bay were found wintering along the Pacific coast of Guatemala, southern Mexico (Chipas), and western Mexico (Colima).

3.10.1.3 Current Mitigation Measures

SOCAL Range Complex training activities encompass a wide array of operations that include aircraft, ocean going vessels, and land-based operations. Currently, the majority of aircraft operations are concentrated at the Naval Auxiliary Landing Field (NALF) San Clemente Island (SCI). In accordance with OPNAV Instruction 5090.1C CH-22, the Environmental Division or Natural Resource Section of a Naval Air Station is responsible for preparing and implementing a Bird Aircraft Strike Hazard (BASH) plan. Following the outcome of an ecological study (wildlife hazard assessment) complete in 2002, several recommendations were made to increase aircraft safety by limiting bird strikes (DoN 2007). General measure CBP-M-1 states that the operators should ensure that the California brown pelican is not in proximity to the over-blast pressure prior to underwater demolition activities. Monitoring of seabird populations and colonies by conservation groups and researchers is conducted intermittently within coastal areas and offshore islands with limited support from various military commands.

3.10.2 Environmental Consequences

3.10.2.1 Approach to Analysis

This section evaluates how and to what degree the activities described in Chapter 2 interface with seabird communities known to occur within the SOCAL Range Complex. In this section an effects analysis has been conducted for potential mortality, habitat destruction, or breeding and roosting disturbance. Migratory and breeding seabirds utilize portions of the SOCAL Range Complex to differing degrees depending on species' foraging and breeding requirements. The alternatives for SOCAL Range Complex training were examined to determine if the Proposed Action would produce one or more of the following effects:

- A direct or indirect effect on seabird populations from mortality attributed to military training activities taking place within the range complex.
- A direct or indirect effect on seabird populations from destruction or disturbance of foraging habitat attributed to military training activities taking place within the range complex.
- A direct or indirect effect on seabird populations from destruction or disturbance of seabird breeding colonies or habitat attributed to military training activities taking place within the range complex.

The SOCAL Range Complex encompasses a vast area from coastal beaches (up to the mean high tide line) to approximately 600 nm (1111 km) offshore including approximately 120,000 square nautical miles (nm^2) (411,588 square kilometers [km^2]). Coastal islands are key to seabird life history; they provide a unique habitat for breeding and migratory seabirds that is relatively free of human disturbance. Based on numerous biological studies, the temporal and spatial fluctuations of productive nearshore marine ecosystems and offshore water masses with a concentration of prey species have a major influence on seabird productivity and habitat preference. Complicating the effects analysis is the fact that the population status of many SCB seabird species is not well understood due to their remote breeding locations and vast migratory ranges.

Potential impacts to seabirds from human activities include loss of habitat, introduction of non-native species, commercial fishing, and disturbance. Disturbance is propagated by noise and light as well as physical presence. The potential for conflict with seabirds centers primarily over islands and adjacent waters, although offshore foraging areas do represent a potential area of effect. The spatial and temporal variability of SOCAL Range Complex training and the seasonal changes in seabird foraging locations complicate the evaluation of direct or indirect effects.

The SOCAL Range Complex consists of three primary components: Ocean Operating Areas, Special Use Airspace, and SCI. A large part of the training within the SOCAL Range Complex is centered on the San Clemente Island terrestrial ranges and includes aircraft, missiles, electronic equipment, motorized and passive vessels, and land-based vehicles and artillery. The analysis of each alternative for potential environmental consequences with regard to seabirds is divided into three categories: aviation operations, ocean operations, and land-based operations. Certain exercises combine these operation types; and although these exercises will be described in a specific section, they will be analyzed for all potential consequences, regardless of media (air, water, or land). Analysis of seabird usage patterns in the SOCAL Range Complex further divides the analysis into seabird species that breed on offshore islands, forage in nearshore waters of the mainland or offshore islands, and species that forage or migrate in only offshore waters (> 15 km offshore).

Thresholds of effect by disturbance differ by type and species. Noise disturbance from motorized vehicles including land based vehicles, aircraft, and ocean going vessels likely differs significantly from explosions that create pressure waves or earth movements. Point Reyes Bird Observatory recommends that recreational boaters maintain at least a 500 ft. (160 m) distance from nesting or roosting seabirds and also advise a 2000 ft. above ground level (AGL) height for aircraft (PRBO 2003). Considering the differences between private and military aircraft, boats, and land based vehicles a buffer distance of 0.25 km (0.13 nm) will be utilized as the threshold distance of potential disturbance related to all types of disturbance from operational activities.

As mentioned in Section 3.10.1.2, Existing Conditions, military readiness activities are exempt from the take prohibitions of the MBTA provided they do not result in a significant adverse effect on a population of a migratory bird species. A number of migratory bird species covered under the MBTA are listed as endangered or threatened, and are discussed in detail in Section 3.10.2.5, Federally Endangered and Threatened Species. Other species (not listed) covered under the MBTA occur within the SOCAL Range Complex and are not limited to, but are included, in Table 3.10.1. A remote possibility exists that individuals may be directly impacted if they are in close proximity to the target area at the point of physical impact during inert/active ordnance delivery or from pressure waves associated with detonations in offshore ranges. Regardless, populations of migratory birds would not likely be affected by the implementation of the common elements of the proposed action. The temporary degradation of habitat or mortality of young (if species breed within the Range Complex and a fire occurred during breeding season) could occur due to ordnance-ignited wildfires. Overall, however, ordnance-ignited and prescribed fires, as well as protection from urban development, have maintained the habitat for such species within the Range Complex. Noise impacts would also potentially affect breeding seabirds, but likely only negligibly affect migratory birds. Although a bird-aircraft strike hazard exists, no adverse impacts to seabird populations are likely to occur do to the relatively low frequency of interaction documented in the wildlife hazard assessment performed for San Clemente Island NALF in 2002.

3.10.2.2 No Action Alternative

Under the No Action alternative military training activities and Research Development Test and Evaluation are performed throughout the SOCAL Range Complex.

3.10.2.2.1 SOCAL OPAREAs

Aviation Operations

Effects to seabirds attributed to aircraft training activities within the SOCAL OPAREAs can be compartmentalized into specific categories regardless of the aircraft or operational exercise. The categories are the basis of the approach to analysis and include destruction or degradation of known seabird breeding colonies, disturbance of seabirds foraging, roosting, or breeding, and destruction or degradation of foraging habitat. Disturbance of seabirds is quantified by examining the proximity of aviation operations (elevation), location of operational exercises (range), and the activity performed during flight activities (observational/bombardment). Considering the parameters used to evaluate disturbance effects, effects would most likely be concentrated around takeoff and landing points on San Clemente Island, San Nicolas Island, and Naval Air Station, North Island.

Aviation training involving lower elevation flight paths, tactical maneuvering, or ordnance deployment in airspace less than 1,000 ft (305 m) AGL presents potential for seabird impacts. Aviation training performed within the SOCAL OPAREAs primarily involves fixed winged aircraft flying at elevations above 1,000 ft (305 m) AGL and occur offshore of coastal areas and islands. Approximately 32,000 aviation operations take place within the SOCAL Range Complex of which 25,120 are attributed to NALF San Clemente Island. Rotary blade aircraft that typically operate at below 1,000 ft AGL and in close proximity to the mainland and offshore islands account for less than 1,000 operations per year, but have the greatest potential to interact with seabirds. Many breeding and migratory seabirds utilizing coastal and offshore waters within the SOCAL Range Complex are roosting or foraging for specific prey species concentrated at current boundaries, nearshore, or near underwater structures that place them below 1,000 ft (305 m) elevation to identify prey.

Aviation training activities actively avoid Santa Catalina Island because the residential population places additional restrictions upon maneuvers. Additionally, Santa Catalina Island has a public airfield that is used daily, with associated airspace restrictions, for approach and take-off of public and commercial aircraft. Santa Barbara Island is managed by Channel Islands National Park and aircraft are required to maintain an elevation of 1,000 ft AGL when in proximity of the island. San Nicolas Island is not utilized for flight training activities below 1,000 ft AGL, according to the operations handbook, and has only limited logistical aircraft traffic.

Effects of aviation training involving lower elevation flight paths, tactical maneuvering, or ordnance deployment in airspace less than 1,000 ft AGL would be limited to impacts on species that roost, forage, or breed on or within 1 km (0.54 nm) proximity to the islands, rather than direct mortality from collision or disruption of foraging behavior of seabirds utilizing offshore waters. Seabird species most likely to be affected by aviation training are those that are resident on offshore islands: specifically, those known to have breeding and roosting colonies on San Clemente Island. The western gull (*Larus occidentalis*) is documented to breed in relatively low numbers (< 300) on San Clemente Island, (>1000) on Santa Barbara Island, and extensively (>6000) on San Nicolas Island and is a ground nester near coastal bluffs. Regional populations are expanding rapidly and it appears likely that this gull species will continue to expand its use of the SOCAL Range Complex islands. Western gulls are gregarious and not easily disturbed or impacted by human encroachment or activities. Aviation operations concentrated at San Clemente Island NALF and in offshore ranges would not have adverse impacts to western gull populations.

Aviation activities in the proximity of Santa Barbara Island and Santa Catalina Island are restricted to elevations greater than 1,000 ft AGL and have minimal potential for effect to seabird foraging or foraging habitat. Ashy storm-petrels, Xantus's murrelets, pigeon guillemot's and Cassin's auklets have been consistently documented to breed on Santa Barbara Island to varying extents and are afforded greater protection there, due to the absence of terrestrial predators (feral cats and Island fox) and the conservation status of the island.

Brandt's cormorants are documented to nest at the southern Channel Islands, primarily on offshore rocks and seamounts. Brandt's cormorants are susceptible to noise disturbance and could be impacted by coastal low elevation aircraft operations. The majority of SOCAL Range Complex aircraft operations conducted less than 1,000 ft AGL are concentrated at San Clemente Island NALF landing strip and in offshore ranges. Considering the greatest amount of primary roosting and nesting habitat for cormorants within the SOCAL Range Complex is on Santa Barbara Island, Santa Catalina Island, and on San Nicolas Island, regional Brandt's cormorant populations would not be effected. Breeding colonies of Brandt's cormorants on San Clemente Island are comparatively small in relation to the other islands; only 56 breeding individuals in 1991 (Carter et al. 1992). Potential effects from low flight aircraft training on the West shore of San Clemente Island within 0.25 km (0.13 nm) of the island or offshore rocks may have isolated and temporary disturbance effects to individual colonies.

Operating Area (OPAREA) 3803, and Shore Bombardment Area (SHOBA) have boundaries that are either adjacent to, or overlap, San Clemente Island. Air strikes with birds are recorded and reported as mandated by Federal Aviation Administration (FAA). A Wildlife Hazard Assessment conducted at NALF San Clemente Island between February 2002 and January 2003 documented 12 bird/aircraft strikes (Cummings and Sheffer 2007). The most numerous birds observed during the assessment period were, in descending order, horned larks, European starlings, house finches, and western meadowlarks.

Aviation training in the proximity of mainland coastal areas has a greater potential for interaction with seabirds as a greater number of species and individuals reside or transit the mainland coastal zone compared to offshore or island areas. The current number of military aviation exercises near the mainland coast within the SOCAL Range Complex is relatively low when compared to commercial and private aviation operations. Exceptions are rotary winged aircraft (helicopters) that operate at low elevation for extended time periods both in close proximity of the mainland coast and offshore islands. For example, Helicopter ASW TRACKEX flies 544 operations averaging 1.8 hours in duration in the waters near SCI (20%) and HCOTA (60%), both areas of known seabird breeding and foraging activity. Seabirds actively avoid interaction with aircraft, however, disturbances of various seabird species may occur from aviation operations on a site-specific basis. Coupled with the large geographic size of the training ranges and the relatively slow air speeds of rotary aircraft (less than 100 knots) across these training ranges, effects from aviation operations would remain temporary and isolated.

Consequently, direct and indirect effects resulting from the destruction or degradation of seabird populations or their habitat from SOCAL Range Complex aviation training activities would be infrequent and temporary under the No Action Alternative.

Ocean Operations

Vessels performing training exercises within the SOCAL Range Complex are primarily large oceangoing ships and submarines operating in waters greater than 328 ft (100 m) and small fast-moving vessels. Large oceangoing vessels (greater than 100 ft [30.4 m] in length) include a host of tactical military ships performing live firing, electronic monitoring, and avoidance maneuvering. Considering the complexity of the training operations and the required logistical mobilization and demobilization requirements, the majority of all ocean operations involve passive transit of vessels within the SOCAL Range Complex. Of the 7,000 ocean operations currently performed within the SOCAL Range Complex, approximately 2,500 are related to amphibious landing operations. Ninety percent of all amphibious landings take place in the Camp Pendleton Amphibious Assault Area (CPAAA). Other than amphibious landing operations the primary ocean operation components are ASW TRACKEX (847 exercises), Electronic Combat Exercise (748 exercises), Air Defense (502 exercises), and Surface-to-Air Gunnery exercises (262 exercises). Large ships operating in offshore waters move at approximately 20 knots at full speed; however, these often operate at significantly slower speeds while engaged in training activities. Seabirds are known to be attracted to ocean going vessels for various reasons; thus providing increased potential for additional interactions between vessels operating in seabird foraging areas and seabirds migrating or foraging in SOCAL Range Complex waters. Since training activities attempt to simulate war like conditions, vessels do not typically utilize large deck lights or strobes in an attempt to remain visually disguised, reducing the potential attraction of nocturnal foraging seabirds.

Effects attributed to ocean operation activities on seabirds breeding in the SOCAL Range Complex are confined to activities that operate within 0.25 km of known breeding seabird colonies on San Clemente Island and associated offshore rocks. Ocean operations do not take place within 0.25 km of Santa Barbara Island, Santa Catalina Island, or San Nicolas Island. Seal Cove and China Cove have documented breeding populations of ashy storm-petrels (50) and Xantus's murrelets (20) that are susceptible to ground and noise disturbance during their breeding season. Naval Surface Fire Support and Expeditionary Fires Exercise expend high explosive ordnance within SHOBA Impact Area II. Detonations from ocean operations occurring within 0.25 km distance of nest sites during breeding season would have potential adverse effects to breeding success.

Amphibious landing vehicles and small vessel operations taking place within OPAREA Northern Air Operating Area (NAOPA), Kingfisher Training Range (KTR), Mine Training Range (MTR), Naval Special Warfare Training Areas (SWATs), Shore Bombardment Area (SHOBA), and Naval Special Warfare (NSW) Training Areas and Ranges (TARs) include advanced special operations by Navy and Marine Corps units as well as mine detection and electronic monitoring. Some operations involve live-fire, explosive detonations; and high speed maneuvering. The potential for interaction between amphibious and small vessels and foraging or breeding seabirds involves training activities operating in close proximity of beaches, offshore rocks, and island areas where roosting or breeding seabirds are concentrated. Amphibious vehicles and small vessel operation is dependent on suitable weather and sea surface conditions, limiting the number of days each year such operations occur. Small vessel operation within the SOCAL Range Complex is concentrated around San Clemente Island and Camp Pendleton where suitable locations exist for nearshore activities. Disturbances to roosting or foraging seabirds related to small vessel operation could occur from vessel movement and explosions occurring within close proximity (500 meters) of seabird populations. Ingress and egress of amphibious vehicles and live-fire and explosive detonations around San Clemente Island are typically confined to Northwest Harbor, Wilson Cove, and SHOBA impact areas. Camp Pendleton Ingress/Egress training activities have a greater potential of affecting a wider variety of species due to their mainland location and the use by a greater variety of seabird and shorebird species. San Clemente Island amphibious landings and raids at San Clemente Island occur at Northwest Harbor, West Cove, Horse Beach Cove, and Pyramid Cove on large sand beaches bordered by rocky headlands on either end. Populations of breeding seabirds within close proximity to the landing beaches are only sparingly documented and similar habitat is available throughout much of San Clemente Island. Species most likely to be impacted are roosting cormorants and pelicans. Any effects on foraging, roosting, or breeding seabird populations related to amphibious landings or small vessel operation would be localized and temporary.

Considering nearshore water within 1km (0.54 nm) is the primary foraging habitat for many of the described seabird species, this area is most likely to incur negative effects from ordnance explosions. Lethal exposure to birds from pressure waves varies, not only from size of the explosive and distance from impact, but also on the water depth at which the detonation occurs, overall depth, bottom substrate, and location of the bird both in distance from the detonation and whether the bird is on the surface or underwater. The only offshore island contained within the SOCAL OPAREAs that Ingress/Egress, live fire, and detonations occur is San Clemente Island. The majority of nearshore habitat, within 1 km (0.54 nm), adjacent to San Clemente Island is rocky bottom less than 100 ft (30 m) containing persistent kelp forests.

Excluding the east shore of San Clemente Island, where few nearshore training activities take place, seabirds are likely to be disturbed to some degree during amphibious vehicle and small boat operations. In-water detonations, planned and targeting error, both underwater and at the surface would affect seabirds in adjacent waters at various distances depending on the size of the ordnance. Several of the sensitive species are nocturnal foragers, utilizing waters greater than 1 km offshore. Xantus's murrelet, ashy storm-petrel, and black storm-petrel are not likely to be affected but California brown pelicans and all three cormorant species are likely to suffer some adverse disturbance effects.

Both single charge and mat weave underwater detonations take place at Northwest Harbor. All Mine Warfare and Mine Countermeasures Operations involving the use of explosive charges must include exclusion zones for marine mammals and sea turtles to prevent physical and/or acoustic effects to those species. These exclusion zones shall extend in a 700-yard arc radius around the detonation site. Although there are not specific range clearance procedures for birds, personnel are instructed to not detonate when birds are in proximity to ordnance activities. Operations are primarily single charges or spaced closely together to allow for minimal time between detonations and to avoid seabird ingress.

Potential effects to seabird species from detonations at Northwest Harbor could occur if seabirds are in close proximity on or under the water at the time of the operation. In-water ordnance detonations would have lethal effects on foraging seabirds if pressure waves exceed 36 psi/msec for birds underwater and 100 psi/msec for birds at the surface (Yelverton et al. 1973). Northwest Harbor is a sandy beach bordered by a rocky headland to the west where seabirds are documented to roost. The Northwest Harbor area is part of a larger complex utilized by NSW and live fire including small arms, riffle, grenades, and underwater explosives take place within the complex regularly. Though adequate habitat for seabird roosting is adjacent to the facility, frequent noise events likely redistribute transient seabird species to less disturbed locations on SCI.

Bombardment within SHOBA impact areas I and II encompasses the coastline of SCI including rocky headlands and sandy beaches. Errors in targeting represent a reasonable chance that detonations would occur in the nearcoastal waters adjacent to impact areas I and II. In water detonations from incoming ordnance discharged by ocean operation vessels within SHOBA have the greatest potential of eliciting lethal effects to seabirds. No site specific data is available with regards to roosting or foraging seabird populations within the SHOBA impact areas but primary roosting and foraging habitat associated with rocky headlands and outcroppings is abundant within both areas. Considering the regular and persistent use of SHOBA impact areas I and II as target areas, for ocean operations bombardment, the likelihood of detonations occurring in near coastal waters is nearly certain. Whether seabird species are present at the time of bombardment is uncertain. The probability that lethal effects, attributed to ocean operations, would have overall seabird population effects is low. Lethal effects to seabirds from in-water ordnance detonations have a low potential to occur considering the infrequency of targeting errors resulting from in-water detonations and the low potential for seabird species to be foraging or roosting in close proximity to explosions.

Potential effects to seabird species attributed to entanglement from debris or materials resulting from ocean operations is low considering the majority of material is negatively buoyant and large in size (i.e. rockets, ordnance, sonobouys).

Information regarding the effects from sonar on seabirds is virtually unknown. One may be able to extrapolate to aquatic birds from Temporary Threshold Shift (TTS) and Permanent Threshold Shift (PTS) data on terrestrial birds, however, the exposure to anthropogenic underwater sounds by aquatic birds, other than diving species such as penguins, is likely to be limited due to their short time under water. Of course, if the sound levels are sufficiently intense, even a short exposure could be problematic. In general, birds are less susceptible to both TTS and PTS than are mammals (Saunders and Dooling, 1974). Moreover, relatively severe acoustic overexposures that would lead to irreparable damage and large permanent threshold shifts in mammals are moderated somewhat in birds by subsequent hair cell regeneration. Reviewing the probability of explosions or sonar occurring within close proximity of seabirds, and specifically diving seabirds, effects to seabird species would be infrequent.

Large vessels operating within the SOCAL Range Complex could temporarily disturb seabirds actively foraging in offshore surface waters. Seabirds foraging in offshore waters have an ability to identify approaching vessels well in advance of a potential collision. They would then reposition to avoid contact and resume foraging. Any effect on seabirds foraging in offshore waters would be localized and temporary, thus not expected to impact the seabirds' energy expenditure or foraging success. Foraging areas near ocean current boundaries and debris lines that contain a concentration of seabird prey are large features extending over miles of open ocean water. The potential for interaction between transiting or stationed large oceangoing ships and foraging seabirds in offshore waters would be low. Any effects from ocean operations on migratory or breeding seabirds related to reduced foraging success or direct mortality in offshore waters would likely be infrequent and minimal.

Overall, direct and indirect effects resulting from the destruction or degradation of seabird populations or their habitat from SOCAL Range Complex ocean training activities would be infrequent and temporary under the No Action Alternative.

3.10.2.2.2 San Clemente Island

Aviation Operations

Breeding habitat critical to seabird species within the SOCAL Range Complex is limited to terrestrial areas located on mainland or on offshore islands. Of the 48 species identified within the Range Complex, only 12 are known to breed on offshore islands within the complex; of those species only five are known, or thought to breed on, San Clemente Island, two are known to breed on San Nicolas Island, two are known to breed on Santa Catalina Island, and 12 are known to breed, or thought to breed on Santa Barbara Island. San Clemente Island is the primary location of potential breeding seabird impacts within the SOCAL Range Complex because aviation operations over Santa Catalina and Santa Barbara Island are restricted to operations above 1,000 ft (305 m) AGL. Historically, long term persistent aviation operations at established airfields have not been shown to have a significant effect on resident or migratory seabirds. Terns and Gulls regularly nest and forage in close proximity to NAS North Island in San Diego Bay where air traffic is extensive and consistent. Air traffic at NALF San Clemente Island has persisted for nearly forty years; flights occur daily numbering over 25,000 per year. Species most likely to be affected by NALF San Clemente Island aviation operations are California brown pelicans and the three cormorant species. Only the Brandt's cormorant is documented to breed on San Clemente Island, but not in the immediate proximity of the landing field. In all likelihood the resident seabirds in the immediate area have either habituated to the physical and noise disturbance from the airfields or have relocated to expansive adjacent habitat over the years.

Crevice nesting seabirds, such as the ashy storm-petrel, black storm-petrel, and Xantus's murrelet have breeding populations historically documented on San Clemente Island near steep cliff areas on the west shore; however, population estimates have been extremely low (< 20 breeding individuals) and consistent evaluations have not been done (Carter et al. 1992). The ashy storm-petrel, black storm-petrel, and the Xantus's murrelet have high site fidelity and forage almost exclusively at night in near coastal waters (1-10 km). Interactions with SOCAL Range Complex aircraft would be rare due to these species' foraging and flight patterns in relationship to aircraft training operations. Exceptions are activities within SHOBA Impact area II ,and SWAT 6 training areas that expend ordnance ashore or nearshore (within 500 m) of known breeding habitat at Seal Cove and China Cove. Additionally, activities that transit within 0.25 km (0.13 nm) of coastal headlands or offshore rocks or utilize extensive lighting in close proximity to these breeding locations could have potential harmful disturbance effects to breeding population of ashy storm-petrels and Xantus's murrelets by potentially inducing nest abandonment or disorientation when returning from foraging offshore. Considering the population size (20), their foraging patterns (night), and the time of day and size of the operational areas that encompass their breeding and foraging habitat it is unlikely that effects from operational activities would affect resident breeding populations.

The expenditure of ordnance by aviation training activities that impact terrestrial areas on San Clemente Island are primarily within the Shore Bombardment Area (SHOBA) impact areas; targets are positioned at various locations, from nearshore waters to well inland of the shoreline, within both Impact areas I and II. Seabird breeding locations for ashy storm-petrels and Xantus's murrelet at China Cove within impact area II are likely to be affected during breeding season (April- Dec) from high explosives detonating within 0.25 km (0.13 nm) of breeding colonies. The significance of the effects on these seabirds from high explosive ordnance activities is unknown due to the fact that the frequency and proximity of explosions within the 0.25 km zone is unknown. Moreover, the current population status and nesting locations are not well documented. Incidental mortalities related to direct impacts from ordnance in flight, on land, and in the water could occur; however, the probability remains low considering the spatial and temporal variability of bombardment activities and the low abundance of seabirds within the SHOBA area. Considering the size of Impact area II and assuming all nest sites are on the offshore rocks outside China Cove, likely because of the feral cats on the main island, adverse disturbance effects would only arise from ingress and egress of low elevation aircraft and exploding ordnance within 0.25 km (0.13 nm) of nesting sites during breeding season. Effects from pressure waves on birds have been previously documented in relationship to the size and proximity of detonations of various magnitudes (Yelverton et al. 1973). Lethal exposure to birds from pressure waves varies, not only from the size of the explosive and distance from impact, but also on the water depth at which the detonation occurs, overall depth, the bottom substrate, and location of the bird both in distance from the detonation and whether the bird is on the surface or underwater. In-water ordnance detonations would have lethal effects to foraging seabirds if pressure waves exceed 36 psi/msec for birds underwater and 100 psi/msec for birds at the surface (Yelverton et al. 1973).

Land Operations

Land-based operations evaluated within the SOCAL Range Complex are limited to areas on San Clemente Island; land-based training operations at Camp Pendleton are not evaluated in this document. Training associated with Santa Catalina Island, Santa Barbara Island, and San Nicolas Island are strictly aircraft or ocean related according to the operations data book and are addressed previously in Section 3.10.2.2.1. Onshore operations within San Clemente Island are divided into three categories: operations onshore within the SHOBA, operations outside SHOBA, and other island operations. Operations performed within SHOBA are typically live firing training activities and include joint training explosive or landing exercises simulating live combat situations. Approximately 500 such operations are performed within SHOBA, of which 176 are Bombing Exercises (BOMBEX), 156 are NSW Direct Action, 47 are Naval Surface Fire Support operations with the remainder consisting of various joint force training exercises that encompass land, air and ocean activities, including Expeditionary Fires Exercise and United States Marine Corps (USMC) Battalion Landing. The area delineated by SHOBA consists of the southern third of San Clemente Island and includes Impact areas I and II. The eastern coastal area of SHOBA is inaccessible from the ocean with steep canyons terminating into mostly deep nearshore waters. The primary coastal areas used in SHOBA are Pyramid Cove, Horse Beach Cove, and China Cove located on the southern end of the island. Impact area I contains both Pyramid Cove and Horse Beach Cove and consists of sandy beaches and rocky headlands. The western portion of SHOBA, Impact area II, includes China Cove and encompasses a wide variety of available roosting and breeding habitat for resident and migratory seabirds.

The greatest potential impact to seabird populations from land operations is disturbance of roosting or breeding colonies within SHOBA. Land based activities within SHOBA related to artillery operations are located in close proximity to access roads and do not typically incorporate to coastal areas, other than with noise and ordnance transit. Amphibious landing exercises take place at Horse Beach Cove, China Cove and Pyramid Cove within SHOBA and present potential disturbance for seabird colonies at adjacent headlands and rocky cliffs. Impacts attributed to direct mortality from collisions or explosions of ordnance from land-based operations would be low, because of the location of the described land operations in relation to potential seabird colonies as well as the temporal and spatial distribution of transiting ordnance. High explosive land based training activities are concentrated near the bomb box in SHOBA impact area II, Artillery Vehicle Maneuvering Areas (AVMA), and TAR 16 (Missile Impact Area). The chance of an explosion near seabird colonies located at headlands or sea cliffs would represent a significant error in targeting or a misfire. The greatest potential disturbance to roosting or breeding seabirds is related to noise. Seabird populations located within SHOBA would be resident or migratory seabirds utilizing breeding or foraging areas on San Clemente Island, or directly adjacent to the island on offshore rocks.

Foraging activities are related to the availability of prey species present and are therefore dynamic in both time and space. The western side of San Clemente Island, including the western portion of SHOBA, contains extensive coastal habitat available to roosting and breeding seabirds. Excluding the southwest corner of SHOBA, which contains Impact Area II, the western side of San Clemente Island incurs minimal disturbance or impact from land operations due to its remote location. Seabirds displaced from foraging and roosting areas attributed to operations within the southern portion of SHOBA are in close proximity to similar habitat. Considering the extensive nearshore foraging habitat available to resident and migratory seabirds along the south and west shore of San Clemente Island, including SHOBA, effects to seabird foraging or foraging habitat would be infrequent and temporary.

Land operations unrelated to logistical support that involves live-fire or utilization of intertidal area on San Clemente Island outside SHOBA is centered at Northwest Harbor and includes amphibious landings at West Cove. Additional operations at Northwest Harbor include underwater demolition and Navy Sea, Air, Land (SEAL) training, including small arms fire. Land operations taking place at inland areas not adjacent to coastal areas present a minimal threat of effect to seabird populations. Of the seabird species that occur within the SOCAL Range Complex, only the gull is known to forage in inland areas on coastal islands. Land operations including small arms training and explosive ordnance disposal would present a low probability of effect on gull populations as gulls are opportunistic and populations are not known to be susceptible to localized disturbance. Seabird species located on adjacent headlands or transiting the area during foraging or migration would incur only temporary and isolated effects from operations.

Additional land-based operations on San Clemente Island include Research Development Test and Evaluation (RDT&E) and NALF operations that are focused in support of other SOCAL Range Complex activities and present minimal threats to seabird populations because of their inland location and limited overlap with seabird activities.

Overall, direct and indirect effects resulting from the destruction or degradation of seabird populations or their habitat from SOCAL Range Complex land-based training activities would be infrequent and temporary under the No Action Alternative.

3.10.2.3 Alternative 1

3.10.2.3.1 SOCAL OPAREAs

Aviation Operations

Aviation training activities within the SOCAL Range Complex would be approximately 20 percent greater under Alternative 1 than under the No Action Alternative. The majority of the increase in aviation training would be related to Mine Neutralization (0 to 732), Helicopter ASW TRACKEX (544 to 1690), SEAL Platoon Operations (340 to 512), and air combat maneuvers (3,608 to 3,970) occurring in offshore ranges.

Additionally, increases in low elevation helicopter training activity within the CPAAA at Camp Pendleton and HCOTA range, offshore of Naval Air Station, North Island, have an increased potential for effect to migratory and resident seabird species transiting known avian flyways associated with the Los Coronados islands, the southern Channel Islands, and the mainland of California and Mexico.

Direct and indirect effects resulting from the destruction or degradation of seabird populations or their habitat from SOCAL Range Complex aviation training activities under Alternative 1 could be potentially greater than under the No Action Alternative. The increase in potential effects to seabird species attributed to increased operational frequency and within the SOCAL OPAREAs is related to disturbance of roosting and foraging seabird species. Effects to migratory seabird species utilizing offshore ranges for foraging is difficult to assess as very little data is available on foraging patterns and the lack of exact coordinates of training activities within expansive range areas. The likelihood of lethal effects to seabirds in offshore ranges from direct aircraft strikes and in-water detonations remains low do to the relatively small change in operational frequency, low concentration of seabird species in offshore ranges, and the high elevation flight patterns of aircraft operating within offshore ranges. Roosting seabirds inhabiting SCI and the mainland coastal areas near Camp Pendleton and Naval Air Station, North Island utilize nearshore waters of the SOCAL Range Complex for foraging on a daily basis. Increases in low elevation helicopter and fixed winged aircraft operations in nearshore waters would result in an increase in the probability that seabirds would be disturbed during foraging activity. Primary foraging habitat is expansive near SCI and the mainland between Camp Pendleton and San Diego Bay. Disturbance to foraging seabirds from aviation operations within the SOCAL OPAREA is likely to increase from increased operations but would not alone contribute a reduction of individual seabird population success.

Ocean Operations

Ocean operations within the SOCAL Range Complex would increase nearly 20 percent under Alternative 1 with respect to the No Action Alternative. The area of greatest potential for adverse effect to breeding seabirds from ocean operations remains San Clemente Island, same as the No Active Alternative. Increases in ocean training activities accessing areas that overlap with those currently frequented by resident and migratory seabirds from Amphibious Landings (7 to 34 exercises) or NSW Direct Action (156 to 163 exercises) increases the potential for adverse effects on breeding seabirds located on San Clemente Island and nearshore rocks.

Increased training activities utilizing amphibious vehicles within the Camp Pendleton Amphibious Assault Area (CPAAA) has the potential to directly and indirectly affect seabird breeding, roosting, or foraging. Species most likely to be affected within the CPAAA are California brown pelicans and California least terns foraging in nearshore waters. Any effect contributed by increased operational activity within the CPAAA would be infrequent and temporary. Considering that ocean operations have limited potential for causing mortality, the focus of the effect is centered on disturbance as it relates to foraging. California brown pelicans or California least terns that forage in the vicinity of the CPAAA would not suffer reduced foraging success attributed to ocean operations to a degree that would impact breeding success.

Increases in ocean training activities within nearshore waters that would include SHOBA Impact area II account for only 20 percent of the increase in ocean training events, although they represent the majority of live fire and ordnance related activities. Increases in operational frequency increase the probability of interaction between ocean operations and seabirds, especially those operations in close proximity to roosting and breeding sites. Though detailed information on the exact location of San Clemente Island seabird breeding colonies and specific training activity detonation sites is lacking, the chance that seabird populations near China Cove incur some lethal and sub lethal effects from detonations is most probable from targeting errors in the SHOBA impact areas.

Nearshore waters (within 3 nm) adjacent to the mainland and offshore islands remain the primary foraging habitat for the majority of seabird species within the SOCAL Range Complex. Ocean operations do not destroy foraging habitat and would only sporadically and temporarily disturb foraging of seabird species in nearshore water. Some operational expansion occurs within the nearshore (within 3 nm) of San Clemente Island, but considering the primary operations are tracking activities performed by large ships, no additional effect from increased operations would occur. Increases in small boat operations throughout the SOCAL Range Complex would not measurably increase the potential for effect to breeding seabirds located on San Clemente Island or Camp Pendleton.

The increase in ocean operations distributed across the offshore ranges FLETA HOT, W-291, and Area 3803 include surface-to-surface gunnery exercises (315 to 350, 11 percent), surface-to-air gunnery exercises (262 to 350, 34 percent), and ASW TRACKEX (544 to 1690). All three operations take place in offshore waters primarily utilized by foraging seabirds that are seasonably variable and concentrated along current interfaces. Breeding seabirds that forage in offshore California current waters could be potentially adversely affected by increases in ocean operation. However, impacts to such species would be low due to the operational frequency and likelihood of overlap of foraging areas and weapon discharge or impact. Any decrease to foraging success attributed to the training activity would not have a measurable effect on the effected seabird populations. Direct mortality to seabirds from ocean operations is unlikely do to the relatively slow speed of vessels and the ability of seabirds to avoid interaction. Little or no data is available on foraging activities within these areas with only general foraging activities assumed for this analysis.

The increased operational frequency would not increase the potential for effect on the seabird populations because the distribution of training activities is within a large geographical area in conjunction with relatively few breeding seabird populations. The overlap of range activities and the variability of foraging locations make the likelihood of any interaction low. Direct and indirect effects resulting from the destruction or degradation of seabird populations or their habitat from SOCAL Range Complex ocean training activities under Alternative 1 would be similar to the effects described for the No Action Alternative.

3.10.2.3.2 San Clemente Island

Aviation Operations

NALF San Clemente Island activities would increase 5 percent from 25,120 to 26,400. Increases to aviation training activities in Alternative 1 are primarily associated with NALF San Clemente Island. Increases in potential seabird effect from the No Action Alternative include up-tempo activity of low altitude (less than 3000 ft AGL) rotary aircraft performing searches or ingress/egress support during training operations. Aircraft related effect to roosting, breeding, and foraging seabirds would increase with increased aviation operations taking place below 1,000 ft (305 m) in close proximity (500 ft (163 m)) to seabird colonies. The extent to which increased low elevation aviation activity affects seabirds colonies is unknown do to the lack of current data on San Clemente Island seabird population numbers and locations. Sensitive seabird breeding colonies and areas remain the same as discussed in the aviation operations effects analysis of the No Action Alternative.

Bombing exercises to land-based impact areas located within SHOBA would increase 12 percent from 176 to 197. The increased operational frequency would not increase the potential of effect on seabird populations unless new land-based impact areas were utilized or nearshore waters with foraging seabirds are present at the time of detonation. The limited increase in operational frequency doesn't change the probability of effect sufficient to overcome the limitations of the data on targeting accuracy or seabird occurrences. Seabird breeding, roosting, and foraging is documented to take place near China Cove and considering the variable presence of seabirds during foraging activity there is a low probability that lethal or sub lethal effects could occur to seabird populations. Ordnance targeting within SHOBA impact areas is not defined for any of the specific operational activities thus it can only be assumed that detonations occur throughout 100 percent of the area and occasionally impact in nearshore waters due to targeting error.

Land Operations

Land operations within the SOCAL Range Complex are confined to San Clemente Island and would increase 30 percent under Alternative 1, with respect to the No Action Alternative. The increase in land operations would be concentrated in the NSW areas located both inside and outside of SHOBA. NSWG-1 SEAL Platoon Operations would increase (340 to 512), San Clemente Island Amphibious Landing and Raids (7 to 34), Land Demolitions (354 to 674), and NSW Direct Action (156-163). Platoon operations access the island at distinct beach access points (Horse Beach Cove, West Cove, and Northwest Harbor) and primarily take place in inland areas able to accommodate large group movements utilizing vehicles and support staff. The land based activities do not access known sensitive seabird roosting or breeding areas and would not significantly increase the potential for effect to seabird populations. Seabird population effects from training-related land operations within the SOCAL Range Complex under Alternative 1 would be similar to the effect described for the No Action Alternative. Effects to seabird populations from land operations under Alternative 1 would not be different than under the No Action Alternative.

3.10.2.4 Alternative 2

3.10.2.4.1 SOCAL OPAREAs

Aviation Operations

Aviation training within the SOCAL Range Complex would be about 31 percent greater under Alternative 2 than under the No Action Alternative. The majority of the increase in aviation training would remain related to NALF San Clemente Island operations (26,400 to 27,400).

The minimal increase of operational frequency in Alternative 2 compared to Alternative 1 would not increase the potential effect to seabird populations unless new land-based areas were utilized for take-off and landing or bombardment. Increases in aviation training activities in the proximity of San Nicolas Island, Santa Catalina Island, and Santa Barbara Island are associated with high elevation (> 3,000 ft AGL) flight that would not account for any additional effects to breeding, foraging, or roosting seabirds. The NALF San Clemente is not located near any known sensitive seabird roosting or nesting areas and has limited potential to interact with resident and migratory seabird species.

Adverse effects to breeding and foraging seabirds by aviation operations have been previously categorized into direct mortality and disturbance related impacts. Small increases from Alternative 1 to Alternative 2 does not markedly change the probability of direct or indirect effects discussed previously under the No Action Alternative. Increases in low elevation and bombardment aviation operations in close proximity to the mainland coast, San Clemente Island, or offshore rocks provide the greatest degree of potential effect. Increased operational frequency was reviewed in Alternative 1 and does not appreciably change for Alternative 2.

San Clemente Island provides suitable seabird habitat adjacent to aviation operational areas providing potentially impacted seabirds adequate locations to avoid interaction with aircraft and persist relatively unaffected. Increases to aviation operations adjacent to the mainland, most notably low elevation helicopter training activity within the HCOTA range, offshore of Naval Air Station, North Island, and CPAAA has a increased potential for effect to migratory and resident seabird species transiting known avian flyways associated with the Los Coronados islands, the southern Channel islands, and the mainland of California and Mexico.

The proposed Shallow Water Training Range (SWTR) encompasses a large area known to support various breeding and foraging seabird colonies including roosting and breeding such as; Brandt’s cormorants, ashy storm- petrels, and Xantus’s murrelets. Depending on the parameters of training activities and their proximity to seabird colonies, potential effects to seabirds could occur.

The increase in potential effects to seabird species attributed to increased operational frequency and expansion of the SWTR range within the SOCAL OPAREAs is related to noise and motion disturbance of roosting and foraging seabirds species. Effects to migratory seabird species utilizing offshore ranges for foraging is difficult to assess as very little data is available on foraging patterns and the lack of exact coordinates of training activities within expansive range areas. The likelihood of lethal effects to seabirds in offshore ranges from direct aircraft strikes and in-water detonations remains low do to the relatively small change in operational frequency, low concentration of seabird species in offshore ranges, and the high elevation flight patterns of aircraft operating within offshore rangesRoosting seabirds inhabiting SCI and the mainland coastal areas near Camp Pendleton and Naval Air Station, North Island utilize nearshore waters of the SOCAL Range Complex for foraging on a daily basis. Increases in low elevation helicopter and fixed winged aircraft operations within nearshore waters would result in an increase in the probability that seabirds would be disturbed during foraging activity. Primary foraging habitat is expansive near SCI and the mainland between Camp Pendleton and San Diego Bay. Disturbance to foraging seabirds from aviation operations is likely to increase within the SOCAL OPAREAs from increased operations but would not alone contribute a reduction of individual seabirds population success.

Seabird population impacts from related aviation training within the SOCAL Range Complex under Alternative 2 would be similar to the effect described for the No Action Alternative. Impacts to seabird populations from aviation operations under Alternative 2 would not be different than under the No Action Alternative.

Ocean Operations

Ocean-based training within the SOCAL Range Complex would increase nearly 25 percent under Alternative 2 in respect to the No Action Alternative. The increase in ocean operations would be distributed across the offshore ranges FLETA HOT, W-291, and Area 3803 presenting a relatively small increase of operational tempo compared to Alternative 1. Breeding seabirds that forage in offshore water near Range Complex islands could sustain potential effects from disturbance; however, current information on foraging patterns within the Range Complex is inadequate to make a comprehensive evaluation.

The expansion of the SWTR extends the training range to the shoreline of San Clemente Island from near Eel Point south to the SHOBA boundary. The new SWTR boundary line encompasses a large area known to support various breeding and foraging seabird colonies including roosting and breeding Brandt's cormorants, ashy storm- petrels, and Xantus's murrelets. Depending on the parameters of ocean training activities and their proximity to seabird colonies, potential disturbance effects to seabirds could occur.

Construction related to SWTR and the shallow water mine field involves the installation of moorings, cables, and hydrophones in waters more than 250 ft (80 m) depth. Potential effects to seabird species would be minimal and would not appreciably change from the No Action Alternative. Potential effects from construction would be related to disturbance from vessel traffic and noise during drilling. Occurrences of seabirds foraging within the proposed construction footprint are not well documented and any effect attributed to construction would be temporary and localized.

The increased operational frequency would not alone increase the potential of effect on seabird populations because the distribution of training activities over a large geographical area in conjunction with the variability of foraging locations makes the likelihood of any interaction low. Seabird population effects from ocean related training within the SOCAL Range Complex under Alternative 2 would be similar to the effect described for Alternative 1.

3.10.2.4.2 San Clemente Island

Aviation Operations

The minimal increase of operational frequency in Alternative 2 compared to Alternative 1 would not increase the potential effect to seabird populations unless new land-based areas were utilized for take-off and landing or bombardment. Increases in aviation training activities in the proximity of San Nicolas Island, Santa Catalina Island, and Santa Barbara Island are associated with high elevation (> 3,000 ft AGL) flight that would not account for any additional effects to breeding, foraging, or roosting seabirds. The NALF San Clemente is not located near any known sensitive seabird roosting or nesting areas and has limited potential to interact with resident and migratory seabird species.

Land Operations

Land operations within the SOCAL Range Complex are confined to San Clemente Island and would increase about 35 percent under Alternative 2 in respect to the No Action Alternative. The increase in land operations would be concentrated in the NSW areas north of SHOBA. NSWG-1 SEAL Platoon Operations would increase from 512 to 668, amphibious operations from 34 to 66, and NSW Direct Action from 163 –190. Platoon operations take place in primarily inland areas able to accommodate large group movements utilizing vehicles and support staff. The increased land-based activities do not physically access known sensitive seabird roosting or breeding areas and would not increase the potential effect on seabird populations.

Training that involves firing artillery from the island to offshore locations presents additional potential for seabird effects from noise disturbance. However, without the expansion of current firing positions, the increase in frequency of operations would not alone provide sufficient disturbance to seabird populations at a level to affect breeding or foraging success. Seabird population impacts from land-related training operations within the SOCAL Range Complex under Alternative 2 would not appreciably change from Alternative 1. Impacts to seabird populations from land exercises under Alternative 2 would not be different than under the No Action Alternative.

3.10.2.5 Federally Threatened and Endangered Species

3.10.2.5.1 Short-tailed albatross (*Phoebastria albatrus*)

Short-tailed albatross (*Phoebastria albatrus*) are rare vagrant migrants that forage in offshore open ocean waters 37 to 55.6 km (20 to 30 nm) offshore. Albatross forage near the sea surface, utilizing pressure differences created by ocean swells to aid in soaring; they are known to land on islands or offshore rocks. Aviation, ocean, and land training within the SOCAL Range Complex that overlaps with areas potentially containing a short-tailed albatross are vessels traveling offshore, ordnance impacting foraging locations, and airspace below 1,000 ft (305 m). The described operations would present no measurable chance for interaction with this species.

Short-tailed albatross remain one of the world's most endangered birds (Unitt 2004); the last documented sighting within the SOCAL Range Complex was described near Santa Barbara Island in February 2002. Considering the rarity of this species in general and the lack of recent sightings, chances for its potential interactions with Range Complex exercises would be extremely low. Although albatross follow a ship's wake, which slightly increases a potential for interaction with aircraft carriers, especially during the launching or landing of aircraft, the probability of direct effects to individuals or populations remains low. The spatial and temporal variability of both the occurrence of a short-tailed albatross and the operations conducted within offshore locations near foraging areas presents an improbable chance that a direct or indirect effect would occur to this species. SOCAL Range Complex operations would have no effect on short-tailed albatross.

3.10.2.5.2 Marbled murrelet (*Brachyramphus marmoratus*)

Marbled murrelets (*Brachyramphus marmoratus)* breed in northern California and the Pacific Northwest. Classified as rare migrants within the Range Complex, individuals have been infrequently sighted along coastal regions as far south as northern Baja, Mexico. This small bird flies close to the sea surface during non-breeding migrations between June and December and does not utilize land areas within the SOCAL Range Complex.

In coastal areas, foraging takes place within SOCAL Range Complex waters. Limited foraging overlap with Range Complex activities does not measurably increase the bird's chance to interface with ocean operations because of the species' limited time spent in the water and the infrequency of operations in nearshore waters. Marbled murrelets fly close to the sea surface and have limited potential of conflicting with aircraft transiting the SOCAL Range Complex. The spatial and temporal variability of both the occurrence of a marbled murrelet and the operations within the SOCAL Range Complex (conducted within nearshore locations or at low elevation levels) combines to produce low probability that a direct or indirect effect would occur in relation to this species. The SOCAL Range Complex operations would have no effect on marbled murrelet.

3.10.2.5.3 Xantus's murrelet (*Synthliboramphus hypoleucus*)

Xantus's murrelets (*Synthliboramphus hypoleucus*) fly close to the sea surface and have limited potential for conflicting with aircraft transiting the SOCAL Range Complex. Potential effects from range operations during the breeding season are most likely to occur from low elevation aviation and land-based operational activities associated with offshore islands rather than open ocean training activities. Low elevation aviation training activities and land based training activities are not performed near Santa Barbara Island or Santa Catalina Island. Santa Barbara Island, home of the largest documented breeding colony in southern California (2,264 in 1996), is part of Channel Island National Park and Channel Island National Marine Sanctuary. Santa Catalina Island is privately owned and supports private residents, vacation resorts, and a commercial airport. The FAA restricts air flight to 1,000 ft AGL for both islands.

Considering the limited number of individuals at San Clemente Island (20 in 1992), the isolated location of their nests (Seal Cove and China Cove), and their nocturnal foraging habits, only a few training operations have a limited potential to affect Xantus's murrelets. Conversely, the small size of the San Clemente Island Xantus's murrelet population makes any mortality a substantial impact to the island population. Nesting sites near Seal Rock are afforded some level of protection from operations since no live-fire activities are described to occur in that area and only recently has the SWTR expanded the nearshore extension to include the shoreline near Seal Cove. Nesting sites near China Cove and Seal Cove are not specifically identified by location and were estimated only by night time mist net captures and vocalizations documented by researchers performing population estimates in adjacent nearshore waters (Carter et al. 1992). Considering the species' high susceptibility to predation from introduced species, and the fact that no nests have been documented in the last two decades on San Clemente Island or Santa Catalina Island, it is possible that Xantus's murrelet only actively nest on remote isolated sea cliffs in this area.

China Cove is located within the SHOBA Impact Area II and is regularly targeted by ordnance launched from aviation and ocean platforms. Any explosion in close proximity (distance depends on size of the ordnance) to nesting sites during breeding season could cause mortality or nest abandonment. Low elevation aircraft transiting the area of Seal Cove or China Cove are not likely to have adverse effects to Xantus's murrelets unless the described aircraft hovers nearby for an extended time or emits bright lights at night.

Ocean or aviation operations would have a low chance of directly or indirectly affecting breeding populations due to the species' habits, low elevation foraging, and the Navy's infrequent use of training areas adjacent to potential nesting sites. Impacts from ocean or aviation operations taking place in offshore waters utilized by foraging Xantus's murrelets during nonbreeding season would probably not occur due to the sheer size of potential foraging habitat and the bird's ability to avoid such disturbance. The SOCAL Range Complex operations would have no effect on the Xantus's murrelet.

3.10.2.5.4 Californian brown pelican (*Pelecanus occidentalis californicus*)

Californian brown pelicans (*Pelecanus occidentalis californicus*) use the SOCAL Range Complex for breeding, roosting and foraging. Within SOCAL Range Complex, all documented breeding colonies occur only at Santa Barbara Island, a conservation management zone, thus, operations conducted within the Range Complex would likely have no effect on the California brown pelican breeding colonies. Brown pelicans roosting or foraging within Range Complex boundaries utilize rocky headlands and nearshore waters at San Clemente Island, San Nicolas Island, Santa Barbara Island, and Santa Catalina Island; no previously displayed adverse effects from range operations have been documented. Any disturbance impacts during foraging or roosting away from the breeding colony would not be sufficient to affect breeding success. The relatively undisturbed habitat available to roosting or foraging brown pelicans at SOCAL Range Complex offshore islands provides a degree of protection to this species greater than the potential negative effect of localized range operations on the population. Overall effects attributed to range operations would be temporary and localized but may effect California brown pelican populations.

3.10.2.5.5 California least tern (*Sterna antillarum browni*)

California least terns (*Sterna antillarum browni*) use the SOCAL Range Complex for foraging only. Nesting colony sites are located in areas adjacent to the Range Complex, including Camp Pendleton and San Diego Bay, but do not occur on offshore islands. California least terns are known to forage up to 3 nm (5.56 km) offshore in coastal waters; however, they primarily forage in estuarine and bay waters in close proximity to nesting and roosting sites. SOCAL Range Complex training associated with oceangoing vessels and aircraft present the only potential for effect to foraging of this species. Aircraft operating in close proximity to coastal areas fly above 1,000 ft (305 m) MSL with the exception of landing and take-off events and some specialized training using helicopters near Camp Pendleton. Oceangoing vessels present a minimal potential effect on foraging terns in coastal waters, as terns forage in nearshore waters and vessel operations within the Range Complex are concentrated in waters greater than 5.5 km (3 nm) off of the United States mainland. Californian least terns are agile, low-flying seabirds capable of avoiding interactions with Range Complex vehicles and would adjust foraging locations accordingly. Overall, California least terns are provided greater protection in and around military installations than in surrounding areas due to the urbanization and disturbance taking place within their preferred habitat locations. Overall effects attributed to range operations would be temporary and localized and would have no effect on California least tern populations.

3.10.2.6 Migratory Bird Impacts

As mentioned in the section “Migratory Bird Treaty Act” military readiness activities are exempt from the take prohibitions of the MBTA provided they do not result in a significant adverse affect on the population of a migratory bird species. Regardless, populations of migratory birds would not be affected by the implementation of the Proposed Action or Alternatives. A remote possibility exists that individuals may be directly impacted if in the locale of the target area at the point of physical impact at the time of inert/practice ordnance delivery. The temporary degradation of habitat or mortality of young (if the species breed at San Clemente Island and a fire occurred during the breeding season) could occur due to ordnance-ignited wildfires. Noise impacts would also potentially, but likely negligibly, affect migratory bird individuals. Although a bird-aircraft strike hazard exists, no adverse impact to bird populations is expected.

3.10.3 Mitigation Measures

Current mitigation measures are described in Section 3.10.1.2. Since impacts are negligible no additional mitigation is required.

3.10.4 Unavoidable Adverse Environmental Effects

There are no unavoidable environmental effects.

3.10.5 Summary of Effects by Alternative

The SOCAL Range Complex encompasses a critical area for foraging and breeding seabirds. Resident seabird populations depend on coastal islands relatively free from human disturbance and close to important foraging grounds. Additionally, migratory seabirds utilize the productive offshore waters associated with the California current to forage during wintering and migratory movements. Although the importance of the SCB waters and Channel Islands is well described, current specific locations of bird species (aside from some island nesting populations), population estimates, and the effect of spatially diffuse military training activities on these values is not well known. While it is possible that military training activities that come within close proximity to shore, such as on San Clemente Island, could have an adverse impact on nesting and nearshore foraging species, the spatial extent of the activity is so small and the surrounding available habitat so wide that seabird species have ample opportunity to move to adjacent quality habitat, thereby lessening effects. Breeding seabirds have high nesting fidelity and most require some degree of isolation from disturbance and predation to maintain viable breeding success. Without the expansion of new land-based impact areas for air-to-surface and surface-to-surface ordnance or an increase in near coastal flight paths near currently documented roosting and breeding seabird colonies, increased training activities should not expect to increase direct or indirect effect to seabird populations, from the No Action Alternative. Based on the analysis of the spatial area available, the limited available data on seabird populations, personal communications with those who study seabirds in southern California, and discussions with military operational professionals, it is thought that effects to protected and migratory seabirds would be minimal. The sheer size of the Range Complex, as well as the temporal and spatial variability of operations superimposed on temporal and seasonal distributions of seabird species poses minimal effect potential to seabird populations.

The DoD manages large tracks of land throughout California that provide mostly protected habitat for various species of birds, mammals, plants, and fish. Considering the extensive loss of terrestrial and aquatic habitat from human development, military installations provide critical open space for many endemic and migratory species. Stewardship of natural resources has been a focus of DoD agencies while successfully fulfilling their mission to maintain military readiness and they have remained a working partner in avoiding sensitive areas and species when such conditions are identified.

Table 3.10-4: Summary of Effects by Alternative

Alternative	NEPA (On-Land and U.S. Territorial Waters)	EO 12114 (Non-U.S. Territorial Waters)
No Action Alternative	• Training activities would have temporary and spatially distinct short-term impacts. • No long-term affects are apparent.	• Training activities would have temporary and spatially distinct short-term impacts. • In addition, effects would be lower in Non-U.S. Territorial Waters because they are farther from seabird nesting and breeding locations. • No long-term affects are apparent.
Alternative 1	• Impacts generally the same as No Action Alternative.	• Impacts generally the same as No Action Alternative.
Alternative 2 (Preferred Alternative)	• Impacts generally the same as No Action Alternative.	• Impacts generally the same as No Action Alternative.
Mitigation Measures	• Operators should ensure that the California brown pelican is not in proximity to the over-blast pressure prior to underwater demolition activities. See Section 3.10.1.2	• Operators should ensure that the California brown pelican is not in proximity to the over-blast pressure prior to underwater demolition activities. See Section 3.10.1.2

3.11 Terrestrial Biological Resources

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3.11 TERRESTRIAL BIOLOGICAL RESOURCES

This section addresses the plant and animal life of the San Clemente Island (SCI) including vegetation, wildlife, and threatened and endangered species. For this report, the discussion of terrestrial biological resources includes avian species found onshore. Avian species found in the SOCAL OPAREAs are addressed in Section 3.10, Sea Birds. The discussion in Section 3.10.2 of the responsibilities of the Navy under the MBTA and its implementing regulations applies equally to avian species found on SCI that are covered by the MBTA. Marine mammals, including species such as seals or sea lions that haul out or breed on the island, are addressed in Section 3.9, Marine Mammals.

SCI is the southernmost of the eight California Channel Islands and among the farthest offshore. It is 50 nautical miles (nm) (93 kilometers [km]) southwest of Long Beach, 43 nm (79 km) from San Pedro, and 68 nm (126 km) west of San Diego. It is 19 nm (35 km) south of Santa Catalina Island, which lies between SCI and the nearest mainland. The climate is arid Mediterranean and conditions are moderated by its maritime location with cooling ocean breezes, frequent fog and low cloud cover, and lack of frost. Because of its history of isolation, the island supports a variety of plant and animal species found nowhere else in the world as well as plants and animals found elsewhere only on one or more of the other California Channel Islands. A map of SCI depicting names of places referenced throughout this section is provided in Figure 3.11-1.

3.11.1 Affected Environment-San Clemente Island

3.11.2 Existing Conditions

3.11.2.1 Vegetation and Wildlife

Information on SCI vegetation communities is drawn primarily from the SCI Integrated Natural Resources Management Plan (INRMP) (DoN 2002). Scientific names are used in addition to common names for plant species in the botanical descriptions because definitive common names are lacking for many of the species. Nomenclature for plant species follows the Jepson Manual (Hickman 1993). Table 3.11-1 lists scientific and common names of representative plant species on SCI. Scientific names for non-avian wildlife species are mentioned along with their common equivalents the first time a species is mentioned in text; common names are used thereafter. Table 3.11-2 gives scientific and common names for non-avian wildlife species. Avian species, which have a definitive and widely used system of common names, are referred to by common names only, based on the American Ornithologist's Union Checklist of North American Birds.

The flora of SCI is similar to that of the mainland with some important exceptions. The island is rich in plant species found only on SCI or shared with one or more of the other Channel Islands, but not found on the mainland. Many of these were more widespread on the mainland in the geologic past and now are found only on one or more of the islands (relictual species), but some are a result of divergent island evolution (Axelrod 1967). Island ironwood (*Lyonothamnus floribundus* spp. *asplenifolius*), for example, is only found in fossilized forms today on the mainland. A mainland or other-island counterpart has never been found for the SCI Indian paintbrush (*Castilleja grisea*).

Figure 3.11-1: San Clemente Island Reference Map

Table 3.11-1: Scientific and Common Names, Growth Form, and Native versus Introduced Status of Selected San Clemente Island Plants

Scientific Name	Common Name	Native/ Introduced[1]	Growth Form[2]
Abronia maritima	Red sand verbena	N	PH
Abronia umbellata	Sand verbena	N	PH
Adenostoma fasciculatum	Chamise	N	S
Adiantum jordani	Maidenhair fern	N	PH
Amblyopappus pusillus	Pineapple weed	N	AH
Ambrosia chamissonis	Beach bur	N	S
Antirrhinum nuttallianum spp. *subsessile*	Nuttall's snapdragon	N	AH
Aphanisma blitoides	Aphanisma	N	AH
Artemisia californica	Coastal sagebrush	N	S
A. nesiotica	Island sagebrush	N	S
Astragalus miguelensis	San Miguel Island milk-vetch	N	PH
Astragalus nevinii	San Clemente Island milk-vetch	N	PH
Atriplex semibaccata	Redscale, Australian saltbush	I	PH
Avena barbata	Slender wild oat	I	AG
Avena fatua	Wild oat	I	AG
Baccharis pilularis	Coyote brush	N	S
Bergerocactus emoryi	Snake cactus, Velvet cactus	N	C
Bowlesia incana	Bowlesia	N	AH
Brodiaea kinkiense	San Clemente Island brodiaea	N	B
Bromus diandrus	Ripgut brome	I	AG
Cakile maritima	Sea rocket	I	AH
Calystegia macrostegia spp. *amplissima*	Island morning glory	N	PH
Camissonia guadalupensis spp. *clementina*	San Clemente Island evening primrose	N	AH
Camissonia micrantha	Small evening-primrose	N	AH
Carpobrotus edulis	Iceplant	I	PH
Castilleja grisea	San Clemente Island Indian paintbrush	N	PH
Ceanothus megacarpus spp. *insularis*	Island ceanothus	N	S
Coreopsis gigantea	Giant coreopsis	N	S
Crassula connata	Pigmy weed	N	AH
Crossosoma californium	Catalina crossosoma	N	S
Cryptantha intermedia	Common cryptantha	N	AH
Cryptantha traskiae	Trask's cryptantha	N	AH
Cynodon dactylon	Bermuda grass	I	PG
Delphinium variegatum spp. *kinkiense*	San Clemente Island larkspur	N	PH
Dendromecon rigida spp. *rhamnoides*	Channel Island tree poppy	N	S
Distichlis spicata	Salt grass	N	PG
Dudleya virens spp. *virens*	Bright green dudleya or Green liveforever	N	PH
Encelia californica	Coastal bush sunflower	N	S
Eriogonum giganteum var. *formosum*	San Clemente Island buckwheat	N	S
Eriogonum grande	Island buckwheat	N	PH
Eriophyllum nevinii	Nevin's eriophyllum	N	SS
Euphorbia misera	Cliff spurge	N	S
Filago arizonica	Arizona filago	N	AH
Filago californica	California filago	N	AH
Frankenia grandiflora	Alkali heath	N	SS
Galium catalinense spp. *acrispum*	San Clemente Island bedstraw	N	S
Galvezia (=Gambelia) speciosa	Showy island snapdragon	N	S
Gnaphalium spp.	Everlasting or cudweed	N	A/PH
Hemizonia clementina	Island tarweed	N	SS
Hemizonia fasciculata	Common tarweed	N	AH
Heteromeles arbutifolia	Toyon	N	S/T
Isocoma menziesii	Coast goldenbush	N	SS
Lasthenia californica	Goldfields	N	AH
Lithophragma maximum	San Clemente Island woodland star	N	B
Lomatium insulare	San Nicolas Island lomatium	N	PH

Scientific Name	Common Name	Native/ Introduced[1]	Growth Form[2]
Lotus argophyllus spp. *adsurgens*	San Clemente Island broom	N	PH
Lotus argophyllus spp. *ornithopus* (=*Lotus argophyllus. var. argenteus)*	Bird-claw silver lotus	N	PH
Lotus dendroideus var. *traskiae*	Trask's island lotus	N	PH/S
Lotus scoparius	California broom or deerweed	N	PH
Lupinus guadalupensis	Guadalupe Island lupine	N	AH
Lycium californicum	California boxthorn	N	S
Lyonothamnus floribundus spp. *asplenifolius*	Fern-leaved Catalina Island ironwood	N	T
Malacothrix foliosa	Leafy malacothrix	N	AH
Malacothamnus clementinus	San Clemente Island bush mallow	N	SS
Malosma laurina	Laurel sumac	N	S
Marrubium vulgare	Horehound	I	PH
Mesembryanthemum crystallinum	Crystalline iceplant	I	AH
Mesembryanthemum nodiflorum	Slender-leaved iceplant	I	AH
Mesembryanthemum spp.	Iceplant	I	AH
Microseris (=Uropappus) lindleyi	Silver puffs	N	AH
Mimulus aurantiacus	Sticky bush monkeyflower	N	S
Mimulus flemingii (=M. aurantiacus)	Island bush monkeyflower	N	S
Mirabilis californica	Wishbone bush	N	SS
Nassella pulchra	Purple needlegrass	N	PG
Opuntia littoralis	Coast prickly pear	N	C
Opuntia oricola	Philbrick's prickly pear	N	C
Opuntia prolifera	Coastal cholla	N	C
Perityle emoryi	Emory rock-daisy	N	AH
Phacelia floribunda	San Clemente Island phacelia	N	AH
Phacelia lyonii	Lyon's phacelia	N	AH
Pholistoma racemosum	San Diego fiesta flower	N	AH
Prunus ilicifolia spp. *lyoni*	Catalina cherry	N	S/T
Pterostegia drymarioides	Fairy mist	N	AH
Quercus chrysolepis	Canyon live oak	N	T
Quercus tomentella	Island oak	N	T
Rhus integrifolia	Lemonadeberry	N	S/T
Salicornia subterminalis	Parish's glasswort	N	PH
Salsola tragus	Russian-thistle	I	AH
Sambucus mexicana	Elderberry	N	S
Selaginella bigelovii	Spike-moss	N	PH
Senecio lyonii	Island butterweed	N	SS
Sibara filifolia	Santa Cruz Island rock-cress	N	AH
Spergularia macrotheca	Sand-spurrey	N	PH
Stephanomeria blairii	Blair's munzothamnus	N	S
Stylophyllum albidum	See *Dudley virens*	N	PH
Suaeda taxifolia	Wooly sea-blite	N	S
Trifolium palmeri (=Trifolium gracilentum var. *palmeri)*	Palmer's clover	N	AH
Trifolium tridentatum (Trifolium willdenovii)	Tomcat clover	N	AH
Vulpia bromoides	Six-weeks fescue	I	AG
Vulpia myuros	Rattail fescue	I	AG
Zauschneria californica (=Epilobium canum)	California fuchsia	N	PH/SS

Notes: [1]Origin
N = native
I = introduced
[2]Growth Form definitions
AG = annual grass
AH = annual herb
B = perennial herb that dies back to a bulb, corm, or rhizome (geophyte)
C = cactus
PG = perennial grass
PH = perennial herb
S = shrub
SS = subshrub
T = tree

Raven (1963) noted also that some components of the flora are related to areas in northern California rather than the nearest mainland sites, while other components are more closely related to drier, more southern locales such as Baja California. The partial explanation is a moister climate that predominated in California during the last glacial epoch. When a warming trend followed, a flora that was adapted to more arid conditions became dominant on the mainland while the Channel Islands acted as a refuge for the northern elements because of more moderate moisture and temperature conditions associated with the maritime climate on SCI.

There are 272 species of native plants, 245 bird species, 6 mammal species, and 2 reptile species known to occur on the island. In addition, there are 140 plant species, 3 bird species, and 8 mammal species that have been introduced to the island (DoN 1993; Ross et al. 1997; Junak 2003). Although the flora of San Clemente Island includes at least 140 non-native plant taxa (Junak 2003), the island also includes 47 plant taxa (species, subspecies, or taxonomic varieties) found only on Islands offshore of California or Baja California (“island endemics”) and these include 15 plant taxa known only from SCI (“endemic to SCI”). SCI has the highest percentage of higher plant endemism of the California Channel Islands (Junak 2003).

Both the flora and fauna of the island have been radically altered by human activities (SCI INRMP, DoN 2002). A feral mammal removal program begun by the Navy in 1972 successfully removed all of the goats and pigs from the island over a period of nearly 20 years (SCI INRMP, DoN 2002). The activities of these non-native species along with those of introduced sheep and cattle, which have also been removed from the Island, have significantly impacted the native vegetation and topsoil. These impacts on vegetation and habitat have also affected the wildlife species present on the island.

Table 3.11-2: Scientific and Common Names of Non-Avian Wildlife Species on SCI

Scientific Name	Common Name	Native/ Introduced
Uta stansburiana	Side-blotched lizard	N
Xantusia riversiana	Island night lizard	N
Myotis californicus	California bat	N
Myotis thysanodes	Fringed bat	N
Plecotus townsendii	Townsend’s big-eared bat	N
Tadaria braziliensis	Free-tailed bat	N
Mus musculus	House mouse	I
Rattus rattus	Black rat	I
Reithrodontomys megalotus	Harvest mouse	I
Microtus californicus	California vole	I
Peromyscus maniculatus clementis	San Clemente Island deer mouse	N
Felis catus (=F. domesticus)	Feral cat	I
Urocyon littoralis clementae	San Clemente Island fox	N

Source: DoN 2002

Plant Community Types

SCI vegetation is currently mapped in 13 community categories. Figure 3.11-2 shows the distribution of vegetation communities of SCI from Sward and Cohen (1980). This vegetation map for SCI was created in the late 1970s using aerial photos flown in 1977 at 15,000 feet. The Thorne classification system (1976) was originally applied. The maps were modified in 1980 by reclassifying the plant communities into the Sward and Cohen classification system, using the same data. Subsequent plant communities have changed (in some cases dramatically). The Santa Barbara Botanic Garden (under cooperative agreement with the Navy) is in the process of remapping vegetation assemblages on SCI.

Table 3.11-3 shows areas and percentages of the island area covered by each vegetation community mapping unit. The following discussion includes the typical and common plant and wildlife species found at each habitat type.

Table 3.11-3: Vegetation Mapping Unit, Area (acres), and Percentage of SCI Area

Vegetation Mapping Unit	Area (acres)	Percentage
Grassland	11,831	33
Maritime Desert Scrub (MDS)-Prickly Pear Phase	7,336	20
MDS-*Lycium* Phase	5,849	16
MDS-Cholla Phase	4,941	14
Disturbed	2,691	7
MDS-Prickly Pear/Cholla Phase	1,514	4
Island woodland	696	2
Stabilized dunes	425	1
Maritime sage scrub	386	1
Active dunes	224	1
Coastal strand	116	0.3
Sea bluff succulent	45	0.1
Coastal salt marsh	19	0.1
Total	36,073	99.5

Source: DoN 2002

Source: DoN 2002

Figure 3.11-2: Distribution of Vegetation Communities on SCI

Grasslands

About one-third of the island, nearly 12,000 ac, is covered by grasslands. The high-elevation plateau is dominated by native perennial grasses with native annual forbs in the interspaces. Mid- and low-elevation grasslands tend to be less diverse and dominated by introduced annual grasses. The introduced annual grasses are believed to be permanently established. Seeds of native needlegrass (*Nassella* spp.) and other plants in this community were probably used for subsistence by the resident Native Americans, who likely conducted burns to increase the yields of plants that were important to their culture.

On the high plateau above about 792 ft (240 m) elevation, a purple needlegrass (*Nassella pulchra*) grassland thrives on shallow, loamy soils. On deeper soils with higher clay content, annual grasses such as slender wild oats (*Avena barbata*) and rattail fescue (*Vulpia myuros*) coexist with cryptogams (lichens, mosses, and liverworts) in the interspaces, while on shallow sites an array of native annual herbs are characteristic: pigmyweed (*Crassula connata*), goldfields (*Lasthenia californica*), common cryptantha (*Cryptantha intermedia*), and silver puffs (*Microseris lindleyi*). Special inhabitants of the high plateau grasslands are the island endemics: SCI larkspur (*Delphinium variegatum* spp. *kinkiense*) (State and Federally listed as endangered) and SCI brodiaea (*Brodiaea kinkiense*). Island morning glory (*Calystegia macrostegia* spp. *amplissima*) is common among rocks, emerging from occasional prickly pear patches and on the sides of gullies. Coyote brush (*Baccharis pilularis*) is increasing in the mid- to high-plateau areas. Island tarweed (*Hemizonia clementina*) is also scattered throughout the grassland. On mid-elevation sites the grasslands become increasingly dominated by slender wild oats, (*Avena fatua*), and common tarweed (*Hemizonia fasciculata*). In shady understory patches, the dominant grass is ripgut brome (*Bromus diandrus*).

There is a poor understanding of the original nature of mid-elevation grasslands on clay soils, currently dominated by exotic grasses. A high range in diversity occurs in the grasslands, with some large areas dominated by only a few species such as slender wild oats, common tarweed (*Hemizonia fasciculata*), and redscale (*Atriplex semibaccata*). Other areas might contain 30 species in a 4,305-ft^2 plot and include occasional shrubs such as coyote brush (*Baccharis pilularis*), Island tarweed (*Hemizonia clementina*), lemonadeberry (*Rhus integrifolia*), morning glory (*Calystegia macrostegia* spp. *amplissima*), or prickly pear (*Opuntia* sp.) near rock outcrops. Many areas are in fair or poor condition because of erosion, limited ground cover, or a high percentage of invasive species.

The open grasslands on SCI support large populations of SCI deer mouse (*Peromyscus maniculatus clementae*), house mouse (*Mus musculus*), and various insect species. This food source supports the native island fox (*Urocyon littoralis clementae*) and non-native feral cat (*Felis catus*). American kestrel, northern harrier, red-tailed hawk, common raven, and barn owl all forage throughout this habitat type. The San Clemente loggerhead shrike (Federally listed as endangered), although more commonly associated with shrubbier habitat for breeding, also forages throughout the open grassland during the winter. This habitat also provides nesting and foraging habitat for other more common avian species including Say's phoebe, meadowlark, horned lark, and savannah sparrow.

Maritime Desert Scrub—Prickly Pear Phase

This community, which occurs from Santa Catalina Island to islands off the coast of Baja California, appears to be a southern variation of mainland coastal sage scrub (Philbrick and Haller 1977). It occupies about 20 percent of the land area of SCI (7,336 ac) and occurs in a band inland from the boxthorn (*Lycium*) habitat and on terrace faces, reaching its peak generally at lower elevations than the main plateau (Figure 3.11-2).

This plant association ranges from dense clumps obscured by a matrix of tall annual grasses to dense thickets mixed with shrub species such as coastal sagebrush (*Artemisia californica*), island sagebrush (*A. nesiotica*), and wishbone bush (*Mirabilis californica*) mixed in with herbaceous plants like fairy mist (*Pterostegia drymarioides*) and Nuttall's snapdragon (*Antirrhinum nuttallianum* spp. *subsessile*). Dense thickets of Maritime Desert Scrub (MDS) are especially prevalent on the terrace faces. The community covers about 20 percent of the island area, grading into grassland, MDS-*Lycium* Phase, MDS-Cholla Phase, and Maritime Sage Scrub at its various extremes.

Typical species are coast prickly pear (*Opuntia littoralis*), wishbone bush (*Mirabilis californica*), bird-claw silver lotus (*Lotus argophyllus* spp. *ornithopus*), everlastings (*Gnaphalium s*pp.), and Emory rock-daisy (*Perityle emoryi*). Philbrick's prickly pear (*Opuntia oricola*) hybrids with coast prickly pear (*O. littoralis*) are widespread on the island's southern end, but less common in the north. Aphanisma (*Aphanisma blitoides*), a rare species over most of its range, but which is not listed as threatened or endangered, is not uncommon in this phase or the phase dominated by California boxthorn (*Lycium californicum*). Winding in and out of the cactus clumps are fairy mist (*Pterostegia drymarioides*), Island morning glory (*Calystegia macrostegia* spp. *amplissima*), and San Diego fiesta flower (*Pholistoma racemosum*). Occasional shrubs are coyote brush (*Baccharis pilularis*), California sagebrush (*Artemisia californica*), coast goldenbush (*Isocoma menziesii*), and lemonadeberry (*Rhus integrifolia*).

Indications are that lemonadeberry (*Rhus integrifolia*) (especially at the lower elevations) and California sagebrush (*Artemisia californica*) were more prevalent before feral herbivores became abundant. Now that the feral grazers have been removed, cactus patch cover is expected to be gradually reduced as a result of competition from species that are more sensitive to grazing. Some fire regimes may affect the competitive balance between the cactus, shrub, and annual species so that, consequently, decreases in cactus cover may not necessarily take place. Some believe that prickly pear (*Opuntia* sp.) patches dampen the intensity of a fire because of the plant's succulence. California sagebrush (*Artemisia californica*) appears to be reproducing abundantly now. The cactus patches acted as havens for palatable shrubs and herbaceous species when goat grazing was at its peak. Unencumbered by grazing, vines like Island morning glory (*Calystegia macrostegia* spp. *amplissima*) are overtaking the cactus patches, leaving the *Opuntia* in a decadent state.

The low patches of cactus and denser thickets of vegetation in this habitat provide retreats for the island night lizard (*Xantusia riversiana*) (Federally listed as threatened) and also provides foraging habitat for San Clemente loggerhead shrike (Federally listed as endangered). Other more common species include the island fox, side-blotched lizard (*Uta stansburiana*), northern mockingbird, house finch, and white-crowned sparrow.

Maritime Desert Scrub—Lycium Phase

This community occurs in a band of well-drained soils on the first few terraces of the west shore adjacent to the coast (Figure 3.11-2). It occupies about 16 percent of the total island area (5,849 ac) and harbors a number of endemic plants. The terrace flats function as depositional areas for the eroding slopes and terrace faces above them.

California boxthorn (*Lycium californicum*) (a drought-deciduous, low, spiny shrub), leafy malacothrix (*Malacothrix foliosa*), snake cactus (*Bergerocactus emoryi*), island tarweed (*Hemizonia clementina*), saltbushes (*Atriplex* spp.), and coast prickly pear (*Opuntia littoralis*) are the major structural components. On more disturbed sites, pineapple weed (*Amblyopappus pusillus*) and iceplant (*Mesembryanthemum* spp.) are abundant. The best developed sites feature a nearly complete cover of shrubs and perennials with periodic violet and yellow displays of wildflowers, including the endemic annual Guadalupe lupine (*Lupinus guadalupensis*) in association with leafy malacothrix (*Malacothrix foliosa*) and goldfields (*Lasthenia californica*). Other lupines, Palmer's clover (*Trifolium palmeri*), tomcat clover (*T. tridentatum*), and occasionally Island butterweed (*Senecio lyonii*) are also found. Interspaces between the shrubs are commonly protected by a lichen layer and a varying cover of annual species such as pigmyweed (*Crassula connata*), California filago (*Filago californica*), and the exotic iceplant (*Mesembryanthemum* spp.), depending on seasonal rains and local site conditions. Commonly tangled within the shrubs are the vine-like annuals—fairy mist (*Pterostegia drymarioides*) and San Diego fiesta flower (*Pholistoma racemosum*).

The community becomes simpler both structurally and floristically on the upper terraces and southward as it grades into the MDS–Prickly Pear Phase.

Evidence of erosion and lack of cryptogamic cover (lichens, mosses, liverworts, which help bind the soil) places many areas in fair to poor condition. The sagebrush is occasional on the terrace faces but may have been more extensive in the past. There is some thought that there may have been an Island sagebrush (*Artemisia nesiotica*) or California sagebrush (*A. californica*) component to the *Lycium* communities on the terrace flats as well (Raven 1963). Based on historic accounts, the community contained much more bright green dudleya (*Dudleya virens* spp. *virens*) (Moran 1995) before sheep and goats consumed it during episodes of drought. There are occasional individuals of California crossosoma (*Crossosoma californicum*) and Island bush monkeyflower (*Mimulus flemingii*).

This habitat supports the highest densities of the island night lizard, which is especially abundant along the lowest elevation terraces on the west shore. This habitat is also prime habitat for the threatened San Clemente sage sparrow that feeds and nests there. This species is most abundant in lower terraces occupied by this habitat type along the west shore. The cover and vegetation in this habitat type also support numerous insects and deer mice, which attract predators such as island fox, feral cat, American kestrel, and northern harrier.

Maritime Desert Scrub—Cholla Phase

This variation of the MDS type is dominated by coastal cholla cactus (*Opuntia prolifera*), which is most pronounced on the southern island slopes and terraces and grades into dominance by the coast prickly pear (*Opuntia littoralis*) as it progresses northward (Figure 3.11-2). The type represents about 14 percent (4,941 ac) of the island vegetation. An additional 4 percent of the island (1,514 ac) is vegetated by MDS transitional between the cholla phase and the prickly pear phase discussed above.

Clumps of cholla vary greatly in density and can be found in a matrix of grassland, annual herbs, or shrubs such as California sagebrush (*Artemisia californica*), cliff spurge (*Euphorbia misera*), or coastal bush sunflower (*Encelia californica*). Other associated species are wishbone bush (*Mirabilis californica*), lemonadeberry (*Rhus integrifolia*), bird-claw silver lotus (*Lotus argophyllus* spp. *ornithopus*), and everlastings (*Gnaphalium* spp.).

As with areas characterized by abundant prickly pear cactus, there is generally a poor understanding of the original nature and extent of this community and how it has been influenced by goat grazing and frequent fire. It may have spread beyond its natural range by such mechanisms as cactus pieces clinging to goats as they moved about and by the artificial suppression of competing shrubs and herbs due to grazing and fire. The current range of species composition is extremely broad. Important rare species within this mapping unit all occur on hot, well-drained slopes, including cliff spurge (*Euphorbia misera*), SCI Indian paintbrush (*Castilleja grisea*), Santa Cruz Island rock-cress (*Sibara filifolia*), bright green dudleya (*Dudleya virens* spp. *virens*), bird-claw silver lotus (*Lotus argophyllus* spp. *adsurgens*), and California crossosoma (*Crossosoma californicum*). SCI bush mallow (*Malacothamnus clementinus*) also occurs on the plateaus of this mapping unit.

Shrubs associated with this type, while sparse, harbor insects that serve as a food source for wildlife (*Artemisia californica* and *Encelia californica*) or are a food source themselves (*Rhus integrifolia* fruits). Dead cholla stems are used as a perch by the loggerhead shrike or for nesting or roosting by other species. Its fruits are a seasonal source of food for birds and for the island fox. With the exception of lemonadeberry (*R. integrifolia*), most of the occasional shrubs occurring in the type are short-lived and considered successional (i.e., prevalent during a particular phase of a community's recovery from disturbance, but scarce in the mature community) where they occur in other localities.

Island Woodland

Woodlands occur in discontinuous clumps tucked in southwestern canyons and become more continuous on the eastern escarpment in most canyons south of Stone Station (Figure 3.11-2). The estimated total acreage of island woodland is 696 ac (about 2 percent of the island area). Stands of fern-leaved Catalina Island ironwood (*Lyonothamnus floribundus* spp. *asplenifolius*) and live oak (*Quercus* spp.) tend to occur on canyon slopes with deeper soils, while the Catalina cherry (*Prunus ilicifolia* spp. *lyonii*) and toyon (*Heteromeles arbutifolia*) are frequently found on low riparian benches that parallel stream courses. All island streams normally flow only after rainfall and become dry during the summer. Fern-leaved Catalina Island ironwood groves tend to follow rock ledges where water accumulates and deeper soils prevail.

Catalina cherry (*Prunus ilicifolia* spp. *lyonii*), Island oak (*Quercus tomentella*), fern-leaved Catalina Island ironwood (*Lyonothamnus floribundus* spp. *asplenifolius*), elderberry (*Sambucus mexicana*), lemonadeberry (*Rhus integrifolia*), and a tree-like form of toyon (*Heteromeles arbutifolia*) are the common tree species. Other species characteristic of canyon walls and cliffs are showy island snapdragon (*Galvezia [=Gambelia] speciosa*), SCI bedstraw (*Galium catalinense* spp. *acrispum*), Nevin's eriohyllum (*Eriophyllum nevinii*), bright green dudleya (*Dudleya virens* spp. *virens*), and the long, tangled arms of snake cactus (*Bergerocactus emoryi*). The understory is variable, depending partly on the degree of canopy closure. Ripgut brome (*Bromus diandrus*) often dominates the more open groves, with occasional shrubs of prickly pear (*Opuntia* spp.), California sagebrush (*Artemisia californica*), coastal bush sunflower (*Encelia californica*), or lemonadeberry (*Rhus integrifolia*). California fuchsia (*Zauschneria californica*), Trask's island lotus (*Lotus dendroideus* var. *traskiae*), and SCI Indian paintbrush (*Castilleja grisea*) are more common in the canyons since goats have been removed. SCI bush mallow (*Malacothamnus clementinus*) occurs as a shrub component on a few sites. The understory is also rich in many diverse perennial herbs or low shrubs such as Blair's munzothamnus (*Stephanomeria blairii*), bowlesia (*Bowlesia incana*), maidenhair fern (*Adiantum jordani*), a local, red-flowered form of sticky bush monkeyflower (*Mimulus aurantiacus*), SCI phacelia (*Phacelia floribunda*), and Lyon's phacelia (*Phacelia lyonii*).

While the canyon woodlands occupy only about 2 percent of the island area, most of the vegetative structure, floral, and wildlife diversity resides there. The woodlands provide the most important structural component of habitat and food for island bird species, and provide watershed protection and create microsite niches for several sensitive plant species.

Many groves, especially of the oak and ironwood trees, appear to consist entirely of mature or old-aged trees with little or no evidence of younger generation presence. Generally, historic sightings reported more instances of live oak (*Quercus* spp.), fern-leaved Catalina Island ironwood (*Lyonothamnus floribundus* spp. *asplenifolius*), and occasional Channel Island tree poppy (*Dendromecon rigida* spp. *rhamnoides*) than are evident today. Reports from the 1960s to 1980s indicate barren soil layered with goat droppings beneath these trees. Overgrazing has resulted in root exposure, loss of topsoil, and subsequent death of trees. Browse lines were evident on woody species throughout the island.

However, with the elimination of feral goats, woodlands are beginning to recover with many indications of the return of understory and structural diversity. Many island ironwood trees that appeared dead are sprouting abundantly after the successful goat removal program and abundant rains of 1992, 1993, and 1995 and subsequent rainy years. All of the primary trees in the woodlands have at least a moderate capacity to resprout from their stumps. Most stands now have at least some understory and there are beginning to be reports of seedlings: a few Island oaks (*Quercus tomentella*); abundant lemonadeberry (*Rhus integrifolia*); and Catalina cherry (*Prunus ilicifolia* subsp. *lyoni*). There is some thought that, historically, most of the eastern escarpment was covered with trees (Raven 1963), with a report of up to 1,000 trees on slopes due east of Mt. Thirst, many more than occur there today. *Lyonothamnus* trees have historically been reported in all eastern canyons from Mt. Thirst south.

This habitat is especially important to the loggerhead shrike, which commonly breeds in the wooded canyons in the southern half of the island. The dense vegetation and available food also make this habitat important to several more common avian species which have been reported to breed in this habitat, including mourning dove, barn owl, scrub jay, orange-crowned warbler, house finch, and chipping sparrow.

Stabilized and Active Dunes

Dunes are best developed on the island's northwest shore but are scattered elsewhere (Figure 3.11-2). About 650 ac, about 2 percent of the island's area, is occupied by active or stabilized dunes. However, the sensitivity and importance of the dune community are disproportionate to its small area since this habitat supports several sensitive species that are restricted to the sandy substrate.

The active areas of the dunes typically support beach bur (*Ambrosia chamissonis*), San Miguel Island milk-vetch (*Astragalus miguelensis*), small evening primrose (*Camissonia micrantha*), SCI evening primrose (*Camissonia guadalupensis* spp. *clementina*), sand verbena (*Abronia umbellata*), and red sand verbena (*Abronia maritima*). Iceplant (*Carpobrotus edulis*) is a weedy exotic pest that is invading most of the northern dune sites. Bermuda grass (*Cynodon dactylon*) is also becoming problematic.

On more stabilized sites a number of species add to the floral diversity. Lemonadeberry (*Rhus integrifolia*) and coyote brush (*Baccharis pilularis*) are prominent. Salt grass (*Distichlis spicata*) is common on the southern dunes, while pineapple weed (*Amblyopappus pusillus*) and the introduced slender-leaved iceplant (*Mesembryanthemum nodiflorum*) and crystalline iceplant (*Mesembryanthemum crystallinum*) are widespread. The endemic SCI milk-vetch (*Astragalus nevinii*), Trask's cryptantha (*Cryptantha traskiae*), and SCI evening primrose (*Camissonia guadalupensis* spp. *clementina*) are also found.

Important issues on the active dunes include invasion of exotics and erosion. The current condition of areas that are free from exotic invaders is good, with dominance or prevalence of sensitive species such as Trask's cryptantha (*Cryptantha traskiae*) and SCI evening primrose (*Camissoma guadalupensis s*pp. *clementinus*). SCI milk-vetch (*Astragalus nevinii*) is sometimes surrounded by iceplant (*Carpobrotus edulis*). Bermuda grass (*Cynodon dactylon*) is probably permanently established on the stabilized dunes. Around the turn of the century active dunes were seeded to "saltbush"(SCI INRMP DoN 2002).

Due to the relative lack of vegetative cover, wildlife that primarily use the stabilized and active dunes on the island include San Clemente Island fox and feral cats. Ravens, kestrels, and harriers also use the habitat on a limited basis for foraging.

Coastal Strand

Although coastal strand is primarily devoid of vegetative cover, it provides important foraging habitat for numerous shorebirds that feed on the abundant invertebrates found along the shore. Despite SCI's extensive shoreline, coastal strand occupies only about 0.3 percent of the island's surface (116 ac), because most of the shoreline is rocky and steep and lacks sand beaches (Table 3.11-3). Other aquatic species such as the California brown pelican, western gull, and Heermann's gull frequently roost on the beach. Most shorebirds such as western snowy plover, black-bellied plover, willet, godwit, and sanderlings are common in the winter along beaches on the north and south ends of the island. Marginal breeding habitat for western snowy plover (Federally listed as threatened) is present on the island but there have been only three nesting attempts documented for this species in recent years (see Section 3.11.1.1.2).

Maritime Sage Scrub

California sagebrush (*Artemisia californica*) and Island sagebrush (*A. nesiotica*) occur in a few plant communities of SCI. The first is the dense scrub type most commonly found on precipitous escarpments on the north end of the island. There is some thought that this may at one time have included hardier chaparral components that now occur only as isolated individuals about the island. These species include toyon (*Heteromeles arbutifolia*), Island ceanothus (*Ceanothus megacarpus* spp. *insularis*), chamise (*Adenostoma fasciculatum*), California crossosoma (*Crossosoma californicum*), Channel Island tree poppy (*Dendromecon rigida* spp. *rhamnoides*), and laurel sumac (*Malosma laurina*) (SCI INRMP--DoN 2002).

The second sagebrush association occurs on the hot, dry aspects of canyon slopes. California sagebrush (*Artemisia californica*) now dominates these sites along with coast prickly pear (*Opuntia littoralis*), whereas, in 1988, Resnick reported sagebrush to be "uncommon" and isolated in the centers of prickly pear patches (DoN 2002). In 1950, Dunkle reported that the California sagebrush-dominated coastal sage community occurred only in small areas of the southern third of the island.

The third occurrence of California sagebrush (*A. californica*) is in clumps on west shore and southern terrace escarpments. On the north end of the island these sites also contain prickly pear. Farther south, species composition typically shifts to more coastal bush sunflower (*Encelia californica*).

The original extent of Maritime Sage Scrub on the island is not known. Currently it is estimated to occupy about 1 percent of the island surface (386 ac). The more mesic phase on the northeastern escarpment has areas that are in good condition with high structural and species diversity. Drier sites on southern canyon exposures appear to be recovering from the peak of goat grazing around the early 1970s, while clumps of coastal sagebrush (*Artemisia californica*) that occur occasionally on western terrace faces appear in remnant condition. The endangered Trask's island lotus (*Lotus dendroideus* var. *traskiae*), if it is like others of the genus, is apparently a successional (seral) species, having a dormant seedbank stimulated to germinate when gaps appear. Such species may be prevalent at some stages during a community's recovery from disturbance, but uncommon in the mature community. This lotus commonly occurs among rock outcrops on the fringes of the more mesic phases, but also is beginning to occur in woodland and other habitats farther south on the island. This community is adapted to but is not dependent on fire.

The shrubs harbor insects and provide important structure and cover for wildlife habitat. They also provide erosion protection for steep slopes.

Sea Bluff Succulent

Nevins' eriophyllum (*Eriophyllum nevinii*), an island endemic with large divided white-hairy leaves and yellow flowers, is the most abundant and showy representative of the sea bluff succulent type. This shrub creates habitat for birds and other wildlife on bluffs above the intertidal zone and can form a monotypic plant association in areas influenced by salt spray. SCI buckwheat (*Eriogonum giganteum* var. *formosum*) and Island buckwheat (*Eriogonum grande*) add diversity to the type, along with Island morning glory (*Calystegia macrostegia* spp. *amplissima*). Over 50 SCI Indian paintbrush (*Castilleja grisea*) occur within this association at one location below Jack Point (Junak and Wilken 1998).

Little is known about this community's historical distribution, extent, and importance and there is minimal baseline information due to the difficulty of accessing it due to the steep terrain. Currently it is estimated that there are about 45 ac of this habitat type, representing about 0.1 percent of the island. SCI buckwheat (*Eriogonum giganteum* var. *formosum*) may be a component of the bluff community or of maritime sage scrub. San Nicolas Island lomatium (*Lomatium insulare*) has not been observed for many years on the bluffs but was formerly known from this habitat (Junak and Wilken 1998).

Coastal Salt Marsh

Small salt marshes occur in the vicinity of the mouths of Horse Beach and Chenetti canyons in SHOBA (Figure 3.11-2, above). These marshes are estimated to occupy less than 0.1 percent of the island area (19 ac) based on mapping from 1977 aerial imagery. Another type of saline habitat occurs behind rock berms along the western shore (DoN 2002). A recent survey of wetlands on SCI by Bitterroot Restoration (2002) delineated 0.64 acres of salt marsh on SCI as jurisdictional wetlands.

Typical species of coastal salt marsh on SCI include woolly sea-blite (*Suaeda taxifolia*), alkali heath (*Frankenia grandiflora*), salt grass (*Distichlis spicata*), and saltbush (*Atriplex* spp.). Parish's glasswort (*Salicornia subterminalis*) is present in low areas, such as along channels. In transitional areas species such as sand verbena (*Abronia umbellata*), coast goldenbush (*Isocoma menziesii*), sand-spurrey (*Spergularia macrotheca*), and sea rocket (*Cakile maritima*) may also be present. The areas mapped as salt marsh in SHOBA (in Horse Beach and Chenetti canyons) appear to be low saline areas with very limited, if any, tidal exchange. The composition of this plant association tends to grade into that of the dunes or MDS-*Lycium* Phase, and is more diverse at this interface.

Disturbed

Areas with vegetation classified as "Disturbed" on the island include the Naval Auxiliary Landing Field (NALF) airfield, areas with facilities, roads, and high-use target areas, which have large open areas devoid of vegetation or frequently affected by fires (Figure 3.11-2). Disturbed habitats constituted about 7 percent of the Island's cover, based on mapping conducted in the late 1970's (Table 3.11-3). Most wildlife species common throughout the island utilize disturbed areas to some extent.

Disturbed areas near facilities support species that tolerate human activity and include mammals such as house mouse, feral cat, and roof rat; and avian species such as house sparrow, European starling, white-crowned sparrow, and house finch.

Wetlands, Vernal Pools, and Other Aquatic Habitat

Other aquatic and wetland habitats on SCI are very limited. Bitterroot Restoration, Inc. (2002) conducted a preliminary survey of wetlands and drainages throughout SCI. Areas with the potential to support the federally-listed branchiopods (fairy shrimp) were surveyed for the presence of these species in accordance with USFWS protocol (see 3.11.1.1.2 Threatened and Endangered Species). This study encompassed large portions of SCI and was conducted for natural resources management purposes. It therefore did not provide comprehensive coverage of the entire island nor was it intended to allow site-specific impact assessments or permitting. The survey included identification of drainages, some of which may be regulated as non-wetland waters of the United States under Sections 401 and 404 of the Clean Water Act, as discussed below. The wetland survey, conducted during 2001, a wet year on SCI, identified a total of 121 three-parameter wetlands among the 568 potential wetlands and 932 drainages surveyed. The remaining potential wetlands (mostly ephemeral pools) were determined to be non-wetlands because they did not meet either the hydrophytic (wetland) vegetation or wetland hydrology criteria. Of the 121 three-parameter wetlands identified, four were salt marsh and 117 were vernal pools. The areas of the surveyed pools ranged between 4.3 ft^2 and 495 ft^2 (0.4 m^2 to 46 m^2). Figure 3.11-3 shows the delineated wetland areas on SCI. The total area of vernal pools delineated as wetlands on SCI is 2.8 acres. These are found in the VC-3 AVMA and overlapping TAR 15 (0.3 ac), in AFP-6 in SHOBA (0.4 ac), and in the IOA (2.1 ac). The total area of salt marsh delineated as wetlands on SCI is 0.64 acres. The salt marsh areas are found TAR 10 (0.14 ac); and in Impact Area I where small salt marsh areas are associated with the mouths of Chenetti Canyon [TAR 20 (0.2 ac)] and Horse Beach Canyon [TAR 21 (0.3 ac)]. The majority of the wetlands and ephemeral pools on SCI are the result of anthropogenic activities, including both military operations and pre-military agricultural land uses.

Figure 3.11-4 shows the network of drainages on SCI. All drainages identified were intermittent streams; none were perennial. Many of the drainages surveyed by Bitterroot Restoration (2002) had bed and banks and were considered Jurisdictional Waters of the United States.

Figure 3.11-3: Delineated Wetland Areas on SCI

Figure 3.11-4: Network of Drainages on SCI

3.11.2.2 Threatened and Endangered Species

SCI has 11 Federally listed endangered or threatened plant and wildlife species, most of which are also State-listed. Island-wide rare plant surveys were conducted by the Santa Barbara Botanic Garden (SBBG) in 1996-1997 and again in 2003-2006 (Junak and Wilken 1998; Junak 2006). Their findings supplement data from earlier surveys. These surveys are conducted periodically for management/monitoring purposes. Though the surveys do not cover all areas of the island, they are valuable in impact analyses because they allow the assessment of localized data/impacts in an island-wide context (i.e., they allow us to evaluate the significance of a potential impact to a listed taxon at a specific location based on its island-wide status). Because these surveys are not funded to the extent that they can provide total coverage of the entire island, they focus on areas of high botanical diversity and areas with the potential for the greatest abundance of a particular listed or rare species. The data capture the areas of greatest significance to each species as well as hotspots of botanical diversity. The island-wide data depict the distribution and abundance of all species of rare plants across the geographic range of the island within these parameters.

To supplement island-wide surveys, rare plant surveys of Special Warfare Training Areas (SWATs) 1 & 2 (including Training Areas and Ranges [TARs] 1-4) and TARs 5, 6, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 21, and 22 (including a 100-m buffer around all perimeters) were conducted in 2005 and are included in the GIS analysis for this project. Focused rare plant surveys of the AVMC, including the AVMAs, AMPs, AFPs, and the IOA were initiated in 2006 and completed in 2007 by Tierra Data, Inc. under contract with the Navy. In 2006, 1992 acres were surveyed within the AVMC. Additional surveys performed in 2007 brought the total survey area to 3547 acres. A report compiling results from the 2006-2007 surveys is in preparation. The methodology for the 2006 and 2007 surveys of the AVMC and IOA included taking GPS locations of individual plants when applicable, leading in some cases to clusters of GPS points with one plant each representing the same species within a localized area. Thus, on an island-wide basis, the numbers of occurrences have a tendency to be overrepresented within the AVMC and IOA, compared to Island-wide totals. For federally and state listed species, the quantitative analysis presented in Appendix D evaluates both number of occurrences and number of individuals as a fraction of SCI totals.

The island-wide surveys by SBBG (Junak and Wilken 1998; Junak 2006) identified additional populations of many species as well as confirmed many previously located populations. However, their studies have not attempted to comprehensively resurvey the entire island or revisit all previously discovered populations, thus previously known populations not in areas specifically covered by Junak and Wilken (1998) and Junak (2006) are presumed extant (still in existence) and therefore, distribution maps in this document show historic populations in addition to populations identified in the Santa Barbara Botanic Garden surveys.

Wet season and dry season sampling for fairy shrimp was conducted in February and October 2001, respectively (Bitterroot Restoration, Inc. 2002). Fairy shrimp or their cysts can be transported between pools by birds, foot traffic, overland drainage, and off-road wheeled and tracked vehicles. Pools throughout SCI were sampled. Results from the wet season show that the common versatile fairy shrimp (*Branchinecta lindahli*) was present in 66 percent (368 pools) of the sampled pools. Dry season results revealed fairy shrimp cysts in samples from 420 pools (Note: Cysts were found in 80 pools in which fairy shrimp had not been found during wet season sampling the preceding February; dry season sampling in some pools in which shrimp had been found during the wet season did not reveal cysts). The Federally listed endangered San Diego fairy shrimp (*Branchinecta sandiegonensis*) was not found in any of the vernal pools and wetlands during the wet or dry season sampling and the study concludes that it is not likely to occur on SCI.

San Clemente Island Indian Paintbrush (*Castilleja grisea*)

The SCI Indian paintbrush (Family Scrophulariaceae) was listed as endangered in August 1977 and is also State-listed as endangered. Found only on SCI, this ash gray, erect, herbaceous perennial has many branches, an abundance of leaves, and pale yellow flowers borne in terminal spikes. The SCI Indian paintbrush is found on steep rocky canyon walls, lower slope bluffs, alluvial benches, and sandy terraces. It is also occasionally found on cliffs of canyons and escarpments on the east side of the island and is uncommon in canyons on the southwest side. Some of the largest populations are found in bowl-shaped swales on the coastal terraces, and it occupies both the coastal sage scrub and maritime cactus scrub plant communities between elevations of approximately 30 and 1,200 ft (10 and 365 m) (Junak and Wilken 1998). Figure 3.11-5 shows known existing and historical occurrences of *Castilleja grisea.*

Although not demonstrated specifically for this species, other species of *Castilleja* have been shown to tap into the root system of another species (called a “host”) to obtain water and possibly nutrients. This species is found with a diversity of other plant species but the species on which it might be dependent is not known, although *Encelia californica*, *Opuntia littoralis* (DoN 1996), and *Isocoma menziesii* have been proposed (DoN 2002).

Members of this genus tend to follow fire and other non-catastrophic disturbance, and occasional fire may help promote this species; fires with short return intervals, however, may inhibit its recovery (DoN 2002).

The effects on this species from disturbances such as fire or trampling would be difficult to assess given the observed wide variation in population numbers and trends on monitored sites where no apparent disturbance has occurred (DoN 2002). However, the numbers of occurrences and individuals of this species have increased substantially following removal of feral goats from the island (DoN 2002).

Historically, this species was relatively common in suitable habitats on the southeast coast of SCI and west-side canyons. Its numbers declined from the 1930s through the 1970s, corresponding to the rise in feral goat numbers, until only a few individuals remained (Oberbauer 1978). By 1984 an estimated 1,000 plants were scattered on rock faces of cliffs in the eastern escarpment canyons, with about 400-500 on a sandy flat at Pyramid Cove, apparently the year following a fire. Junak and Wilken (1998) reported a total of 77 occurrences of SCI Indian paintbrush, collectively comprising about 3,500 individuals; some populations ranged from isolated plants to populations between 4 and 600 individuals. Many additional occurrences have been found since then (DoN 2002; Junak 2005; Junak 2006). Junak (2006) lists 198 occurrences with 9,718 individuals based on surveys conducted between 2003 and 2006 and lists the population as increasing. Current estimates based on surveys through 2007 are 335 occurrences with 14,064 individuals, all on SCI.

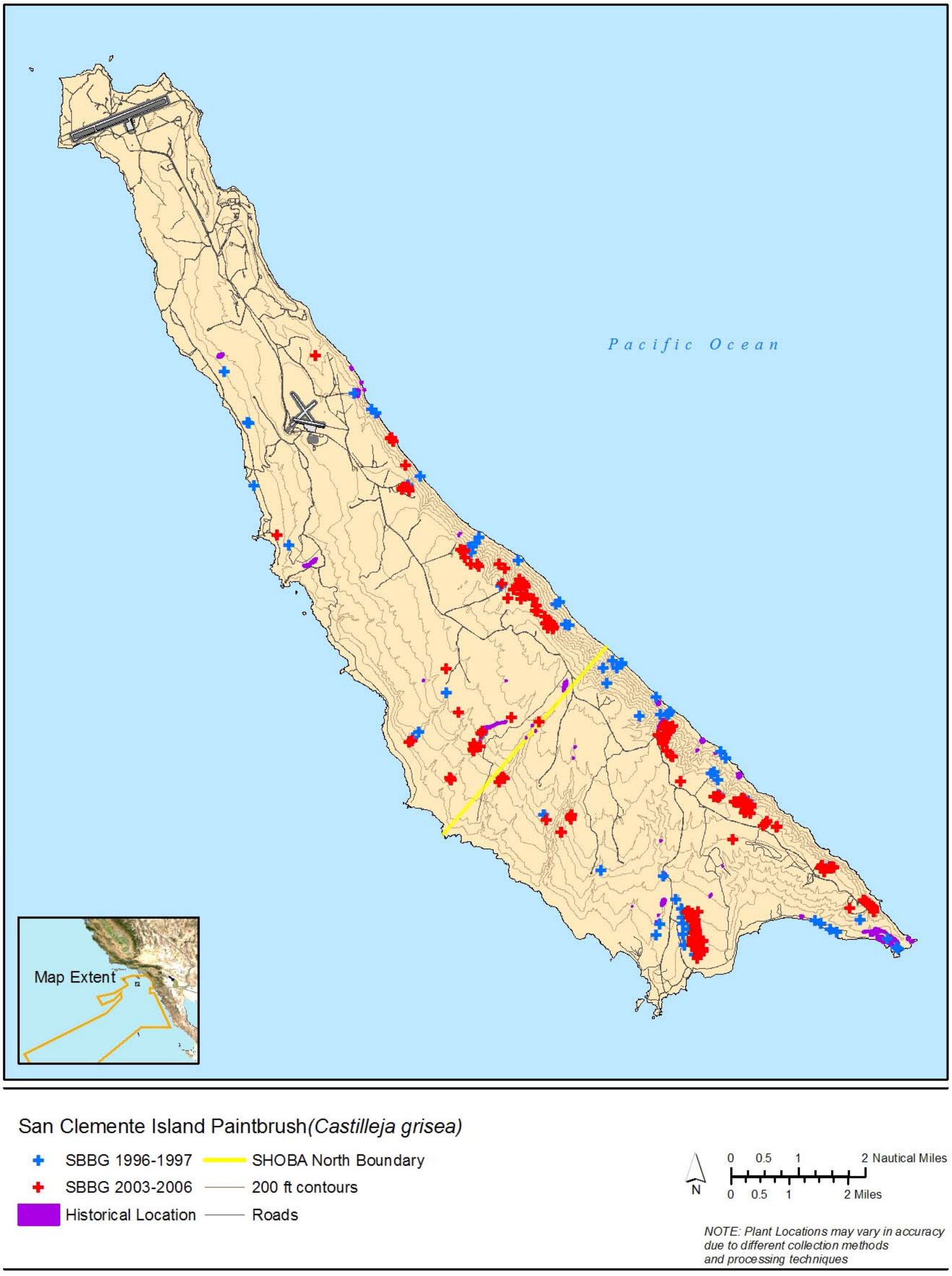


Figure 3.11-5: Existing Locations of San Clemente Island Indian Paintbrush (*Castilleja grisea)*

San Clemente Island Larkspur (*Delphinium variegatum spp. kinkiense*)

The SCI larkspur (Family Ranunculaceae) was listed as endangered in August 1977 and is also State-listed as endangered. Found only on SCI, it is a tall, herbaceous short-lived perennial with two-thirds of the stem mostly leafless. Its whitish flowers are arranged in a terminal raceme and may be pollinated by bumblebees as are other species of *Delphinium* with blue to white flowers (Junak and Wilken 1998). Its habitat has been described as grassland on clay, but it is also found on dark gray-brown loam, 5-10 inches (in) (13-25 centimeters [cm]) deep (SCI INRMP DoN 2002). It grows mainly on gently sloping open grassland terraces between 262 and 837 ft (80 and 255 m) in elevation. About 40 separate populations of SCI larkspur have been mapped since the 1960s. It occurs mainly on the mainland facing slopes of the island to about the middle of the island (Figure 3.11-6), where it is replaced by the similar Thorne's royal larkspur (*Delphinium variegatum* spp. *Thornei*), which continues southward to the vicinity of Pyramid Head. The similarity of appearance of these two subspecies, which differ principally in flower color, has led to some confusion in past records. There appears to be very little overlap in the distribution of the two subspecies. Additional occurrences of SCI larkspur may be present because this species can be easily overlooked if not in flower. Junak and Wilken (1998) reported a total of 17 occurrences of this species, comprising over 5,700 individual plants. Population sizes ranged from 7 to more than 1,400 individuals, with the majority of occurrences located east of VC-3. Because a number of historical sites for this species were not visited by Junak and Wilken during preparation of the 1998 report and subsequent surveys (Junak 2006), the total number of individuals and the distribution of the species on the island are likely to be greater than reported. Figure 3.11-6 shows known and historical occurrences of SCI larkspur. Junak (2006) reports an additional 16 occurrences and 1,871 individuals from surveys conducted between 2003 and 2006 but lists the population as possibly decreasing. Current estimates based on surveys through 2007 are 38 occurrences with 7,389 individuals, all on SCI.

Populations of SCI larkspur were threatened by feral herbivores, which have been removed from the island. However, populations are also threatened by erosion and gullying and possibly by competition from neighboring grassland species. The latter may be an important factor for populations located on the eastern, high plateau *Nassella*-dominated grasslands on the north and central portions of the island.

This species may be tolerant to fire during its dormant period (USFWS 1984) and may regenerate more from resprouts than seeds (SCI INRMP, DoN 2002). Other species of *Delphinium* respond favorably to fire, but burns occurring prior to seed set and dormancy could be adverse.

San Clemente Island Woodland Star (*Lithophragma maximum*)

The SCI woodland star (Family Saxifragaceae) was federally listed as endangered in August 1997 is also State-listed as endangered. Found only on SCI, it is a rhizomatous, perennial herb with broad leaves and stout stems up to 2 ft (0.61 m) high bearing many white, bell-shaped flowers. The plant appears to be restricted to cooler areas with persistent year-round moisture and is generally found on gentle north-facing slopes in moist canyon bottoms on the east side of the island between elevations of 400 and 1,100 ft (121-335 m). Its distribution is entirely within SHOBA but is remote and protected by terrain from ordnance impact areas.

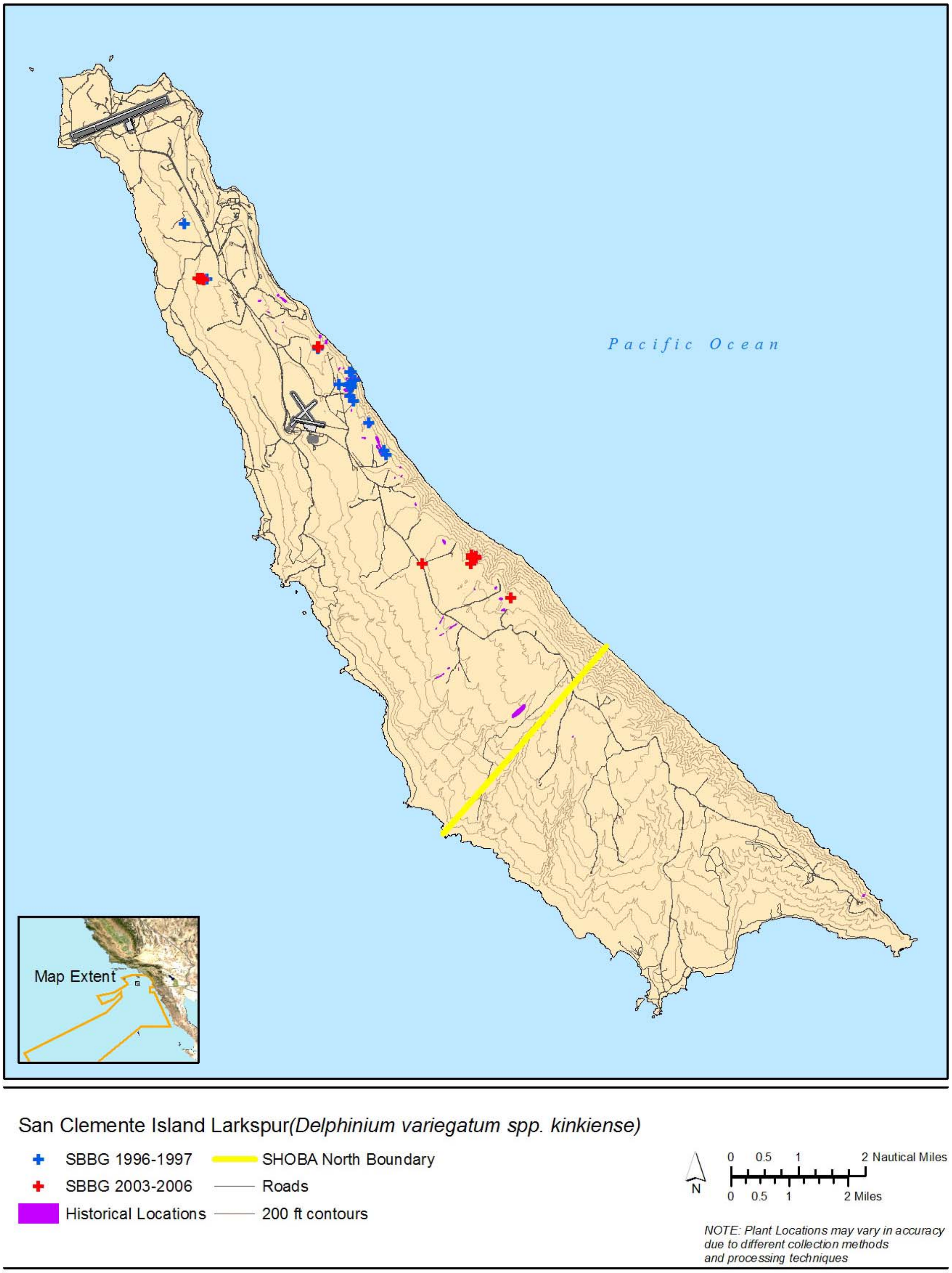


Figure 3.11-6: Existing Locations of San Clemente Island Larkspur (*Delphinium variegatum* spp. *kinkiense*)

The plant was thought to be extinct until its rediscovery in 1979 by M. Beauchamp and H. Ferguson. Junak and Wilken (1998) found a total of ten occurrences comprising approximately 465 individual plants on the island, while surveys in 2003 and 2004 by the SBBG added approximately two new occurrences with 17 individuals (Junak 2006). Current estimates based on surveys through 2007 are 12 occurrences with 482 individuals, all on SCI. Figure 3.11-7 depicts currently known populations of SCI woodland star. It is found in suitable habitat in the vicinity of Bryce, Mosquito, and Eagle canyons. Junak (2006) lists this species as possibly decreasing on SCI.

The east side canyons where this species is found have shown dramatic recovery since goats were removed in the early 1990s (DoN 2002). Tolerance to fire is generally unknown. However, its principal habitat is in canyon bottoms that are unlikely to burn during the growing season of this plant, making it generally unlikely that this species would be impacted by fire.

San Clemente Island Broom (*Lotus dendroideus var. traskiae*)

SCI broom (also known as Trask's island lotus) was listed as endangered in August 1977 is also listed as endangered by the State. A member of the pea family, Fabaceae, it is a short-lived semi-woody shrub with slender and erect green branches, dark green foliage, and small, yellow, pea-like flowers. Found only on SCI, it occurs around rock outcrops in grassy areas or along the interface between grassland and maritime sage scrub.

Periodic surveys conducted between 1984 and 1996 indicated that approximately 30 separate populations of SCI broom exist. However, Junak and Wilken (1998) reported a total of 64 occurrences comprising over 3,000 individual plants. These occurrences ranged from isolated individuals to populations of 5 to 750 plants. In 2001, an estimated 1,000 plants occurred around Wilson Cove, where only 10 to 15 were reported in 1979. Midway down the island, 30 to 40 plants were noted at a northwest-facing terrace-face site that was fenced in the early 1980s. Surveys in 1995 located west shore sites in three canyons. Surveys in 1996 and 1997 located hundreds of plants from the bluffs at Pyramid Head, to Wilson Cove on the eastern side of the island, and in many canyons that drain to the west. Surveys in 2003-2006 by the Santa Barbara Botanic Garden identified 69 occurrences and approximately 6,568 individuals (Junak 2006). There were a number of new occurrences along the eastern escarpment and on the western slopes of the island (Figure 3.11-8). Current estimates based on surveys through 2007 are 147 occurrences with 9,674 individuals, all on SCI. Junak (2006) identifies the population as increasing.

The SCI broom is expanding in range since the removal of exotic herbivores. It is found currently in habitats that range from prickly pear patches to rocky grassland. It readily occupies disturbed areas and some occurrences are close to buildings, roads, and pipelines (SCI INRMP DoN 2002). The response to fire in this short-lived species is not well known but other members of this genus seed prolifically after fire. Populations are found along the length of the island on both the east and west shores (Figure 3.11-8).

San Clemente Island Bush Mallow (*Malacothamus clementina*)

The SCI bush mallow (Family Malvaceae) was listed as endangered in August 1977 and is also State-listed as endangered. Found only on SCI, it is a rounded sub-shrub with numerous white (fading to lavender) flowers. Seedlings are rare, and it normally reproduces by underground runners. Individual plants as far as 30 ft (9 m) from another may be connected through underground runners (SCI INRMP, DoN 2002). The habitat of the SCI bush mallow ranges from rocky canyon

Figure 3.11-7: Existing Locations of San Clemente Island Woodland Star (*Lithophragma maximum*)

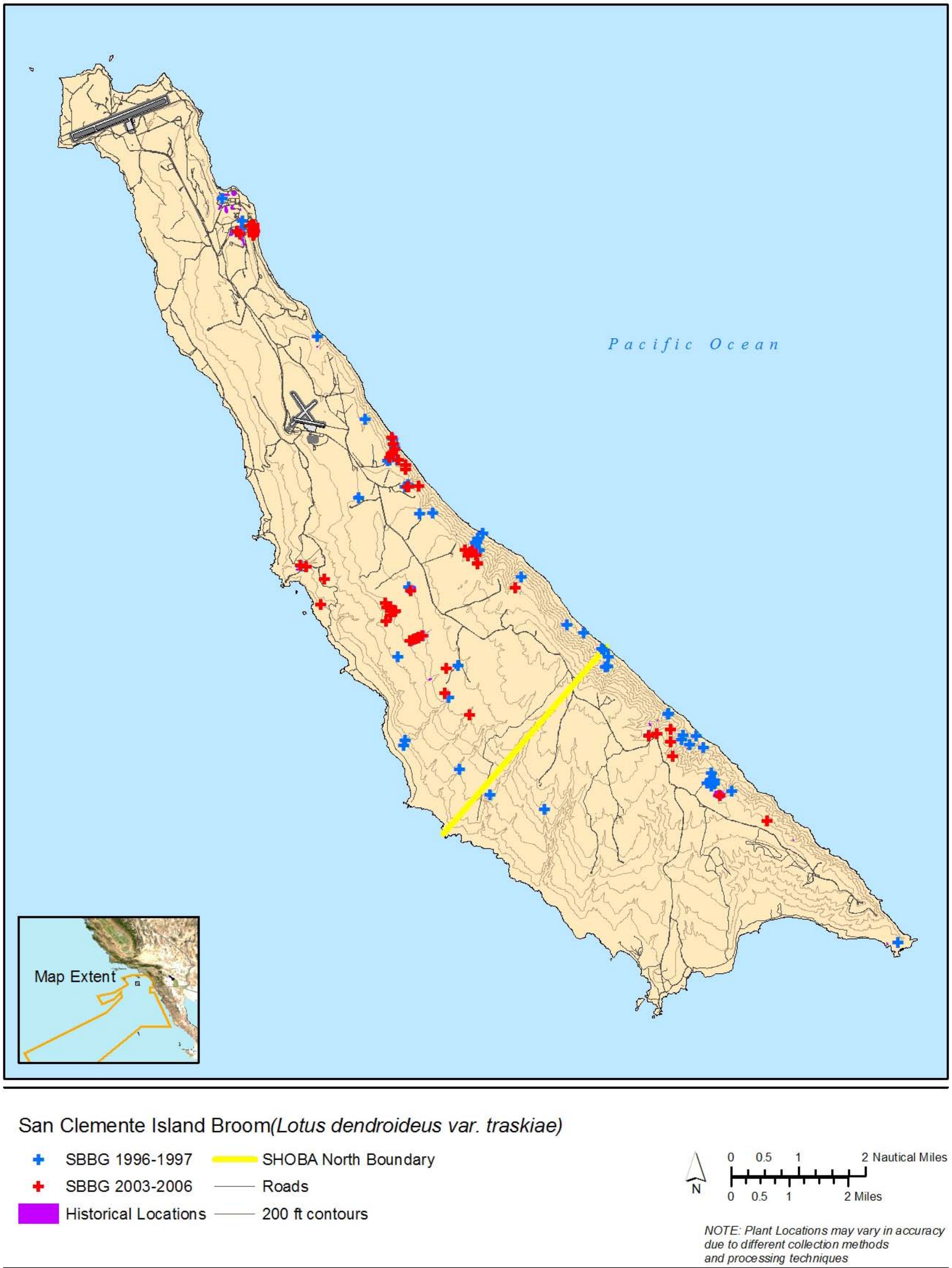


Figure 3.11-8: Existing Locations of San Clemente Island Broom (*Lotus dendroideus* var. *traskiae*)

slopes to valley and foothill grasslands, coastal flats with maritime cactus scrub vegetation, and vegetated flats in canyon bottoms. Populations have been found at elevations between 50 and 775 ft (15-236 m). Most occurrences of this plant are on the southwestern and southern part of the island from Middle Ranch Canyon southward. The greatest number of occurrences and numbers of individuals are in Horse Beach Canyon (Figure 3.11-9).

The SCI bush mallow appears to be a vigorous resprouter after fire, similar to other members of its genus. Populations in the fire support area are scarred by fire but persist despite very frequent burns (DoN 2002). In the absence of fire or other disturbance, this species may be outcompeted by native shrubs in Horse Beach Canyon (DoN 2002).

SCI bush mallows occur in a wide range of habitats. The most common is on low canyon benches, just outside active stream channels. Historical sites include “on walls of canyons running into the sea,” “rocky canyon walls,” ridges (probably because of goat foraging) and on an “open, south-facing hillside with *Mirabilis* and *Atriplex*” (SCI INRMP, DoN 2002). This species currently occurs on rocky canyon walls, canyon bluffs, low canyon benches, alluvial deposits, and rocky grassland sites of the plateau. Additional evidence of SCI bush mallow’s broad ecological range comes from its ease of cultivation in diverse soil types (USFWS 1984). The plant may naturally occur in recently disturbed (early-successional) situations and can vigorously resprout after fire, as can other members of the genus. Junak and Wilken (1998) reported a total of 18 occurrences of this species on SCI, comprising about 290 large shrubs. Populations ranged from isolated plants to colonies of between 3 and 50 individuals. Junak (2006) reported 61 occurrences with over 1,300 plants identified during surveys conducted between 2003 and 2006 and identified the SCI bush mallow population as increasing. Current estimates based on surveys through 2007 are 80 occurrences with 1,591 individuals, all on SCI.

Santa Cruz Island Rock-Cress (*Sibara filifolia*)

Santa Cruz Island rock cress (Family Brassicaceae) was listed as endangered on 8 August 1997 (62 Federal Register 42692). It is a slender annual herb with pink to purplish flowers having spoon-shaped petals. Previously known from coastal scrub habitats on Santa Cruz and Santa Catalina islands, Santa Cruz Island rock cress was thought to be extinct until it was discovered on SCI in 1986. It was re-discovered on Santa Catalina Island in 2001. It has not been seen on Santa Cruz Island since 1932 (Junak 2006). On SCI, Santa Cruz Island rock cress occurs in several saddles on three adjacent, open ridgetops and on nearby flats at the southern end of San Clemente Island near Pyramid Head (Figure 3.11-10), at elevations between 300 and 540 feet (Junak 2006). Surveys conducted by Junak and Wilken in 1996 and 1997 found a total of five populations comprising a total of 758 individuals (Junak and Wilken 1998). Three additional occurrences with a total of 67 individuals of this inconspicuous plant have since been reported in the same general area (Junak 2006). Current estimates based on surveys through 2007 are 12 SCI occurrences with 905 SCI individuals. All known occurrences on SCI are in the vicinity of Pyramid Head (Figure 3.11-10).

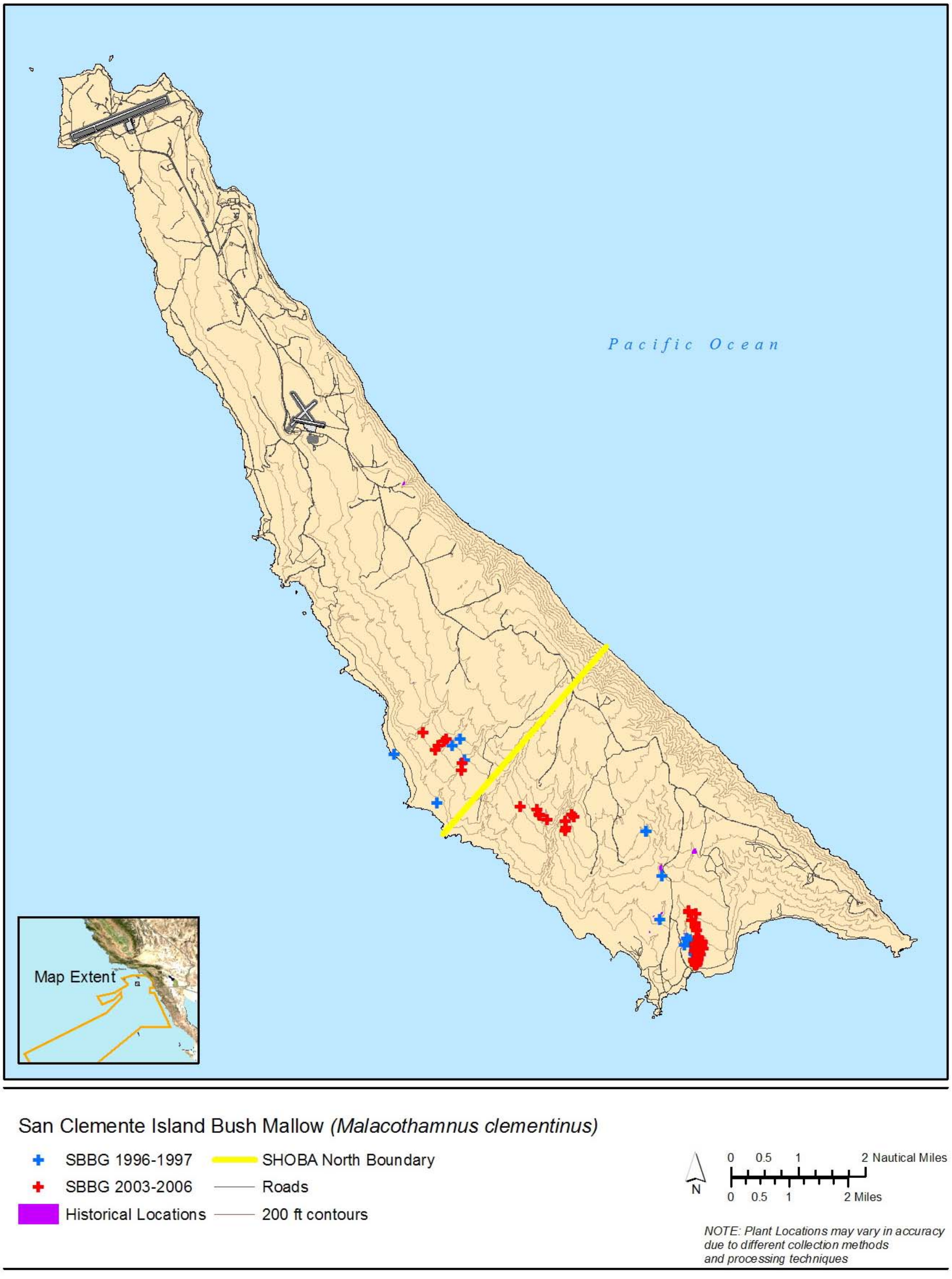


Figure 3.11-9: Existing Locations of San Clemente Island Bush Mallow (*Malacothamnus clementinus*)

Figure 3.11-10: Existing Locations of Santa Cruz Island Rock Cress (*Sibara filifolia*)

Island Night Lizard (*Xantusia riversiana*)

The island night lizard was Federally listed as threatened in August 1977. Its range is restricted to SCI, San Nicolas Island (SNI), and Santa Barbara Island. Population sizes are small except on SCI. Although once proposed to be in its own genus *(Klauberina)*, genetic studies show it to be related to other members of the night lizard genus *Xantusia*, especially the yucca night lizard *(X. vigilis)*. It differs from its congeners by having 16 rows of ventral scales and two rows of supraoculars. It is the most morphologically and genetically distinct of the endemic vertebrate species on the Channel Islands (Bezy et al. 1980). It is the largest member of the *Xantusiidae* family, growing to a maximum snout-vent length of 4.2 in (10.7 cm) (females) and 4.0 in (10.2 cm) (males).

The island night lizard occupies restricted distributions on SNI and Santa Barbara Island, but they occur in virtually every habitat type found on SCI except active dunes and closed canopy canyon shrubland and woodlands (Figure 3.11-11; Mautz 2001). Population densities of the species on SCI are highest on the northwestern tip and along the southwest-facing coast. Despite their name, island night lizards are diurnally active but are secretive and not easily seen. They favor the spaces between and under rocks and similar objects, including man-made objects, to escape from predators and heat, since the species cannot withstand temperatures in excess of 40°C (104°F) (Mautz 1979).

Studies of life history characteristics of the island night lizard (Goldberg and Bezy 1974; Bezy et al. 1980) and of the mainland species *X. vigilis* and *X. henshawi* (Miller 1951; Zweifel and Lowe 1966; Lee 1975) reveal an unusual and extreme pattern of a lizard that grows slowly, matures late, has a low reproductive rate, low predation rate, and a long lifespan (Tinkle 1969). They exhibit a sex ratio of 50:50 on the island, but only about half of the adult females breed in any given year (Goldberg and Bezy 1974; Bezy et al. 1980). Females do not reproduce until about their fourth year, while males do not reach maturity until the spring of their third year. Breeding begins in March and young (mean number of offspring is 4.4) are born in September. Four to five young are produced per breeding cycle and their life expectancy ranges from 11 to 13 years. The species eats a variety of insects, as well as the fruits, leaves, and flowers of boxthorn plants *(Lycium sp.)*.

Estimating population size can be difficult due to the secretive nature of the island night lizard, but successful eradication of grazing animals from SCI may have had a significant, positive impact on population numbers due to the increase in covering plants. Although no population size was estimated for lizards on SCI during the listing period, Mautz (1982) later estimated a density of 1,976 to 3,211 lizards per acre in prime habitat. A crude population estimate based on this density information and the number of acres of prime habitat on SCI as noted above, would equate to about 6 to 10 million lizards around the time of listing. Additional surveys, with improved methods and more transects conducted in the 1990s and in 2001 (after the removal of feral goats, sheep, and deer), now estimate the population of lizards on SCI to be approximately 20 million individuals (Mautz 2001) and is thought to be stable. INL Trap capture rates and counts, despite the drought conditions in fall 2004, reveal population densities as high as the earlier 2001 data. The island night lizard population on SCI is monitored every 3 years using established survey transects. Estimated densities of the night lizard in grassland and different phases of Maritime Desert Scrub (MDS) habitat range from 462 individuals per acre in grassland to 1,036 individuals per acre in MDS-prickly pear phase (SCI INRMP, DoN 2002, based on data in Mautz 2001).

Figure 3.11-11: Island Night Lizard Habitat

Scattered rock outcrops with abundant loose boulders, smaller stones, low thickets of shrubs, and dense low patches of cactus provide retreats for this species. The lizard has also been observed in significant numbers under debris in Impact Area II and Mautz (2001) observed that island night lizards can live in close proximity to human habitation as long as there is adequate low vegetative cover and ground surface and subsurface shelter. Mautz (2001) found viable populations of the species widespread over most of the island grassland on the central plateau and the eastern escarpment. Habitats without rocks, woodlands, and dunes tend to support low numbers of this species, most likely due to the lack of suitable shelter.

The highest densities of island night lizard are associated with MDS habitats on the west side of the Island, as noted in INRMP Management Units (MUs) 7, 10, 12, and 13 (Terrace Canyon, Seal Cove, Lost Point, and Cave Canyon, respectively [Figure 3.11-11]). These four MUs account for an estimated 56 percent of the island night lizard population on SCI (based on data in DoN 2002, Appendix D). An area encompassing the western parts of these units plus the northwestern corner of MU 16 (China Cove) was identified as an Island Night Lizard Management Area (INLMA) in previous consultations with USFWS (1997c). However, the Navy does not propose to carry this designation forward, given the adoption of the INRMP (DoN 2002), which provides a more comprehensive and up-to-date management framework.

Based on data that indicate island night lizard populations to be viable and self-sustaining, the U.S. Navy submitted a petition on March 22, 2004, to designate SCI and SNI populations of the species as distinct population segments and to remove them from the Federal list of threatened species pursuant to the ESA (DoN 2004b). The U.S. Navy, using the best available scientific data, states that the island night lizard populations on SCI and SNI meet the three criteria for distinct population segments for delisting: discrete populations, significant populations, and population segment status. Since the Federal listing of the species as threatened, the U.S. Navy has eradicated feral grazers, formerly the primary threat to island night lizard habitat on SCI, and continued monitoring and adequate conservation measures are in place to ensure the long-term persistence of this species (DoN 2004b).

San Clemente Loggerhead Shrike (*Lanius ludovicianus mearnsi*)

The San Clemente loggerhead shrike was listed as endangered in August 1977, due to its declining population size from past habitat degradation, feral predators, and anthropogenic threats. The San Clemente loggerhead shrike is endemic to SCI and has been determined to be a genetically and morphologically distinct subspecies, separate from the other Channel Island populations, the mainland population, and from wintering visitors to SCI (Mundy and Woodruff 1996). San Clemente loggerhead shrikes are considered non-migratory, although individuals may disperse off-island. Shrikes from Catalina Island or the mainland also occasionally appear on SCI during the winter (DoN 2002), but are not known to breed on the island. Two life history traits of the shrikes, a predominantly monogamous mating system and a relatively short life span, make them vulnerable to extinction when combined with a small population size.

Around the turn of the century, the loggerhead shrike was considered “tolerably common” and well distributed on SCI (DON 2002). However, early field ornithologists, such as Grinnell, did not quantify their narrative assessments of species abundance, so it is not possible to make a numerical interpretation of the phrase “tolerably common.” Between 1985 and 1998 the population estimates ranged from 6 (1988) to 16 pairs (1994) (DoN 2002). The population did not reach 16 pairs (observed in 1994) again until 2001 when 16 of 20 pairs successfully nested in the wild (Plissner et al. 2002). Figure 3.11-12 summarizes the trend in numbers of breeding pairs between 1991 and 2005. During that period the shrike population increased from four breeding pairs in 1991 to over 40 breeding pairs in 2005 (Lynn *et al*. 2006). Since 2002, more than 60 percent of the shrike nest locations have been located outside the Shore Bombardment Area

(SHOBA) gate (Table 3.11-4). Locations of nest sites occupied during 2005 are shown in Figure 3.11-13.

San Clemente loggerhead shrikes begin to form pair bonds as early as December, and the breeding season can extend from January through mid-July, although most clutches are laid by May (DoN 2002). Average clutch sizes range from four to six eggs. The fledgling stage begins when nestlings leave the nest. Adults feed the fledglings frequently, tending the juveniles for 25-95 days post-fledging. Juveniles are considered independent after 40 days of age. During the fledgling stage, one or both members of the pair may initiate a new nesting attempt. Wing and tail feathers are not fully developed at fledging and consequently the offspring are very vulnerable to predators for the first 20 to 30 days after fledging. Second nesting attempts are made after either failure or fledging of the first nest (Scott and Morrison 1995), although, earlier clutches tend to be more successful than later clutches. Shrikes reach maturity after 1 year and some pairs remain together for multiple years (DoN 2002).

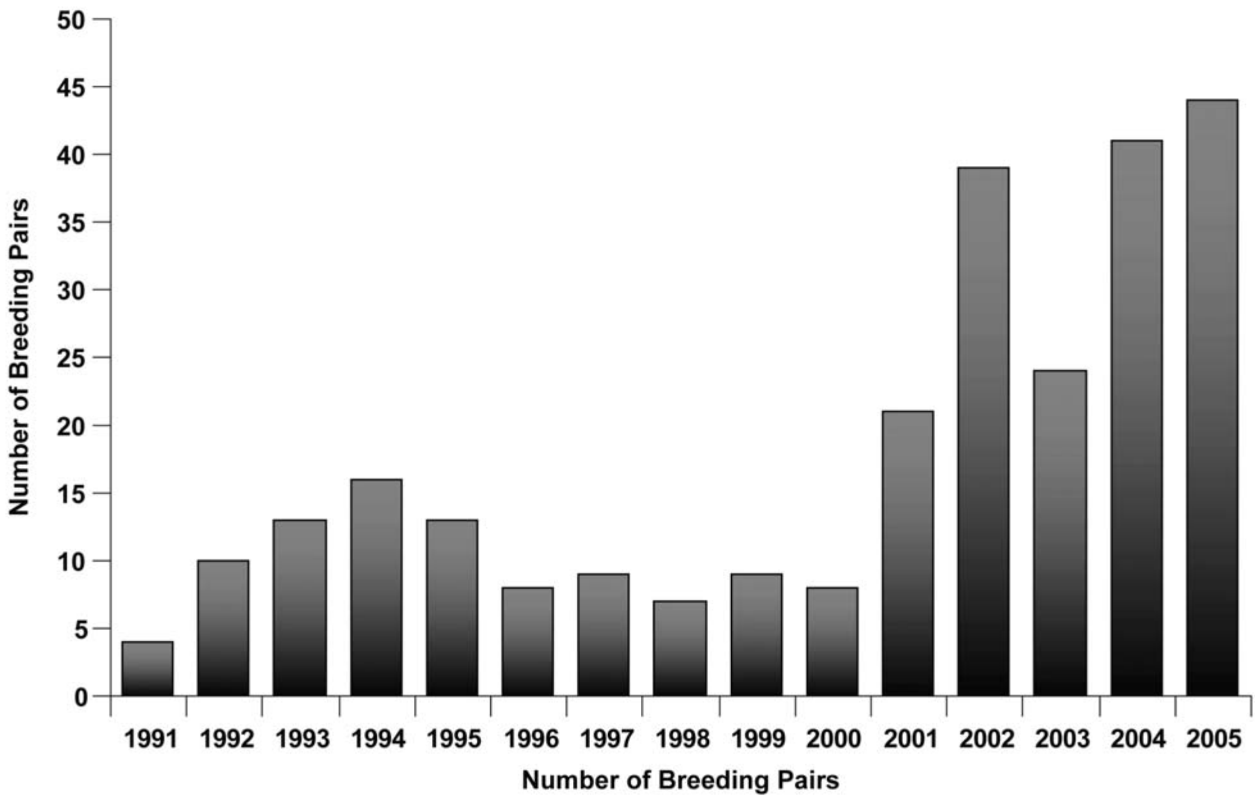


Figure 3.11-12: Number of San Clemente Loggerhead Shrike Breeding Pairs on SCI: 1991-2005 (Source: Lynn et al. 2006)

Table 3.11-4: Number of Loggerhead Shrikes Monitored During the Breeding Season and their Distribution in Relation to SHOBA

Year	Population Estimate*	% Territories Occupied IN SHOBA	% Territories Occupied OUTSIDE SHOBA
1993	35	54	46
1994	35	56	44
1995	27	38	62
1996	20	75	25
1997	20	67	33
1998	14	67	33
1999	16	78	22
2000	18	63	37
2001	50	43	57
2002	90	38	62
2003	55	30	70
2004	83	38	62
2005	90	33	67
2006	82	33	67
2007	89	26	74

*Number of adult shrikes known (or upper estimate range) to be alive at the start of the year (Jan 1).
Source: Annual San Clemente Loggerhead Shrike monitoring reports (See Bradley, et al. 2006; Lynn et al., 2006).

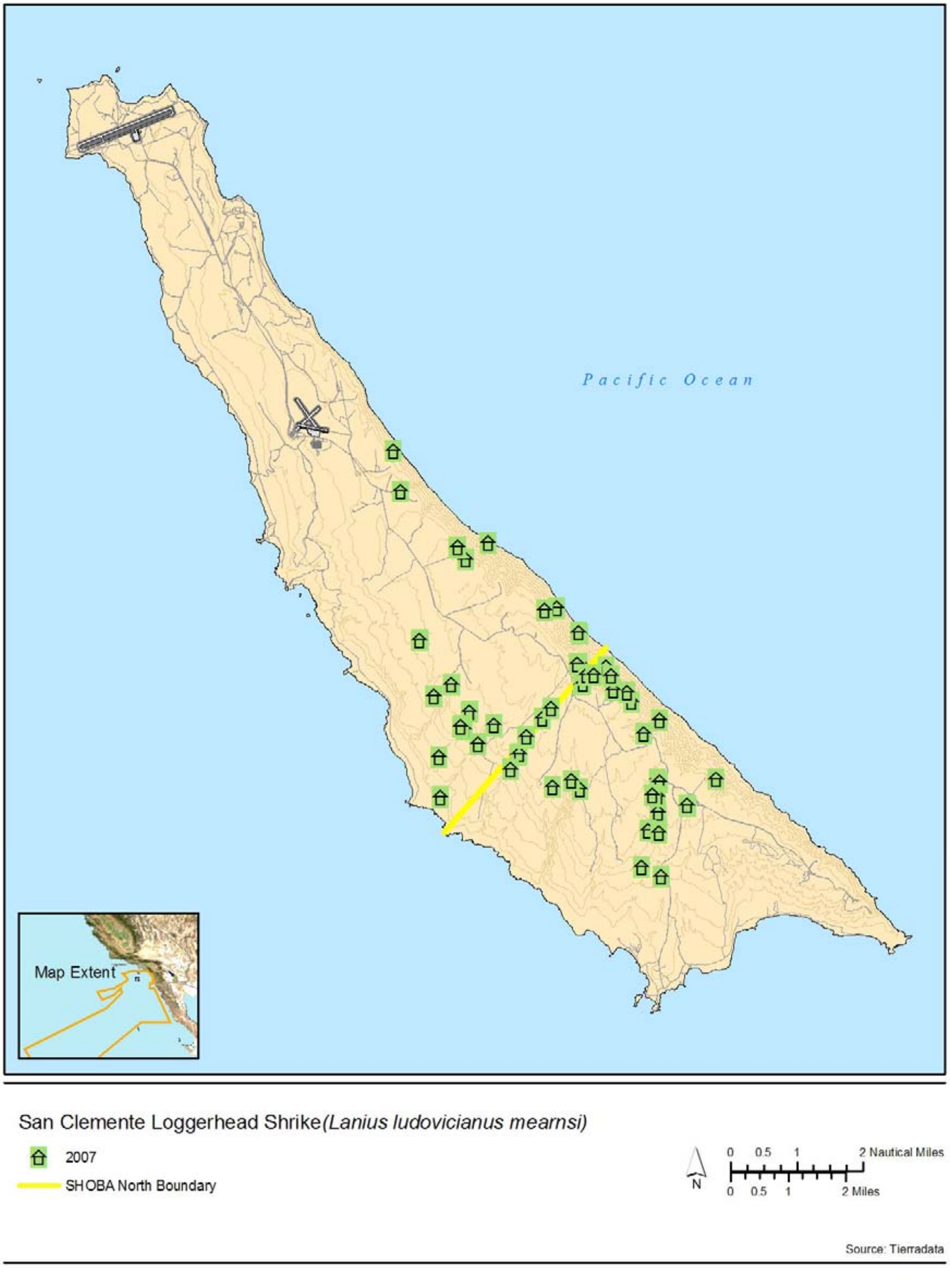


Figure 3.11-13: Location of Loggerhead Shrike Nests in 2005

Monitoring data from 2005 illustrate several facets of the shrike breeding season. Four shrike pairs began forming before January 1, all of these pairs had bred the preceding year. Nest building was first observed on January 17, and the median date of nest-initiation was March 13. The last nest observed under construction (that later contained eggs) was initiated approximately June. 5 Egg-laying commenced on February 21, a record early date, and the last clutch was initiated approximately June 9. The median date for the initiation of first clutches was March 26. There was no difference in nest success among nests that were initiated before the median date and those initiated after the median date.

The median fledging date for first nests was May 6, 2005. Five pairs attempted to breed again after successfully fledging young, three of which fledged a second nest in 2005. Four pairs successfully fledged young during their second nesting attempt after their first attempt failed. Three pairs failed twice before successfully fledging young on their third nesting attempt (Lynn *et al*. 2006).

San Clemente loggerhead shrikes are vulnerable to predation by a number of species. Rats tend to prey on the nests at the egg and chick stages, and mice prey on the eggs. Feral cats, red-tailed hawks, barn owls, and possibly American kestrels prey on adults, fledglings, and juveniles (Harvey 1996; DoN 2002). It is possible that some captive-reared shrikes found dead and eaten may have been preyed on by island foxes. Island foxes have been videotaped entering trees that contain shrike nests with nestlings. In 2005, predators were the suspected cause of failure at a minimum of 19% of failed nests. Predation by rats was directly observed by video in one case and suspected in several others.

The loggerhead shrike typically requires large shrubs or trees for nesting and roosting cover, elevated perches, open foraging areas in adjoining habitats, and a readily available supply of invertebrate and small vertebrate prey. Shrikes concentrate foraging around nesting locations during the breeding season and then may forage throughout the island from late summer to early January, although the males typically maintain the nesting territory during this period. Shrikes typically hunt from perches in sparse vegetation and attack prey on the ground (Lynn *et al*. 2003).

Shrikes hunt from snags, shrubs, and rock outcrops (Scott and Morrison 1990) and their diet consists of a wide range of insects, plus lizards and mice (DoN 2002). Typically, a bird has several preferred perches within the territory from which it hunts, constantly moving from one to another. When supplemental foraging perches were added to occupied territories, the foraging success rate and foraging area increased (DoN 2002).

Historically, nest sites had been located in trees or large shrubs in island woodlands near the bottoms of canyons along both sides of the southern half of the island. However, with the population expansion since 1999, a greater diversity of nest locations and nesting substrates have been used. In 2005, San Clemente Loggerhead Shrikes nested in nine species of plants and one artificial structure (Lynn *et al*. 2006). Of 59 known completed nests, 32% were built in island cherry, 27% were built in lemonadeberry, 20% in sagebrush, 7% in toyon, 3% each in coyote brush and Catalina ironwood, and 2% each in oak, morning glory, artificial substrate and climbing penstemon (Lynn *et al*. 2006). The range of structural complexity demonstrated by this selection of nest shrubs suggests that shrikes may be more flexible in their choice of nest substrate than previously assumed (Lynn *et al*. 2006).

In 1998, nest locations were largely restricted to SHOBA; China Canyon in SHOBA contained 62.5 percent of all nests (DoN 2002). With the population expansion in recent years, a growing majority of shrike locations are currently outside the SHOBA gate (Table 3.11-4). During 2001, San Clemente loggerhead shrikes nested for the first time on the island's plateau in grassland habitat along Ridge Road between VC-3 and Stone Station. Two nests, both in coyote brush (*Baccharis pilularis*), were produced at this location. One of these produced six fledglings, the other was predated (Plissner *et al*. 2002). Since 2001, additional successful nesting attempts have been made in these general areas, leading to further expansion. The shrikes may continue to expand into new areas and habitat types in future years as the population continues to increase.

On SCI, shrikes defend territories year-round and are often observed on nesting territories the entire year. Territory size can vary greatly depending on rainfall. Territories have been reported to range from 2.7 acres (1998 nesting territories) to 670 acres (2002 nesting territories) (Lynn *et al*. 2004b). Solitary shrikes in the winter and fall typically occupy the island's upper mesas (USFWS 1984). Shrikes have been detected during the winter in the vicinity of the proposed sites at TAR 9 (Photo Lab site), the Lemon Tank area, TAR 14, and various locales around Wilson Cove (DoN unpublished data, provided by CNRSW NRO, 2004). Monitoring results in Lynn *et al*. (2003) show that female shrikes typically leave their breeding sites to establish separate winter home ranges while males tend to remain on breeding territories throughout the year. Shrikes from Santa Catalina Island or the mainland also occasionally appear on SCI during the winter (DoN 2002).

Some sites are used successively each winter by the same individual, similar to breeding sites (DoN, CNRSW, NRO unpublished data). If, for some reason, the "owner" of a winter site does not occupy that site (in the case of adults) then that individual is thought to be lost from the population—it usually does not show up in the population again.

Some individual shrikes maintain a stationary, well-defended area throughout the winter while others shift about and may establish several sequential and temporarily defended areas. The former is especially true of females that depart breeding sites and the latter especially true about first year birds (juveniles of the year) or migrant shrikes.

Historic shrike population declines have been linked to severe habitat damage resulting from overgrazing by feral herbivores (Lynn *et al*. 2002), which have subsequently been eliminated from SCI. Nesting habitat on SCI was severely degraded by feral goats with the greatest amount of damage believed to have occurred between 1934 and 1976 when the goat population was not controlled. Many nesting and roosting sites were probably eliminated as direct or indirect effects of prolonged goat browsing.

To promote recovery of the shrike, the U.S. Navy established an intensive field monitoring program in 1990 and integrated it with a captive breeding and release program in 1991. The program was established in cooperation with organizations including the Western Foundation of Vertebrate Zoology, the Zoological Society of San Diego, Endangered Species Recovery Council, Institute of Wildlife Studies, and the PRBO. The captive breeding program has utilized a variety of approaches for protecting and augmenting breeding on SCI. Nestling birds and eggs have been taken from the wild, raised, and then kept in captivity as breeding stock under a number of different protocols. Wild nests have been protected, manipulated, augmented, or otherwise enhanced. Captive bred birds have also been released under a variety of strategies such as female releases, bonded pair releases, family releases, and juvenile releases (Turner *et al*. 2002). A total of 52 shrikes were released in 2001, of which 75 percent were recorded 1 month after their release. Of the 16 adults released, 5 successfully fledged young and produced 5 fledglings, 3 of which survived to independence (Turner *et al*. 2002). In 2005 (Lynn et al 2006), 45 captive-reared shrikes were released to the wild via three methods: family group releases (six adults and eleven juveniles in three family groups), single male releases (two adult males), and independent juvenile releases (twenty-six juveniles). One of the released adults initiated a nest within seven days of its release, in which five eggs were laid and from which 5 young fledged and reached independence. Twenty percent of shrikes that bred in 2005 were released in previous years (Lynn *et al*. 2006).

Wild and released birds have been given supplemental food, supplemental perches, and protection against predators, and are closely watched to identify any problems. Future release sites for captive bred shrikes are subject to review by the Fleet prior to implementation and are likely to occur in the canyons that lie north of SHOBA and drain toward the West Shore. Lynn *et al*. (2004b) report that supplementally fed individuals often modified their behavior in the presence of observers. Unfed shrikes tended to be secretive and less visible when observers were close to their territories, whereas supplementally fed birds often approached observers and remained nearby while observers monitored the site.

In addition, a predator control program to reduce these threats to shrikes was initiated to manage populations of feral cats, island foxes, and rats and other rodents. Since 2003 all predator control towards native species ceased, except in limited circumstances of imminent danger (which have not yet materialized) and efforts are focused on non-native predators including feral cats and rats (Kershner *et al*. 2004). Although some of the efforts to protect and increase the SCI population of shrikes got off to a slow start and had several setbacks, they have recently begun to show significant results. Most of these measures were instituted to help in the recovery of the shrike population. However, other species, such as San Clemente sage sparrow and island night lizards, may also benefit. The captive breeding and release program was administered to bolster the dwindling wild San Clemente loggerhead shrike population. Removal of abandoned/dead eggs from shrike nests serves for captive rearing, genetic analyses of the present breeding population, and research into cause of egg death. Key features of the shrike captive breeding program are summarized in Table 3.11-5. There is no direct arithmetic relationship between the numbers of young or eggs taken from the wild, the numbers of captive bred birds, and the numbers released in the wild in any given year.

During the 2004 shrike breeding season, a maximum population of 169 shrikes and a maximum estimated breeding population size of 81 shrikes was thought to occur in the wild, which indicates an over-winter survivorship of 68 percent for adults and 55 percent for hatching–year individuals (Lynn *et al*. 2005). During the 2004 nesting season, a total of 41 pairs of shrikes nested in the wild, initiating 64 nests at 40 breeding sites. A majority of the breeding sites (n=27) were located north of the SHOBA impact areas (north of SHOBA gate), while 13 were located within the SHOBA gate (Lynn *et al*. 2005). Of the 115 fledglings born in the wild, approximately 90 (77 percent) of these were believed to have attained independence, surviving to at least 40 days in age (Lynn *et al*. 2005).

The shrike population reached an all-time high in 2005, recovering from a dip in the population attributable in part to low over-winter survivorship between 2002 and 2003 (Lynn et al. 2006). Twenty percent of SCLS that bred in 2005 were released in previous years. In 2005, 40 SCLS pairs built at least 68 nests (1-5 nests per pair) that contained eggs. At least 205 eggs were produced. One hundred and twenty-three juveniles fledged from 32 successful nests (47% nest success) of 29 pairs. At least 91 fledglings survived to independence (41 days). Productivity remained above the 15-year mean for this population. As in past years, supplementally fed shrikes fledged more young and raised more young to independence than did shrike pairs that did not receive supplemental food. Above average rainfall leading into the 2005 breeding season, supplemental feeding, and continued predator control at breeding sites likely contributed to the increase in the breeding population (Lynn et al. 2006).

At the official end of the breeding season, 15 August, the maximum shrikes population in the wild was estimated to be as high as 90 adults (82 wild or released in previous years and 8 released in 2005) and 127 independent juveniles (96 wild and 31 released in 2005).

Analysis of data from 1998 to 2005 suggests that number of fledglings produced per successful pair was primarily related to mouse abundance (Lynn *et al*. 2006). Not surprisingly, home range sizes were inversely correlated with mouse abundance, that is, home ranges were smaller when mice were abundant and larger when they were scarce.

Table 3.11-5: San Clemente Loggerhead Shrike Captive Breeding Program Summary

Year	Notes from Captive Breeding Program
1991	5 eggs (3 fertile and viable) and 7 nestlings removed from SCI and taken to San Diego Zoo. 7 wild nestlings survive and 3 chicks survive from the 5 eggs. No releases.
1992	6 birds survive to form 3 pairs and produce 7 chicks (all remain in captivity). 20 eggs (20 fertile and viable) removed from 4 nests on SCI; 8 are reared and released too young; none can be accounted for shortly after release.
1993	26 eggs (17 fertile and viable) taken from 3 different nests, with 8 releases. 18 captive bred with 8 releases, again too young.
1994	16 eggs* removed from 3 nests, 12 birds captive bred, 8 releases of much more mature birds.
1995	11 eggs (5 fertile and viable) removed from the wild, 6 captive bred, 6 adults released.
1996	N/A eggs removed from the wild, 2 captive bred, 2 adults released.
1997	19 eggs (7 fertile and viable) removed from the wild, 4 captive bred, 0 releases.
1998	9 eggs (8 fertile and viable) removed from the wild, 28 captive bred, 0 releases.
1999	5 eggs* removed from the wild, 64 captive bred, 33 releases, including 9 adults.
2000	38 eggs (6 fertile and viable) removed from the wild, 43 captive bred, 44 releases, including 21 adults.
2001	20 eggs* removed from the wild, 47 captive bred, 53 releases, including 17 adults.
2002	N/A eggs, 1 chick removed from the wild, 55 captive bred, 44 releases, including 5adults.
2003	25 eggs*, 1 chick removed from the wild, 13 captive bred, 18 releases, including 11 adults.
2004	11 eggs*, 2 chicks removed from the wild, 20 captive bred, 20 releases, including 8 adults.
2005	0 eggs removed from the wild, 6 chicks removed from wild, 39 captive bred, 34 releases.

Source: Harvey (1996); Brock, NASNI (2000); Turner *et al.* (2004); Farabaugh *et al*, (2005). N/A=Not available. 2005 data from Brock, Navy Region Southwest, July 31, 2006 *Eggs salvaged; 0 fertile and viable upon arrival at facility.

San Clemente Sage Sparrow (*Amphispiza belli clementeae*)

The San Clemente sage sparrow was Federally listed as threatened in August 1977, due to its limited distribution (found only on portions of SCI) and threats to its habitat by feral goats and pigs. Current threats to the species include predation by feral cats and rats, limited distribution, exotic plant introduction, fires and fire suppression activities, and other human disturbances.

Sage sparrows occur throughout arid regions of western North America. San Clemente sage sparrows are distinguished from the mainland forms by their larger size and larger bill. San Clemente sage sparrows are non-migratory and are limited to the western and northern terraces of the island. Grinnell (1897) described them as “quite common” in *Lycium californicum* (MDSLY) and cactus habitat. Currently, the population occupies three more or less distinct habitat areas. The northernmost is centered north of the airfield in the vicinity of Whale Point and supports low and medium density populations (Figure 3.11-14). The most extensive band of habitat includes high, medium, and low density habitat and extends southward along the western shoreline and low terraces from just south of West Cove to the vicinity of Seal Cove. South of Seal Cove the habitat is limited to a narrow coastal band less densely populated with MDSLY and having medium to low densities of this species. This area extends southward into SHOBA terminating in Impact Area II with a small area on China Point (Munkwitz *et al*. 2002).

Recent surveys have indicated that sage sparrow population numbers and their spatial distribution on the island appear to expand and contract in different years (Table 3.11-6). Previous estimates show that these populations have fluctuated from a low of 38 individuals in 1984 to a high of 1,519 adults in 2002 (reviewed in Beaudry *et al*. 2004). During the 2001 breeding season, 140 nests and 170 adult sage sparrows were counted. Of the 140 nests counted, 106 nests were considered successful (76 percent), producing 307 fledged young (Munkwitz *et al*. 2002).

Little sage sparrow activity is expected around the NALF and VC-3 Assault Vehicle Maneuver Areas (AVMAs) because San Clemente sage sparrow habitat is of low quality or absent. The Old Rifle Range AVMA contains low density sage sparrow habitat contiguous with a large block of low, medium, and high density sage sparrow habitat to the west.

There appears to be little movement of San Clemente sage sparrows on SCI. The MDSLY habitat is occupied during both breeding and non-breeding seasons, with 64 percent of the nests found in the lowest terraces, 29 percent in the middle terraces, and only 7 percent in the upper terraces (KEA Environmental 1997). Although nearly 6,000 ac of MDSLY habitat occurs on the island, areas with larger boxthorn shrubs are more favored, and these occur mainly on the lower terraces on the western side of the island (Figure 3.11-14). Nests are placed in the boxthorn, which, due to its dense, thorny branches, provides important protection and cover against predators. Other plants such as lichen (*Roccella babingtonii* and *Roccella fimbriata*), island butterweed (*Senecio lyonii*), and island tarplant (*Hemizonia clementina*) are also used for nesting (Munkwitz *et al*. 2002) and the presence of cactus and forbs in the surrounding habitat is apparently also important to sage sparrows.

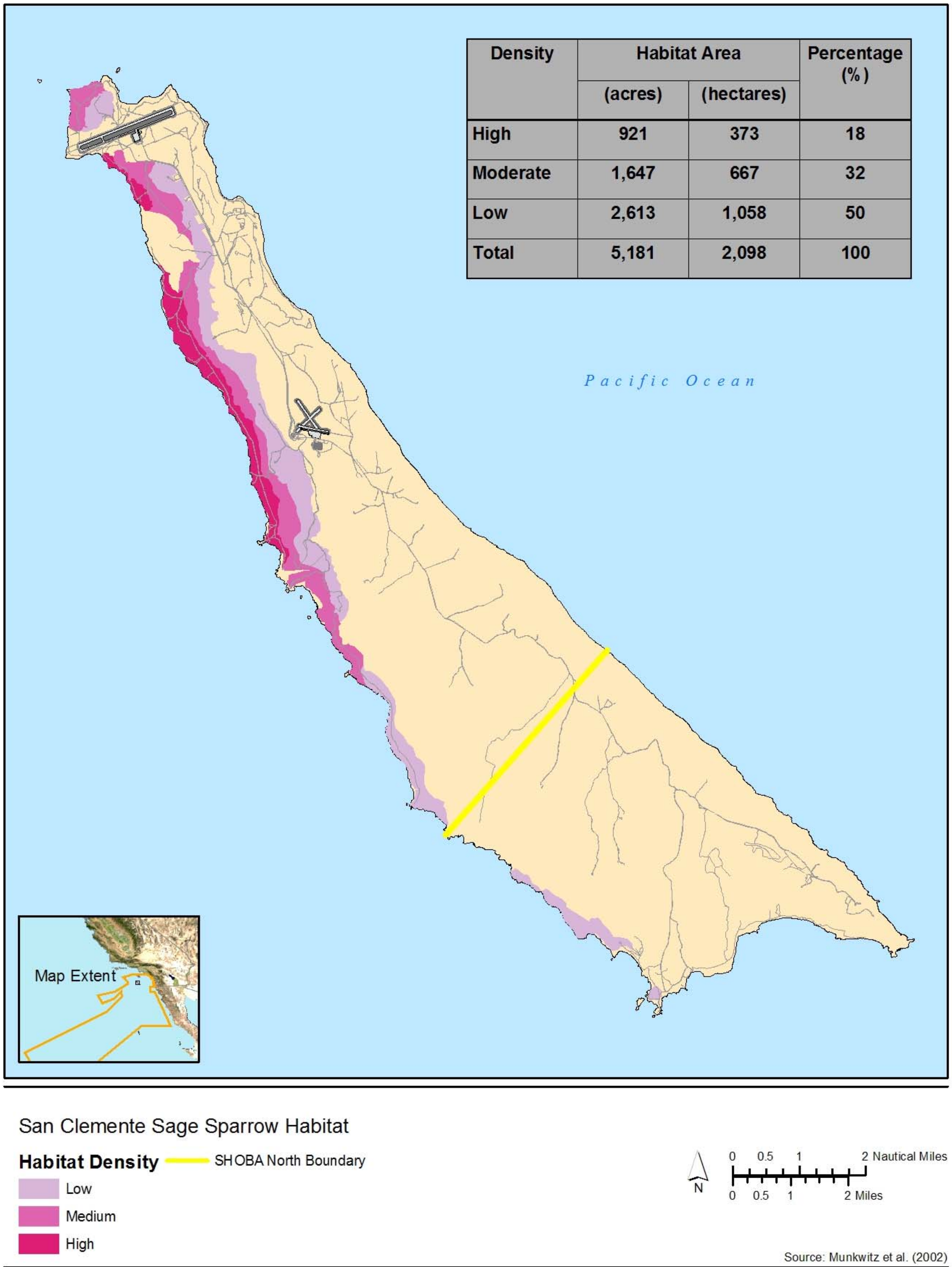
Breeding behavior begins in late January or early February, and nesting begins in mid-March, extending through June. Two to three eggs are laid in a clutch, and some birds may lay two or three clutches in a year. Incubation takes 12-13 days, and nest success is high (90-97 percent). After the breeding season, adults and juveniles form flocks (3 to 25 birds), which may be stable sub-populations. San Clemente sage sparrows forage on boxthorn fruit, as well as cactus fruits, *Atriplex*, and other plant seeds and insects. They are wary when feeding and tend to stay under good cover when foraging on the ground.

Table 3.11-6: 1976 to 2005 Estimated Population Size of San Clemente Sage Sparrows on SCI

Survey Year	Total Population Estimate, Unless Otherwise Noted
1976	112
1980	176
1981	360
1982	205
1983	198
1984	38
1985	91
1997	294 (adults only)
1999	578 (adults only)
2000	460 (adults only)
2001	578 (adults only)
2002	1,519 (adults only)
2003	544 (adults only)
2004	980 (adults only)
2005	685 (adults only)
2006	1216 (adults only)
2007	716 (adults only)

Sources: Biological Opinion 1-6-00-F-19 (USFWS, 2001b); Munkwitz *et al*. (2002); Beaudry *et al*. (2003); Beaudry *et al*. (2004); Turner *et al*. (2004); Turner *et al*. (2005), Kaiser *et al*. (2007).

Much of the core population is currently along the West Shore terraces (Figure 3.11-14) in the West Cove, Terrace Canyon, and Seal Cove MUs, where management emphasis is maintaining military values with high flexibility for maintaining natural resource values as an integral part of day-to-day operations, as described in the SCI INRMP (DoN 2002). The INRMP identifies and ranks MUs according to their military-use value and natural resources value. As indicated in Table 3.11-6 and discussed above, sage sparrow population size fluctuates significantly from year to year, as does the occupation of marginal habitat areas. Munkwitz et al (2002) found that nest productivity is similar between habitats that are considered high and medium/low density for sage sparrows, although similar productivity does not necessarily result in similar survivorship rates. Factors that could affect survivorship include the amount of cover and food supply, varying predation pressures, and differential disturbance from human activities and fires. When population size is low, such as in 1984 when there were only an estimated 38 individuals, random factors could combine to cause sage sparrow extinction. With more than one population locus (center), and with larger numbers of birds, such a catastrophic event is much less likely.



Density	Habitat Area (acres)	Habitat Area (hectares)	Percentage (%)
High	921	373	18
Moderate	1,647	667	32
Low	2,613	1,058	50
Total	5,181	2,098	100

Figure 3.11-14: San Clemente Sage Sparrow Habitat (Source: Munkwitz et al 2002).

Year-to-year fluctuations in sage sparrow populations are anecdotally explained by year-to-year fluctuations in the amount of rainfall (Beaudry *et al*. 2004). Intensity and distribution of rainfall affect the timing and extent of plant vegetative growth and flowering, which in turn presumably affects the production of invertebrates. At the later end of the breeding season, prolonged vegetative growth and flowering could be an important factor in extending the breeding season, as these plants can continue to provide resources for maintaining adult breeding condition and for feeding nestlings (Martin and Carlson 1998, as cited in Beaudry *et al*. 2004). Beaudry (2004) hypothesized that fluctuations in rainfall are a source of environmental variation that strongly affects demographics of the San Clemente sage sparrow. For example, after the 2001-2002 winter when rainfall totaled 2.7 in (6.8 cm), almost none of the observed females bred. After the 1998-1999 winter, a relatively dry winter for which the estimated rainfall was 5.1 in (13.1 cm), all observed females bred. Somewhere between these two values lies a "catastrophe threshold" below which reproduction is greatly reduced and survival is affected. Beaudry (2004) chose 3.1 in (8 cm) of rainfall to be the threshold level and, using Catalina Island rainfall data, found that rainfall below 3.1 in (8 cm) has occurred seven times in the past 55 years.

The observed decline in 2003 population from the 2002 population was expected given that observed breeding activity in 2002 was nearly absent (Beaudry *et al*. 2003, as cited in Beaudry *et al*. 2004). Additionally, the below average winter rainfall of 2001-2002 likely reduced the survival rate of all sage sparrows from 2002 to 2003 by limiting the amount of available resources. Population fluctuations additionally depend on the growth rate of the San Clemente sage sparrow; the population appears to be most sensitive to juvenile mortality. Other studies of passerines have also concluded that juvenile mortality is the most important factor influencing population growth (Beaudry 2004). Juvenile mortality is also directly related to recruitment into the breeding population for species that breed their first year as adults (Beaudry 2004).

Western Snowy Plover (*Charadrius alexandrinus nivosus*)

The Pacific Coast population of the western snowy plover was Federally listed as threatened in March 1993. Although critical habitat was designated for this species in December 1999, SCI was not included in the final critical habitat designation. Habitat loss for western snowy plovers along the Pacific coast of North America is largely responsible for the reduction in the breeding population size since the late 1800s (Page *et al*. 1995 as cited in Lynn *et al*. Western Snowy Plover Surveys 2004a) leading to listing of the Pacific coast population as threatened. Consistent presence of western snowy plovers in the winter and known coastal origin of all identifiable individuals on SCI during the winter suggest that this island is an important wintering area for the coastal population of this species (Lynn *et al*. 2004a).

The western snowy plover breeds along the Pacific coast from southern Washington to southern Baja California, as well as interior areas of Oregon, California, Nevada, Utah, New Mexico, Colorado, Kansas, Oklahoma and north central Texas. The Pacific coast population is genetically isolated from western snowy plovers that breed in the interior (USFWS 1993). The coastal population during winter is a mix of both resident and migratory birds. Some plovers winter in the same area as they breed, while others will migrate either northward or southward (Warriner *et al*. 1986; Page *et al*. 1986). The breeding season of the coastal population extends from mid-March through mid-September (USFWS 1993). Plovers will re-nest and double brood, either in the same location or another area, sometimes up to 100 miles (mi) (161 km) away (Warriner *et al*. 1986). Nests are unlined, shallow depressions in hardened clay, silt, loose cobble, pebbles, or sand Adults and eggs are cryptically colored because nests are in the open making them vulnerable to predators and exposed to the elements. Typical clutch size is three eggs with incubation averaging 27 days, and fledging time averaging 31 days, and sexual maturity is typically reached in 1 year for both sexes (Warriner *et al*. 1986). The chicks are precocial, leaving the nest within hours after hatching to search for food. At beach locations they feed on invertebrates in the wet sand and within kelp along the high tide line.

The snowy plover is a fairly common winter visitor to SCI., as suggested by numerous reports (Linton 1908; Howell 1917; Jorgenson and Ferguson 1984; Page *et al*. 1986; USFWS 2001b). Band recoveries in previous years (Powell *et al*. 1997; Foster and Copper 2003) suggest that some of the western snowy plovers that breed in San Diego County regularly move out to SCI during the winter. Powell *et al*. (1998) also detected a plover from Monterey County using Pyramid Cove during the fall of 1997. The visitors sighted are usually in low numbers and it seems that, in the last hundred years, sightings and numbers of individuals have been consistent. There is no evidence that snowy plovers from inland populations spend the winter on or migrate through SCI, although band recoveries from other studies show that birds from inland populations have wintered on the mainland Pacific Coast (Page *et al*. 1995).

Typically, the number of western snowy plovers on SCI peaks in November; recent surveys reveal that at least 41 western snowy plovers were observed in October of 2003, representing 11 to 18 percent of the minimum to maximum estimated numbers of plovers that winter in all of San Diego County (Lynn *et al*. 2004b).

The draft recovery plan for the western snowy plover (USFWS 2001b) identified five beaches on SCI as important for wintering birds: Pyramid Cove, Horse Beach, China Cove, West Cove, and Northwest Harbor (Figure 3.11-15). These five beaches constitute only 2.8 mi (4.6 km) of the 55 mi (88.5 km) of SCI coastline and are frequently inundated during high tides.

Wintering plovers are seen in largest numbers in Pyramid Cove, China Beach, and West Cove; Pyramid Cove was observed to have a maximum of 28 western snowy plovers in October 2003, China Cove had a high count of 19 in November 2003, and a high of 11 birds was observed in West Cove in October 2003. Recent surveys (between November 2000 and December 2003) recorded 27 to 41 snowy plovers on SCI beaches (Foster and Copper 2000, 2003; Lynn *et al*. 2004b).

A total of 20 plover breeding areas currently occur in coastal California, with 8 of those areas supporting a majority (78 percent) of the coastal California breeding population (Page *et al*. 1991). Two of those areas are Santa Rosa and SNI. Sand spits, dune-backed beaches, wide unvegetated beach strands, and open areas around estuaries and beaches at river mouths are preferred for nesting; however, these are generally lacking on SCI. Breeding was never confirmed on SCI until an adult and a chick were observed at West Cove in 1989. The only subsequent records were in 1996 and 1997. In 1996, Brian Foster and Robert Patton observed a nest with three eggs at Horse Beach that was later depredated and the three chicks did not survive. In 1997, at Horse Beach Cove, one nest with three eggs was observed to hatch three chicks (Foster 1998; Powell *et al*. 1998). More recent surveys have shown no evidence of snowy plover breeding activity on SCI from 2000 to 2003 (Foster and Copper 2000, Foster and Copper 2003; Lynn *et al*. Western Snowy Plover Surveys 2004b, Lynn *et al.* 2005, Lynn *et al*. 2006).

Figure 3.11-15 shows the location of western snowy plover habitat on the SCI. Predator activity is high at these locations, also limiting the prospects of successful nesting. During the 2002 breeding season surveys conducted by Point Reyes Bird Observatory, 1,387 adults were estimated from California coast populations. Roughly one-third of these were found on military installations from Vandenberg Air Force Base southward.

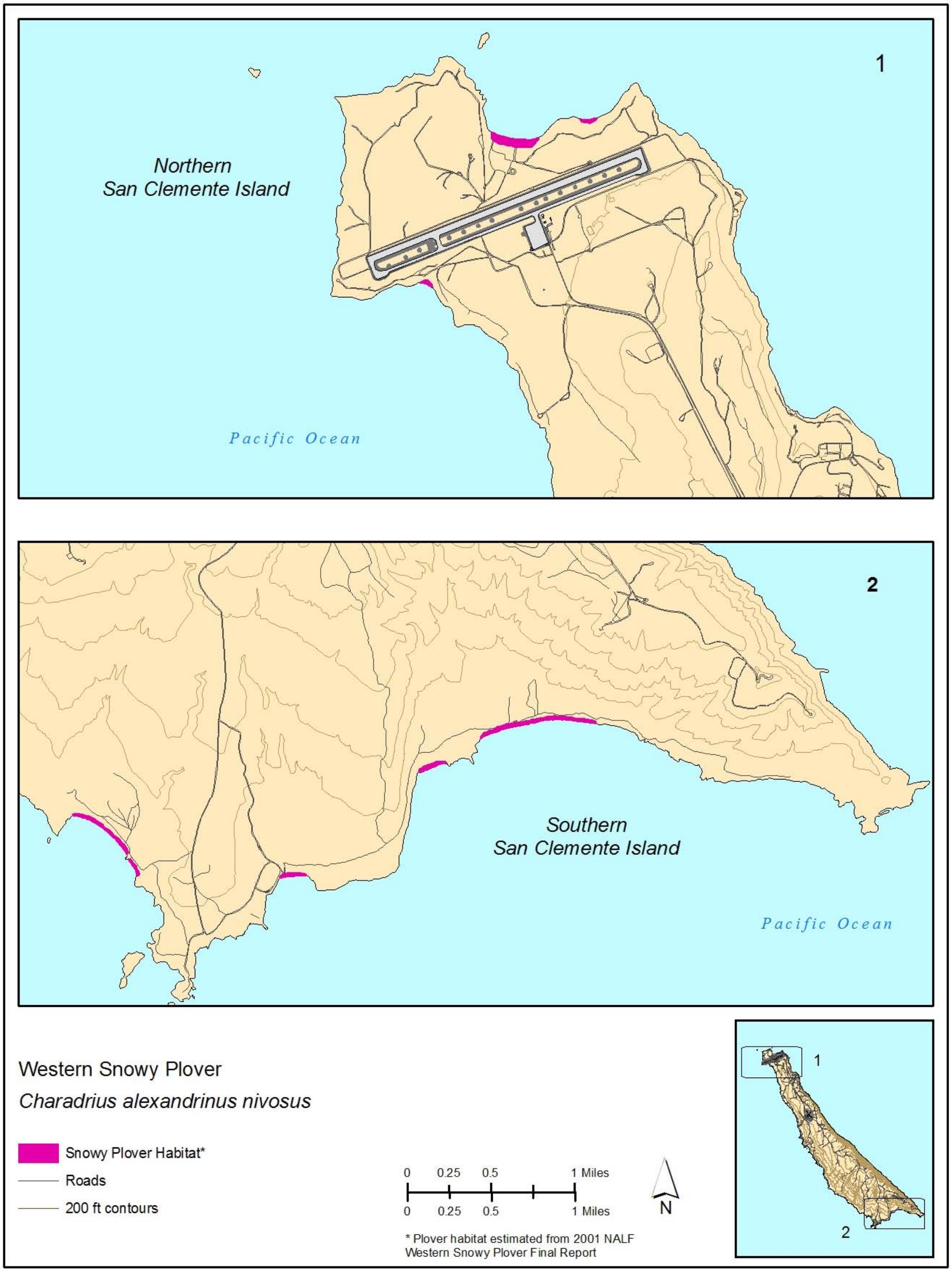


Figure 3.11-15: Western Snowy Plover (*Charadrius alexandrinus nivosus*) Habitat

Although increased recreational use of beaches and development have been cited as a cause for the decline in western snowy plover populations on the California coast and their subsequent listing as threatened in 1993, SCI is unlikely to be an important breeding area for this species due to a combination of factors. These include the limited extent of sandy beaches on SCI, the narrowness of the beaches, and the abundance of predators. The narrowness of the beaches results in periodic tidal inundation of potential nest sites and limited area within which to escape predation from the abundant native and non-native predators, which include island foxes, common ravens, and feral cats. Native island foxes and non-native feral cats forage on eggs or young that nest on the beach in sparse cover, and large populations of ravens in the same area also prey on eggs and young. Anthropogenic sources of disturbance other than military training may also contribute to the low western snowy plover nesting population, for example, fishing and other recreational activities of off-duty personnel at West Cove.

3.11.2.3 State-listed species

SCI supports four species listed as rare, threatened or endangered by the State of California that are not also Federally listed as endangered or threatened. These include San Clemente Island fox, Xantus's murrelet, Santa Catalina bedstraw, and SCI silver hosakia.

San Clemente Island Fox (*Urocyon littoralis clementae*)

The island fox (*Urocyon littoralis*) is represented on six of California's Channel Islands, with different subspecies occurring on the different islands. The species is listed as threatened under the California Endangered Species Act and the subspecies occurring on Santa Catalina, Santa Cruz, Santa Rosa, and San Miguel islands are listed as endangered under the Federal Endangered Species Act (ESA). The SCI subspecies is not listed under the ESA. However, in January 2003, the Navy entered into a Conservation Agreement (CA) with the USFWS to identify and implement proactive measures for the San Clemente Island fox, with the intent of avoiding population declines that might lead to Federal protection under the ESA. The following account is drawn primarily from the SCI INRMP (DoN 2002) and a BA and BO for the SCI Road Improvement Project (DoN 2004a and USFWS 2004, respectively).

The San Clemente Island fox subspecies is endemic to SCI, and is one of six island fox subspecies found on the Channel Islands. Although they can be observed in almost all vegetation communities on the island, this species prefers areas with burrows, dense shrubs, and rocky areas for protective cover. Additionally, it prefers areas with a relatively complex vegetation layer composed of woody, perennial, and fruiting shrubs. The fox is primarily nocturnal, with activity peaking in the early morning and before sunset, although they can be seen active during daylight hours. Pair bonding typically starts in January, with breeding occurring from late February through March. The fox can use a variety of objects as dens, including burrows, rock crevices, and tree hollows. The San Clemente Island fox is an opportunistic omnivore, feeding on a variety of fruits, rodents, birds, invertebrates, and carrion.

Population estimates of island foxes on SCI are associated with considerable uncertainty. Several population size estimates (based on fox density values) were calculated between 1988 and 1997; they ranged from 560 to 1,000. Home range studies done in 2000 and 2001 with radio telemetry indicate that all earlier population size estimates based on mark-recapture methods are overestimations. In 2001, the population size estimate ranged from 387 to 595, depending on method. Dune and Maritime Desert Scrub (MDS) habitat supports higher densities of foxes than grassland habitat. Subsequent population estimates are slightly higher (USFWS 2004).

The San Clemente Island fox population was affected by efforts to protect and recover the San Clemente loggerhead shrike between 1999 and 2002. In 2002, the USFWS agreed with a recommendation from the Navy to discontinue all manipulation of these foxes to protect nesting loggerhead shrikes beginning in 2003. Fox monitoring data since 2002 show increases on most study grids, although climatic conditions also improved in 2003. Most SCI fauna experience natural, cyclical changes in their populations in response to changing climatic conditions. Manipulations of foxes to protect loggerhead shrikes overlapped periods of drought conditions and probably exacerbated a natural decline in the fox population.

Collisions with vehicles have decreased since the CA was implemented (from 42 in 2001, to 12 in 2002 and 32 in 2003); the maximum speed limit on SCI was reduced from 45 mph to 35 mph and periodic clearing of road shoulders has increased visibility of foxes to motorists. Road kills increased during 2005 to about 55, which may be influenced by a relative increase in island foxes in areas where people and vehicles are most frequent on the Island. The age class data of foxes killed by vehicles have not been completely compiled and analyzed, but road kills typically increase in late summer or early fall when juvenile foxes are likely to be roaming in search of a territory. Analysis of 2003 road kill data from Schmidt and Garcelon (2005) where sex and age class were determined (N=30) showed that 27 percent of road kills were adult male, 40 percent were adult female, and 34 percent were pups, divided equally between male and female.

The Navy is continuing the practice of mowing vegetation on road segments where the Navy's mortality database reveal high incidence of road kills, including the San Clemente Ridge Road from the NALF airfield to the missile impact range and the Perimeter Road around the NALF. The project's contract requires 2-3 events of roadside mowing of 14 miles of road (28 miles of road shoulders) per year, with the mowing schedule determined after recent rainfalls and vegetation growth at a minimum six inches in height.

Disease and predation do not appear to be major threats to the San Clemente Island fox. The primary year-round predatory pressure on juvenile island foxes besides feral cats is raptors (buteos and accipiters). Predation by golden eagles and disease are responsible for the decline of island foxes on other Channel Islands. Golden eagles are not present on SCI, but bald eagle vagrants from Santa Catalina Island are occasionally detected. Bald eagles have not been identified as a predatory threat to island foxes. Recent veterinary findings indicate that canine distemper may be a natural component of the Channel Islands ecosystems, and flare-ups of the disease are cyclical (about every 7 to 10 years). As a precaution, foxes captured on some study grids in 2003 were inoculated with a canine distemper vaccine.

Resource competition between foxes and feral cats on the island, and habitat degradation from historical grazing by feral goats, may also contribute to a decline in the fox's population. Direct competition for resources between foxes and feral cats has been suggested as a possible source of the emaciated body condition and parasitic infestations recorded in some foxes. Fox study grids where declines are being measured are primarily in non-native grasslands recovering from decades of overgrazing. As a result of this recovery, grasses are tall and dense with a thick layer of thatch, which may impede fox movements or foraging capabilities.

Ongoing research is being conducted by the Navy into Island fox biology and life history. Additionally, a veterinary service has been set into place to care for sick and injured foxes on SCI, especially those encountered in or near town, and to determine causes of illness and mortalities. An island-wide database of fox mortality is being maintained. Preliminary results from the life history study indicate high survival rates ranging above 80 percent, with lower survival rates of foxes living near roads. Of 40 documented fox mortalities during calendar year 2007, 23 were road kills. The data on fox home range, dispersal, and factors related to road mortality including road segment, traffic, seasons, and types of vehicles are being analyzed.

San Clemente Island Bedstraw (*Galium catalinense spp. acrispum*)

SCI bedstraw is a shrub found only on SCI. It is listed as endangered by the State of California and is considered rare and endangered in California and elsewhere by the California Native Plant Society (CNPS List 1B). It occurs on open coastal slopes, steep canyon walls, and in canyon bottoms in sage scrub communities between 33 and 1,492 ft (10 and 455 m), commonly in inaccessible locations (Junak and Wilken 1998).

Current estimates based on surveys through 2007 are 224 occurrences with 2,647 individuals, all on SCI. Occurrences range from 1-2 individuals to over 75 individuals. Locations include Nanny Canyon, Burns Canyon, Twin Dams Canyon, Tota Canyon, Chamish Canyon, Thirst Canyon, Mosquito Canyon, Eagle Canyon, Middle Ranch Canyon, Kinkipar Canyon, Chenetti Canyon, Wall Rock Canyon, Lemon Tank Canyon, Horton Canyon, Vista Canyon, Waynuk Canyon, Horse Beach Canyon, Chukit Canyon, China Canyon, Bryce Canyon, Box Canyon, Norton Canyon, and Cave Canyon (Junak and Wilken 1998). Junak (2006) lists this species as "stable to increasing", with very healthy populations, many with numerous juvenile plants, recorded during the 2003-2006 surveys.

San Clemente Island silver hosakia (*Lotus argophyllus var. adsurgens*)

SCI silver hosakia is a woody subshrub with striking silvery foliage. This variety occurs only on SCI and is listed as endangered by the State of California and is considered rare and endangered in California and elsewhere by the California Native Plant Society (CNPS List 1B). It is found primarily within SHOBA on south-facing slopes and ridge tops in grassland and scrub communities between 20 and 1,320 ft (6 and 402 m) (Junak and Wilken 1998). About 70 occurrences collectively comprising about 2,400 individuals were identified by Junak and Wilken (1998). During surveys conducted between 2003 and 2006 32 occurrences with 2,661 individuals were identified (Junak 2006). Current estimates based on surveys through 2007 are 207 occurrences with 5,505 individuals, all on SCI. Occurrences range from 3-150 individuals. Key locations include China Canyon, Kinkipar Canyon, Chenetti Canyon, Knob Canyon, Bryce Canyon, Snake Cactus Canyon, Horse Beach Canyon, and Pyramid Point (Junak and Wilken 1998). Junak (2006) lists this species as "stable to increasing", with very healthy populations, many with numerous juvenile plants, recorded during the 2003-2006 surveys.

3.11.2.4 Other Sensitive Species

In addition to the Federally-listed and State-listed endangered and threatened species discussed above, SCI supports numerous species found only on SCI or only on SCI and other channel islands and recognized by authorities such as the California Native Plant Society as being sensitive. Table 3.11-7 lists species occurring within the action area on SCI that have been recognized by the California Native Plant Society as rare or endangered in California and elsewhere (CNPS List 1B species). Figure 3.11-16 shows the locations of occurrences of state-listed and CNPS List 1B species on SCI documented since 1998.

Table 3.11-7: Sensitive Plant Species Known from or Potentially Occurring on SCI

Species Name	Sensitivity Status	Plant Communities	Distribution and SCI Localities/Abundance[1]
Non-Listed Sensitive Species (CNPS 1B)			
Aphanisma *(Aphanisma blitoides)*	CNPS List 1B	Maritime desert scrub at elevations between 33 and 131 ft (10 and 40 m). Occurs near coastline, on flats immediately inland from beach.	Coastal California and Baja California, Mexico, including several of the California Channel Islands and islands off Baja California. On SCI, documented from between China Point and China Cove, Seal Cove, North Head, Whale Point, between "Spray" and Eel Point, and between Randall and Chamish Canyons (Junak and Wilken 1998; DoN 2002). SCI estimated population: 175 occurrences with 9,761 individuals. Junak (2006) notes this species as "increasing" on SCI.
SCI milk vetch (*Astragalus nevinii*)	CNPS List 1B	Stabilized dunes and coastal flats between 33 and 230 ft (10 and 70 m) in elevation. A few populations found in caliche soils in elevations reaching 394 ft (120 m) (Junak and Wilken 1998).	Found only on SCI. Documented from several locations at the north end of the island (e.g., the vicinity of the airfield and southward to Chamish Canyon), also at point south of Eel Cove on the west shore and Horse Beach Canyon on the southern end of the island (Junak and Wilken 1998). SCI estimated population: 205 occurrences with 21,554 individuals. Junak (2006) notes this species as "increasing" on SCI.
Coulter's saltbush *(Atriplex coulteri)*	CNPS List 1B	Coastal bluff scrub, coastal dunes, coastal scrub, grasslands (CNPS 2008).	Known from several California Channel Islands and adjacent mainland including Baja California, Mexico. Few recent sightings. Reported from SCI but no specific locality or habitat information available (DoN 2002).). SCI estimated population: No data.
South coast saltscale *(Atriplex pacifica)*	CNPS List 1B	Coastal flats and bluffs, open slopes and ridge tops. Gentle slopes or flats with south exposures at elevations between 49 and 1,476 ft (15 and 450 m) (DoN 2002).	Known from California Channel Islands except San Miguel Island and on adjacent mainland from Ventura County southward into northern Baja California, Mexico. Sonoran Desert localities in Arizona and Sonora, Mexico. Appears rare throughout range. On SCI, documented from Chukit Canyon, Box Canyon, Norton Canyon, Eel Cove Canyon, Seal Cove, Middle Ranch Canyon, Snake Cactus Canyon, and Pyramid Target (Junak and Wilken 1998; DoN 2002). SCI estimated population: 67 occurrences with 585 individuals. Junak (2006) notes this species as "increasing" on SCI.

Species Name	Sensitivity Status	Plant Communities	Distribution and SCI Localities/Abundance[1]
SCI brodiaea (*Brodiaea kinkiensis*)	CNPS List 1B	Grasslands in central portion of plateau between 984 and 1,854 ft (300 and 565 m).	Found only on SCI. Documented from Waynuk Canyon, Wall Rock Canyon, Tota Canyon, Lemon Tank Canyon, Twin Dams Canyon, Norton Canyon, flats along Horton Canyon Road, near junction of Horton Canyon and Ridge Road. Thousands of individuals were observed during spring 2003 surveys conducted for the P-493 Project. SCI estimated population: 142 occurrences with 64,015 individuals. Junak (2006) notes this species as "increasing" on SCI.
SCI suncup (*Camissonia guadalupensis clementina*)	CNPS List 1B	Sand dunes, partially stabilized and unstabilized, generally between 33 and 279 ft (10 and 85 m) (Junak and Wilken 1998).	Found only on SCI. Documented from the vicinity of the airfield, Flasher, between Eel Cove and Seal Cove on the west shore, and China Cove on the south end of the island (Junak and Wilken 1998). SCI estimated population: 89 occurrences with 23,456 individuals. Junak (2006) notes this species as "increasing" on SCI.
Island apple-blossom *(Crossosoma californicum)*	CNPS List 1B	Rocky coastal slopes, canyon walls on west side of SCI. Flats and west- and south-facing slopes at elevations between 59 and 1,345 ft (18 and 410 m) in maritime desert scrub (DoN 2002).	Found only on SCI, Santa Catalina Island and Guadalupe Island and the Palos Verdes Peninsula (Los Angeles County). On SCI, documented from Horse Beach Canyon, Seal Cove, Tombstone Canyon, Warren Canyon, Eel Cove Canyon, Chenetti Canyon, Wall Rock Canyon, Terrace Canyon, Bryce Canyon, China Canyon, Mail Point, West Cove, Middle Ranch Canyon, and near Camera Pad "Frank" (Junak and Wilken 1998; DoN 2002). SCI estimated population: 60 occurrences with 79 individuals. Junak (2006) notes this species, which occurs as isolated individuals or in very small populations, may be decreasing .
Trask's cryptantha (*Cryptantha traskiae*)	CNPS List 1B	Sandy coastal flats, partially stabilized sand dunes near coast. On flats, usually found in openings between maritime scrub dominants. Species occurs at elevations between 33 and 230 ft (10 and 70 m) (DoN 2002).	Found only on San Nicolas and San Clemente Islands. On SCI, documented from Northwest Harbor, near BUD/S Camp, sand dunes near Flasher, between Eel Cove and Seal Cove, and China Cove (Junak and Wilken 1998). SCI estimated population: 25 occurrences with 13,906 individuals. Junak (2006) lists this species as decreasing, with a dramatic decline noted between the 1996-1997 surveys and 2003-2006 surveys. It is an annual plant that may have "dramatic annual fluctuations in population sizes depending on the quantity and timing of rainfall in any given year ". Junak (2006) notes that on San Nicolas Island, the other known location, the species is facing ever-increasing competition from invasive, non-native plants.

Species Name	Sensitivity Status	Plant Communities	Distribution and SCI Localities/Abundance[1]
Thorne's royal larkspur *(Delphinium veriegatum* spp. *thornei)*	CNPS List 1B	Grassy, north-facing slopes, often near the heads of canyons of the east side of SCI, or associated ridges or swales, mostly in southern portion of SCI. Species occurs at elevations between 1,312 and 1,804 ft (400 and 550 m) (DoN 2002).	Found only on SCI. Documented from escarpments near Mosquito Canyon, Bryce Canyon, Eagle Canyon, and Vista Canyon, and escarpments near Camera Pad "Malo" (Junak and Wilken 1998; DoN 2002). SCI estimated population: 78 occurrences with 10,026 individuals. Junak (2006) notes this species may be decreasing.
Channel Island tree poppy *(Dendromecon harfordii* spp. *rhamnoides)*	CNPS List 1B	Chaparral, canyon woodland, maritime desert scrub, and maritime sage scrub (DoN 2002).	Found only on Santa Catalina Island and SCI. No known extant populations on SCI. Historical locations on SCI are from near Northwest Harbor and some precipitous cliffs near the south end of SCI (DoN 2002). SCI estimated population: No current occurrences known. Presumed to be extinct on SCI (Junak 2006).
California dissanthelium *(Dissanthelium californicum)*	CNPS List 1A	Maritime desert scrub.	Known only from SCI, Santa Catalina, and Guadalupe Islands. Thought to be extinct throughout its range (Santa Catalina, Guadalupe, and San Clemente Islands) but rediscovered in March 2005 on Santa Catalina Island. SCI estimated population: No current occurrences known. Presumed to be extinct on SCI (Junak 2006).
Island green dudleya *(Dudleya virens* spp. *virens)*	CNPS List 1B	Coastal bluffs on steep, rocky canyon walls at elevations between 33 and 1,739 ft (10 and 530 m) (DoN 2002).	Found only on SCI. Documented from escarpments near Camera Pad "Malo," Cave Canyon, Mosquito Cove, Burns Canyon, Middle Ranch Canyon, Bryce Canyon, Thirst Canyon, Chamish Canyon, Snake Cactus Canyon, Norton Canyon, Eagle Canyon, Knob Canyon, Lemon Tank Canyon, Wall Rock Canyon, Twin Dams Canyon, Tota Canyon, Chenetti Canyon, Vista Canyon, Waynuk Canyon, Larkspur Canyon, Chukit Canyon, Horse Beach Canyon, Horse Canyon, Box Canyon, China Canyon, and numerous unnamed escarpments and bluffs (Junak and Wilken 1998; DoN 2002). SCI estimated population: 324 occurrences with 20,425 individuals. Junak (2006) did not quantify its occurrences in his more recent surveys due to its increasing abundance and widespread distribution on SCI.

Species Name	Sensitivity Status	Plant Communities	Distribution and SCI Localities/Abundance[1]
SCI buckwheat *(Eriogonum giganteum* var. *formosum)*	CNPS List 1B	Coastal slopes and flats on steep canyon walls and canyon bottoms at elevations between 33 and 1,500 ft (10 and 455 m) (DoN 2002).	Found only on SCI. Documented from Eagle Canyon, Snake Cactus Canyon, Chamish Canyon, Mosquito Cove, Mosquito Canyon, China Canyon, Waynuk Canyon, Thirst Canyon, Twin Dams Canyon, Middle Ranch Canyon, Vista Canyon, Kinkipar Canyon, Matriarch Canyon, Horse Beach Canyon, Horse Canyon, Box Canyon, and Chukit Canyon (Junak and Wilken 1998). SCI estimated population: 270 occurrences with 15,523 individuals. Junak (2006) notes this species as "increasing" on SCI.
Nevin's eriophyllum *(Eriophyllum nevinii)*	CNPS List 1B	Canyon woodland, sea bluff succulent scrub, maritime sage scrub.	Found only on SCI, Santa Catalina Island, and Santa Barbara Island. On SCI it is very abundant and widespread , found on canyon walls, sea bluffs, and rocks. Not mapped by Junak and Wilken (1998) or Junak (2006). No exact locality information available (DoN 2002). SCI estimated population: Abundant and widespread; no specific locational data or population numbers. Also known as *Constancea nevinii.*
Island snapdragon *(Galvezia speciosa)*	CNPS List 1B	Common on canyon walls and in woodlands (DoN 2002).	Found only on SCI, Santa Catalina, and Guadalupe islands. On SCI, documented from Knob Canyon, Tota Canyon, Warren Canyon, Eel Cove Canyon, Cave Canyon, Chukit Canyon, Box Canyon, Horton Canyon, Twin Dams Canyon, Burns Canyon, Mosquito Canyon, Chenetti Canyon, Horse Beach Canyon, China Canyon, Kinkipar Canyon, and Eel Point (DoN 2002). Not mapped by Junak and Wilken (1998). SCI estimated population: Abundant and widespread; no specific locational data or population numbers.
SCI hazardia *(Hazardia cana)*	CNPS List 1B	Steep canyon walls, canyon bottoms, and terrace faces at elevations between 230 and 1,214 ft (70 and 370 m) (DoN 2002).	Found only on SCI and Guadalupe Island. On SCI, documented from Middle Ranch Canyon, Mosquito Canyon, escarpments near Camera Pad "Malo," Eagle Canyon, China Canyon, Chenetti Canyon, Twin Dams Canyon, Matriarch Canyon, Cave Canyon, Bryce Canyon, Norton Canyon, Horse Canyon, Horse Beach Canyon, and Box Canyon (Junak and Wilken 1998). SCI estimated population: 153 occurrences with 3,347 individuals. Junak (2006) lists this species as "stable to increasing", with very healthy populations, many with numerous juvenile plants, recorded during the 2003-2006 surveys.

Species Name	Sensitivity Status	Plant Communities	Distribution and SCI Localities/Abundance[1]
Southern island tree mallow (*Lavatera assurgentiflora* spp. *glabra*)	CNPS List 1B	Swales in northern and central portions of the island on west- and north-facing slopes between elevations of 70 and 500 ft (21 and 152 m). Also on stabilized and active dunes (DoN 2002). Commonly used in landscape plantings around Wilson Cove.	Found only on SCI and Santa Catalina Island. On SCI, documented from near the west end of the airstrip, the south side of the airstrip, the vicinity of Flasher, and from Chamish Canyon (Junak and Wilken 1998). Survey reports from the mid-1800s suggested that it was formerly more abundant and widespread and even dominant at many locations. SCI estimated population: 32 occurrences with 276 individuals. Junak (2006) notes this species may be decreasing on SCI.
Robinson's pepper-grass *(Lepidium virginicum* var. *robinsonii)*	CNPS List 1B	Maritime desert scrub on south-facing ridge tops and slopes at the south end of the island between elevations of 328 and 525 ft (100 and 160 m) (Junak and Wilken 1998).	Known from SCI and Santa Cruz Islands and coastal mainland locations from Monterey County to Baja California, Mexico. On SCI, documented from southeast end of SCI near "Guds" (Junak and Wilken 1998; DoN 2002). SCI estimated population: 5 occurrences with 285 individuals. Junak (2006) notes this species may be decreasing on SCI.
Pygmy linanthus *(Linanthus pygmaeus* spp. *pygmaeus)*	CNPS List 1B	Grassland.	Found only on SCI and Guadalupe Island. No specific locality information, but fairly frequent on SCI in purple needlegrass grasslands (DoN 2002). SCI estimated population: Abundant and widespread on SCI; no specific locational data or population numbers in Junak and Wilken (1998) or Junak (2006). Also known as *Leptosiphon pygmaeus* ssp*. pygmaeus.*
San Nicolas Island lomatium (*Lomatium insulare*)	CNPS List 1B	Sea bluffs (DoN 2002).	Known only from SCI, San Nicolas Island, and Guadalupe Island. SCI estimated population: Presumed extinct on SCI.
Guadalupe Island lupine *(Lupinus guadalupensis)*	CNPS List 1B	Slopes and flats in grasslands and open flats in maritime desert scrub at elevations between 33 and 1,312 ft (10 and 400 m) (DoN 2002).	Found only on SCI and on Guadalupe Island, Baja California, Mexico. On SCI, documented from Norton Canyon, near Eel Point, Eel Cove Canyon, Wall Rock Canyon, escarpments near Camera Pad "Malo," near West Shore Road, Tota Canyon, near Camera Pad "Pebble," near Camera Pad "Bud 3," near Camera Pad "Darter," Eel Cove Canyon, Warren Canyon, near Triangulation Station "Arizona," Kinkipar Canyon, Wilson Cove, Box Canyon, Middle Ranch Canyon, coastal flats between "Spray" and Eel Point, near Camera Pad "Wing," and near Chamish Canyon (Junak and Wilken 1998; DoN 2002). SCI estimated population: 356 occurrences with 65.902 individuals. Junak (2006) notes this species as "increasing" on SCI.

Species Name	Sensitivity Status	Plant Communities	Distribution and SCI Localities/Abundance[1]
Santa Catalina Island desert-thorn (*Lycium brevipes* var. *hassei*)	CNPS List 1B	Coastal slopes below 197 ft (60 m) in elevation (DoN 2002).	Historic range included SCI, Santa Catalina Island, and Palos Verdes Peninsula (Los Angeles Co.). SCI estimated population: Presumed extinct on SCI (Junak 2006).
Santa Cruz ironwood *(Lynothamnus floribundus* spp. *aspleniifolius)*	CNPS List 1B	Steep north-facing canyon walls on the east escarpment at elevations between 984 and 1,608 ft (300 and 490 m). Occasionally present in canyon bottoms and on the west side of the island at elevations as low as 295 ft (90 m) (DoN 2002).	Found only on SCI, Santa Cruz Island, and Santa Rosa Island. Reproduces vegetatively by stump sprouting so an individual "stand" may be one genetic individual. On SCI, documented from Mosquito Canyon, Vista Canyon, Eagle Canyon, near Camera Pad "Malo," Bryce Canyon, Matriarch Canyon, Thirst Canyon, Canchalagua Canyon, Horse Canyon, and near Knob Canyon (Junak and Wilken 1998; DoN 2002). SCI estimated population: 153 occurrences with 569 individuals. Not included in Junak (2006).
SCI phacelia *(Phacelia floribunda)*	CNPS List 1B	Loose talus slopes with large angular rocks and rocky flats in canyon bottoms at elevations between 10 and 1,214 ft (3 and 370 m) (DoN 2002).	Found only on SCI and on Guadalupe Island, Baja California, Mexico. On SCI, documented from the southeast end of SCI near "Guds," Middle Ranch Canyon, Seal Cove, near "Jack," Norton Canyon, Wall Rock Canyon, Horse Canyon, Cave Canyon, North Head, Whale Point, near Pyramid Point, and Wilson Cove (Junak and Wilken 1998; DoN 2002). SCI estimated population: 52 occurrences with 2,983 individuals. Junak (2006) notes this species may be decreasing on SCI.
Santa Catalina figwort (*Scrophularia villosa*)	CNPS List 1B	Open north- and east-facing slopes and canyon bottoms along the eastern escarpment between 20 and 1,394 ft (6 and 425 m) in elevation (DoN 2002).	Found only on SCI and Santa Catalina Island. On SCI, documented from Stone Canyon, Burn's Canyon, Horton Canyon, and Thirst Canyon (Junak and Wilken 1998). SCI estimated population: 47 occurrences with 1,432 individuals. Junak (2006) notes this species as "increasing" on SCI.
Blair's munzothamnus *(Stephanomeria blairii)*	CNPS List 1B	North- and west-facing, very steep and very rocky canyon walls with little vegetative cover in the central and southern portions of SCI. Species occurs at elevations between 16 and 1,804 ft (5 and 550 m) (DoN 2002).	Found only on SCI. Documented from Middle Ranch Canyon, Twin Dams Canyon, Eagle Canyon, Tota Canyon, Burns Canyon, Bryce Canyon, Warren Canyon, Tombstone Canyon, Thirst Canyon, Mosquito Canyon, Vista Canyon, Waynuk Canyon, Horse Canyon, Mosquito Cove Canyon, and Box Canyon (Junak and Wilken 1998; DoN 2002). SCI estimated population: 296 occurrences with 6,150 individuals. Not updated in Junak (2006).

Species Name	Sensitivity Status	Plant Communities	Distribution and SCI Localities/Abundance[1]
SCI triteleia *(Triteleia clementina)*	CNPS List 1B	North-facing canyon walls of the eastern escarpment of SCI at elevations between 33 and 1,509 ft (10 and 460 m) (DoN 2002).	Found only on SCI. Documented from Eagle Canyon, Lemon Tank Canyon, Knob Canyon, Wall Rock Canyon, near Camera Pad “Malo,” Bryce Canyon, escarpments near Mosquito Canyon, Mosquito Canyon, Box Canyon, near Nanny Canyon, near “Malo 1,” near Tota Canyon, and near Camera Pad “Snapper” (Junak and Wilken 1998; DoN 2002). SCI estimated population: 88 occurrences with 4,818 individuals. Junak (2006) notes this species may be decreasing on SCI.

CNPS List 1B Species are those Listed as” Rare and Endangered in California and Elsewhere” by the California Native Plant Society. CNPS List 1A Species are those Listed as “Presumed Extinct in California.” CNPS List 4 is a “watch list”. Sources: SCI INRMP (DoN 2002), Sensitive Plant Status Survey (Junak and Wilken 1998). Estimated numbers of occurrences and SCI estimated population size is from results of surveys conducted by the Santa Barbara Botanic Garden from 1996 through 2005.

Figure 3.11-16: Locations of Occurrences of State-listed and CNPS List 1B Species

3.11.3 Summary of Resources within Operations Areas

Operations Areas on SCI include the Assault Vehicle Maneuver Corridor (AVMC), including Assault Vehicle Maneuver Areas (AVMAs), the Assault Vehicle Maneuver Road (AVMR) and AVMR-SHOBA, as well as Artillery Maneuvering Points (AMPs) A through D, and Artillery Firing Points (AFPs) 1 and 6 (Table 3.11-8). Additionally Training Areas and Ranges (TARs), (Table 3.11-9) and the Infantry Operations Area (IOA) have been designated that support principally or exclusively foot traffic. Of the Island's land area of approximately 36,000 ac, about 1,087 ac have been identified within Assault Vehicle Maneuver Areas (3 percent of the Island Area) not including non-adjacent AVMR or AVMR-SHOBA, and 1,840 ac of land area (5.4 percent of the Island area) have been included in the TARs. Portions of TARs 5, 14, 15, and 21 are overlapped by AVMAs. Most of the AMPs are included in the AVMA total, but approximately 164 additional acres outside the AVMAs have been identified as AMP-C (5.5 ac) or are contained within AFP-1 (34.1 ac) and AFP-6 (124 ac). The IOA encompasses 8,815 ac (about 25 percent of the Island's area) but it is overlapped by virtually all of the AVMAs; AMPs, AFP-6 and AFP-1. The IOA is also overlapped by TARs 9, 12, 14, 15, and 16; and by about one third of TAR 21.

Table 3.11-8: Proposed Vehicular Operations Areas on SCI

Proposed Vehicle Operations Area		Comments
AVMAs	Area (Acres)	
NALF AVMA	272.4	
Old Rifle Range AVMA	200.3	
VC-3 AVMA	587.8	
AVMC in SHOBA[1]	26.3	
Total Area of AVMAs	1,086.8	
AMPs/AFPs		
A. Island Airfield AMP	20.2	Overlaps NALF AVMA
B. Old Rifle Range AMP	25.4	Overlaps Old Rifle Range AVMA
C. Self Help AMP	5.5	
D. Old Airfield AMP	6.2	Overlaps VC-3 AVMA
AFP-1 SHOBA	34.1	
AFP-6 SHOBA	124.0	
Total Area of AMPs/AFPs	215.4	
AMP/AFP area not overlapping AVMAs	163.6	

Notes:

1) Estimated area, requires engineering design

TAR Sites

The following section describes habitat types and general wildlife use of the TARs identified on SCI. Table 3.11-9 lists the different TAR sites, habitat types, and provides summary notes on the listed and sensitive species potentially occurring at each site. TARs 1, 4, and 16 were previously addressed in the Environmental Assessment (EA) Small Arms, Demolition Ranges and Training Areas for Naval Special Warfare Group ONE at San Clemente Island, California, and the accompanying January 17, 2001 USFWS Biological Opinion. TARs 1, 4, and 16 are existing components of the SOCAL Range Complex. The remaining 19 TARs are part of the Proposed Action. The following characterization of the TAR sites is based on field reconnaissance and literature reviews by the preparers including results of surveys and management reports prepared for the Navy encompassing T/E and sensitive plant and wildlife species. Information on surveys and threatened, endangered and sensitive plant and wildlife species is presented above under Threatened and Threatened and Endangered Species (3.11.1.1.2)

Table 3.11-9: Habitat Types and Sensitive Species at TAR Sites on SCI

Site	Site Characteristics	Comment[1]
TAR 1	Disturbed vegetation, small portion of stabilized sand dunes.	No listed or sensitive species are known from this TAR.
TAR 2	Grassland, coastal strand, dirt roads, and several sheds.	California brown pelican.
TAR 3	Grassland, coastal strand, foredunes, and roads, trails, and facilities associated with BUD/S Camp.	Snowy plover wintering, California brown pelican.
TAR 4	Disturbed vegetation, MDS-*Lycium* Phase, and a small portion of coastal strand.	San Clemente sage sparrow, California brown pelican, island night lizard, island poppy and Guadalupe Island lupine.
TAR 5	Coastal strand, rocky shoreline, landing site, and dirt access road.	Snowy plover wintering habitat; California brown pelican, SCI milk-vetch and SCI evening primrose.
TAR 6	Disturbed grassland, road, and building.	No listed or sensitive species are known from this TAR.
TAR 7 TAR 8	Open water.	California brown pelican.
TAR 9	Grassland, roads, parking area, buildings, and facilities associated with the Photo Lab.	Historic location for SCI milk-vetch not relocated during 2005 focused surveys of TARs.
TAR 10	Large previously disturbed area, MDS-*Lycium* phase, stabilized dune.	San Clemente sage sparrow, California brown pelican, island night lizard, aphanisma, SCI milkvetch, SCI evening primrose, Southern island tree mallow, Guadalupe Island lupine.
TAR 11	Maritime sage scrub, road, and abandoned missile site.	SCI broom, island sagebrush.
TAR 12	Grassland, maritime sage scrub, road, and abandoned radar facility.	No listed or sensitive species are known from this TAR.
TAR 13	Grassland, maritime sage scrub, disturbed, and MDS Prickly Pear, road, abandoned bunker, and attendant facilities.	Island night lizard; SCI bedstraw, island sagebrush; jepsonia.
TAR 14 TAR 15	Grassland, MDS Prickly Pear, road, buildings and facilities associated with the old VC-3 airfield. Numerous small depressions are found in the southern tip of the TAR, 0.3 ac of which are delineated as three-parameter wetlands and appear to run together in Figure 3.11-3, due to the small scale of the map. This area had been previously used for aerial bombardment.	Island night lizard in grassland and MDS habitat (scarce or absent over old VC-3 runways and taxiways). Existing occurrence of Guadalupe Island lupine is at the southern tip of TAR 15. Occurrences of SCI larkspur are downslope from the eastern TAR boundary.

Site	Site Characteristics	Comment[1]
TAR 16	Severely disturbed grassland without listed plant or animal species.	SCI brodiaea at southern TAR boundary.
TAR 17	Disturbed vegetation communities, MDS-*Lycium* phase.	High density San Clemente sage sparrow habitat, California brown pelican; SCI Indian paintbrush, SCI broom, aphanisma, SCI milkvetch, south coast allscale, and Guadalupe Island lupine.
TAR 18	Severely disturbed area north of the runway. Nearly barren except for scattered individual native and exotic plant species.	No listed or sensitive species are known from this TAR.
TAR 19	Severely disturbed area on the south east side of the runway. Nearly barren former borrow pit.	No listed or sensitive species are known from this TAR.
TAR 20	Disturbed, coastal salt marsh, overlaps Impact Area I.	Snowy plover wintering, California brown pelican, island night lizard.
TAR 21	Coastal salt marsh, MDS-*Lycium* phase, island woodland; overlaps Impact Area I.	Snowy plover wintering, California brown pelican, island night lizard, San Clemente loggerhead shrike wintering habitat (nest sites up-canyon from boundary). SCI bush mallow, SCI Indian paintbrush, aphanisma, island sagebrush, SCI milkvetch, SCI evening primrose, island green dudleya, island poppy, Guadalupe Island lupine.
TAR 22	Stabilized sand dunes, MDS-*Lycium* phase, MDS-cholla phase, island woodland; overlaps Impact Area II.	Snowy plover wintering, California brown pelican, island night lizard, San Clemente sage sparrow low density habitat, San Clemente loggerhead shrike nest site on boundary. SCI bedstraw, SCI evening primrose, Island green dudleya, SCI buckwheat, island poppy, SCI hazardia, Guadalupe Island lupine, SCI tritelia.

Notes: 1. Island night lizard could be present at most of the TARs except the ones that are beaches or are very sandy habitats. They are listed at TARs where the species' habitat has been mapped. Island fox may be found in any of the onshore TARs. Wintering San Clemente loggerhead shrikes may be found at many locations on the Island but many individuals winter in the same general locations as their nesting territories. California brown pelican may fly by or forage in the waters off of any coastal TARs. They are present year-around but do not breed on SCI. Species noted in this column are believed to be present at the TAR site based on information collected since the mid 1990s. "Historic location" indicates an earlier record not subsequently confirmed, however the species may still be extant at that location unless otherwise noted.

TAR 1—Demolition Range Northeast Point

TAR 1, which has been previously established and is currently being used, is composed of mostly disturbed vegetation and a small portion of stabilized sand dunes. There are no known listed plant or terrestrial animal species within the boundary of TAR-1, which is set back approximately 328 ft (100 m) from the shoreline.

TAR 2—Graduation Beach Underwater Demolition Range

TAR 2 is characterized as disturbed habitat and contains abundant evidence of human use including a dirt road, a few abandoned facilities, and a lack of shrubby vegetation. Most of the area is dominated by non-native grasses and iceplant (*Carpobrotus* sp.). This area also includes a narrow beach that could be used by shorebirds during the winter for foraging or roosting. The open habitat could be used occasionally by foraging raptors including American kestrel and northern harrier.

TAR 3—BUD/S Beach Underwater Demolition Range

The habitat of TAR 3 includes both coastal strand and disturbed sand dunes. The foredunes show evidence of heavy human use and contain numerous trails and debris. Common plant species include iceplant (*Carpobrotus* sp.), sand verbena (*Abronia maritima*), sea rocket (*Cakile maritima*), beach bur (*Ambrosia chamissonis*), and milk-vetch (*Astragalus* sp.). The many-flowered phacelia (*Phacelia floribunda*) was formerly noted from this site, but it no longer appears to be present based on recent surveys of the site. The area along the shoreline is used during the winter by shorebirds including western snowy plover, willet, killdeer, and sanderlings. Bird Rock is located several hundred yards offshore of this TAR and is a roosting site for western gulls, cormorants, and California brown pelicans. Western gulls and Brandt's cormorant are possible breeders on this rock and along the rocky shoreline to the west (see Section 3.10-Seabirds).

TAR4—Whale Point/Castle Rock

TAR 4 is composed of disturbed vegetation and MDS-*Lycium* phase. There is a small portion of coastal strand. No listed plant species are present; however, this area contains medium-density San Clemente sage sparrow habitat (Beaudry *et al*. 2004) and medium-density habitat for island night lizard. A comparison of sage sparrow population dynamics from a study plot at TAR 4 with other plots established on the island indicated that this plot generally fell within the range of other plots for most parameters, including percent nest success (high); number of fledglings per nest (high); percent of birds re-sighted on the plot from 2002 (high); mean territory size (moderately high); and percentage of banded individuals that disappeared in 2003 (high), despite ongoing construction and military use since its establishment (Beaudry *et al*. 2004). Island poppy and Guadalupe Island lupine are present.

TAR 5—West Cove Amphibious Assault Training Area

TAR 5 consists of coastal strand foredune and disturbed habitats. The foredunes in the area are heavily disturbed and colonized by iceplant (*Carpobrotus* sp.). The SCI milk-vetch (*Astragalus nevinii*) and the SCI evening primrose (*Camissonia guadalupensis* spp. *clementina*) have been documented from the boundaries of this site. The beach within this TAR provides habitat for shorebirds such as western snowy plover, black-bellied plover, willet, sanderlings, and turnstones. Wintering western snowy plovers are frequently observed on this beach. Due to the proximity of disturbed habitat, the frequent presence of feral cats, ravens, and island fox, and the high frequency of human activities at this beach, this site provides only marginal breeding habitat for snowy plover. California brown pelicans forage in the nearshore waters.

TAR 6—White House Training Area

This TAR consists of a small fenced-off portion of a bluff overlooking Wilson Cove. The habitat inside the fenced area and in the vicinity is primarily disturbed grassland vegetated with non-native grasses outside the fencing and a mixture of non-native grasses and Russian-thistle (*Salsola tragus*) inside the fencing. This area would offer low-quality habitat for most wildlife species. However, raptors, owls, and ravens may use the facilities and fencing for perches.

TAR 7—Wilson Cove Offshore Parachute Drop Zone

This offshore TAR is expected to be used by numerous species of aquatic birds including California brown pelican; royal tern; western gull; ring-billed gull; common loon; and Brandt's, pelagic, and double-crested cormorants (see Section 3-10-Seabirds).

TAR 8—Westside Nearshore Parachute Drop Zone

This offshore TAR would support the same wildlife species as described for TAR 7. A large kelp bed lies offshore of the island in this area.

TAR 9—Photo Lab Training Area

TAR 9 consists of roads, buildings, facilities, and disturbed grassland vegetated primarily with non-native grasses and introduced Australian saltbush (*Atriplex semibaccata*). This site was a historical location for SCI milk-vetch (*Astragalus nevinii*), but it is no longer present. This area provides habitat for numerous insect species, deer mice, and house mouse and would attract foraging feral cats and island fox. The numerous telephone lines and facilities provide perches for common raven, American kestrel, meadowlark, and Say's phoebe. Wintering San Clemente loggerhead shrikes were observed in this vicinity during 2000 but not subsequently.

TAR 10—Demolition Range West

TAR 10 contains vegetation communities of MDS-*Lycium* phase, stabilized dune, and a large previously disturbed area some of which has regenerated native shrub cover. Sensitive plant species include aphanisma, SCI milkvetch, SCI evening primrose, Southern island tree mallow, Guadalupe Island lupine. An 0.14 ac area in the northwestern part of the TAR has been delineated as salt marsh wetland. This TAR is located within high density San Clemente sage sparrow habitat.

TAR 11—Surveillance Training Area

This site contains an abandoned missile site on a bluff facing east. Most of the site contains disturbed grassland that supports insects, deer mice, and house mouse and the predators who feed on these prey items. The cliffs adjacent to this site are vegetated with healthy stands of maritime sage scrub habitat, including a dense population of island sagebrush (*Artemisia nesiotica*). Several occurrences of SCI broom (*Lotus dendroideus* subsp. *traskiae)*, an endangered species, are present on this site.

TAR 12—Radar Site Training Area

TAR 12 contains a small target area high on a bluff and consists of an abandoned radar facility; eroded gully; and a mixture of grassland, disturbed, and small patches of woody vegetation, including lemonadeberry (*Rhus integrifolia*), in the gully. The denser shrubs provide cover for nesting bird species such as scrub jay, sparrows, and finches. Island fox likely forage in the shrubbier vegetation for deer mice, and abandoned buildings are expected to be commonly used by all rodent species found on the island.

TAR 13—Randall Radar Site Training Area

The habitat in the vicinity of TAR 13 includes grassland, disturbed, MDS-Prickly Pear/Cholla Phase, and maritime sage scrub. The steep slopes at this site are marked with gullies and patches of shrubbier vegetation, which includes lemonadeberry (*Rhus integrifolia*), Island morning glory (*Calystegia macrostegia* spp. *amplissima*), snake cactus (*Bergerocactus emoryi*), horehound (*Marrubium vulgare*), and boxthorn (*Lycium californicum)*. Patches of island tarweed (*Hemizonia clementina*) are frequent. Catalina bedstraw (*Galium catalinense acrispum*), Island sagebrush (*Artemisia nesiotica*), and jepsonia (*Jepsonia malvifolia*), area present in the TAR . Island night lizard is present. Avian species include rock wren, scrub jay, yellow-rumped warbler, house finch, and white-crowned sparrow.

TAR 14—VC-3 Onshore Parachute Drop Zone

TAR 14 is primarily open grasslands with occasional patches of prickly pear (*Opuntia littoralis*), cholla (*O. prolifera*), Australian saltbush (*Atriplex semibaccata*), common tarweed (*Hemizonia fasciculata*), and abundant evidence of human activities related to the abandoned airfield. One large occurrence of Guadalupe Island lupine (*Lupinus guadalupensis*) occurs at the southwestern corner of this TAR. This open grassland supports large numbers of mice and is often frequented by foraging raptors and owls. Meadowlark, horned lark, and savannah sparrows are common throughout the area.

TAR 15—VC-3 Airfield Training Area

The VC-3 airfield and surrounding grassland support the same plant and wildlife species as described for TAR 14, including large occurrences of Guadalupe Island lupine (*Lupinus guadalupensis*). A population of SCI larkspur (*Delphinium variegatum* var. *kinkiense*) is located near the northeastern boundary of the TAR and the plant is relatively abundant on the slopes below the eastern boundary. Numerous small depressions are found in the southern tip of the TAR, 0.3 ac of which are delineated as wetlands. This area had been previously used for aerial bombardment.

TAR 16—South VC-3 (Missile Impact Range)

TAR 16 is entirely composed of severely disturbed grassland. Two occurrences of SCI brodiaea are located at the southern TAR boundary. There are, however, historical populations of SCI broom and SCI larkspur within approximately 1,312-1,640 ft (400-500 m) of the TAR boundary.

TAR 17—Eel Point Tactical Training Range

This TAR consists of MDS-*Lycium* phase and disturbed vegetation communities and most of the TAR contains and is surrounded by high density San Clemente sage sparrow habitat and medium-density INL habitat. California brown pelicans are known to frequent the area. A documented occurrence of SCI Indian paintbrush is located outside this TAR, approximately 66 ft (20 m) from its inland boundary. No individuals were found within the TAR during focused surveys of the TARs conducted by Santa Barbara Botanic Garden in 2005 (Junak 2005). Aphanisma, SCI milkvetch, couth coast allscale, island poppy, and Guadalupe Island lupine are present within the TAR.

TAR 18—Close Quarter Combat Training Area

The close-quarter combat training area is proposed to be developed north of the runway in an area that was severely disturbed during construction of the runway. This area is nearly barren except for scattered individuals of native and exotic plant species that have colonized the site since the runway was constructed. There are no endangered, threatened, or sensitive plant species known or expected to occur on the site; however, one of only thirty two known occurrences of southern island mallow (*Lavatera assurgentiflora* subsp. *glabra*) on SCI is confined to a localized area about 650 ft (200 m) west-southwest of the site. Except for the island night lizard, which is nearly ubiquitous on the island and may be present on the site, and the island fox, which may traverse the site, no endangered, threatened or sensitive plant or wildlife species are known or expected to use the site. The site offers little in the way of resources for wildlife.

TAR 19—Simulated POW Camp and SAM Site

TAR 19, which is located in a large borrow pit several hundred yards east of the airfield control tower on the south side of the NALF runway and taxiway, consists entirely of previously disturbed soil with no vegetation and no listed plant or animal species with the possible exception of the island night lizard. The proposed Prisoner of War (POW) holding camp and Surface-to-Air Missile (SAM) site for Sea, Air, Land (SEAL) training would use the entire previously disturbed 3-ac site.

TAR 20—Pyramid Cove Training Area

This tactical firing area is located in SHOBA Impact Area I on the southeast end of the island. The site contains coastal strand, coastal salt marsh, disturbed, and MDS-*Lycium* Phase habitats. The salt marsh habitats occupy low areas where tributaries of intermittent drainages come together. They appear to be saline habitats primarily fed by an elevated groundwater table and appear to have little tidal influence. Very little wildlife use was noted in this habitat. The invertebrates found in the coastal strand habitat and foredunes along this portion of the island attract wintering shorebirds including western snowy plover, black-bellied plover, willet, and sanderlings. Species such as California brown pelican, western gull, and cormorants roost on the beaches and rock outcroppings along the shoreline. Much of the scrub habitat has been recently burned and there is trash and debris scattered throughout the area. The loss of vegetation resulting from frequent fires has also resulted in erosion and sparse vegetative cover in places. The debris and spiny plants, which include prickly pear, snake cactus, California boxthorn (*Lycium californicum*), and cholla provide retreats for island night lizards and side-blotched lizards. Common avian species in the scrub habitat include Say's phoebe, common raven, house finch, and white-crowned sparrow. Island fox tracks were observed throughout this site and along the shoreline during a November 1998 site visit.

TAR 21—Horse Beach Cove Training Area

Much of the habitat at this TAR site is similar to habitat described for TAR 20 and would support similar wildlife species. The coastal strand at Horse Beach Cove supports wintering western snowy plover, and the foredunes in the area provide marginal breeding habitat for this species. The coastal salt marsh habitat is associated with the lower portion of Horse Beach Creek. An extensive meadow of salt grass (*Distichlis spicata*) with occasional shrubs of alkali heath (*Frankenia grandiflora*) extends eastward from the creek mouth on sandy soil. Adjacent areas with clay soils west of the creek mouth are nearly bare of vegetation. The salt marsh includes patches of pickleweed (*Salicornia* sp.), sea-blite (*Suaeda* sp.), and alkali heath that grow along this drainage. There appears to be occasional tidal overflow into the channel of Horse Beach Creek but tidal exchange appears to be minimal and the occurrence of salt marsh species appears to be governed more by salinity and available groundwater than by tidal exchange. One large population of SCI milk-vetch (*Astragalus nevinii*) occurs near the center of the TAR along the watercourse. SCI bush mallow (*Malacothamnus clementinus*) is present within the TAR, a short distance up Horse Beach Canyon. Other sensitive plant species, including SCI Indian paintbrush (*Castilleja grisea*), aphanisma, SCI evening primrose, island green dudleya (*Dudleya virens* subsp. *virens*), and Guadalupe Island lupine are also located within this TAR and continue further up the canyon. A single loggerhead shrike was observed on this site near the beach during a site visit in January 1999.

TAR 22—China Cove Training Area

TAR 22 is vegetated with MDS habitat with a prevalence of *Lycium californicum* and prickly pear cactus. Although this site has been affected by years of military use, much of the foredune habitat is intact and free of iceplant and other non-native invasive plant species. This site is also characterized by patches of bare soil, gullies, and large amounts of ordnance debris. An extensive flat dominated by saltgrass is located on the east side of the canyon. Within or near the TAR, the canyon walls provide habitat for Island sagebrush (*Artemisia nesiotica*), Island poppy (*Eschscholzia ramosa*), SCI buckwheat (*Eriogonum giganteum* var. *formosum*), SCI Indian paintbrush (*Castilleja grisea*), and SCI bedstraw (*Galium catalinense* spp. *acrispum*). Other sensitive plant species include SCI evening primrose and SCI hazardia, Guadalupe Island lupine, and SCI tritelia. Island green dudleya (*Dudleya virens* spp. *virens*) occurs near the shore in the southern part of the TAR. SCI bush mallow formerly occurred in this TAR. The shoreline in this area has portions of rocky outcrops and sandy beach, which is used by wintering western snowy plovers. This site supports island night lizard, and island fox tracks were observed in the scrub habitat and along the sandy beach (site visit January 1999). The common wildlife species would be similar to those described for TAR 20.

3.11.3.1 Vegetation Communities Contained within the Different Operations Areas on SCI

The AVMAs and AMPs consist predominantly of disturbed habitat, which was a key environmental consideration in their selection. AFP-1 is mapped principally as Maritime Desert Scrub Prickly Pear/Cholla phase, a type that is prevalent in SHOBA. The operations areas generally include high proportions of disturbed and grassland habitats. The majority of the coastal salt marsh habitat on the Island is found in SHOBA within TARs 20 and 21. In addition, between 25 and 30 percent of the Island's Maritime Desert Scrub Prickly Pear/Cholla phase is found within the IOA and the overlapping AFP 1 and AFP-6. Fifteen percent or less of the remaining vegetation types on the Island are overlapped by the Operations Areas outlined above. Table D-1 (Appendix D) provides a breakdown of vegetation types in the different operations areas.

3.11.3.2 Listed Wildlife Species Habitat Present within the Different Operations Areas on SCI

Figures 3.11-17 through 3.11-21 show locations of operations areas and known distribution of endangered and threatened species on SCI.

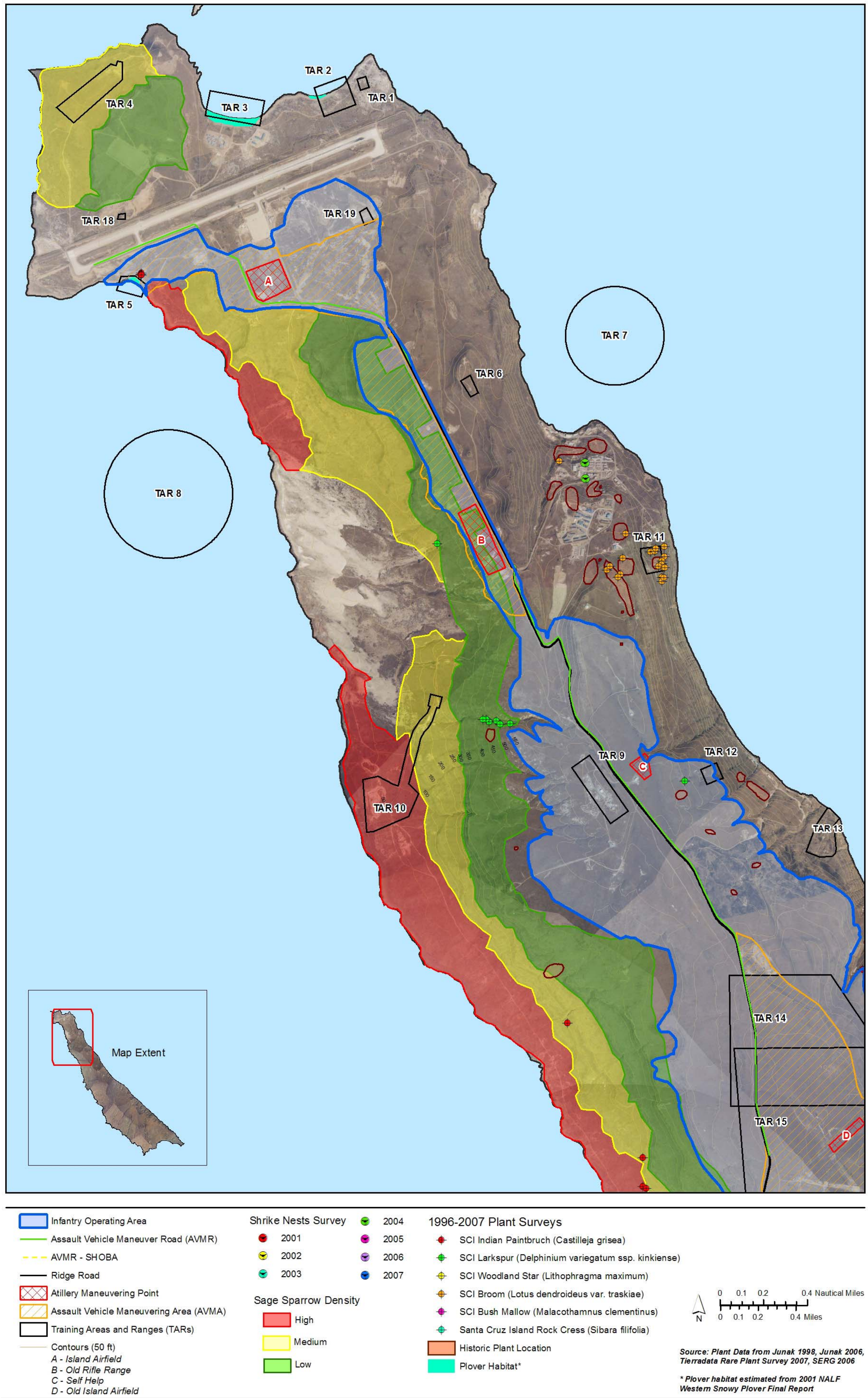


Figure 3.11-17: Listed Endangered and Threatened Wildlife and Plant Species Located in Northern San Clemente Island

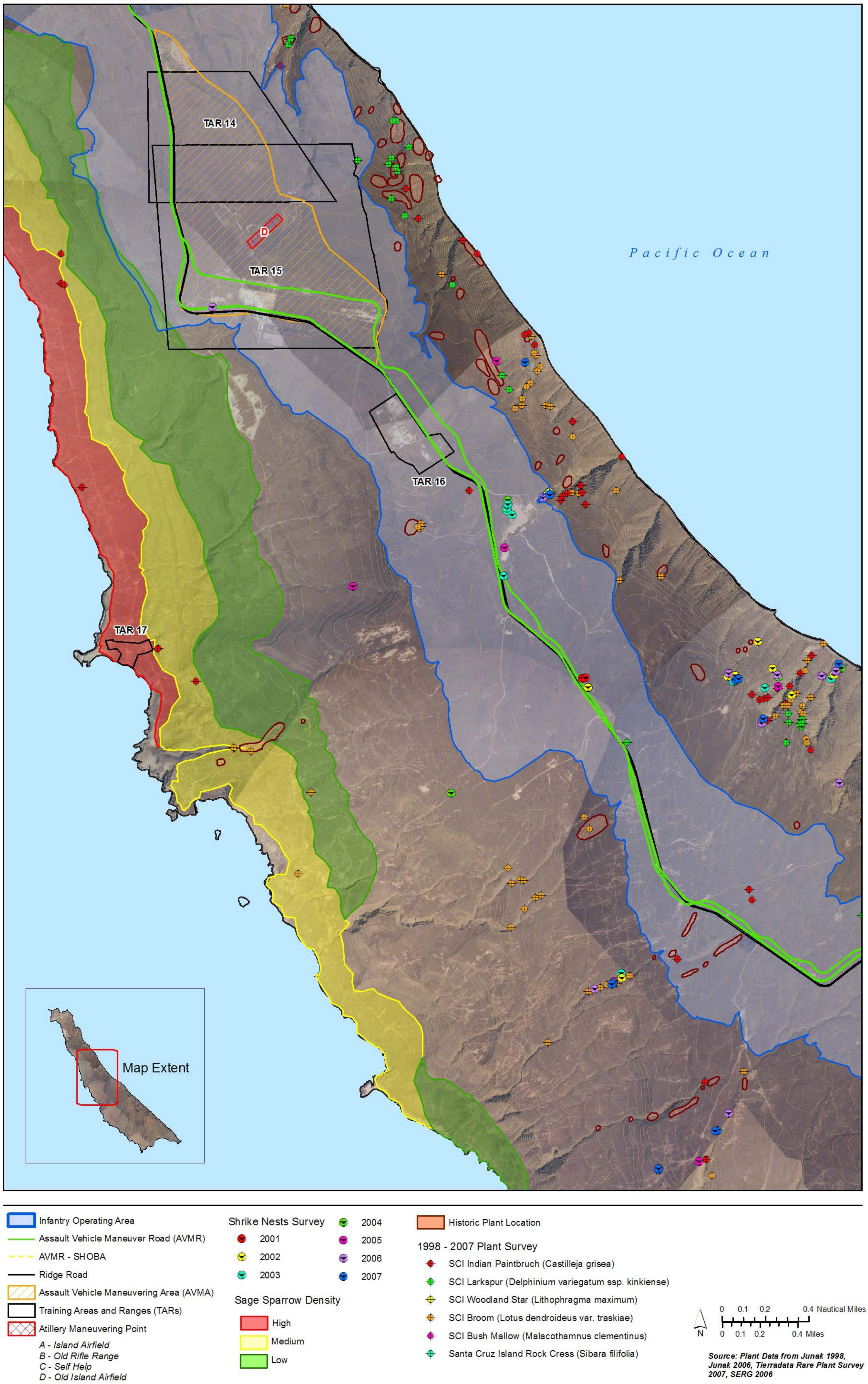


Figure 3.11-18: Listed Endangered and Threatened Wildlife and Plant Species Located in Middle San Clemente Island

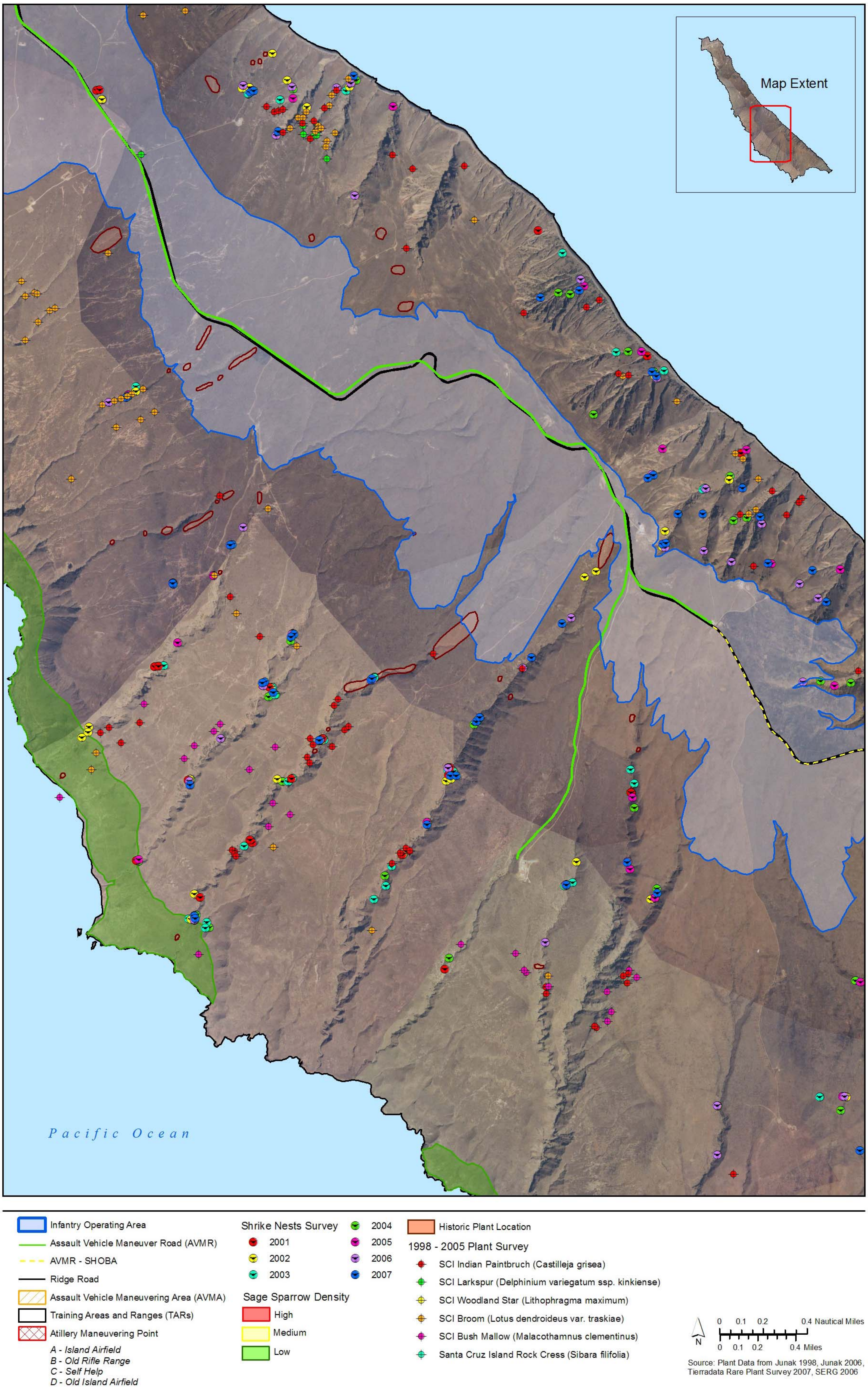


Figure 3.11-19: Listed Endangered and Threatened Wildlife and Plant Species Located in Southwest San Clemente Island

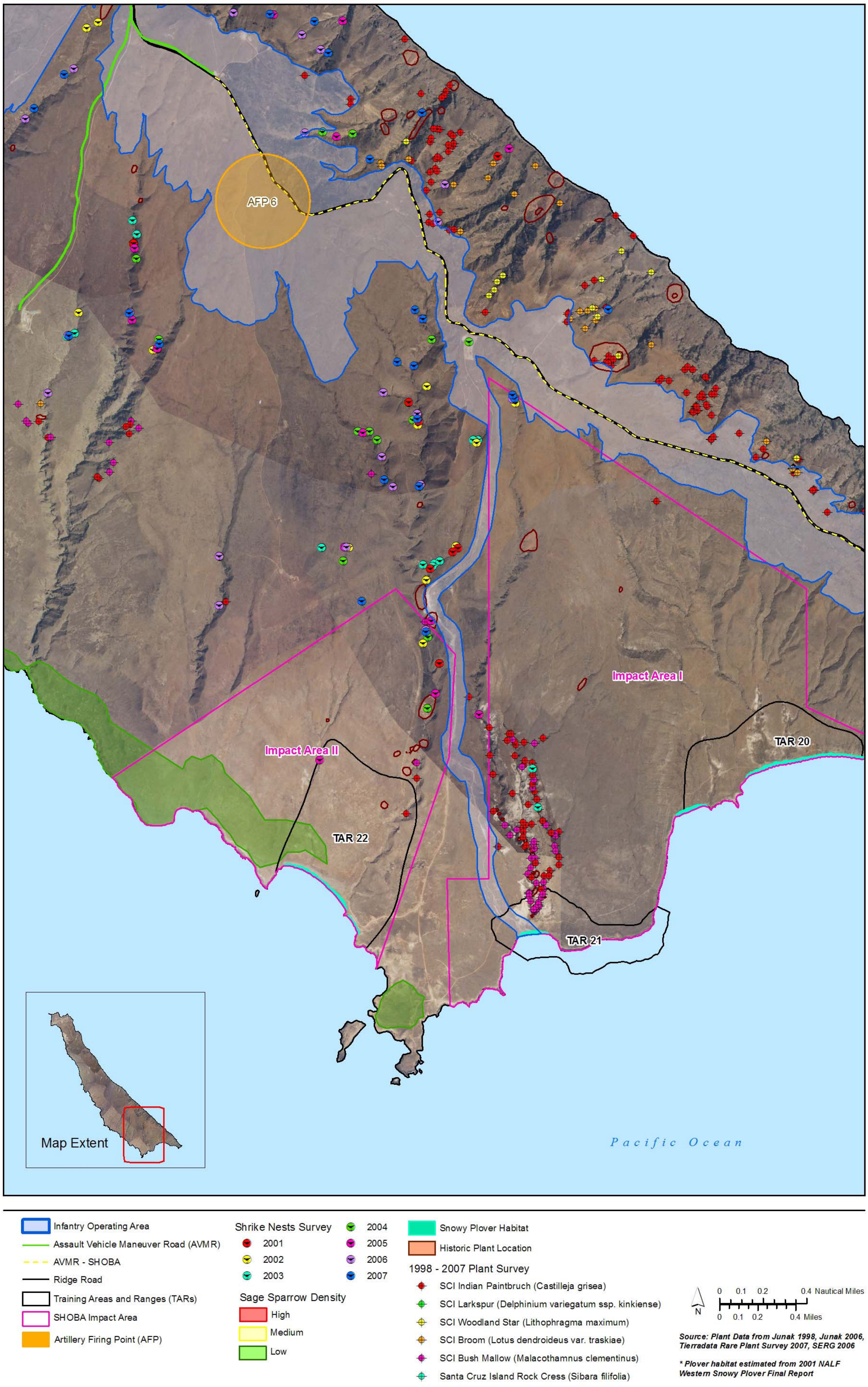


Figure 3.11-20: Listed Endangered and Threatened Wildlife and Plant Species Located in Southern San Clemente Island

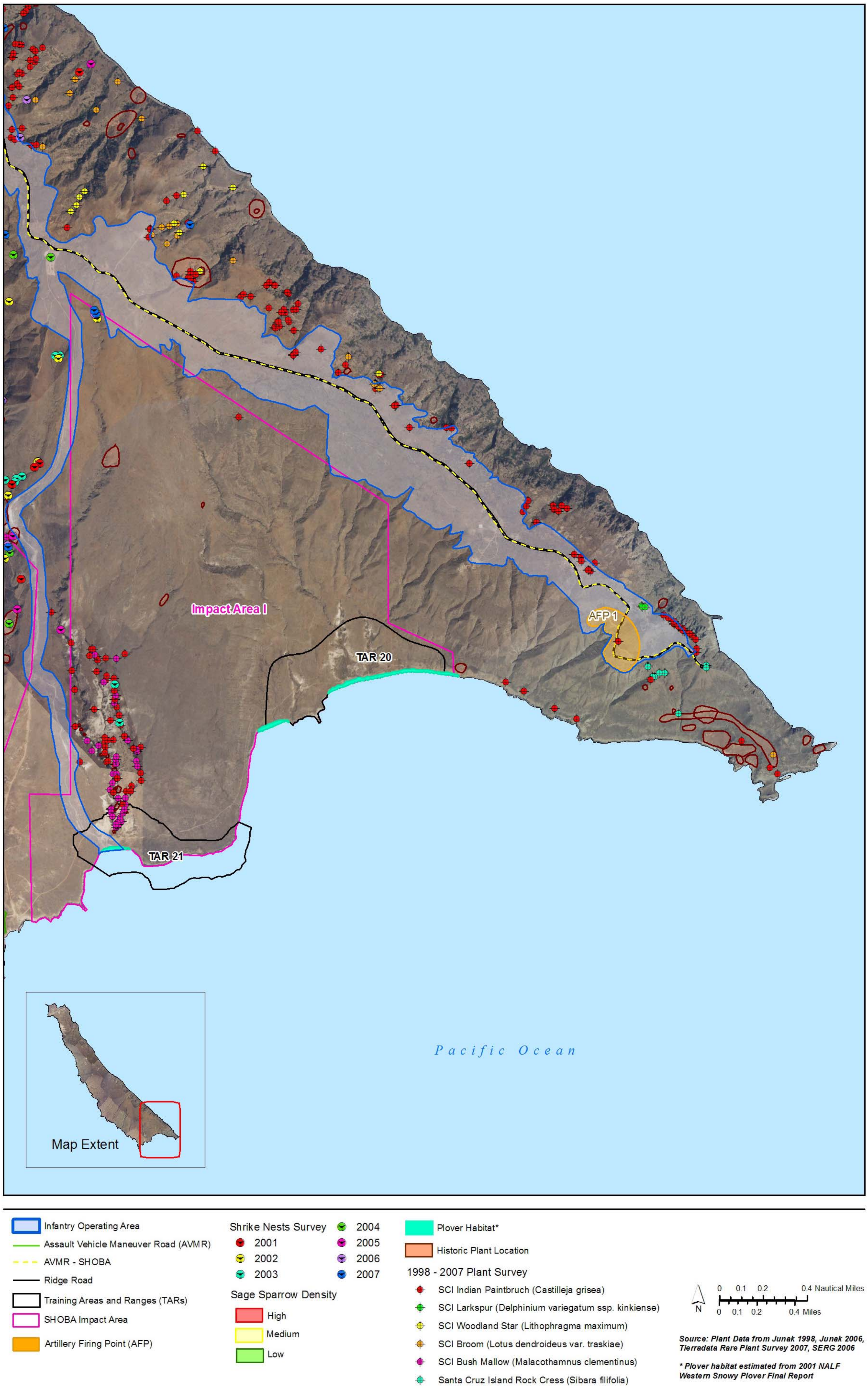


Figure 3.11-21: Listed Endangered and Threatened Wildlife and Plant Species Located in Southeastern San Clemente Island

About 441 (9 percent) of the 5,185 ac of San Clemente Sage Sparrow habitat mapped on SCI is contained in Operations areas. Mostly of this is low density habitat included in the Old Rifle Range AVMA and IOA, however 55.5 ac of high density sage sparrow habitat is contained within TARs 10 and 17 and 38.4 ac of moderate density habitat are contained within TARs 4 and 10. About 33 percent of island night lizard habitat is within operations areas, with low and lowest density habitat most heavily represented. An overview of island night lizard habitat distribution is shown in Figure 3.11-11. A very small fraction (<3 percent) of high density island night lizard habitat and about 23 percent of the medium density habitat are contained within operations areas, principally within the IOA which has the lowest intensity of use. More than 50 percent of the beach habitat mapped for western snowy plover is contained within operations areas, principally within TARs 3, 5, 20, 21, and 22.

Fifty out of 261 (19 percent) mapped San Clemente loggerhead shrike nesting territories or release sites used in recent years have been located within operations areas on SCI, including Impact Areas I and II. Most of these have been located within the IOA, where the training activity would be infrequent and dispersed. None of the shrike nest/release sites is within or near the AVMAs, AMPs, or AFP-1; however two sites used in recent years have been near the Ridge Road.

3.11.3.3 Listed Plant Species Habitat Present within the Different Operations Areas on SCI

Of the six federally listed plant species on SCI, four are found within operations areas, specifically within Impact Areas I and II, NALF AVMA, AFP-1, TARs 11, 21, and 22, and within the IOA. San Clemente Island woodland star and Santa Cruz Island rock-cress are not known from within any operations area. Both species have occurrences relatively near but outside the IOA in SHOBA.

Based on all-island surveys conducted through 2007, most of the occurrences of endangered and threatened plant species on SCI are outside the Operations Areas. Occurrences within operations areas include:

- Nine of 141 (6.1 percent) known occurrences of SCI broom are in TAR 11 and several additional occurrences are located in the vicinity of the TAR. Fourteen additional occurrences are within the IOA (9.6 percent of total SCI occurrences).
- Fifty four of 80 (68 percent) known occurrences of SCI bush mallow are in Impact Area I, mostly in Horse Beach Canyon. Seventeen of these fifty four occurrences are also within the TAR 21 boundary. Impact Area II contains two occurrences of the SCI bush mallow.
- Seven of thirty eight (18.4 percent) occurrences of SCI larkspur are within the IOA, including one occurrence just outside of the northeastern boundary of TAR 15. Twelve of the 46 (26 percent) pre-1998 historic occurrences comprising 15 percent of the pre-1998 acreage known for this species are also known from the IOA.
- Fifty two of 335 (15.5 percent) known occurrences for SCI Indian paintbrush are from within Impact Area I, including one in TAR 21. These are virtually all located in Horse Beach Canyon. Small occurrences are also found in Impact Area II, NALF AVMA, AFP-1, TAR 21, and TAR 22. The IOA contains fifty three occurrences (15.8 percent) of the species' known occurrences.

Additional information on the occurrence of listed and other sensitive plant species in operations areas on SCI can be found in Appendix D.

3.11.4 Current Mitigation Measures

3.11.4.1 SCI Wildland Fire Management Plan

The SCI Wildland Fire Management Plan (Fire Plan) will shape fire-related policy, management, and decisions on the Island for the next 5 years. It sets the course for sound integration of the U.S. Navy's mission, fire protection, and natural resources protection on SCI. Its primary purpose is to provide for a full and complete range of training opportunities for military users, while complying with environmental laws and achieving sustainable ecosystem management.

The Fire Plan addresses all aspects of wildland fire management consistent with Federal fire policy (Interagency Federal Wildland Fire Policy Review Working Group 2001) and environmental laws. The Fire Plan is consistent with all Federal policy as it was adopted by the DoD Wildland Fire Policy Working Group in 1996 and made DoD fire policy through DoD Instruction 6055.6 (DoD Fire and Emergency Services Program 10 October 2000).

The core elements of the Fire Plan begin with the adoption of a Fire Danger Rating System (FDRS), which is the first line of defense to prevent ignitions in conditions where suppression is difficult. Suppression assets will be staged at increasing states of readiness as fire danger increases. The use of incendiary ordnance is conditioned upon appropriately staged suppression response teams. Other elements of the core strategy include prevention; fuels management; rapid-attack suppression and habitat condition success targets. These targets are proposed to manage the risks of extreme fire scenarios, which may be catastrophic to individual species. The success targets can be summarized by habitat community: canyon woodland, 3 ac; high-density sage sparrow, 5 ac; moderate-density sage sparrow, 20 ac; low-density sage sparrow and other boxthorn or boxthorn/grassland transition, 40 ac; maritime sage scrub, 200 ac; and loamy or clay grassland, 300 ac.

3.11.4.2 Management Changes with the Wildland Fire Management Plan

Implementation of the SCI Wildland Fire Management Plan and its Biological Assessment (DoN 2006) will enhance Navy efforts to manage and minimize the effects of fire on the island's species and habitat. Examples of changes in range management include:

- Increased road maintenance to improve accessibility for fire emergency vehicles. The primary example is the P-493 road project to pave and improve Ridge Road, the roadway from Ridge Road to Range Electronic Warfare Simulator (REWS) and construct new support structures/facilities such as laydown areas, drainage culverts, soil borrow pit, rock quarry, and water crossings.
- Conduct prescribed burning for up to 300 ac per year for strategic resources protection and/or habitat enhancement.

With these and other changes the outlook for the biological footprint and potential effects of fire are expected to be:

- Greater awareness and attention to the dangers of fire on the Island and its habitat
- Smaller fire size and lower fire frequency (on average across the Island as a whole)
- Smaller fire size by using a combination of fire retardant, herbicide, and prescribed fire around SHOBA Impact Areas and other locations
- Increased fire return intervals across the Island as a whole by confining areas of likely repeat fires and reduced fire sizes

The nature of fuels changes on SCI over time as more perennial vegetation develops (perennial grasses, shrubs, and trees). Although perennial vegetation can carry a fire, it is less easily ignited than fine dry annual grasses because of its structure and higher moisture content. Fires are influenced by the amount of fuel and the moisture content in vegetation. Since the elimination of feral goats and pigs from the island beginning in the early 1970s and completed in the early 1990s, there has been increasing plant growth, with especially luxuriant growth of annual grasses following years of abundant rainfall (e.g., 1993 and 1995). These grasses die after a few months of growth and by late spring provide a nearly continuous bed of easily ignited fine fuel capable of supporting extensive fires. These fires tend to spread rapidly over the plateaus and upper terraces where the fuel is abundant and continuous. The fires tend to skip over canyons for several reasons including discontinuities in fuel, especially grasses, on canyon walls and presence of less easily ignited fuels in the canyon bottoms. It is expected that natural trends augmented by ongoing management activities would lead to continued increases in native perennial vegetation and less annual vegetation, making the area less easily ignited. During the process of recolonization of annual grasslands by native shrubs, which is happening over much of the island's upper plateau, the annual grasses remain to provide easily ignitable flashy fuels, while the shrubs contribute to the overall fuel load making a fire more difficult to suppress.

There is a growing awareness of the potential danger of wildland fires on SCI, and management practices are changing to improve firefighting techniques and responsiveness. Rapid suppression leads to smaller fires and also promotes discontinuities in fuels, which in turn would tend to reduce the tendency for large fires. Management measures are proving quite successful, as depicted in Figure 3.11-22, which shows the positive trend in the size of fires on SCI attributed to operational sources. This figure does not include fires from sources classified as "unknown", some of which may have resulted from unknown operational sources.

Fires from non-operational sources are preventable, and all fires are a threat. The Navy has embarked on an aggressive fire prevention strategy to minimize the danger to the environment. Wildland fire prevention, awareness, detection, and firefighting capabilities have been improved for SCI, as have fire suppression methods. SHOBA is remote from the main firefighting resources on the island, and until 1999 the only aerial firefighting assets were with the U.S. Forest Service (USFS) based on the mainland. This caused longer response times. The Navy addressed the urgent need for better firefighting response as early as 1999 by stationing a contract helicopter at the airfield and training the aircrews to deliver water to provide firefighting support. The HC-85 helicopter detachment on SCI took on the aerial firefighting mission beginning with the 2000 season. The civilian helicopter contract is maintained as a backup.

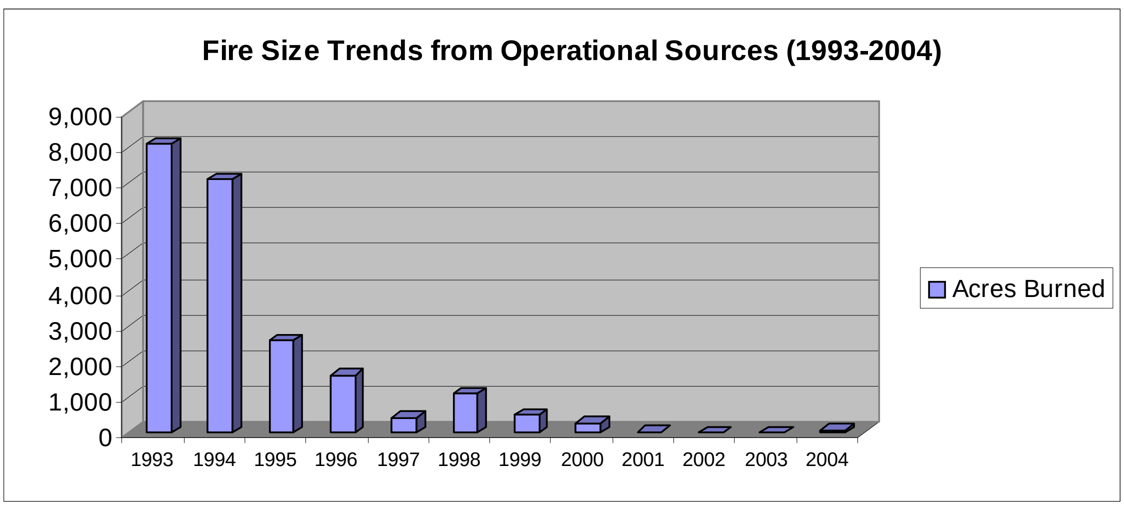


Figure 3.11-22: Wildfire Size Trends from Operations Sources (1993-2004)

3.11.4.3 Current Mitigation Measures

The Navy implements multiple general, area-specific, and species-specific measures intended to to avoid, minimize, or compensate for effects of Navy activities on biological resources including listed species on SCI.. These are discussed in detail in Section 3.11.4. Key management and monitoring activities include completion and implementation of the SCI Wildland Fire Management Plan; continued monitoring and management activities for all endangered species but with particular attention to San Clemente loggerhead shrike, San Clemente sage sparrow, island fox, and federally-listed and other sensitive plant species; invasive species monitoring and control efforts; continued operation of the on-island nursery and restoration efforts being conducted by nursery staff; vegetation condition and trend assessment; and continued implementation of the SCI Integrated Natural Resources Management Plan (INRMP).

General mitigation measures include (see also Section 3.11.4):

- Control invasive exotic plant species on an island-wide scale.
- Feral cat and rat control efforts and monitoring level of feral cat and rat populations.
- Implementation of the INRMP per funding availability, with review and revision per Navy regulations.
- Continued review and coordination of dissemination of environmental conservation measures to island users.
- Conduct any necessary Explosive Ordnance Disposal (EOD) ordnance detonations in or near endangered or threatened species habitat in a manner that minimizes the potential for wildfire without compromising personnel safety.
- Coordination of range access to achieve optimal flexibility between training operations and NRO activities, according to range use instructions and with priority given to military training.
- Prior to coming to SCI, military and non-military personnel to conduct a brief check for visible plant material, dirt, or mud on equipment and shoes. Any visible plant material, dirt or mud should be removed before leaving for SCI. Wash tactical vehicles for invasive species prior to embarkation for SCI.
- Enforce the existing 35 mph speed limit on Ridge Road for shore installation and administrative traffic. Continue public awareness programs and monitor roadways for kills of protected or conservation agreement species including San Clemente loggerhead shrike, San Clemente sage sparrow, and island fox.
- Tracked and wheeled vehicles will continue to be routed to avoid sensitive habitat areas and wetlands and use the existing routes for ingress to and egress from training areas.

Additional species-specific mitigation measures include (see also Section 3.11.4):

- Continue surveys and population analysis for the San Clemente sage sparrow.
- Continue the currently successful program of habitat restoration, predator management, monitoring, captive breeding, and re-introduction to benefit the San Clemente loggerhead shrike.
- Continue island night lizard population monitoring at 3-year intervals and annual habitat evaluations.

- Ensure that California brown pelicans are not in proximity to over-blast pressure prior to demolition activities.
- Continue annual breeding and non-breeding season surveys for the western snowy plover at West Cove and Northwest Harbor.
- Continue educational work with on-island civilian and military personnel to prevent feeding, handling of island foxes.

3.11.5 Environmental Consequences

The analysis in this section addresses the potential impacts on terrestrial biological resources, including endangered, threatened, and sensitive species of the operations under the No Action alternative, Alternative 1, and Alternative 2.

3.11.6 Approach to Analysis

The approach is based on information concerning the environmental resources discussed in Section 3.11.1, and a systematic evaluation of the components of each operation that may affect these resources. Interviews with personnel associated with operations and natural resources management, especially the recovery effort for the San Clemente loggerhead shrike, have been factored into the analysis. In the project alternatives discussion, factors of significance related to context and intensity of impacts are discussed.

Because a wide variety of operations under analysis have certain features in common that may result in effects on listed species, we provide a general analysis of the effects of fire, access, ordnance use, noise, and off-road foot and vehicle traffic in Section 3.11.2.2. Section 3.11.2.2 describes the major operations areas evaluated in this analysis and the occurrence of listed species within them. Sections 3.11.2.3, 3.11.2.4, and 3.11.2.5 provide an operation-by-operation analysis of potential effects on listed species. Mitigation measures are identified in Section 3.11.3. The Summary of Impacts (Section 3.11.1.6) presents a resource-by-resource analysis of potential effects, which employs an analysis of quantitative Geographic Information Systems (GIS) data on each resource in each of the operations areas and describes the potential project effects for each of the operations areas in which the species occurs.

A GIS database maintained by the CNRSW NRO was used to determine areas of resources within operations areas identified in this Draft Environmental Impact Statement (EIS)/Overseas Environmental Impact Statement (OEIS) (hereafter referred to as "EIS/OEIS"). The operations areas and species distribution data are depicted above in Figures 3.11-5 through 3.11-21. For listed or other sensitive plant species, the units were locations and numbers of individuals for data collected by the SBBG (Junak and Wilken 1998; Junak 2006). Data collected in the 10 years or so preceding the SBBG surveys are referred to as "historic" locations and consist of polygons from which an area can be determined. Because the SBBG studies did not focus on revisiting known populations but rather to explore new areas, especially ones believed likely to contain new records, it is generally assumed in the absence of information to the contrary that historic locations are still in existence. The database contains data from surveys of TARs, AVMAs, AMPs, AFPs, and the IOA conducted through 2007.

For island night lizard and San Clemente sage sparrow maps have been developed identifying habitat for the species categorized by the likely density of individuals contained within the habitat. For island night lizard vegetation types are identified as habitat supporting high, medium, low, and lowest density of the species and conversion factors are provided in the analysis that follows. The habitat classification system is that developed by Sward and Cohen (1980) and described under Plant Community Types in Section 3.11.1.1. For San Clemente sage sparrow the habitat was classified into high, medium, and low density and densities per unit area were developed for monitoring data taken annually since 1999, excluding 2002 which had a population level 2.6 times the median population size during that period. The density values assumed a 1:1 ratio of males to females. For western snowy plover area of habitat was used. Although a variety of sources of inaccuracy exist in mapping the narrow coastal habitat of the western snowy plover, the locations of their habitats are well documented and the overlap of operations areas with these habitats is unambiguous. For San Clemente loggerhead shrike, which can occur over most of the island during the winter, the nest sites are important indicators of the distribution of the birds during the breeding season and the general areas of the nests are also frequented by some of the birds, especially the males that nested there, during the winter. Two sets of data were used during the analysis, nest sites used sometime in the interval between 2001 and 2005 and nest sites used during 2005.

3.11.7 Potential Effects Common to Many Operations

Before addressing specific operations, a review of fire, island access, ordnance use, noise, and off-road foot and vehicle traffic is appropriate because these topics apply to a wide variety of operations under analysis; a general assessment is presented here and subsequently referenced in the analysis of the applicable operations.

3.11.7.1 Wildland Fire

Wildland fire on SCI is a concern because of its threat to personnel, property and the recovery of threatened and endangered species and their habitat. Key issues regarding fire and threatened and endangered species on SCI include the potential for fire to cause:

- Mortality of listed or other sensitive plant or wildlife species
- Nest abandonment in endangered avian species
- Alteration of nesting and foraging habitat (e.g., loss or damage to trees and large shrubs used for nesting and perching)
- Habitat type conversion (repeated fires in the same place within a short period of time [1-2 years] could diminish the abilities of endangered, threatened, and sensitive plant species or their habitat to regenerate after fire leading to a conversion of habitat from one type to another)

Fire, depending on its location, has the potential to affect any of the listed or other sensitive plant species on SCI. The response of plants to a fire depends on characteristics of the affected species and timing and intensity of the burn. Many plant species growing in the fire-prone Mediterranean climate of southern California (and other Mediterranean-climate regions of the world) have well-known mechanisms which enable them to survive fire, or to regenerate after fire (Mooney and Conrad 1977). Many plant species require fire as part of their life histories, either to stimulate reproduction or to create favorable habitat conditions. Regeneration mechanisms applicable to the listed species on SCI, which include annuals, herbaceous perennials and small shrubs, include regeneration from seed and/or resprouting from protected buds on underground regenerative organs.

Listed wildlife on SCI include four species of birds and one lizard. Two of the species, western snowy plover and California brown pelican, occupy habitats on SCI that should not be directly affected by fire, and the species would have the ability to avoid an approaching fire by flying to another location. San Clemente sage sparrow and San Clemente loggerhead shrike can escape fire by flying; however, fire can affect their habitat, eggs, and nestlings. Island night lizards are relatively sedentary but escape fire in large numbers by taking cover in refuges such as under rocks or in rock crevices or soil cracks, as described in Section 3.11.1.1.1.2.

Not all impacts from fire are adverse. For example, short-term beneficial effects from burning include the release of nutrients, which facilitate the growth of native annual and perennial plants, and breaking of seed dormancy (Shoenherr et al. 1999; Holland and Keil 1995; Carroll et al. 1993). Similarly, periodic fire can have beneficial effects on fauna, for example by leading to changes in prey or forage availability (Cunningham et al 2002; Smith [ed.] 2000). Animal species are adapted to survive the pattern of fire frequency, season, size, severity, and uniformity that characterized their habitat. When fire frequency increases or decreases substantially or fire severity changes, habitat for many animal species declines (Smith [ed.] 2000). The long-term response to fire of listed and other sensitive plants on SCI is not well known, although the San Clemente Island Indian paintbrush and the San Clemente Island bush mallow have persisted in areas subject to repeated fires (DoN 2005).

Periodic fires have been a natural component of most Californian ecosystems for many thousands of years, and most plant and animal species in this environment have mechanisms that allow them to survive or readily reestablish after fires. The primary natural ignition source, lightning, is infrequent (for example, only three lightning-caused wildland fires had been documented on the California Channel Islands during the 140 years prior to 1993 (Carroll et. al. 1993). However, on July 22, 2006 lightening ignited at least two fires on Santa Catalina Island, which burned about 1,200 acres. Native Americans who inhabited SCI for at least 8,000 to 9,000 years likely ignited fires either accidentally and purposefully, as they have done elsewhere in coastal California (e.g., Timbrook et al. 1982; Blackburn and Anderson 1993, Greenlee and Langenheim 1990). The island's species have evolved with the fires on the islands, originating from mainland ancestors that had been routinely exposed to wildland fire for millennia. From several lines of evidence, Carroll et al. (1993) concluded that fire has been a continued selective influence on the California Channel Islands. This conclusion was drawn despite the infrequency of naturally caused fires in the past 140 years for which there is a historical record. Most of the period for which there is a record corresponds to a period of low vegetation density related to grazing by domestic livestock and feral goats, sheep, and pigs.

The Navy's normal training and testing activities can provide ignition sources for fires, especially live ordnance. However, until the late 1980s and early 1990s the vegetation had been so sparse in most years that fires generally did not ignite readily or burn over large areas. Wildland fires became more frequent and extensive as a consequence of extensive regrowth of vegetation, especially grasses, after the Navy eliminated the non-native goats and feral pigs from the island (beginning in the early 1970s and completed in the early 1990s). The Navy recognized fire as a significant problem that affects both the mission and the natural resources on the Island. The NRO has developed a draft San Clemente Island Wildland Fire Management Plan (DoN 2005) to integrate the many elements of fire prevention, detection, firefighting, reporting and management.

Quantitative Analysis

NSW-related wildfires are a source of special interest because of the Proposed Action to designate additional TARs. A detailed review of NSW-related fire incidents reveals the following. There were 31 NSW-related wildfires in the period 1995-2004. Although the ignition sources of the 11 fires in 2004 were not identified, the fires tend to be distributed among six areas of NSW training: the BUD/S Rifle Range; Demolitions Range; other areas north of the NALF runway, near Ridge Road; SHOBA; and Impact Area IIA inside SHOBA. NSW-related wildfires differ from other ignition sources in several ways:

(1) Size: NSW fires tend to be smaller. The largest NSW-ignited fire was reported to be only 135 acres, and the average FY96-04 was 11.4 acres. As a comparison, the average of all wildfires on SCI in this same period was 80 ac. Cumulatively, NSW fires only account for 5.2 percent of the acreage burned from wildfires.

(2) Frequency: NSW fires tend to be more frequent. Of the 85 wildfires in the FY96-04 period, 36.5 percent are believed to be from NSW sources. However, many of these fires are very small, burn themselves out, and go unreported.

(3) Location: Most of SCI's wildfires begin in SHOBA, whereas most of the NSW-related fires occur north of the airfield runway, in the rifle, demolition, grenade or TAR 4 ranges.

(4) NSW-related fires tend to originate in close proximity to training cadres. Once SEALs emerge from the ocean, they are generally on foot, in sight and in close contact with their adversary forces. Thus, they tend to see the origin of fires sooner than observers who are more remote from impact areas (in SHOBA Observation Posts or airborne observers). They are also directly on the scene to react to the fire and initiate fire fighting procedures. NSW-related fires are primarily caused by grenades and small arms tracers. Providing on-site fire-fighting teams should be responsive to this potential threat.

(5) As the number of TARs and NSW training events increases, this is a vital factor to mitigate the relatively frequent occurrence of fires related to NSW live ordnance training.

Table 3.11-10: Distribution of Wildfires by Size, with Ignition Source and Location (1996-2004)

Ignition Source	Acres Burned	Percent Burned	No. of Fires	Percent of Fires	General Locations
Unknown Source	2278	60.9%	24	34.8%	SHOBA and NW Harbor
Naval Shell	660	17.7%	7	10.1%	SHOBA
Illumination Round-Naval*	230	6.2%	4	5.8%	SHOBA
Grenade	228	6.1%	5	7.2%	Ridge Road, BUD/S
Small Arms Rounds	117	3.1%	4	5.8%	North of NALF
Demolition Charge	59	1.6%	9	13.0%	All in NSW Demolition Range
Spark off Target	55	1.5%	1	1.4%	SHOBA
Tracer Round*	51	1.4%	6	8.7%	Small Arms Range
Flare*	48	1.3%	5	7.2%	Lemon Tank, VC-3 & SHOBA
UAV Crash	8	0.2%	2	2.9%	VC-3
Artillery Shell	2.5	0.1%	1	1.4%	SHOBA
Illumination Round-Mortar*	2.5	0.1%	1	1.4%	SHOBA
Total	3,739	100.0%	69	100.0%	

*Incendiary device
Sources: Wildland Fire Inventory and NRO GIS data

The trend in NSW-related fire size is the same as other sources--downward. Whereas the actual number of NSW-related fires shows no pattern of increase or decrease, the average size of the fires has decreased almost as dramatically as the overall statistics. In the four-year period 1996-1999, NSW-related fires reportedly burned 213 ac. Comparing that period to 2001-2004, the total size of NSW-related fires had decreased to 115, or nearly one-half. In most of the recent years the actual acres burned are below the targets set by the Fire Plan.

A quantitative analysis of Table 3.11-10 and all the other available fire data for SCI results in the following observations:

- Most of the types of operations (74 percent) that take place on SCI have no history of fire.
- The number of wildfires from operational sources on SCI over 1996-2004 ranges between 0 and 18 per year, with a mean of 9.4.

- The total area of wildfire acres burned in 2004 (72 ac) is only 0.9 percent of the 1993 total areas (8,110 ac). The median fire size was similarly reduced. The median size for 2004 fires was only 6.5 acres, compared to the median size of 1,352 ac in 1993. For comparative purposes, the range of fire size in 2004 was from one to 25 ac, and in 1993 it was from 2 to 5,000 ac.
- The average wildfire size occurring in the period 1996-2004 was 48 ac per fire. The range is from 1 to 900 ac. With the exception of 2004 (average of 6.5 ac burned per fire), the trend is downward, with the 1996 average being 201 ac burned per fire and the 2001 average being 5.6 ac burned.
- SHOBA fires tend to be larger. The mean fire size in SHOBA is 132 ac, as compared to 31 ac per fire north of SHOBA. This is probably due to several spatial and safety factors:
    - Many fire ignitions in SHOBA are not observed, and detection occurs only after the fire has spread to a larger area.
    - Fire response in SHOBA is delayed because of the 18-mile distance from the Fire Department and fire-fighting helicopter at the airfield.
    - Fire response is also prevented in many parts of SHOBA by the widespread presence of Unexploded Ordnance (UXO), which poses a threat to firefighters both on the ground and in the air.
- Non-operational sources have been a major source of the most damaging wildfires. Electrical wiring and transformer failure caused four fires in 1998-99, which were exceptionally large. Their total size (1931 ac) is the second largest category (unknown source is the largest) of out-of-control wildfires. This acreage is 28.1 percent of the total area burned over the period 1996-2004.
- There are 11 documented operational sources of wildfires. The largest number of fires (11) was caused by large caliber naval shells (to include “Illumination Round-Naval”) in Naval Surface Fire Support (NSFS) operations. Many of the ignition devices were illumination flares used to qualify ships’ crews at night. NSFS operations’ fires were all in SHOBA, totaling 900 ac burned (or 13.3 percent of the area burned by operational sources).

Marine Corps live-fire operations account for two small fires in SHOBA (an artillery white phosphorus shell and a mortar illumination round) both on the same day in 1999 and each of 2.5 ac in size. There is no record of any fire related to Marine Corp activities outside of SHOBA in the 13 years of recorded data.

Future Projections

The projection of fire statistics and trends from the recent past into the future is problematic for several reasons, including conflicting or incomplete data, extreme variability in weather patterns and rainfall, changing fuel conditions and adaptive management practices. Even with more complete current information, there are data gaps and difficulty in determining exact causation. In addition, conflicts within the data lead to uncertainties in projection of trends. For example, one fire in 1999 burned approximately 1,483 ac by one account and 3,000 ac by another; the smaller estimate was 75 percent of the total for that year.

FARSITE Fire Spread Model

The Navy used a fire spread model, Fire Area Simulator (Finney 1998) (FARSITE version 4.1 of February 2005) to evaluate the effects of ignitions in new and previous locations. FARSITE simulates the growth and behavior of potential fires as they spread through variable fuel and terrain under changing weather conditions. The model was run for VERY HIGH and EXTREME fire weather conditions, using both northwest and northeast wind scenarios. Example ignition points were modeled within the TARs and SHOBA Impact Areas. Model predictions of fire footprint for TARs 4, 10, 14, and 17 are shown in Table 3.11-11. The higher spread rates occur where grasses (fine fuels) are more dense.

Table 3.11-11: Potential Threat to Habitat from Fire at Selected TARs

TAR	Elapsed Time (minutes)	10 mpg Wind		15 mph Wind	
		NE Acres	NW Acres	NE Acres	NW Acres
4	30 60	3.1 15.7	3.1 15.5	8.4 38.2	8.1 40.6
10	30 60	2.1 10.5	2.1 10.4	4.9 23.3	4.7 23.6
14	30 60	57.7 261.6	57.6 280.8	122.4 405.8	122.6 585.1
17	30 60	2.1 8.0	2.1 10.0	4.6 11	4.7 20.8
Source: Biological Assessment, SCI Wildland Fire Management Plan, Draft July 2005, Appendix B. Analysis: FARSITE fire spread scenarios from several ignition points.					

Note from the table that a modeled wildland fire originating on TAR 14, coupled with VERY HIGH to EXTREME Fire Danger Rating System (FDRS) conditions, shows the potential for substantial spread into SCSS habitat and SCI larkspur habitat under northeast and northwest winds, respectively. However, these results overestimate the potential threat because they do not take into account precautions and countermeasures already implemented and those additional precautions specified in the SCI Fire Plan. The Plan incorporates a series of increasing precautions and fire suppression measures related to increasing FDRS ratings, including having users pre-position a fully equipped and staffed fire truck within line of sight of the TAR and having the ability to be on scene and pumping water within 10 minutes of an ignition report whenever any type of incendiary ordnance is used and at higher danger ratings. The SCI Fire Plan BA specifically states, “such scenarios [as modeled under Table 3.11-11] are not expected, or would be accidental” [emphasis added].

Although projections for 30 and 60-minute intervals are displayed in this table, the likelihood is low that a fire caused by operational sources would burn this long. The SCI Fire Plan states that whenever any type of incendiary ordnance is in use within a designated TAR, a fully equipped fire truck, with a minimum of 500 gallons of water, and staffed with three wildland fire certified personnel shall be placed in the vicinity where the training is taking place and available to take initial actions. The decision about where to place the standby fire engine will be that o the Range Safety Officer, but there must be line-of-sight visibility and the ability to be pumping water within 10 minutes of an ignition report. The use of pyrotechnics, demolitions and other heat/flame producing devices with that TAR will be limited as much as possible to night-time activity, a cleared area or areas previously burned over.

In addition, when the fire danger conditions become higher than MODERATE in the daytime, flame-producing ordnance are restricted to nighttime, early morning or late evenings, when higher humidities reduce fire ignition and spread potential. The higher fire danger conditions also require the staging of water supplies for refilling the fire engine at TAR locations in sage sparrow habitat (specifically, TARs 4, 10, and 17).

Potential Impacts of Fire on Terrestrial Biological Resources

The Biological Assessment (BA) for the SCI Fire Plan analyzed the habitat or individuals of known listed biological species that could be affected under three fire scenarios, assuming a worse-than-average 1-hour duration fire (DoN 2005). The results of this analysis considered the potential direct effects on several species of interest. Table 3.11-12 summarizes the conclusions from the analysis in the Fire Management Plan BA.

Table 3.11-12: Potential Effects of Fire on Sensitive Terrestrial Resources

Name	Potential Effect
Island night lizard	Ecological studies on fire effects have shown no adverse effects either short-term or long-term on island night lizard populations.
San Clemente loggerhead shrike	Uncontrolled fires ignited in TAR 14 could have adverse effects on the habitat that has started to support nesting loggerhead shrikes. Only a negligible effect of new fires at other locations are expected for the San Clemente loggerhead shrike, which could use this area for foraging.
San Clemente sage sparrow	Recent work has concluded that the sage sparrow is resilient to some loss of habitat which may result from new fire locations, which can result in both a temporary loss of habitat and possible type conversion of small acreages.
Santa Cruz Island rock cress	Where this plant occurs, fuel hazard is very low and the area is unlikely to carry a fire. Because of the extremely low fuel load, the only time this area would have the potential of supporting a fire would be after the rock cress had set seed, which would further minimize risk to this species.
San Clemente Island broom	This species is expected to benefit from fire due to enhanced seeding and altered competitive status through gap opening and decreased competition.
San Clemente Island bush mallow	Fire is considered a net benefit to this plant as long as the interval between fires is at least 5 years.
San Clemente Island larkspur	This herbaceous perennials has a fleshy tap root, and is likely to be dormant when a fire passes through, so would not be directly affected, but could benefit from canopy opening and other aspects of altered competitive status.
San Clemente Island woodland star	No plants would be affected by any of the model scenarios.
San Clemente Island Indian paintbrush	The available evidence suggests occasional fires may benefit this species.
Catalina Island ironwood tree	This sensitive species is mainly located in the upper canyons of the eastern escarpment and is vulnerable to fires in the Infantry Operations Area (IOA). In this location, it is not likely to be affected by fire due to the lack of live ordnance training here. It resprouts after fire but has not been observed to reproduce by seed on SCI.

In an analysis using baseline parameter values in a metapopulation model, none of the habitat loss scenarios considered yielded a measurable risk of extinction of San Clemente sage sparrow. This is because of the sage sparrow's high annual reproductive capacity, high nest success, and the ability to produce several broods within a single breeding season. Primary fire effects could be at TAR locations (such as TARs 10 and 17) in sage sparrow habitat, and fires that spread into sage sparrow habitat from the vicinity of VC-3 (such as TAR 14). TAR 14 under northeast winds have the greatest potential to affect sage sparrow habitat if left unchecked. Existing fire patterns north of the runway (TAR 4) also contribute to effects on sage sparrows. These effects will be avoided and minimized through staging quick-attack suppression equipment, water and managing the use of flame-producing ordnance with the FDRS. Fires are not expected to actually burn on SCI under EXTREME danger conditions because the use of incendiary ordnance is restricted under those conditions. Under full compliance with the SCI Fire Plan, expected new fire locations at TAR 10 and TAR 17 will each encompass less than 1 ac in sage sparrow habitat. Allowing for a worse than standard response at these locations shows burns in sage sparrow habitat to not exceed 2 ac (TAR 10 and TAR 17) in size, for a total of 4.2 ac.

Indirect effects. The indirect effects of increased operations and the new fire locations are more difficult to discern. Repeated wildfires may alter the vegetation communities that support the island night lizard population. Without historic ignitions patterns at TAR 14, the effects on the relatively new north-of-SHOBA nests for the loggerhead shrike are unknown. Repeated fires over time may cause type conversion, which would diminish the habitat quality for the sage sparrow and decrease the population density. On the whole, regular fires, depending on many factors including return interval and species biology, could favor native perennial listed and other sensitive plants over invasive grasses, but long-term protection of genetic diversity may require some establishment by seed or nursery assistance. However, the Natural Resources Office has two funded vegetation programs to address this long-term issue: the Seed Collection and Propagation program and the Site Selection, Outplanting, and Maintenance program.

The issue of wildland fire is a concern with the Proposed Action for the reasons that increased live-fire operations inherently bring the potential for more fires. While the battalion landings have an insignificant potential for fires north of SHOBA, the designation of additional TARs will add multiple locations for live-fire where it has never been introduced in the recent past. The response to this expanded potential seems to be in the FDRS and its embedded restrictions on the use of incendiary ordnance in periods of higher danger. Whether this operational response is adequate will be a matter of continuing command interest.

In summary, wildland fire effects on terrestrial biological resources are expected to be less than significant in scope and intensity for several reasons:

- The SCI Wildland Fire Management Plan is nearing publication, and its major elements are expected to reduce the sizes of fires, produce a lower fire frequency and increase fire return intervals. These major elements are a FDRS and fire prevention, a fuels management program, increased human resources capacity for improved suppression, improved firefighting organization, allocation of roles and responsibilities, improved firefighting roads and communications infrastructure, and the development of appropriate implementation mechanisms.
- Department of Navy users, range managers and island officials have a heightened situation awareness of the danger of wildland fire and the measures needed to contain and minimize the adverse impacts on natural resources as well as personnel and facilities.
- The fire history data shows that most of the operations (74 percent) that take place on SCI have no history of fire.
- With the exception of 2004 (ten wildfires), there is a downward trend in the numbers of out-of-control wildfires, with only one fire occurring in 2002 and zero in 2003.
- The size of wildfires from operational sources has decreased steadily along with their number. Operational ignitions burned 1,609 ac in 1996. 495 in 1999, 28 in 2001, and none in 2002, 2003 or 2004.

3.11.7.2 Access

Access to SCI range areas is important for fleet operations and for environmental management. The Fleet needs access to conduct operational training and RDT&E activities. Natural Resources Program personnel have specific requirements to survey and monitor for the shrike recovery effort. The basic requirement for NRO access to SHOBA is the *U.S. Fish and Wildlife Service (USFWS) Biological/Conference Opinion (BO) on Training Activities on SCI, San Diego County, California, 15 March 1997*, which outlined two periods of access during the breeding season: 1200 Friday to 1200 Monday and 1200 Wednesday to 1200 Thursday. This guidance was subsequently modified by NASNI message 9 February 1999, which, with consensus agreement, provided dates (1 February to mid-August) for the breeding season, and revised the requirement for mid-week access to a floating 24-hour period, Tuesday-Thursday. As the shrike population increased, the proportion of the population nesting outside of SHOBA increased substantially (Table 3.11-4) In the 5 years since 2002, between 60 and 74 percent of the population has nested outside of SHOBA. Accordingly, NRO reduced its access requirements from 90 hours per week to 60 hours. The 2006 NRO request was for 44-48 hours per week, spread over 5 days.

Increased awareness of potential safety hazards to personnel has caused the Navy to recently revise its access policy to high explosive impact areas for both military and non-military personnel. To reduce risk to personnel, Commander Navy Region Southwest (CNRSW) has issued an Instruction (COMNAVREGSW INSTRUCTION 4000.2 dated 18 July 2006 and updated 7 September 2007) pertaining to Ground Entry/Access to Operational Range Complexes to reduce the hazard of unexploded ordnance. This policy applies to operational range complexes throughout Navy Region Southwest, including Impact Areas I and II on SCI. To reduce the risk to non-military personnel, for High Explosive Impact Areas (such as Impact Areas I and II on SCI), the policy explicitly states: "Any activity associated with archaeological or biological monitoring and surveys or recreational use (to include hunting) is strictly prohibited.”

This precludes access by natural resource professionals to Impact Areas I and II, including the entirety of TARs 20, 21, and 22 for any purpose, including monitoring and management of endangered and sensitive species and their habitat. This policy does not apply to the remainder of SHOBA outside of Impact Areas I and II, where scheduling of access as described above would still apply.

Portions of the Impact Areas I and II are highly disturbed, especially around targets, and have low value as habitat for endangered or threatened species due to the long history of use as impact areas for Naval artillery, bombs, mortars, rockets, and ground based artillery. However, significant resources still exist, especially in canyons and away from the actual target areas. About 16 percent of the endangered SCI Indian Paintbrush occurrences and 70 percent of the endangered SCI bush mallow occurrences occur within Impact Areas I and II (the majority of the occurrences are concentrated in Horse Beach Canyon in Impact Area I). In addition over 13 percent of the known occurrences of SCI silvery hosackia, a state listed endangered plant, is located within Impact Areas I and II, the majority within Impact Area I. Impact Areas I and II combined contain < 6 percent of the estimated island night lizard population and habitat. During recent years, Impact Areas I and II combined have averaged only about three San Clemente Loggerhead Shrike nests per year (~5 % of the shrike nest sites on SCI). A small area of low density San Clemente sage sparrow habitat is located in Impact Area II. Although snowy plovers have seldom bred on SCI, China, Horse Beach, and Pyramid Cove beaches, which are encompassed by Impact Areas I and II, collectively support the largest numbers of wintering snowy plovers on SCI.

The main consequences of implementing this policy on endangered, threatened, and sensitive species would be indirect effects related to non-native predators (e.g., feral cats and rats) and invasive plant species. Additionally, future data on the condition and recovery status of listed and other sensitive species populations within the impact areas would not be available.

3.11.7.3 Ordnance Use

The Navy and Marine Corps use a variety of types and sizes of ordnance on SCI at several locations including live and inert 5-inch naval artillery rounds, 105mm and 155mm land based artillery (howitzer) rounds, 81mm mortar rounds, tank rounds, illumination rounds, small arms ammunition, live and inert practice bombs, grenades, flares, flash-bangs, smoke, and demolition explosives. Ordnance use (or ensuing fire) can result in several types of impacts to terrestrial biological resources, including modification of habitat, injury or death to plants or wildlife, and potential for toxic effects from munitions constituents (e.g., ingestion of lead), as discussed below. Impacts from noise associated with ordnance use, and other noise-producing activities on the island also are addressed.

Effects on Habitat

Effects on vegetation and wildlife from ordnance impact and detonation would be within existing ordnance Impact Areas I and II in SHOBA, which have a long history of use as naval bombardment areas. Alteration of vegetation and soils and potential for increased erosion resulting from loss of ground cover is associated with ordnance impact or detonation. Habitat may also be affected by fire resulting from ordnance use. Within the designated Impact Areas, the habitat ranges from highly disturbed in the immediate vicinity of targets and within the area designated as Impact Area IIA (the “heavy ordnance area”) to relatively undisturbed. The level of disturbance within the impact areas diminishes with distance from the targets. The habitat outside of the Impact Areas is in generally good condition, although evidence of past ordnance impact from misses and skipped rounds is visible.

Given their distribution relative to impact areas and targets, the listed wildlife species, with the exception of island night lizards, occupy habitats that occur on the edges of the impact areas and/or are sheltered by topography. Both of these factors reduce the frequency of ordnance “hits” in their habitat and as a result the habitat is in relatively good condition. Island night lizards are relatively common even in highly disturbed sections within the Impact Areas, possibly by virtue of the amount of time they spend under cover.

Outside of SHOBA, live ordnance use would be at designated TARs or the existing small arms range and demolition pit. At TARs, use of explosive demolition charges would be confined to existing, previously disturbed areas. Where tactical live firing is permitted, small arms projectiles would have little effect on habitat because of their minimal individual impact and because the different directions and angles of fire would minimize any collective effect.

Direct Mortality or Injury

Within Impact Areas I and II, island night lizards are relatively abundant, even in heavily disturbed areas, and wintering western snowy plovers are present on the beaches, especially in Impact Area I. San Clemente loggerhead shrikes nest in sheltered locations in China Canyon within and just outside of Impact Area II and near the edge of Impact Area I in Horse Beach Canyon and upper Chenetti Canyon. Low density San Clemente sage sparrow habitat extends south into Impact Area II on the lowest marine terrace ending at the west end of China Beach near the mouth of Red Canyon and with an additional small patch of habitat near China Point. In parallel with the pattern of habitat disturbance, the potential for direct mortality or injury to species decreases with distance from target areas and also as a result of topography. Island night lizards are likely to be affected because of their relative abundance in the immediate vicinity of the targets. For the other listed wildlife species, impacts causing injury or death would be limited to extremely rare chance events and the likelihood of impacts causing injury is not expected to measurably increase with the proposed operations. For the San Clemente loggerhead shrike, San

Clemente sage sparrow, and island night lizard there is the potential for injury to individuals or their habitat resulting from fire spreading from impact areas.

Among the listed and other sensitive plant species, four have substantial occurrences in SHOBA where they could be exposed to incoming explosive ordnance. These are Santa Cruz Island rock cress, San Clemente Island bush mallow, San Clemente Island Paintbrush, and SCI silvery hosackia. On SCI, the rock cress and SCI silvery hosackia are known only from SHOBA. The rock cress is located on ridges outside Impact Area I, about halfway between the eastern boundary of Impact Area I and Pyramid Head. Its location outside of the impact areas make it very unlikely that it would be affected by incoming ordnance. The SCI silvery hosackia is abundant on south facing slopes and ridgetops, largely away from target areas. Many of the locations are very sparsely vegetated and unlikely to carry fire. San Clemente bush mallow has substantial distribution within Impact Area I, near its western boundary in Horse Beach Canyon. Except for plants nearest the canyon mouth, individuals in Horse Beach Canyon are somewhat protected by topography from surface firing and are not near targets, making direct hits unlikely. San Clemente Island Indian Paintbrush has substantial distribution, both within Horse Beach Canyon (Impact Area I), above the eastern end of the beach in Pyramid Cove (outside Impact Area I), and China Canyon (at edge of Impact Area II). Its populations are well distributed and expanding on SCI. Impacts on these species from direct ordnance impact are unlikely because of location and topographic situations with regard to target areas and, if they occurred, would be infrequent and localized and thus unlikely to have substantial effect on the local population. Fire resulting from ordnance use is more likely to reach endangered or threatened plant populations than direct impacts, but impacts from fire would likely not be significantly adverse given the resilience and fire adaptation of the species and their habitat, unless return intervals are too brief to allow regeneration of seed bank or reserves for resprouting.

Accumulation of Ordnance Related Materials

Ordnance use on SCI has the potential to release munitions constituents that may be harmful to the biological environment. Munitions constituents can be released during high- and low-order detonations, and to a lesser extent from duds.

The ordnance expended from activities conducted on SCI would result in liquid and solid emission products. These are summarized in Section 4.3. The majority of the products by weight would be generated from activities conducted within SHOBA, where approximately 37,060 kg (81,703 lb) of ordnance was expended. The major munitions constituents and their contribution to this total include:

Aluminum oxide (Al_2O_3): 60%

Carbon (C): 24%

Water (H_2O): 10%

Lead (Pb): 2.5%

Carbon, aluminum oxide, and water are common constituents of the natural environment and are not discussed further. Lead can be toxic to wildlife if ingested (Eisler 1988). Metals or other chemicals from munitions have the potential to enter the food chain through direct ingestion or accumulation in plants. Ingestion of lead is known to result in poisoning of waterfowl, vultures, and raptors. In waterfowl, lead ingestion has been generally attributed to lead bird shot incidentally consumed by birds (especially mallards and pintails) feeding on the bottom of shallow water bodies where lead shot used in waterfowl hunting has accumulated. In raptors and vultures, poisoning may result from ingesting lead shot embedded in the flesh of prey (Eisler 1988; Kendall, et al. 1996). Lead objects are ground down by the gizzard or dissolved by stomach acids and absorbed into the body as lead salts, which disrupt normal body functions, especially the digestive and nervous systems of birds. Lead poisoning is uncommon in upland birds, but has been documented in mourning dove from areas where lead buckshot, similar in size and shape to seed and grit ingested by birds, is used extensively (Kendall et al. 1996). Whether lead poisoning would occur in species such as sage sparrows that feed primarily on boxthorn berries and to a lesser extent on seeds and insects or occur in species such as loggerhead shrikes that prey upon live invertebrates and vertebrates is not known, but appears unlikely. Their food habits would indicate a much lower vulnerability than for raptors or waterfowl because of the lack of a pathway for lead to be ingested, other than for inadvertently ingesting any residue that adhered to food items gathered from the ground.

3.11.7.4 Sound and Noise

Sound sources on the island include ordnance use, aircraft, vehicle and equipment use, and other training activities. Sound can travel from a single point source (such as an artillery piece) or from a line source (a road). Generally speaking, sound energy decreases as a function of distance from a point source at a rate of 6 dB and from a line source at a rate of 3 dB for each doubling of the distance from the source (USAF et al. 1978).

Impacts on wildlife as a result of increased sound levels are difficult to quantify because the evaluation of sound in the environment is generally linked to human reaction (annoyance level), and the literature base for evaluating how sound may affect wildlife is extremely limited. Although the reaction/response of wildlife to sound in the environment is difficult to measure and characterize, noise can be defined as sound that may be harmful or disturbing to the health and activity of wildlife and can degrade the quality of the habitat. Additionally, what may be considered an adverse effect on one particular species, or individual, may not necessarily translate into the same type of effect on another species or individual.

Studies generally indicate that birds hear very well over a very limited range between 1 and 5 kilohertz (KHz) but specific species hearing can extend to higher and lower frequencies (Beason 2003). The sensitivity of birds to disturbance may also vary during different stages of the nesting cycle. Similar noise levels may be more likely to cause nest abandonment during incubation of eggs than during brooding of chicks because birds have invested less time and energy and have a greater chance of re-nesting (Knight and Temple 1986). In a related manner, a bird may be more likely to defend its nest later in the season because it already has invested more time and energy in reproduction and care (Barash 1975; Grubb and Bowerman 1997; VanderWerf et al. 2000). Unlike other species, birds have the ability to regenerate hair-cells in the ear, usually culminating in considerable anatomical, physiological, and behavioral recovery within several weeks (4-12). However, the temporary loss of some hearing may affect a bird's ability to successfully breed (Dooling et al. 1997).

Additional studies (e.g., Delaney et al. 1999, Pater et al. 1999) have emphasized the need to carefully measure the sound stimuli caused by training activities, the proximate behavioral responses of subject animals, and the long-term demographic consequences of training noise (VanderWerf et al. 2000). A study conducted at the Schofield Military Reservation on Oahu monitored the behavior of nesting 'Elepaio birds in response to blast noises from 155mm and 105mm howitzers, 81mm and 60mm mortars, hand grenades, and demolition of UXO at various distances (VanderWerf et al. 2000). The responses at eight nests were observed for 283 blasts which varied in noise level at the nest site from 89 to 116 dB, representing the maximum sound pressure level measured over the evaluation period, 10 to 12 hours. In no case did an 'Elepaio flush from the nest or pause when returning to the nest in response to artillery noise. As a result, artillery noise was judged to have a negligible effect on the behavior of 'Elepaio. In addition, nest attendance and nestling provisioning rates during periods of firing at Schofield Barracks were similar to rates at a control site that did not experience military training. These results indicated there are no long-lasting effects of artillery blast noise that inhibit ‘Elepaio from resuming normal nesting behavior after the artillery noise has subsided (VanderWerf et al. 2000). It is not clear whether the lack of effects on ‘Elepaio by the blast noise was due to limitations in the frequencies which they can hear or if they acclimated over time to the occasional blast. It is also possible that if ‘Elepaio residing near the blast noise areas had been constantly subjected to sound pressure levels that damaged their hearing receptors, then auditory alerts may be at frequencies that were undamaged by the noise (Beason 2003). Regardless of the conclusion, there is no evidence of significant effect on ‘Elepaio behavior.

Evidence of some species flushing from nest sites is also available in the literature. A study of the red-cockaded woodpecker recorded flushing in response to single event noise levels ranging from 88-107 dB (Delaney et al. 2000). In another study of this species, the data suggest that disturbance exceeding certain levels of activity could be detrimental to reproductive success (Hayden et al. 2002). However, the disturbance in this case consisted of nearly constant Army training noise throughout the daytime in the breeding season and is far greater in frequency than Naval training noises at SCI. Specific data concerning hearing thresholds on the wildlife species of concern are not available. A threshold for the distance from the sound at which red-cockaded woodpeckers flushed from the nest was developed by Pater et al. (1999) and indicated that if distances are greater than 152 meters (m) from nests to blast locations of artillery or live-fire exercises, red-cockaded woodpeckers do not flush (Delaney et al. 2002). Their results also indicated that woodpeckers do not flush during the nesting season when the single activity sound level (e.g., a single gun firing) for artillery simulators is less than 89 dB. For comparison, the peak noise level from .50 caliber blank fire is less than 82 dB, small caliber live-fire events are less than 79 dB, large caliber live-fire events are less than 103 dB, and grenade simulators are under 91 dB (Pater et al. 1999; Delaney et al. 2002).

Sound Associated with Ordnance Use

As noted, SHOBA has a long history of naval bombardment. Compared to baseline, future use of heavy ordnance in SHOBA would stay the same or increase slightly for Naval Surface Fire Support Exercises (FIREX) and Expeditionary Firing Exercises (EFEX). Use of live and inert munitions would increase for Close Air Support (CAS), but the use of live bombs would be confined to Impact Area II A, which is highly disturbed and farther removed from nesting shrikes than the naval artillery targets evaluated in the following analysis. Although it has been conducted in previous years, the Battalion Landing was not conducted during the baseline period and would be considered a “new” use. It would occur up to twice a year.

Table 3.11-13 presents the instantaneous noise levels of several types of ordnance. Operations such as FIREX (80 5-inch/54 rounds per day), EFEX (106 5-inch/54 or 5-inch/62 rounds over a 3-day period), and the Battalion Landing (200 5-inch/54 or 5-inch/62 rounds over 4 days) could place wildlife under some degree of stress during the operation. Firing of naval artillery would be combined with firing of other weapons coming from various directions (for example, the Battalion Landing also includes approximately 100 155mm artillery rounds, 147 81mm mortar shells and over 100,000 rounds of small arms fire). Because operations involving ordnance use in SHOBA happen routinely, species which are not in the immediate target areas would be expected to acclimate to the noise and show little or no behavioral response. This is because there would be no association between noise and other adverse effects.

As stated above, sound pressure levels decline over distance, a process known as attenuation. For small arms, noise levels range from 90-115 dB at 50 ft from the source, declining to 30-75 dB at 2,000 ft. Noise modeling on Camp Shelby, Indiana, as part of the Camp Shelby Installation Environmental Noise Management Plan (U.S. Army 2001) predicted that peak impulse noise levels from a 120mm tank gun are approximately 137.8 to 143.2 peak decibels (dBP) at 500 m from the source, and decline to approximately 101.3 to 106.7 dBP at 5 kilometers (km) from the source (U.S. Army 2001). Noise levels from a 155-mm Howitzer range from 127.0 to 141.0 dBP at 500 m from the source, and decline to approximately 90.5 to 104.5 dBP at approximately 5 km from the source (U.S. Army 2001). Peak decibels are sometimes used in the measurement of impulse noise (such as blasts and explosions) as a measure of the highest instantaneous sound pressure level. For human exposure to instantaneous sound pressure levels between 140 dBP and 165 dBP, hearing protection such as ear plugs or muffs is recommended. For exposures to louder impulse levels (165-185 dBP), two forms of protection (such as plugs plus muffs) are required (USMC Hearing Protection Program, Marine Corps Order 6260.1E, 5 April 2000).

Table 3.11-13: Approximate Ordnance Noise Levels

Ordnance Type	Noise Level Range (dB) (Reference SEL at 50 feet)
Grenade Launcher	102
Mortar Rounds	101-108
Practice Bombs (Inert)	60
Live Bombs	110-125
Explosives	110
Flares and Smoke	60-65
Artillery Ammunition	101-108
Cannon Shells	105-115
Naval Artillery Shell	110
Small Arms Ammunition	90-115
Rockets	90
Grenade (at 50 feet)	164

Source: R. Tavares, personal communication, U.S. Army 2001, U.S. Army 2004

The species of greatest concern with respect to noise is the San Clemente loggerhead shrike, which has some nests within several hundred meters of targets for live incoming ordnance. More detail on species specific impacts from noise associated with ordnance is discussed in section 3.11.5. In general, a 5-inch/54 round with a contact fuse creates the loudest temporary noise of approximately 125 dBP upon impact (Section 3.5, Acoustic Environment). Although sustained exposure to continuous noise at or exceeding this level could be damaging, the noise from incoming shells during a typical exercise is momentary, with a frequency up to several times per hour during an exercise; this exposure would not be expected to cause any physiological damage or hearing loss to birds, including shrikes. At the moment of impact, most other sounds, such as bird songs, including contact calls from conspecifics or mates, and songs that attract mates, would be momentarily masked. In between impacts, noise levels would decline to typical background levels. For comparison, a thunderstorm would generate sound pressure levels between 90 and 120 dB, reaching higher levels during extreme thunderclaps.

Flyover and Helicopter Activity Noise

Table 3.11-14 presents approximate ground level noise levels from a variety of rotary wing and fixed wing aircraft at progressively higher flyover altitudes (U.S. Army 2001; U.S. Air Force 1999).

A study of bald eagles determined that military activity disturbed birds to a limited extent, but the activity was not disruptive enough to preclude high eagle use of the study area (Stalmaster 1997). Results of a trial measuring the effect of aircraft noise on the crested tern (*Sterna bergii*) indicate that the maximum responses observed, preparing to fly or flying off, were restricted to sound level exposures greater than 85 dB(A). While the experiment provided good control on simulated aircraft noise levels, preliminary observations of tern colonies responses to balloon overflights suggest that visual stimulus is likely to be an important component of disturbance, such as can be caused by aircraft overflight (Brown 1990).

Studies of the effects of simulated aircraft noise on desert ungulates (mule deer and mountain sheep) suggest that animals became habituated to sounds of low-altitude aircraft. Captive and free ranging pronghorn (*Antilocapra americana*) habituated to low-level F-16 flyovers (Note: sonic booms are not permitted near SCI). During the first two F-16 overflights, pronghorn bolted forward and ran, then stopped and stayed alert. Degree and duration of heart rate elevation decreased with successive exposures (Workman et al. 1992). Weisenberger et al. (1996) had similar findings with mountain sheep (*Ovis canadensis*) and mule deer (*Odocoileus hemionis*). Heart rates returned to pre-disturbance levels within 1-3 minutes and behavior returned to pre-disturbance conditions within about 4 minutes or less. All animal responses decreased with increased exposure suggesting that they habituated to simulated sound levels of low-altitude aircraft (Weisenberger et al. 1996).

Responses of nesting peregrine falcons (*Falco peregrinus*) and other raptors to low-level jet overflights were often minimal and were never associated with reproductive failure (Ellis 1981; Ellis et al. 1991). The effects of low-level military training flights on wading bird colonies in Florida were measured by indirect evidence using colony distributions and turnover rates. There were no demonstrated effects of military activity on wading bird colony establishment or size (Tiller, et al. 1984). Fixed-winged jet aircraft disturbance did not seem to adversely affect waterfowl observed during a study in coastal North Carolina (Conomy et al. 1998a). In another study, increased military aircraft activity prompted an evaluation on whether waterfowl and other wildlife are adversely affected by aircraft disturbance. Study results indicated that the time required to habituate may depend on the frequency and intensity of exposure per unit time. For example, the author suggested that black ducks may habituate and wood ducks did not exhibit the same pattern of response, suggesting that the ability of waterfowl to habituate to aircraft noise may be species specific (Conomy et al. 1998b).

Vehicle and Equipment Sound

Sound levels from individual vehicle pass-bys vary with vehicle type and speed. Noise levels generated by High Mobility Multipurpose Wheeled Vehicles (HMMWVs) and two-axle military trucks are estimated as comparable to noise from medium trucks (about 65 to 70 dBA at 50 ft [15 m]) and other heavy duty trucks (about 70 to 80 dBA at 50 ft [15 m]). Peak pass-by noise levels would drop by 15 dBA at a distance of 500 ft (152 m) from the travel path (U.S. Army 2004).

Similar to other noise analyses, impacts of on-road vehicle noise on wildlife are difficult to quantify. What may be considered an adverse effect on one particular species, or individual, may not translate into the same type of effect on another species or individual. Studies suggest that both wildlife and domestic animals become accustomed, or habituate to the level of sound that occurs regularly. The existence of wildlife at airports suggests that aircraft noise levels alone do not prevent utilization of wildlife habitat (Busnel 1980). Given the apparent tolerance to traffic noise that some shrikes have demonstrated by nesting within 5–50 m of the road (Lemon Tank 2 and Tota 1), shrikes appear to tolerate traffic noise levels as high as 80 dB to 90 dB. Therefore, road traffic noise would not likely adversely affect nesting shrikes.

Table 3.11-14: Maximum Noise Levels of Aircraft (dB) at Ground Surface from Aircraft Overflight at Different Altitudes

	Altitude					
Aircraft	**200**	**500**	**1,000**	**2,000**	**5,000**	**10,000**
AH-1 Cobra*[2]	93.3	85	78.5	71.6	61.2	52.1
AH-64 Apache[2]	91.8	83.4	76.8	69.8	59.1	49.6
CH-47D Chinook[2]	97.5	89.3	83	76.5	67.1	59.1
OH-58D Kiowa Warrior[2]	89	80.5	73.8	66.7	56.1	47.1
UH-1 Huey*[2]	91	82.8	76.4	69.8	60.2	52.1
UH-60 Blackhawk[2]	91	82.5	75.9	68.7	57.8	48
C-17 Globemaster[2]	101	91.4	83.3	74.7	62.1	51.8
C-130 Hercules*[2]	100.2	100.2	91.5	77.2	66.3	56.9
A-10 Thunderbolt II*[1]	-	95	89	82	72	63
F-16 Falcon*[1]	-	103	98	91	81	70
F/A-18 Hornet*[1]	-	114	108	101	89	77
AV-8B Harrier*[3]	116	-	-	-	-	-

Identified as commonly used as part of routine operations at SCI.
[1] U.S. Army 2001
[2] U.S. Air Force 1999
[3] NAS Point Mugu 1999

3.11.7.5 Off-Road Foot and Vehicle Traffic

Foot traffic. Virtually the entire island is open to foot traffic, with the provision that prior clearance is needed for entrance to some facilities. During the Battalion Landing exercises, large forces (about 1,500 Marines plus equipment) from a Marine Expeditionary Unit (MEU) would deploy on SCI for a 4-day exercise up to twice per year. Foot traffic would be confined to a broad corridor designated as the IOA. When in an offensive formation, the Marine infantry typically maintains a 15-ft (5-m) spacing between individuals, which would tend to spread the individuals over a large area but limit the intensity of impact in any local area. Sanitation needs would be met by port-a-potties, which would be transported and picked up by island authorities. All troops would be instructed in their use and field sanitation. Digging would be prohibited. Refuse would be collected at assembly points, stored temporarily in field sanitary conditions and protected from consumption by native and feral birds and wildlife (especially feral cats, rats, and ravens), and removed at the conclusion of the exercise. The IOA comprises about 25 percent of the Island's land area and is located on the island's plateau, an area vegetated mostly by non-native grassland, with spurs in SHOBA leading to Horse Beach Cove (TAR 21) and to a point near the terminus of the Ridge Road in the vicinity of Pyramid Head.

In contrast, NSW operations involving off-road foot traffic generally would consist of fewer than 25 people covertly walking over an area. Because the covert nature of these Special Forces activities requires special training and a light footprint, effects on habitat would be comparatively minimal.

Several of the listed plant species on SCI are likely to be affected to some degree by foot traffic because of the presence of individuals or colonies in or near the IOA and TARs. However, the IOA was designed to optimize avoidance of known populations of sensitive plants. These species include San Clemente Island Indian Paintbrush, San Clemente Island broom, San Clemente Island larkspur, and San Clemente Island bush mallow. San Clemente Island rock cress and San Clemente Island woodland star occur mostly or exclusively in canyons or steep slopes below the plateau on which the IOA is located and are located outside the IOA boundary. These species are unlikely to be directly affected by foot traffic because of their location outside the IOA and their relative inaccessibility from frequently used areas.

Off-road foot travel has the potential to cause damage to individual listed and other sensitive plants from trampling or crushing. Off-road foot traffic would result in some level of soil compaction, which may locally impede germination and seedling growth of listed and other sensitive plants that rely on seeds rather than vegetative means for reproduction. However, this effect would be localized and incremental, given the long history of grazing and military activity that has already led to some level of soil compaction. Trampling effects on individual plants would be adverse, but temporary, and the affected plants would be expected to recover, even if individual stems are broken. Trampling effects on the habitat would also be expected to be generally minimal and dispersed over the terrain, except when soils are very wet and subject to compaction, sloughing, and erosion.

Off road foot travel also has a low potential to affect listed wildlife species. There is the potential for injury or mortality to island night lizards caused by personnel stepping on objects under which individuals of this species may have taken cover. San Clemente sage sparrow and San Clemente loggerhead shrike adults would be expected to maintain a safe distance from personnel activities, but there is a chance that nests of either species could be disturbed, with possible but very unlikely injury or loss of eggs or young given the very low density of nests. Since 2001, San Clemente loggerhead shrikes have nested in low shrubs at one or more locations within the IOA near Ridge Road, where some likelihood exists for close approach by persons on foot. Given the normal 5 m (15 ft) spacing between individuals, one or two infantry personnel might closely approach a shrub containing a nest. Most likely a person would walk around a shrub leaving the nest physically undisturbed. Anyone walking past a shrub or other vegetation that contains a nest could cause the bird to flush from the nest. It is not known whether or not San Clemente sage sparrow nest within the IOA; however, low density sage sparrow habitat does overlap the IOA in the vicinity of the Old Rifle Range Artillery Maneuvering Point (AMP) and northward. At nighttime, diurnal birds tend to allow a very close approach before flushing (much closer than during daylight) but have a greater tendency to be disoriented when they do flush (SAIC staff observations) and would likely be more vulnerable to injury or predation. The likelihood of flushing, however, is low because they tend to remain still until a person is within a very short distance. Snowy plovers forage during daylight and at nighttime (SAIC staff observations) and do not appear disoriented when they move or take flight at night, possibly related to the openness of their habitat and the need to avoid mammalian predators.

Invasive species are widely recognized as a leading cause of loss of species world wide, second only to direct habitat loss and fragmentation (Pimm and Gilpin 1989) and island ecosystems and species are especially vulnerable to invasion (Mack et al. 2000). Invasive species may affect ecosystem processes, for example, invasion of grasses may alter fire frequency by rapid production of highly flammable fuel, thus leading to more frequent fires and eventual conversion of shrublands or forested lands to grasslands or savannas (D'Antonio and Vitousek 1992). SCI has the highest percentage of endemic species (native especies found only on SCI) of the California Channel Islands (Junak 2003). The high degree of native plant endemism on SCI makes the adverse effects of invasive plant species of particular concern, because of the vulnerability of endemic plant species to extinction or local extirpation.

Junak (2003) provides a summary of the distribution of selected invasive plant species on SCI. Three species that are currently localized but have a high likelihood of spreading given their current locations and the locations of proposed operations include: (1) veldt grass (*Ehrharta calycina*), which is currently restricted to the northern portion of the island and occurs within the IOA and AVMA just south of the runway and at West Cove; (2) salsify (*Tragopogon porrifolius*), which is currently spreading from VC-3; and (3) asphodel (*Asphodelus fistulosus*), which occurs east and south of the NALF airfield runway very close to the IOA. Junak (2003) also identifies a number of species with relatively small infestations that have the potential to spread widely over the island and cause ecological changes such as fuel-mediated changes in fire frequency, competition, and type conversion that would adversely affect listed species. These species include Mediterranean grass (*Schismus arabicus*), Saharan mustard (*Brassica tournefortii*), and false brome (*Brachypodium distachyon*). The locations of these species near the Ridge Road, roads in SHOBA, and/or in the northern Assault Vehicle Maneuver Area (AVMA) would facilitate accidental spreading more widely on SCI, as part of Battalion Landing or other large-scale exercises involving the AVMA and IOA. The large size of the IOA and the dispersed nature of off-road foot traffic would combine to make newly established infestations of invasive species more difficult to detect when they are small and most treatable.

Vehicle Traffic. Vehicle travel is restricted on SCI to existing roads and two tracks, and would be allowed in specifically designated areas including the Assault Vehicle Maneuver Corridor (AVMC), which would consist of the AVMA, Assault Vehicle Maneuver Road (AVMR), and AVMR-SHOBA plus four designated AMPs and Artillery Firing Points (AFPs) 1 and 6 (Table 3.11-8, above). An exception is that small balloon-tired All-Terrain Vehicles (ATVs) may be driven off-road by authorized personnel for specific natural resources management activities.

Vehicle traffic on or off-road has the potential to cause direct mortality to wildlife, including endangered, threatened, or sensitive species. Collisions with vehicles have been an ongoing source of mortality of island foxes. Conservation measures implemented by the Navy include posting signs and mowing and maintaining vegetation along the sides of portions of Ridge Road to make it easier for drivers and foxes to have visual contact, enabling them to avoid collisions. Use of tracked vehicles in the AVMC, particularly the AVMAs, could increase the potential for fox mortality somewhat, particularly at nighttime when the foxes may be active and visibility is limited. The increase of vehicular traffic on the main roads as well as the AVMC increases the risk of collision with foxes. Vehicle-caused mortality to fledgling San Clemente loggerhead shrikes has also been documented.

The restriction of vehicle traffic to designated areas described above is in recognition that driving vehicles off existing roads and designated corridors can impact vegetation and soils, potentially leading to soil compaction, erosion, and establishment and spread of non-native invasive plant species, which tend to exclude native and desirable species (as described above).

Tracked vehicles maneuvering within an authorized area have the potential to initiate impacts capable of spreading outside the boundaries of the maneuver area in the form of erosion, and wind borne, water borne, or gravity drawn sediment, especially when maneuvering near bluffs, steep slopes, or drainages that lead offsite.

During the dry season, tracked vehicles would loosen the soil, thereby exposing it to wind erosion, especially in windy areas on the plateau. Spreading dust from off-road vehicular traffic would be deposited on vegetation in adjacent areas potentially affecting essential plant processes including photosynthesis, gas exchange, and pollination, and may cause increased incidence of plant pests and diseases. Once deposited, dust would tend to remain on leaves until rainfall or heavy fog drip washed it off. The effective distance traveled by dust is not well known but one study showed economic losses in horticultural plants due to dust generation from an unpaved road out to a distance of 200 m from the road (McCrea cited in New Zealand Ministry of the Environment 2001).

When soils are damp or wet, the action of tracked and wheeled vehicles compacts soil, increasing runoff by reducing infiltration of rainfall. On SCI, the low total annual precipitation and the great year-to-year variability in precipitation limit the growth and recovery of vegetation that protects the soil from erosion, making soils there more susceptible to erosion than in most areas of the country. Despite the low total annual precipitation, rainfall intensity during some individual events can be as high as anywhere in the United States. In recognition of these concerns, the Navy conducted a watershed-by-watershed soil erosion assessment addressing the potential for accelerated soil erosion losses from the establishment and operation of AVMAs and AMPs, and AFPs. The study predicts substantial increases in sheet and rill erosion as a result of vehicular operations in certain locations, as summarized in Table 3.11-15. The study methodology does not address erosion resulting from piping and gullying or erosion caused by wind, both of which also contribute to erosion on SCI.

Table 3.11-15: Proposed AVMA, AMP, and AFP Locations Having Predicted Increase in Sheet and Rill Erosion Greater Than 1 Ton Per Acre Per Year Within Proposed AVMAs (by watershed).[1]

Location (AVMA/AMP/AFP)[2]	Water-shed Number	Projected Erosion Baseline (tons/acre/year)	Projected Erosion with AVMA Use (tons/acre/year)	Increase in Erosion with AVMA use (tons/acre/year)	Comments
NALF (includes AMP A)	5	0.414	2.181	1.79	
Old Rifle Range	6	1.311	5.784	4.47	Steep Slopes SCSS Habitat
Old Rifle Range	9	0.483	2.216	1.73	
Old Rifle Range (includes AMP B)	10	0.459	2.298	1.84	
VC-3	26	0.057	1.955	1.90	
VC-3	29	0.442	5.867	5.43	Steep slopes
VC-3	35	0.137	4.32	4.18	Steep slopes
VC-3	37	0.052	1.796	1.74	
VC-3	40	0.073	1.896	1.82	

Location (AVMA/AMP/AFP)[2]	Water-shed Number	Projected Erosion Baseline (tons/acre/year)	Projected Erosion with AVMA Use (tons/acre/year)	Increase in Erosion with AVMA use (tons/acre/year)	Comments
VC-3 (includes AMP D)	39	0.23	1.689	1.46	
VC-3 (includes AMP D)	42	0.134	1.563	1.43	
AFP-6	119	0.137	1.242	1.10	
AFP-1	190	0.949	3.31	2.36	
AFP-1	199	0.99	3.454	2.46	

Notes:

1) Source: DoN 2007
2) Proposed AMPs A, B, and D are within proposed AVMAs, as indicated. Proposed AMP C is on a more or less level area outside the proposed AVMAs and predicted increase in erosion is < 1 ton/acre/year.

The greatest projected increases in erosion are at specific drainage areas within the Old Rifle Range AVMA and the VC-3 AVMA, where steep slopes exist in proximity to drainages.

Maintaining the boundaries of authorized tracked vehicle travel so that they do not extend into sensitive adjacent areas may be difficult. If the boundaries of the area are not clearly marked and detectable especially during conditions of reduced visibility (e.g., caused by heavy dust, fog, or darkness) vehicular traffic may accidentally travel into sensitive areas outside the authorized area. Once an area has been tracked by a single vehicle, other vehicles have a tendency to follow.

The following Sections 3.11.2.3, 3.11.2.3, and 3.11.2.5 provide an operation-by-operation analysis of the No Action Alternative, Alternative 1, and Alternative 2, respectively. The operations evaluated in these sections are summarized in Table 3.11-16. The analysis focuses on the operations types that may directly affect terrestrial resources on SCI and are a subset of the operations listed in Tables 2-5 and 2-8. For this chapter, Operation 25, Amphibious Landings and Raids (on SCI), is broken out into its component portions (labeled 25A through 25I) for the analysis because of the differences among the component portions pertaining to terrestrial biological resources on SCI.

Table 3.11-16: Operations evaluated in the Terrestrial Biology Analysis by Project Alternative.

Navy Warfare Area	No.	Operation Type	No Action	Alternative 1	Alternative 2
Amphibious Warfare	21	Naval Surface Fire Support	X	X	X
	22	Expeditionary Firing Exercise	X	X	X
	23	Battalion Landing	-	X	X
	24	Stinger Firing Exercise	-	X	X
	25	Amphibious Landings and Raids (on SCI)			
	25A	Reconnaissance Mission (25A)	-	X	X
	25B	Helicopter Assault	-	X	X
	25C	Armored Operations	-	X	X
	25D	Artillery Operations	X	X	X
	25E	Amphibious Assault	-	X	X
	25F	Combat Engineering	-	X	X
	25G	AAV/EFV Exercise Operations	-	X	X
	25H	EFV Company Assault	-	-	X
	25I	Assault Amphibian School Battalion Operations	-	-	X
Naval Special Warfare	31	NSW Land Demolition	X	X	X
	32	Underwater Demolition	X	X	X
	33	Underwater Mat Weave	X	X	X
	34	Marksmanship-Small Arms Training	X	X	X
	35	Land Navigation	X	X	X
	36	NSWG-1 UAV Ops	X	X	X
	39	NSWG-1 SEAL Platoon Operations	X (ops in existing TARs 1,4,16 assessed)	X (remaining TARs assessed through TAR 19)	X
	40	NSW Direct Action	X	X (TARs 20-22 assessed)	X

Strike Warfare	**41**	Bombing Exercises – Land	X	X	X
	42	Combat Search and Rescue	X	X	X
EOD	**43**	EOD	X	X	X
Air Operations Other	**45**	NALF Airfield Ops	X	X	X
RDT&E	**51**	Missile Flight Tests	X	X	X

Notes: #37 NSW Insertion/Extraction (in W-291) is addressed as part of #39 NSW SEAL Platoon Operations and #40 NSW Direct Action and is not addressed separately . #38 NSW Boat Operations is an open ocean exercise and is not addressed in chapter 3.11 (Terrestrial Biology).

3.11.8 No Action Alternative

3.11.8.1 Naval Surface Fire Support

FIREX operations consist of surface ships firing rounds at targets on land as described in Section 2.4.2. Under the No Action Alternative, FIREX operations would occur 47 times annually and would expend approximately 7,537 rounds (5-inch/54 or 5-inch/62 shells) per year within Impact Areas I and II. The naval artillery rounds include smoke rounds, high explosive rounds, illumination rounds, and inert rounds. Aircraft may participate and drop practice bombs. Mortars are fired from an onshore location (OP-3) to mark targets. A period of continuous illumination is required for this exercise. Currently, this is conducted in the predawn hours when humidity and fuel moisture is highest to minimize the potential for spread of a wildfire from the illumination round.

Vegetation and Wildlife. Ordnance hits associated with FIREX would affect vegetation and wildlife in Impact Areas I and II directly through ordnance impact and explosions, and indirectly through fires. Both impact areas have had a long history of ship-to-shore bombardment and vegetation is sparse and highly disturbed around targets, where ordnance impacts would be most concentrated. Within Impact Areas I and II, the frequency of ordnance hits decreases with distance from the actual targets and habitat quality increases. The disturbance associated with individual ordnance hits would be localized. The impact of additional naval bombardment within the existing target areas is expected to be less than significant due to the existing level of disturbance and sparse vegetation within the target areas, especially around the targets, and the localized impacts of individual ordnance hits at greater distances from the targets. Areas of natural vegetation and habitat within the overall impact areas are sheltered from frequent ordnance impact by distance from the target sites and terrain features (such as canyons or ridges). These factors plus the sparseness of the vegetation around the targets and measures now being implemented by the Navy would limit the frequency of wildfires in good habitat areas. Therefore, potential impacts on vegetation and wildlife are expected to be less than significant.

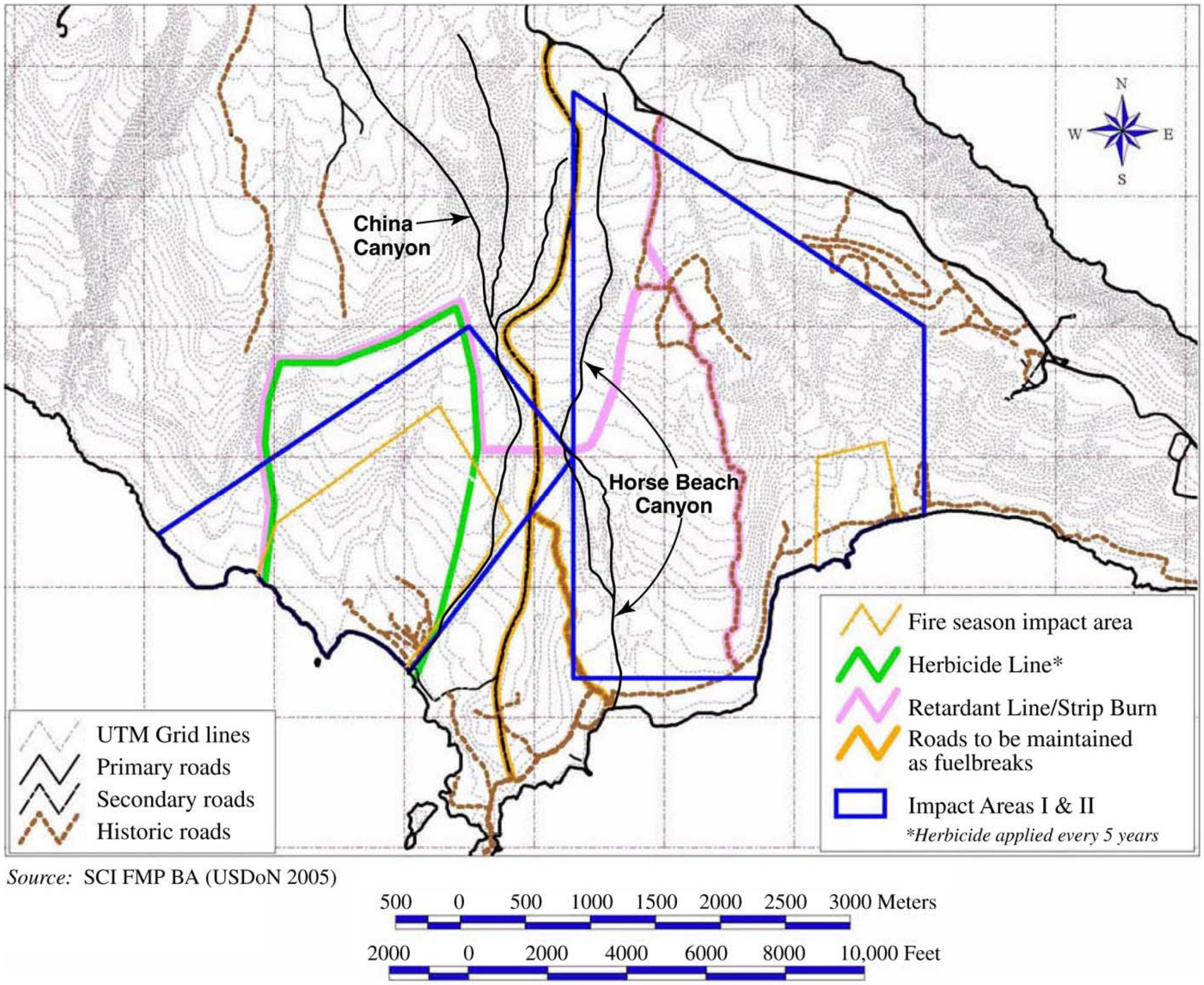
Endangered, Threatened, and Other Sensitive Species. FIREX activities could affect any sensitive species occurring within or adjacent to Impact Areas I and II. Listed species that occur in and adjacent to the impact areas include San Clemente Island bush mallow, San Clemente Island Indian paintbrush, San Clemente Island bedstraw, San Clemente Island silvery hosackia, western snowy plover, San Clemente loggerhead shrike, island fox, and island night lizard as discussed below. There is no formally designated “critical habitat” for endangered or threatened species on

SCI. Impacts to species could occur as a result of being hit by, exposed to the noise of, or having habitat disturbed by incoming ordnance. In addition, ship-to-shore gunfire, including illumination rounds used at night, has historically been one of the most frequently cited causes of wildfires on SCI.

Impact Areas I and II have a long history of disturbance, including frequent fires. Fuelbreaks have been strategically placed to reduce the spread of fires outside of the impact areas (Figure 3.11-23). Currently, fire retardants are used to create and maintain the fuelbreaks. Fire-suppression equipment, including a helicopter on stand-by, is now stationed on the island to decrease the time needed to respond to fires outside of the impact areas. The SCI Wildland Fire Management Plan (DoN 2005) states that “SHOBA is unsafe for any ground suppression.” No aerial firefighting is assumed within the designated SHOBA Impact Areas I and II fuelbreaks. However, aerial assets would be used to keep fires originating in SHOBA from crossing designated fuelbreaks and from passing into adjacent management areas. Although both Impact Areas I and II have a long history of receiving heavy ordnance, Impact Area II, including Impact Area IIA, currently receives about 94 percent of the incoming heavy ordnance and Impact Area I receives about 6 percent.

The San Clemente loggerhead shrike has been of concern with regard to noise impacts because of the historical nesting in SHOBA. The largest naval artillery round (5”/54 round) with a contact fuse creates a noise of approximately 125 dB L_{max} upon impact. The sound level from this impact would decrease with distance as discussed in Section 3.11.2.2.4. The shortest distance between a target and the nearest San Clemente loggerhead shrike home range (based on 2004 nest locations) is about 2,467 ft (752 m). At this distance, the maximum sound from impact of a 5”/54 naval artillery round would be about 83 dB L_{max}. This sound level, which would be experienced multiple times during an exercise, could temporarily interfere with communication or cause an alert response; however, is not likely to adversely affect the survival or productivity of shrikes. This conclusion is supported by the fact that during the lowest population levels reached by the shrike, the remnant population was concentrated in SHOBA near Impact Area II despite its ongoing history of naval bombardment. Under present-day conditions (2005-2007), more than 65 percent of the shrike population is located outside of the SHOBA gate, away from the direct influence of naval artillery (Table 3.11-4). In recent years only 2-3 shrike territories have been located in Impact Areas I and II combined.

A fire ignited by naval artillery that burned into canyons occupied by nesting loggerhead shrikes could cause nest abandonment, possible loss of eggs or young, and possible damage to nest trees. These effects would be considered significant due to the low shrike population size, but the probability of their occurrence could be minimized and impacts reduced to less than significant levels by a number of impact avoidance, minimization, and species conservation measures incorporated in the SCI Wildland Fire Management Plan Biological Assessment (DoN 2005) and measures developed during ongoing Endangered Species Act Section 7 Consultation between the Navy and USFWS. As shown in Table 3.11-4, an increasing proportion of the shrike population is nesting outside of SHOBA (67 percent in 2005 and 2006; 74 percent in 2007), making the species increasingly less vulnerable to fire originating within a SHOBA impact area. Most nest sites are outside the fuelbreaks developed within the impact areas.



Source: DoN 2005

Figure 3.11-23: Current Firebreaks in Impact Areas I and II

San Clemente Island Indian paintbrush and San Clemente Island bush mallow are locally abundant in the western part of Impact Area I (in Horse Beach Canyon), where over 20 percent and 50 percent of their known populations, respectively, are located. They are also present in small numbers (1-2 percent of their known populations) at the edges of Impact Area II. Because the areas where the plants are concentrated are located away from target areas and would seldom receive incoming large ordnance, wildland fires represent the main potential effect from the FIREX operation for these species. Both of these species are adapted to periodic disturbance, including fire (FMP BA--DoN 2006), and fires separated by five years or more may have a beneficial effect on both species. Impacts to these plant species are anticipated to be less than significant. Foot traffic for FIREX is almost exclusively limited to the immediate area around the Observation Posts, which are heavily disturbed, and lack these species. Impacts associated with the limited amount of foot traffic associated with FIREX would be negligible.

San Clemente Island bedstraw and San Clemente Island silvery hosackia (also known as SCI bird's foot trefoil) are state listed as endangered. They are both restricted to SCI. San Clemente Island bedstraw is well distributed on steep slopes in the southern two-thirds of the island and has about two percent of its occurrences in SHOBA impact areas. San Clemente Island silvery hosackia is found primarily within SHOBA where individuals occur chiefly in areas with steep slopes and in nearly barren rocky areas. This species has about thirteen percent of its known occurrences in Impact Area I and an additional one percent in Impact Area II. Both species have been subjected to fires and other effects of military operation for years and continue to flourish. The habitats in which they are found tend to escape fire because the steep rocky slopes do not normally have enough vegetation to carry fire. Fires separated by five years or more may have a beneficial effect on both species. No significant impacts on San Clemente Island bedstraw or San Clemente Island silvery hosackia are anticipated.

Indirectly, the cumulative effects of FIREX and other operations in SHOBA at present use-levels may limit the frequency and duration of times that shrike biologists and predator control personnel have access to shrike breeding and wintering areas within SHOBA. Lack of access in the past has been perceived by the shrike biologists as an impediment to monitoring and protecting the shrikes, and thus potentially to the recovery of the shrikes. This has been addressed by the Navy, and mechanisms to ensure access for natural resource management as well as Fleet activities have been put into place as described above in Section 3.11.2.2.2. The analysis presented in Section 3.11.2.2.2 shows that the access requirements for the shrike program and other NRO needs can be met under present conditions and for the foreseeable future, except within the boundaries of Impact Areas I and II where a minority (about 5 percent on average between 2001 and 2005) of the shrike nest sites have been located in any given year.

The beaches within Impact Areas I and II are used by the western snowy plover for winter foraging and roosting. Numbers are highest during the winter months and plovers are generally absent during the breeding season months. Plovers may respond to noise or visual effects from shelling by temporarily leaving the affected area during FIREX exercises.

Although island night lizards do occur in SHOBA, neither Impact Area contains high density island night lizard habitat, and the pattern of habitat disturbance from ordnance impacts would be expected to remain essentially the same, given the long history of similar use. No observable effect on the population would be expected. Island fox also occur in SHOBA. Because only localized areas are impacted by artillery associated with FIREX and large areas of habitat occupied by foxes would be unaffected by this operation, significant adverse impacts on island fox are not anticipated. Fire resulting from FIREX activities could affect both island night lizards and island foxes and their habitat, an indirect impact. Impacts on both species would be expected to be temporary and less than significant for several reasons. Both species are widely distributed on SCI and would be expected to repopulate the burned area in a short period of time. In addition, measures recently or currently being implemented by the Navy or proposed in this document including implementation of the Wildland Fire Management Plan are expected to continue a trend toward smaller and less frequent wildfires resulting from operations such as FIREX.

3.11.8.2 Expeditionary Firing Exercise

EFEX exercises are complex, amphibious operations in SHOBA involving coordinated air, land, and sea units and happen about 6 times per year in the No Action Alternative. EFEX exercises include Marine Corps participation, amphibious landings, travel to SHOBA, and close air support. Beach landings in SHOBA are not part of EFEX exercises. Impacts from Naval bombardment associated with EFEX activities would be similar to those discussed above under FIREX. However, although there would be far fewer Naval artillery rounds, EFEX activities involve many other types of ordnance such as towed land-based artillery, cannon, mortars, grenades, illumination rounds from land based artillery and 81 mm mortars, smoke, and small arms fire (approximately 2,795 total rounds). This mix of ordnance may present a higher risk of wildfires than associated with FIREX. EFEX activities also involve amphibious vehicles and Marine ground units; however, any activities on beaches would occur outside SHOBA, and these are analyzed elsewhere in this document.

Vegetation and Wildlife. Impacts to vegetation and wildlife could occur due to fires, as discussed below. Some temporary damage to vegetation and wildlife could also occur if Marines stray from the roads and the Assault Maneuver Corridor enroute from West Cove to OP 1. However, such impacts would be less than significant unless they affected sensitive species or loggerhead shrike habitat.

Endangered, Threatened, and Other Sensitive Species. Although there are flares and other incendiary ordnance in EFEX activities, there has only been one fire associated with artillery operations. The potential for wildfire in SHOBA for this operation is about the same on a per-operation basis as for FIREX. Therefore, the risk of damage to woody vegetation within habitat for threatened and endangered species in SHOBA, specifically the loggerhead shrike, is also about the same, as is the chance for nest abandonment or possible loss of eggs or young. As discussed above under FIREX, these effects could be considered significant due to the extremely low population size of the shrike, but the probability of their occurrence can be minimized and impacts reduced to less than significant levels by a number of mitigation measures recently or currently being implemented by the Navy or proposed in this document. These include implementing the SCI Wildland Fire Management Plan.

Assuming continuation of existing fire containment and prevention measures that are resulting in reduced frequency and size of operations-related wildfires, impacts on island night lizards and island fox are anticipated to be less than significant for the reasons described above for FIREX. Impacts can be further reduced by implementation of the mitigation measures described above for SCI loggerhead shrike.

Ground disturbance from maneuvering artillery pieces and mortars is not expected to affect listed or other sensitive plant species, because the maneuvering would be confined to the AVMR and a previously disturbed portion of AFP-1 in SHOBA. The effect of noise on shrikes from artillery firing on the AFPs is addressed in Sections 3.11.2.4.3, and 3.11.2.5.3 (Infantry Battalion-sized Amphibious Landing).

In summary, the EFEX operation is similar to FIREX in that it presents several potential threats and impacts to listed and sensitive species. The risk of wildfire damage to shrike habitat is about the same as for FIREX. However, each of these impacts can be mitigated to a less than significant level by the implementation of mitigation measures, many of which are already underway.

3.11.8.3 Battalion Landing

Infantry Battalion-sized Amphibious Landings are not within the No Action Alternative, but are proposed in Alternatives 1 and 2 (Sections 3.11.2.4.3 and 3.11.2.5.3).

3.11.8.4 Stinger Firing Exercise

Stinger Firing Exercises are not within the No Action Alternative, but are proposed in Alternatives 1 and 2 (Sections 3.11.2.4.4 and 3.11.2.5.4).

3.11.8.5 Reconnaissance Mission

This event is not within the No Action Alternative, but is proposed in Alternatives 1 and 2 (Sections 3.11.2.4.5 and 3.11.2.5.5).

3.11.8.6 Helicopter Assault

This event is not within the No Action Alternative, but is proposed in Alternatives 1 and 2 (Sections 3.11.2.4.6 and 3.11.2.5.6).

3.11.8.7 Armored Operations

Armor Operations are not within the No Action Alternative, but are proposed in Alternatives 1 and 2 (Sections 3.11.2.4.7 and 3.11.2.5.7).

3.11.8.8 Artillery Operations

Artillery operations would take place 5 times per year under the No Action Alternative. These operations are intended to practice ship to shore movement, landings of artillery units, and maneuvering and coordination with aerial escorts and live-fire. The units, which include artillery pieces, heavy trucks, and support vehicles for up to 50 Marines, would land at Wilson Cove and West Cove during the daytime (administrative landing) and travel inland on main roads to SHOBA. The artillery firing point in SHOBA has been disturbed by previous operations. Artillery operations also are performed as part of an EFEX and Battalion Landing, and those portions of the operation that take place in SHOBA are also discussed under those operations. Outside SHOBA no ordnance would be used.

Helicopters would be used to escort the artillery convoys and the howitzers may be airlifted out of SHOBA by CH-53 helicopters to amphibious ships offshore.

Vegetation and wildlife. Operations would have minimal effect on vegetation and wildlife habitat, with effects confined to the artillery firing point, which is accessed by SCI Ridge Road and is already disturbed, and the target area, typically in Impact Area IIA, which is also highly disturbed. Impacts would be less than significant.

Endangered, Threatened, and Other Sensitive Species. The AFP is about 2.5 miles to the east of the nearest nest site used since 2000 by the loggerhead shrike, and the AFP would be out of the line of sight from the shrike nest sites. Activities at the AFP may cause nearby wintering or foraging shrikes to temporarily avoid the activity. No San Clemente sage sparrows or snowy plovers are known to occur in the action area. Therefore, no effects on these species are anticipated as a result of artillery operations. No listed or sensitive plant species are known from the immediate vicinity of sites historically used as the AFP. Listed plant species may be present in the impact areas where individuals could be eliminated or damaged by incoming artillery rounds, but any effect would be localized and less than significant.

Effects on shrikes of noise from land based artillery firing are discussed under I MEF Battalion Landing; and noise and visual disturbance from aircraft overflight is discussed under CAS. These operations are not expected to affect San Clemente sage sparrow.

Beach landings at Wilson Cove and West Cove may result in some level of disturbance to California brown pelicans that are in flight or foraging near the shore; pelicans may temporarily move to avoid the activity. This effect would be considered short-term and less than significant.

3.11.8.9 Amphibious Assault

Amphibious Assault Vehicle operations (company-sized) are not within the No Action Alternative, but are proposed in Alternatives 1 and 2 (Sections 3.11.2.4.9 and 3.11.2.5.9).

3.11.8.10 Combat Engineering Operations

Combat Engineer operations are not within the No Action Alternative, but are proposed in Alternatives 1 and 2 (Sections 3.11.2.4.10 and 3.11.2.5.10).

3.11.8.11 Amphibious Assault Vehicle and Expeditionary Fighting Vehicle Exercise Operations

Amphibious Assault Vehicle and Expeditionary Fighting Vehicle operations are not within the No Action Alternative, but are proposed in Alternatives 1 and 2 (Sections 3.11.2.4.11 and 3.11.2.5.11).

No action equivalent in the No Action Alternative.

3.11.8.12 NSW Land Demolition

Demolition practice on land takes place in the existing Land Demolition Range (a bermed demolition range in NW Harbor (SWAT 2)). Grenade explosions would occur within a certified grenade range located in the Northwest Harbor area. 354 NSW land demolition operations are within the No Action Alternative.

Vegetation and Wildlife. Due to the long-term and frequent disturbances in these areas, little vegetation and wildlife habitat is present. No significant adverse impacts to vegetation or wildlife are therefore anticipated.

Endangered, Threatened, and Other Sensitive Species. No significant adverse impacts to sensitive or listed plant or wildlife species are anticipated because demolitions would occur in areas with no vegetation.

3.11.8.13 Underwater Demolition

These exercises are similar to the land demolitions and teach the safe use of explosives for beach clearance. Conducted in the nearshore areas of Northwest Harbor BUD/S beach or Graduation Beach and SHOBA. There are basically three types of underwater demolition: Single charges, Mat Weave, and Obstacle Loading. Single charge training includes smaller explosives between 5 and 20 lb (2 and 9 kg) of C-4 and detonation cord. The charges are assembled on the beach and placed in 5-20 ft of water. A Safety Observer patrols the area in a CRRC, and his job is to keep the water clear of boats, swimmers, or divers. He also would warn of the presence of any marine turtle or marine mammal in the area. Approximately 72 single-charge demolitions training events annually are within the No Action Alternative.

Vegetation and Wildlife. Because these operations take place under water, no terrestrial vegetation would be affected. Seabirds may avoid the human activity associated with the operation, but some may be habituated to the activity and be attracted to it as described below. No significant adverse impacts to vegetation or wildlife habitat are anticipated.

Endangered, Threatened and Other Sensitive Species. Due to human activity associated with the operation, snowy plover would be expected to move away from any close-approaching activity on the beach. Bird Rock is located several hundred yards offshore from the demolition site in Northwest Harbor and is a roost site for California brown pelicans. Detonations have the potential to result in temporary disturbance and injury or mortality to pelicans that may be resting or foraging in the water near the planned shallow-water demolition exercises. However, in the thirty years that NSW has been conducting underwater command detonation training in Northwest Harbor, there has been no occurrence of injury to brown pelicans. Preliminary beach activities of BUD/S and SEAL team members associated with ordnance preparation for underwater explosives training attracts pelicans and other seabirds to surrounding beaches. Pelicans sit on the beaches, awaiting the underwater explosion. Once ordnance is detonated, pelicans opportunistically feed on surface prey. Should a situation arise that a pelican is flying or in the water over the submerged ordnance, detonation is held off until the pelican is out of the blast area. No other potentially significant adverse impacts to sensitive wildlife are anticipated.

3.11.8.14 Underwater Mat Weave

The largest of the underwater demolitions is a Mat Weave, which uses two lattices of line-charge explosives in quick succession in about 5 ft of water. Each lattice (checkerboard) has 10 charges of 25-ft, 2.75-in diameter demolition tubing with 50-lb Net Explosive Weight (NEW). The intersections of the 5 x 5 cross-hatch pattern are tied together by detonation cord. A second large demolition exercise is Obstacle Loading, which is 16 charges of 20-lb C-4 explosive per charge, exploded in 15 ft of water. Approximately seven of the MV demolitions and seven obstacle loading exercises were conducted in the baseline year. Safety clearance is to 2,000 ft for obstacle loading demolition. Advanced training also takes place in Horse Beach Cove in SHOBA. Approximately 14 underwater mat weave training events annually are within the No Action Alternative.

Vegetation and Wildlife. Because these operations take place under water, no significant adverse impacts to vegetation or wildlife habitat are anticipated as described above under Underwater Demolition.

Endangered, Threatened and Other Sensitive Species. Due to human activity associated with the operation, snowy plover would be expected to move away from any close-approaching activity on the beach. Detonations have the potential to result in temporary disturbance and injury or mortality to pelicans that may be resting or foraging in the water near the planned shallow-water demolition exercises as described above under Underwater Demolition. However, in the thirty years that NSW has been conducting underwater command detonation training in Northwest Harbor, there has been no occurrence of injury to brown pelicans. There is no pelican roost in Horse Beach Cove where this exercise would take place and no adverse impacts on brown pelican would be expected as described above. Should a situation arise that a pelican is flying or in the water over the submerged ordnance, detonation is held off until the pelican is out of the blast area. No other potentially significant adverse impacts to sensitive wildlife are anticipated.

3.11.8.15 Marksmanship – Small Arms Training

Small arms training takes place in the small arms range, a developed area nearly devoid of vegetation and wildlife. These exercises expend nearly a million rounds of ammunition per year, as well as smaller numbers of flares, MK-131 charges, and grenade simulators. Approximately 171 such training events annually are within the No Action Alternative.

Vegetation and Wildlife. Because this operation takes place in the developed small arms range portion of SWAT 1, which is highly disturbed and in frequent use, little vegetation or wildlife habitat is present. No significant adverse impacts to vegetation and wildlife are therefore anticipated.

Endangered, Threatened, and Other Sensitive Species. Because this operation takes place in the developed small arms range portion of SWAT 1, which is highly disturbed and in frequent use, little vegetation or wildlife habitat is present and no listed species would be expected to occur in the area at the time of the operation. Medium to low density habitat for San Clemente Island sage sparrow surrounds the site. Although individual birds may alter their foraging patterns, reveal their presence to predators and be preyed upon, or disperse from the area in response to the activity (Delaney et al. 2002), it is also possible that the birds would continue their normal activities despite the activity and noise at the small arms range. The latter scenario is supported by similarity of most metrics of population dynamics for sage sparrows in a plot established encompassing the vicinity of rifle range and TAR 4 to values obtained in 6 other plots located away from most human activity. The TAR 4 plot compared favorably to the other 6 plots with respect to nest success, number of fledglings per successful nest, mean territory size, and number of banded individuals resighted from 2002. The number of banded birds that disappeared during the breeding season was higher in TAR 4 than the comparable values obtained on 5 of the 6 plots sampled, however (Beaudry et al. 2004). Fires in the Surface Danger Zone (SDZ) below the steel pistol ranges have resulted from use of the ranges. This has the potential to harm or harass sage sparrows, however, deleterious effects of this has not been detected in the results of the population monitoring described above. Island night lizards would be subject to temporary disturbance. No listed or other sensitive plant species are known to occur in or near the developed small arms range area. Therefore, the proposed activities in this area would not affect listed or other sensitive plants.

3.11.8.16 Land Navigation

These exercises involve six to eight-person squads, usually three squads per night for six nights. The squads attempt to locate a missing object between the MIR and NALF. Approximately 99 land navigation training events annually are within the No Action Alternative.

Vegetation and Wildlife. Impacts to vegetation and wildlife would be less than significant because of the relatively small number of personnel and the relatively large areas over which they would be spread.

Endangered, Threatened, and Other Sensitive Species. The likelihood of a small number of people spread over a large area encountering a listed species, except for island night lizards and island fox, appears low. The operations are conducted at night, so the likelihood of trampling an island night lizard, which is active during the day, would be negligible. Island fox would move away from the activity if approached too closely. Therefore, proposed activities may affect, but are not likely to adversely affect these species. Land navigation activities may trample individuals of listed or other sensitive plant species such as the San Clemente Island broom, which is known from a few scattered occurrences on the east side of the Ridge Road and is the only listed plant known from the area between the MIR and NALF. But the potential is low given the small number of personnel involved in the operation and the plant would be expected to recover from the trampling within a short period of time.

Listed bird species that could be affected by land navigation activities include the San Clemente sage sparrow and wintering San Clemente loggerhead shrikes. Wintering shrikes might temporarily move from people during the daytime but would most likely not react to nearby people at nighttime. Effects to the sage sparrow from a small number of personnel on foot would be negligible unless the operations occurred in sage sparrow nesting habitat during the nesting season where there is a small chance that a nest could be disturbed or even trampled. The odds of this are remote, given the small number of people and nests and the practice of tactical environmental movement, described above, which would minimize the trampling of bushes.

3.11.8.17 NSWG-1 Unmanned Aerial Vehicle Operations

NSW proposes to reactivate the VC-3 airfield and develop a UAV Center of Excellence to conduct photo imaging and capture, reconnaissance, communications, and ordnance on target training missions (both basic and advanced) in the onshore, nearshore, and offshore environments, including over the horizon ingress and egress. Ordnance used in target operations would be no larger than the Hellfire. UAV aircraft, would be staged out of existing VC-3 Building 60306. Operations are conducted during both daytime and nighttime. Approximately 5 such training events annually are within the No Action Alternative.

Vegetation and Wildlife. Impacts to vegetation and wildlife would be less than significant because the VC-3 project area is previously disturbed and ordnance would be released at existing target areas. The potential for bird aircraft strikes is low and would not be a significant source of mortality for any species.

Endangered, Threatened, and Other Sensitive Species. The UAVs would fly above the normal flight levels of songbirds such as San Clemente loggerhead shrike and San Clemente sage sparrow; it is considered unlikely that there would be any adverse impacts to listed species or other sensitive species.

3.11.8.18 NSWG-1 SEAL Platoon Operations

NSWG-1 operations are a set of complex tactical evolutions conducted by SEALs. They involve insertion, movement, small arms, flares, explosives, occasional support aircraft and support boats. In the No Action Alternative, 340 operations would be conducted including 270 operations in previously established TARs 1, 4, and 16 (as described below) and an additional 70 operations which could occur elsewhere on the island (rather than in designated TARs as in Alternatives 1 and 2), and would occur year-round. Most of the operations would occur at night. Impacts would range from less than significant to possibly significant, depending on the location, time of year, and other factors, for a specific operation. However, impacts identified could be mitigated to a less than significant level by measures identified in this document. There are currently three designated TARs.

TAR 1—Demolition Range Northeast Point. TAR 1 provides basic demolition and OTB tactical training. Operations include NSWG-1 SEAL Platoon actions at the objective, OTB operations, target assault, and land demolitions. No live-fire of small arms. All explosives, flares, illumination rounds, and pyrotechnics are non-shrapnel-producing and no more than 100 lb (45 kg) NEW. It is 1 ac in size and 23 operations per year would occur under the No Action Alternative. TAR 1 contains no listed plant or terrestrial animal species and the area is composed of mostly disturbed vegetation, therefore, impacts from these operations would be less than significant. A large population of Trask's cryptantha, a low annual CNPS List 1B species, was observed near the location of TAR 1 in 1996 (Junak and Wilken 1998) but the current status of this occurrence is not known.

TAR 4—Whale Point/Castle Rock. TAR 4 was previously used as a demolition range and is 27.4 ac in size. There would be 222 operations per year under the No Action Alternative. Operations include land demolition training, OTB, strategic reconnaissance, direct action tactical training, immediate action drills, small arms live-fire, MOUT operations, helicopter landings, UAV operations, and convoy/mounted operations. No listed plant species are present, however, TAR 4 contains medium density sage sparrow habitat (Beaudry et.al. 2004). Construction activities, accidental fires, demolitions, and other disturbances documented during 2003-2005, have degraded vegetation, including sage sparrow habitat and, based on timing and location, may have a causal association with the disappearance of a marked adult sage sparrow and a nest failure (Turner et al. 2005). However, despite these incidents, studies by Beaudry et al. (2004) and Turner et al. (2005, 2006) have shown no demonstrable effect from current operations on sage sparrow fecundity to date; therefore, impacts from operations on sage sparrow populations at TAR 4 would be less than significant. Under the No Action Alternative, continued operations at the current levels would be expected to adversely affect vegetation and habitat at TAR 4, leading to a significant impact. Completion and implementation of the SCI Fire Management Plan, which is part of the No Action Alternative, would be expected to reduce the impact to less than significant as would implementation of mitigation measures that are associated with Alternatives 1 and 2.

TAR 16—South VC-3 (Missile Impact Range). The missile impact range is a parachute drop zone, tactical air assault area and target objective. NSW training operations at TAR 16 include strategic reconnaissance, direct action, convoy/mounted actions and sniper training. TAR 16 would be used 25 times per year under the No Action Alternative. Future uses would include the USMC for the proposed battalion landing and SPAWARSYSCEN for missile tests. There are no listed plant or animal species within the TAR boundary and the entire area has been disturbed; therefore, impacts from operations on TAR 16 would be less than significant.

3.11.8.19 NSW Direct Action

Direct Action operations can occur anyplace in SHOBA, but they would tend to cluster in Pyramid Cove, Horse Beach Cove, or China Cove. Pyramid Cove is located on the southeastern end of SCI. It is a wide cove with sandy beaches backed by low bluffs. Approximately the western half of the cove is within Impact Area I. Horse Beach Cove is a small cove between Pyramid Cove and China Cove. It has a short, narrow beach crossed by a small drainage and wetland toward the west end and a small low dune area at the eastern end. China Cove is just west of the southern tip of the island (China Point). It is intermediate in size between Pyramid and Horse Beach coves and lies within Impact Area II. It consists of a long thin strip of sand abutted on the southern end by a rocky cliff, by coastal dunes in the middle, and on the northern end by disturbed grassland. China Canyon drains to the coast near the southern end of China Cove. TARs 20, 21, and 22 are designated under Alternatives 1 and 2.

Under the No Action Alternative, 156 Direct Action operations would occur each year. Of these, approximately 28% would be conducted in Pyramid Cove, 51% in Horse Beach Cove, and 21% in China Cove. A Direct Action operation typically involves a SEAL platoon supported by 5-8 additional personnel and/or a Special Operations Craft, which provides offshore transportation and covering fire during extraction. Direct Action is usually conducted at night and may take place anywhere in SHOBA. It includes some foot traffic (setting up target materials, inland movement of the platoon to the target). There would be relatively little potential for fire from tracers fired from .50 cal. machine guns offshore. However, there would be as large number of illumination rounds and flares per year, including paraflares, as well as 8 stinger missiles, automatic weapons fired from boat to shore, 40mm grenades, small arms fire, and detonations as described in section 2.4.2. These operations have small footprints on the island and each operation has a short time frame (less than 1 hour) so the effects of noise and other disturbances would be short-term.

Vegetation and Wildlife. Impacts to vegetation and wildlife could result from fires started by incendiary ordnance including flares and illumination rounds, some of which may drift into areas infrequently burned. The nighttime hours when most of the operations take place typically have the highest humidity and fuel moisture conditions and thus limit the potential for fire ignition. Vegetation and wildlife on SCI are generally adapted to survive or regenerate after fire and the incremental risk of fire is less than significant for most areas, however substantial degradation is likely to occur in the vegetation and habitat at the Horse Beach Cove/TAR 21area from continued operations occurring at the frequency experienced in the recent past. Completion and implementation of the SCI Fire Management Plan, which is part of the No Action Alternative, would be expected to reduce the impact to less than significant as would implementation of mitigation measures that are associated with Alternatives 1 and 2.

Endangered, Threatened, and Other Sensitive Species. Direct Action operations could affect listed plant species that are present in the vicinity of target sites, including SCI Indian paintbrush and SCI bush mallow. The likelihood of impacts would be greatest in Horse Beach Canyon, where several listed and sensitive plant species are located beginning a short distance (about 656 ft.) inland from the beach at Horse Beach Cove. San Clemente loggerhead shrikes nested unsuccessfully about 2,950 ft. from the beach during 2003 and could be expected to attempt to nest in the vicinity again. A second nest site successfully used during 2003 is located about 3,940 ft. inland from the beach. The likelihood of direct ordnance impact on the shrike nest locations and most of the sensitive plant populations is moderated by their distance from the beach. A large number are additionally protected from boat to shore firing by topographic shielding caused by bends in the canyon.

Accidental fires could adversely impact these species and their habitat if they occurred at brief return intervals (less than about 5-10 years). As discussed in section 3.11.2.2.1, occasional fires (at intervals greater than 5-10 years) would not adversely affect these populations and their habitat and would be expected to have a renewing effect on some of the species, including SCI bush mallow. However, repeated fires with short between-fire intervals have the potential to adversely affect the species (e.g., SCI Indian paintbrush) and alter the habitat. The SCI Wildland Fire Management Plan (DoN 2005) specifically addresses interval between fires. Impacts would be less than significant with mitigation.

The activities of a platoon (approximately 14-16 persons on foot) moving overland to a target could disturb wildlife including loggerhead shrikes or island foxes. Disturbance to island fox by the platoon movement would be temporary and less than significant. Significant impacts to shrikes could be mitigated to a less than significant level by locating the targets away from shrike habitat and avoiding platoon movements and small arms fire up the canyons.

3.11.8.20 Bombing Exercises – Land

Bombing exercises (BOMBEX) generally do not include personnel on the ground in SHOBA, except occasionally one or two laser spotters, so impacts associated with foot traffic would be considered negligible. The vast majority of air-dropped weapons are inert 25-pound (lb) practice bombs. Under the No Action Alternative, there would be 231 MK-82 (500 lb) and 92 MK-83 (1,000 lb) live bombs per year. Since these are all over 500 lb., they would only be dropped in Impact Area IIA, an area designated for heavy ordnance and essentially denuded of vegetation. A fuelbreak separates Impact Area IIA and portions of the surrounding Impact Area II from sensitive habitats. Therefore, the potential for fire that would escape the disturbed portions of Impact Area II would be low. Over 90 percent of the ordnance would be fired into Impact Area II, including Impact Area IIA. Approximately 176 such training events annually are within the No Action Alternative.

Vegetation and Wildlife. Impacts to vegetation and wildlife due to direct impact or fires are unlikely; The impact zone is highly disturbed and fire escaping the disturbed area and burning into sensitive habitat is unlikely to result from BOMBEX. There is no record of BOMBEX causing fires.

Endangered, Threatened and Other Sensitive Species. Less than significant impacts to threatened or endangered plant or wildlife species, including shrikes, are expected. The only explosive ordnance would be dropped in Impact Area IIA, a highly disturbed area, unlikely to carry fire, devoid of endangered or threatened plants or wildlife, and situated nearly 1,200 yards (1,100 m) away from typical shrike nesting locations.

3.11.8.21 Combat Search and Rescue

The purpose of this training event is to locate, protect, and evacuate a pilot or other crewmembers from downed aircraft (simulated). The operation can include reconnaissance aircraft to find the downed aircrew, helicopters to conduct the rescue, and fighter aircraft to perform CAS to protect both the downed aircrews and the rescue helicopters. Approximately 7 such training events annually are within the No Action Alternative.

Vegetation and Wildlife. Only a single person would be on the ground during these operations, so impacts to vegetation and wildlife would be less than significant.

Endangered, Threatened, and Other Sensitive Species. Impacts to sensitive plant species would be negligible. Noise from the aircraft may cause a short-term, less than significant impact to some sensitive wildlife. Disturbance to wildlife of a single person on foot and the helicopter maneuvering would be a less than significant impact unless this activity took place within the breeding area of San Clemente loggerhead shrikes or San Clemente sage sparrows during the breeding season. Recent losses of young shrikes being released occurred when helicopters circled overhead and the birds became disoriented and were lost. This impact could be mitigated to a less than significant level by avoiding CSAR operations within San Clemente loggerhead shrike nesting areas or San Clemente sage sparrow habitat during the breeding season.

3.11.8.22 Explosive Ordnance Disposal

Specially trained EOD personnel working on roads or traversing disturbed habitat would carry out this operation. Operations are proposed to occur during the daytime, and once the ordnance is found it is transported to a designated previously cleared location in the VC-3 area to be detonated. These operations are similar to EOD operations in SHOBA. Approximately 4 such training events annually are within the No Action Alternative.

This operation would be carried out by specially trained EOD personnel. Operations occur during daytime, and once the ordnance is found it is carefully transported to Impact Area IIA (if feasible) where it is detonated, employing extensive safety precautions. Access by EOD personnel would be on foot or all-terrain vehicle (ATV). Impacts due to explosions (noise, risk of fire, blast effects) can therefore be managed to avoid or minimize adverse impacts to wildlife and sensitive plant species during the controlled detonation.

Vegetation and Wildlife. There would be 10 personnel involved in sweeping SHOBA for unexploded ordnance and fragments, so there would be minimal potential for impacts due to foot and vehicle traffic; therefore, impacts on vegetation and wildlife would be less than significant. Detonations within Impact Area IIA would have minimal effect on biological resources.

Endangered, Threatened, and Other Sensitive Species. Impacts to sensitive plant and wildlife species could occur from controlled detonations very near their location, in the event the ordnance can not be safely transported back to Impact Area IIA. In addition, EOD activity has the potential to ignite fires that can spread into endangered species habitat. Appropriate precautions would be taken to minimize the potential for fire to be ignited by controlled detonation, resulting in less than significant impacts.

3.11.8.23 NALF Airfield Operations

NALF airfield operations (25,120 baseline operations) occur mainly on or immediately above the landing field, which is a previously disturbed area capable of supporting little wildlife. Bird-aircraft strikes occur very infrequently on SCI and are unlikely to impact any bird species population, including endangered, threatened, or sensitive species. Only four bird strikes (undetermined species) have been recorded during the first 9 months of 2006. The approach and departure paths are over water but are well elevated above the level typically flown by marine birds and shorebirds over water and there are no wetlands or other areas particularly attractive to birds on land in the vicinity of the runway. An accident on approach or takeoff is possible but would be unlikely to cause significant biological impacts because of the extremely low frequency of bird strikes coupled with the scarcity of significant resources at and near the airfield; therefore, impacts would be less than significant.

3.11.8.24 Missile Flight Tests

This operation is proposed to be conducted 5 times in the No Action Alternative. The Joint Standoff Weapon (JSOW) missile testing program at SCI was the subject of an EA in 1996 which resulted in a FONSI. An EA was also completed for Tomahawk missile testing at SCI. There are three primary target areas, the Missile Impact Range (MIR), offshore ships, and SHOBA. No impacts would be anticipated at the MIR because of heavy disturbance and offshore targets, but there would be some risk of fires within loggerhead shrike habitat associated with use of SHOBA targets. These missiles can be extremely accurate, and all the targets, including target areas within SHOBA, are in previously disturbed areas of relatively low value to wildlife and unlikely to carry fire. However, areas outside the MIR and in SHOBA contain habitat for sensitive species of wildlife. Since SHOBA is a contingency target for terminated missiles, missile debris could land in undisturbed habitat potentially affecting sensitive species including San Clemente loggerhead shrike. However, since these missiles contain redundant termination systems, it is assumed in this analysis that no missiles would be allowed to land in or near shrike habitat. Therefore, impacts to vegetation and wildlife and endangered, threatened, and sensitive species are less than significant.

3.11.9 Alternative 1

3.11.9.1 Naval Surface Fire Support

FIREX operations in Alternative 1 would increase about 6 percent from 47 operations per year to 50 operations per year. Impacts would be qualitatively similar to those discussed above under the No Action Alternative for vegetation and wildlife as well as special status species. The incremental increase from about 7,800 to 8,018 ship-to-shore rounds would not significantly increase the risk of fire or change the pattern of habitat disturbance.

3.11.9.2 Expeditionary Firing Exercise

EFEX operations in Alternative 1 would increase from 6 operations per year to 7 operations per year. Impacts on terrestrial biological resources would be essentially the same as described for the No Action Alternative.

3.11.9.3 Battalion Landing

In Alternative 1, one Battalion Landing per year is proposed. The Battalion Landing is the largest historical operation and the largest proposed on SCI in terms of on-island participants (approximately 1,500 Marines and Sailors), the most wide-ranging (virtually the entire island), the longest lasting (4 days), and the most complex operation occurring on SCI. It combines aspects of amphibious landings, FIREX, GUNEX, EFEX, CAS, reconnaissance, and other exercises discussed elsewhere in this EIS. This operation would occur no more than once per year under Alternative 1, and live ordnance use would be within SHOBA. The Battalion Landing exercise does not include some of the ordnance suspected to have caused many of the wildfires in the recent past, such as flares and missiles. Other major fire risks, such as naval gun rounds, mortars, and grenades, are included in substantially lower numbers than in other operations such as FIREX and EFEX. For instance, the Battalion Landing would expend approximately 200 naval gun rounds compared to 3,358 for FIREX and 1,206 for EFEX. On the other hand, all 200 naval gun rounds would be shot during a 4-day span in the single Battalion Landing exercise, while no more than 59 (FIREX) or 73 (EFEX) rounds would be fired in any single exercise in the other operations. Of the estimated 102,737 total ordnance rounds expended during the four days of activities involving ordnance in a Battalion Landing, small arms account for all but about 550 rounds.

Amphibious landings would occur in Northwest Harbor, West Cove, and Horse Beach Cove. Much of the movement of personnel occurs outside of SHOBA and occurs on existing roads, including the AMC. Many of the activities would take place at previously disturbed sites, such as the old airfield (VC-3).

Vegetation and Wildlife. Impacts to vegetation would be generally similar to those described for FIREX, GUNEX, and EFEX. Troop movements would be on established roads or within the IOA. Ordnance use would be restricted to SHOBA Impact Areas I and II. The Impact Areas have been previously disturbed and would have low sensitivity to additional disturbance from ordnance use associated with this exercise. Troop movements within the IOA have the potential to disturb nesting San Clemente loggerhead shrikes or sage sparrows and listed plant species such as San Clemente Island larkspur. Northwest Harbor, West Cove, and Horse Beach Cove have important wildlife habitat. Horse Beach Cove contains a small salt marsh in the vicinity of the creek mouth. The sandy beach, foredune, and wetland habitat could be impacted by vehicles and personnel going ashore, a significant impact that could be mitigated by establishing a corridor for vehicular egress through the area that would minimize impacts on the foredune and beach habitat and that would avoid the wetland and sensitive species. There is a substantial potential for introduction or spread of invasive plant species as a result of the activities of troops and vehicles in the IOA and AVMC as described above under off-road foot and vehicle traffic (Section 3.11.2.2.5).

Endangered, Threatened, and Other Sensitive Species. Ordnance impacts to the San Clemente Island bush mallow and the San Clemente Island Indian paintbrush would be similar to those described for FIREX and EFEX. Ordnance would be fired upon existing target areas within Impact Areas I and II, including IIA, from offshore vessels and from artillery firing from AFP-1 or AFP-6. There is a potential for wildland fire from these activities spreading from target areas and impacting San Clemente loggerhead shrikes, island night lizard, and these two listed plant species. However, to reach habitat for the shrike and the two listed plant species a fire would have to spread across fuelbreaks illustrated in Figure 3.11-23 (above). The effects from wildfire would be reduced by implementing the SCI Wildland Fire Management Plan (as described in Section 3.11.1.3.2, above).

Company landings taking place at Northwest Harbor, West Cove, and Horse Beach Cove have the potential to disturb snowy plovers, if present. These sites are used as wintering habitat by the plovers, and single breeding attempts were made at Horse Beach Cove in 1997 and 1998 but not subsequently. The vicinity of Horse Beach Cove also supports wintering loggerhead shrike and substantial populations of several endangered and sensitive plant species, including the endangered San Clemente Island bush mallow and SCI Indian paintbrush, a short distance from the beach. Impacts to these species would be less than significant with mitigation.

Landings at West Cove and Horse Beach Cove include Landing Craft, Air Cushion (LCAC) vehicles. LCAC landings could affect western snowy plovers through noise, visual, and physical (sand blowing and vehicle trampling) disturbances. However, based on observations by Lynn, *et al.* (2004a) of plovers' response to LCAC landing, unloading, and embarking as well as close approach by people, plovers would be expected to move a short distance away from the activity and quickly resume their normal behavior. Lynn *et al.* (2004a) also noted that observations of recognizable individual plovers at widely dispersed localities around the island on successive dates indicate that wintering plovers are capable of moving long distances from locality to locality on the island.

Impacts on the foredune and beach habitat and sensitive species would be minimized by identifying and briefing an approved route for access to or egress from the beaches that would include avoidance of a localized area that supports SCI Indian paintbrush, SCI silvery hosackia, Southern island tree mallow, and SCI milkvetch just inland from the TAR 5 boundary. Maneuvering of tracked vehicles, wheeled vehicles, and artillery off road would be restricted to AFPs, AMPs, AVMR, and AVMAs, which generally lack occurrences of sensitive plant species. Periodic monitoring of the AVMR, AVMAs, and AMPs and AFP would help ensure that impacts from activities remain confined to the designated areas so that the disturbed area isn't expanding and affecting undisturbed habitat. Potential effects to listed species from elements of this operation outside SHOBA are also addressed in a subsequent section that pertains to USMC amphibious training outside SHOBA.

The Eel Point vicinity, where a platoon-sized reconnaissance team of approximately 12 Marines would land and proceed at nighttime on foot, cross country, to VC-3, contains high density San Clemente sage sparrow habitat and is within known island night lizard habitat.

The IOA contains several occurrences of the San Clemente Island larkspur, San Clemente Island broom, and San Clemente Island Indian paintbrush. Individual plants would be subject to trampling, but the large area over which the foot operations would occur would tend to limit the likelihood of encountering a listed plant. When in an offensive formation, the Marine infantry typically maintain a spacing of 16 ft (5-m) between individuals, which would also limit the intensity of impact in any local area.

The numbers of personnel and vehicles involved in battalion landings and the fact that landings and movements are occurring on many parts of the island increases the likelihood of introduction or spreading of invasive non-native plant species not already well established on the island and accelerate the spread of invasives from one part of the island to another as described in Section 3.11.2.2.5. Junak (2003) identifies and provides locations of invasive plant species present on SCI but not yet widespread on the island. Establishment or spread of invasive plant species could have adverse effects on listed plant species and the large size of the IOA will make beginning infestations challenging to detect and treat. This impact can be minimized but not completely avoided by strict adherence to Navy policies requiring vehicles to be pressure washed before embarking to SCI in order to remove dirt, mud and potential weed seed. Prior to coming to SCI, military and non-military personnel to conduct a brief check for visible plant material, dirt, or mud on equipment and shoes. Any visible plant material, dirt or mud should be removed before leaving for SCI. The Navy will wash tactical vehicles for invasive species prior to embarkation for SCI. Additional washing is not required for amphibious vehicles after 15 minutes of self-propelled travel through salt water prior to coming ashore on SCI. The Navy will continue to control invasive exotic plant species on an island-wide scale, with an emphasis on the AVMC, the IOA, TARs, and other operations insertion areas such as West Cove, Wilson Cove and the airfield. A pretreatment survey to identify areas needing treatment, one treatment cycle, and a retreatment cycle (when necessary) will be planned each year to minimize the distribution of invasive species. The focus of the invasive exotic plant control program will continue to be the control of highly invasive exotic plants that have the potential to adversely impact habitat for federally listed species in known locations, and the early detection and eradication of new occurrences of such species.

The seasonal timing of the landings, which is not fixed, would influence the potential for effects on different resources. Breeding loggerhead shrikes, which traditionally have occupied only a few isolated places during the nesting season, have expanded their nesting into new areas and types of habitat, largely as a result of successful recovery efforts being implemented by the Navy. The expanded breeding range, although healthy for the shrike population as a whole, increases the likelihood of infantry and vehicular operations coming into contact with nesting shrikes. For example, since 2001, there have been one or more nest sites within the IOA in close proximity to Ridge Road and the AVMR on relatively level terrain (in contrast to the typical canyon bottom location for shrike nest sites observed previously).

Land-based artillery and tank firing would be done from AFP-1 or AFP-6 located off of Ridge Road in SHOBA. About 100 artillery rounds and 40 tank rounds would be expended during one battalion landing. Most of the firing would occur during the daytime. Listed species potentially occurring on or in the vicinity of the AFP include SCI Indian paintbrush (one occurrence with 28 individuals), wintering shrikes, and island night lizards. Four occurrences including 289 individuals of the state-listed endangered SCI silvery hosackia are located in the eastern portion of the site, at least some of which are in operationally inaccessible areas. Santa Cruz Island rock cress is known from about 0.07 miles outside the site boundary.

3.11.9.4 Stinger Firing Exercise

USMC Stinger Firings are conducted from positions onshore in SHOBA. This operation involves small heat seeking missiles fired from onshore positions toward aerial targets over the ocean. They are shoulder launched or are launched from an Avenger vehicle, a HMMWV equipped with a missile launcher having two pods of four missiles each. They would be launched from the China Point or Impact Area II areas. Spent missiles would land in the ocean. It is assumed that firing positions would be located on existing roads or disturbed areas near China Point or China Beach and would not involve new surface disturbance and that the RPVs would be recovered in disturbed areas.

This operation would occur 3 times per year under Alternative 1. Because this operation involves platoon-sized groups on foot and/or an Avenger rubber-tired vehicles operating from roads and occurs in mostly previously disturbed areas, impacts to terrestrial biological resources would be less than significant.

3.11.9.5 Reconnaissance Mission

Reconnaissance mission activities would involve about a dozen Marines inserted by helicopter on the broad uplands on SCI. Their main mission would be patrolling and reporting, and there would be no live ordnance. The mission would take about 48 hours, and virtually all activity, including insertion and extraction, would occur at nighttime. Under Alternative 1, such training would occur 8 times per year.

Vegetation and Wildlife. Impacts to vegetation and wildlife would be less than significant.

Endangered, Threatened, and Other Sensitive Species. Impacts to sensitive plant or wildlife species from activities including helicopter landings and takeoffs and foot traffic by small units are unlikely and expected to be less than significant.

3.11.9.6 Helicopter Assault

This operation consists of the airlift of approximately 150 Marines and four Fast Attack Vehicles from amphibious ships offshore into a landing zone near the Old Airfield, VC-3. Insertion and extraction would be by helicopter with support from AH-1 attack helicopters and AV-8B Harrier jets. The operation would take about 8 hours and involve daytime or nighttime movement from VC-3 to NALF along the AVMR and practice of airfield seizure techniques. No ordnance would be used. Helicopter assaults as described would occur 8 times per year under Alternative 1.

Vegetation and Wildlife. Impacts to vegetation and wildlife would be less than significant, given the disturbed nature of the sites and AVMR and the short-term nature of the activity.

Endangered, Threatened and Other Sensitive Species. Sensitive plant species are unlikely to be present in the activity areas and if present effects would be temporary and less than significant. Wintering shrikes, INL, and island fox may be present in the area but impacts of troop movements and aircraft overflight would be temporary and less than significant.

3.11.9.7 Armored Operations

In these events, four M-1 tanks, four HMMWVs, and 25 Marines would land at West Cove, offloading from two LCUs and two LCACs. The tanks would proceed to SHOBA via the AVMC, and the HMMWVs via Ridge Road. The force could be escorted by attack helicopters and fighter / attack aircraft. In SHOBA, they would conduct live-fire operations with the tanks; the impact discussion within SHOBA is detailed in the EFEX discussion. The exercise would last for 2 days and operations would occur mostly during the daytime. Under Alternative 1, such armor operations would occur three times per year.

Vegetation and Wildlife. No significant impacts to vegetation or wildlife habitat are anticipated from this operation. Wildlife in the vicinity oft the landing sites and AFPs may temporarily move away from the activity. Adverse impacts are not expected to be associated with movements from the beach to SHOBA via the AVMC and Ridge Road.

Endangered, Threatened, and Other Sensitive Species. Beach landings at West Cove may result in temporary avoidance by California brown pelicans that may be flying through or foraging near the shore in West Cove at the time of the landings. This would have a minimal effect, if any, on pelicans. The landings could cause snowy plovers, if present, to move a short distance away from the landing site before resuming activities. Transit of vehicles associated with armor operations from West Cove to SHOBA via the AVMR and Ridge Road could temporarily disturb wintering

San Clemente loggerhead shrikes and there is some potential for shrikes to be injured by collisions with vehicles. This would be most likely in the area between Nanny Canyon and Stone Station where there have been 4 shrike nesting attempts in coyote brush shrubs near the Ridge Road and the AVMR alignment since 2001. Nests would be exposed to noise from passing tanks and HMMWVs, as discussed above under Battalion Landing. No effects on the San Clemente sage sparrow would be expected unless the tanks maneuver in the Old Rifle Range AVMA (see Section 3.11.1.2). They are not present along the AVMR or at the AFPs. Noise from tank firing at AFP-6 could affect shrikes nesting in nearby territories (in Cave and Eagle Canyons) as discussed under Artillery operations (Sections 3.11.2.3.8, 3.11.2.4.8, and 3.11.2.5.8).

3.11.9.8 Artillery Operations

Under Alternative 1, artillery operations would increase from 5 to 6 operations per year and Under Alternative 1, four Artillery Maneuvering Points (AMPs) north of SHOBA and two AFPs in SHOBA would be designated. The AMPs would range from about 5 to about 25 ac in extent and would be located in previously disturbed areas on the Island plateau, accessible from SCI Ridge Road. The two AFPs that would be designated in SHOBA include AFP-6, a 124-ac site located primarily in grassland habitat and AFP-1, about 34 ac in extent near the end of SCI Ridge road above Pyramid Head.

Vegetation and wildlife. Maneuvering of wheeled and tracked vehicles and placement of howitzers for simulated or actual attack at AMPs and AFPs are expected to cause reduction of vegetative cover in general and disturbance of soils, leading to an increase in wind and water erosion and causing soil and vegetation to remain in a disturbed condition and would maintain conditions favorable to establishment or spread of invasive plant species. Wildlife would temporarily avoid activities on the site, and the quality of habitat would be reduced for some species as a consequence of changes in vegetation and soils and establishment of weeds and invasive species. Impacts would be less than significant with mitigation.

Endangered, Threatened, and Other Sensitive Species. One AMP supports a small amount of San Clemente sage sparrow habitat, and three of the sites contain some habitat for island night lizard. Habitat for these species would be degraded, and there is some potential for injury or mortality to individuals of these species as discussed in Section 3.11.5. No listed or sensitive plant species are known to occur at the AMPs, owing to their generally disturbed condition. INL habitat is present in both AFPs and would be degraded by the activities, with some potential for injury or death of individual lizards. Three sensitive plant species (Santa Cruz Island rock-cress, San Clemente Island silver hosackia, and south coast saltscale) are known from the general vicinity of AFP-1 but they are outside the AFP boundary and are unlikely to be affected by maneuvering and disturbance to soils and vegetation. Nesting shrikes in Cave and Eagle canyons are within 1,300 to 2,600 ft. of AFP-6 and may forage on the site. The nest sites are at a lower elevation and topographically shielded from the AFP site. They would be exposed to noise from the artillery firing but would be out of the line of sight from the AFP and out of the line of fire, as well. The noise levels at these sites would be difficult to predict, given the topographic factors, but there would be no visual or other accompaniments to the firing and some habituation to artillery noise would be expected as a result of regular exposure to more distant naval artillery without any accompanying threat. AFP-1 is about 2.5 miles to the east of the nearest nest site used since 2000 by the loggerhead shrike and the AFP would be out of the line of sight from the shrike nests. Impacts to listed and sensitive species would be less than significant with mitigation.

3.11.9.9 Amphibious Assault

Amphibious Assault Vehicles (AAVs) would use SCI and the surrounding ranges two times per year for company-sized Amphibious Assault Operations. Each operation would involve an AAV platoon (10 to 14 AAVs) and up to 240 personnel. The AAV and associated personnel are transported to SCI by Navy amphibious shipping and come ashore at West Cove. HMMWVs and Light Armored Vehicles (LAVs) would offload from LCACs and LCUs landing at Wilson Cove. Movement of personnel and vehicles from the landing sites would occur within the AVMC and Ridge Road south to SHOBA where live firing exercises would take place. The movement of Marine force could be accompanied by four to five helicopters, AH-1s, and an UH-1. In SHOBA, AV-8Bs may provide CAS during the exercise. These operations usually take 1-2 days to complete. The groups leave the island by moving north along the AVMC and then into West Cove and Wilson Cove for reboarding onto Navy amphibious ships. Most amphibious landings would occur in daylight conditions and would be 2 days in duration.

Vegetation and Wildlife. Impacts to vegetation or wildlife at West Cove would be temporary and less than significant. Effects of tracked vehicles on vegetation and soils in AVMAs and AMPs would be as described previously.

Endangered, Threatened, and Other Sensitive Species. Areas used for amphibious assault operations would include the AVMAs and the AVMR, which are located in disturbed areas away from known populations of listed plant species; therefore, no direct effects to listed plant species are anticipated. Possible indirect effects on one listed (Santa Cruz Island rock-cress) and two sensitive plant species could occur from activities at AFP-1. These species are outside the AFP boundary. The Old Rifle Range AVMA overlaps broadly with low density San Clemente sage sparrow habitat and maneuvers during the breeding season have the potential to disturb adults and possibly to directly impact nests, which are located near the ground in low shrubs. Indirect effects to nearby populations of listed species from dust, erosion, or invasive species establishment caused by activities on the AVMAs, AVMR, and AFPs are possible. Effects to the island night lizard and the California brown pelican would be similar to those described previously for Artillery Operations and would be less than significant. There is a potential for effects of noise or collisions with SCI loggerhead shrike as described above under Armor Operations. Effects of Amphibious Assault Operations on endangered, threatened, and other sensitive species would be less than significant with mitigation.

3.11.9.10 Combat Engineering Operations

Combat Engineering Operations involve demolition training with live ordnance at the Northwest Harbor demolition training area. The operation requires approximately 30 Marines to come ashore from an LCU along with three HMMWVs and one 5-ton truck. Each operation lasts 1 day. One operation per year is proposed under Alternative 1.

Vegetation and Wildlife. Impacts would be from foot traffic and demolition training activity at the objective. Vehicles would remain on roads and developed areas after leaving the beach. Impacts on vegetation and wildlife habitat would be temporary and less than significant.

Endangered, Threatened, and Other Sensitive Species. Impacts to sensitive plant species would be unlikely and less than significant. Snowy plovers use Northwest Harbor to forage during the winter months and California brown pelicans transit over the harbor and beaches and use offshore rocks. Activities may cause these species to temporarily move away from the activity; however, anecdotal observations indicate that pelicans are attracted to Basic Underwater Demolition/SEAL (BUD/S) students as the students prepare for underwater explosives training. Pelicans flock in droves to Graduation Beach to await the underwater explosions. Given that no breeding occurs in these areas, the effects of any disturbance would be temporary and considered less than significant. No impacts to INL or other sensitive wildlife species or habitats are anticipated.

3.11.9.11 Amphibious Assault Vehicle and Expeditionary Fighting Exercise Operations

AAV and EFV Operations are proposed to occur six times per year under Alternative 1. Each exercise would take approximately 3 days and would take place during both daytime and nighttime hours. Twelve AAVs (and increasingly after 2007, new EFVs) with 100 Marines would land at West Cove or Horse Beach Cove from amphibious Navy ships offshore. The EFV, when employed, would practice live firing exercises onshore and in nearshore waters off SHOBA. AAV/EFVs would move inland along the AVMR to the VC-3 where an assault would be conducted on an objective. Offshore access to SHOBA would be provided at Horse Beach Cove. EFV vehicles would traverse SHOBA via transit routes to be established on a portion of the AVMC to be developed along previously used tank trail parallel to the Ridge Road and a route to Horse Beach Cove that would run parallel to and in places be co-located with the China Point Road, ultimately diverging eastward from the China Point Road down an existing unpaved road to Horse Beach Cove. Development of these routes would be addressed under a separate environmental review.

Vegetation and Wildlife. Impacts would occur to vegetation, soils, and wildlife habitat from tracked vehicle activity along the AVMC including the AVMAs and AMPs, as described previously. Vehicle traffic would be confined to elements of the AVMC after leaving the beach.

Endangered, Threatened, and Other Sensitive Species. No listed plant species are known to occur in the immediate vicinity of West Cove, the AVMA or AVMR. However, the endangered San Clemente Island bush mallow occurs on sandy flats a short distance inland from the beach in Horse Beach Cove, where it and its habitat could be affected by maneuvering vehicles or ordnance from EFVs firing from the nearshore waters. Physical impacts to this species from maneuvering vehicles could be avoided by establishing and briefing a route that exits Horse Beach Cove while minimizing damage to the habitat and conducting any maneuvering or staging at an existing disturbed area on a terrace above and to the west of the Cove, outside of sensitive habitat.

Impacts from the use of ordnance and fire as a result of ordnance use associated with this exercise have been described previously. California brown pelican may temporarily avoid the immediate vicinity of AAVs or EFVs during approach to the beach and landing. No adverse effects are expected. Wintering individuals of the western snowy plover in Horse Beach Cove (typically less than 5) or West Cove (typically 5-10) would be expected to temporarily move away from the landing vehicles to another part of the beach and resume their activities (foraging, loafing, etc.) without harm. There is a very low possibility of take of individuals during the breeding season because island-wide numbers decline toward 0 in June. Given the infrequency of nesting attempts on SCI and limitations on nesting associated with physical constraints of the habitat (especially limited beach size and beach width and frequency predators), breeding of plovers on SCI would be regarded as accidental and sporadic and of little consequence to the plover population overall or in the coastal Southern California region.

Adverse effects to island night lizards include injury or mortality from tracked vehicle maneuvering within AVMAs supporting habitat for the species. These effects are likely to be negligible and essentially undetectable given the ability of island night lizards to seek cover or otherwise avoid such impacts upon approach of personnel or vehicles.

Potential effects on shrikes and sage sparrows from use of the AAV or EFV in the uplands include temporary disturbance to sage sparrows and to wintering loggerhead shrikes, if present, along the AVMR and VC-3 from noise and the activity of vehicles and personnel. San Clemente sage sparrows are not known to breed within 500 m of the AVMR (DoN 2004a) and thus use of the route would not affect sage sparrow breeding. Habitat for San Clemente sage sparrows is present in the Old Rifle Range AVMA and tracked vehicle activity there would affect the habitat and has the potential to affect sage sparrows nests during the breeding season. Use of the AVMR during the breeding season could affect breeding shrikes, particularly in the interval between Nanny Canyon Road and Stone Station because shrikes have nested in coyote brush within the Island plateau grasslands near the AVMR. Four nesting attempts were documented in three individual coyote brush shrubs between 2001 and 2003, with three of the attempts successful in raising independent offspring (DoN 2004a). Most of the shrikes nesting in this area were of captive origin (USFWS 2004) and it can be expected that additional nesting will occur on the plateau as the shrike population expands and grassland habitat becomes more suitable for nesting. Noise from passing vehicles in transit may temporarily interfere with shrike communications and there is a chance of harm to shrikes, especially inexperienced fledglings, caused by collisions with vehicles as described previously.

Peak Sound Exposure Levels (SEL) created by AAV and EFV vehicles while underway are listed in Table 3.11-17_along with representative pieces of equipment for comparison. These reported noise values are within the range of values monitored for trucks and construction equipment on Ridge Road (DoN 2004 a) and the apparent tolerance to traffic noise that some shrikes have demonstrated by nesting within 5-50 m of the Ridge Road suggests that shrikes will tolerate traffic noise levels as high as 80-90 dB (DoN 2004a).

Table 3.11-17: Representative Vehicle Sound Exposure Levels

Vehicle	SEL (IN DBA) AT 100 FEET (31 M)	
	Idle	Moving
Fork Lift	65	93
Backhoe	64	79
Steel Roller	63	85
Sweeper	66	87
Bob-Cat	62	81
Tractor-Trailer	69	79
AAV (in Water)	72	88 [a]
AAV (on Land)	72	87 [b]
EFV (in Water)	72	84 [a]
EFV (on Land)	72	90 [b]

Notes: a. Representative noise level dependent on means of propulsion.
b. Represents average based on range of speeds.

Source: USMC 2004

3.11.9.12 NSW Land Demolition

This operation under Alternative 1 would increase from 354 to 674 operations per year compared to the No Action Alternative. Impacts on vegetation and wildlife and endangered, threatened, and other sensitive species however would be less than significant as discussed under the No Action Alternative.

3.11.9.13 Underwater Demolition

This operation under Alternative 1 would increase from 72 to 85 operations per year compared to the No Action Alternative. Impacts on vegetation and wildlife and endangered, threatened, and other sensitive species however would be less than significant as discussed under the No Action Alternative.

3.11.9.14 Underwater Mat Weave

This operation under Alternative 1 would increase from 14 to 16 operations per year compared to the No Action Alternative. Impacts on vegetation and wildlife and endangered, threatened, and other sensitive species however would be less than significant as discussed under the No Action Alternative.

3.11.9.15 Marksmanship – Small Arms Training

This operation under Alternative 1 would increase from 171 to 205 operations per year compared to the No Action Alternative. Impacts on vegetation and wildlife and endangered, threatened, and other sensitive species however would be less than significant or mitigable to less than significant as discussed under the No Action Alternative.

3.11.9.16 Land Navigation

This operation under Alternative 1 would increase from 99 to 118 operations per year compared to the No Action Alternative. Impacts on vegetation and wildlife and endangered, threatened, and other sensitive species however would be less than significant as discussed under the No Action Alternative.

3.11.9.17 NSWG-1 Unmanned Aerial Vehicle Operations

This operation was performed 5 times during the baseline year and would increase to 15 or more operations under Alternatives 1 and 2. Impacts would be qualitatively the same as for the No Action alternative and the increased number of flights would not have a substantial effect on biological resources. Therefore, impacts on terrestrial biological resources from UAV training would be less than significant.

3.11.9.18 NSWG-1 SEAL Platoon Operations

Under Alternative 1, 19 TARs would be added and operations would increase. The increase would be about 51 percent (from 340 to 512 operations per year), and expenditure of small arms rounds would would more than double compared to the No Action Alternative. The biggest change would be that NSWG-1 operations under Alternative 1 would be clustered in the TARs specially designated for tactical use. The impacts of these operations to each proposed new TAR are described below.

<u>TAR 2—Graduation Beach Underwater Demolition Range</u>

Graduation Beach Underwater Demolition Range is a heavily disturbed area. It has been used for demolition exercises for over 20 years, and is part of SWAT-2. It contains disturbed grassland, non-native grasses, and iceplant. There is also a small sandy beach. Under Alternative 1 there would be 24 exercises per year, including demolitions of up to 100 lb on land within a bermed demolitions area, and 500 lb in the water. There would be no small arms fire.

Vegetation and Wildlife. Although the beach contains suitable foraging habitat for a small number of shorebirds, including snowy plovers, and raptors might forage over the grasslands, TAR 2 is already heavily disturbed and of relatively low value to wildlife. Therefore, impacts to wildlife would be less than significant.

Endangered, Threatened, and Sensitive Species. No impacts are anticipated to sensitive plant species at this TAR. The only sensitive wildlife species likely to use TAR 2 is the snowy plover. Although snowy plovers may occasionally forage on the beach, they are not regularly found here, and do not nest there. During Naval activities in TAR 2 snowy plovers would be expected to forage elsewhere. Brown pelicans are present in the area and may be attracted to demolitions activity as described above under <u>NSW Center Underwater Demolitions</u>. Therefore, impacts to endangered, threatened, and sensitive species would be less than significant.

<u>TAR 3—BUD/S Beach Underwater Demolition Range</u>

BUD/S Beach Underwater Demolition Range includes coastal strand and disturbed dunes. The TAR extends into the shallow-water areas of NW Harbor. When the TAR is not in use the beach supports foraging by shorebirds including snowy plovers, killdeer, willets, and sanderlings. Other species known to use the area include great blue heron, rock wren, common raven, and house finch. Brown pelicans, western gulls, and Brandt's cormorants perch and roost on the large offshore rock, and with the exception of pelicans, may nest there. Under Alternative 1, 82 operations would occur in TAR 3 each year, which would include detonations up to 500 lb, but no live-fire. All detonations would be underwater.

Vegetation and Wildlife. Although the beach contains suitable foraging habitat for a number of shorebirds, most of TAR 3 is under water, and the explosions would occur there. Therefore, impacts to vegetation and wildlife would be less than significant.

Endangered, Threatened, and Other Sensitive Wildlife. No sensitive plant species occur in TAR 3, therefore, no impacts to sensitive plant species are anticipated. During NSWG-1 activities in TAR 3 snowy plovers would be expected to move away from the immediate vicinity of the activity and resume their activity. Brown pelicans are present in the area and may be attracted to demolitions activity as described above under, Section 3.11.2.4.14. Therefore, impacts to endangered, threatened, and sensitive species would be less than significant.

TAR 5—West Cove Training Area

West Cove consists of coastal strand, foredune, and disturbed habitats. A small beach supports foraging shorebirds such as black-bellied plovers, black and ruddy turnstones, sanderlings, and other common species. It also attracts predators such as domestic cat, island fox, and ravens. In addition, humans come to fish, eat lunch, and walk along the beach.

Vegetation and Wildlife. NSW activities at this site would consist of low impact insertions and extractions of personnel several times per year. These would have minimal direct impacts on vegetation and wildlife; however, cumulative impacts of NSW activities with other activities involving vehicular access and egress from this beach could cause degradation of the sensitive foredune and coastal strand habitats there. This would be mitigable by establishing and maintaining a clearly marked corridor for access to and egress from the beach.

Endangered, Threatened, and Other Sensitive Species. Occurrences of two sensitive plant species are known from the periphery of TAR 5, where they are unlikely to be affected by NSWG-1 activity. Impacts to sensitive plant species would be less than significant through avoidance. In December of 1999 the USFWS designated Critical Habitat for the western snowy plover but SCI was not included in that designation. However, take of individuals, nests, eggs, or nestlings, would be considered a significant adverse impact, and a violation of the Endangered Species Act, unless a §10(a)(1)(A) permit is obtained, or a consultation with USFWS is conducted regarding the western snowy plover and a Biological Opinion is issued including an "Incidental Take" provision. Snowy plovers nested at TAR 5 as recently as 1989, but the beach, which was formerly much wider; is now subject to periodic inundation during high tides and high predation making it unsuitable for nesting. Under Alternative 1, 25 NSW operations would occur in TAR 5. These operations would consist mainly of low-impact insertions and extractions of personnel, and would not involve demolitions or small arms fire. Therefore, no adverse impacts to wildlife are anticipated.

TAR 6—The White House Training Area

The White House Training Area consists of a very small, fenced disturbed area, vegetated with non-native grasses and Russian thistle. It is of little value to wildlife. However, raptors may use the fence for hunting perches. Under Alternative 1, eight operations would occur in TAR 6. These operations, which would include aircrew rescue and simulated small arms practice, would not involve demolitions or live-fire. No adverse impacts to vegetation or wildlife or endangered, threatened, or sensitive plant or wildlife species are anticipated.

TARs 7 and 8—Wilson Cove Offshore Parachute Drop Zone (DZ) and Westside Nearshore Parachute Drop Zone

TARs 7 and 8 are located off the coast of SCI and lack terrestrial resources except marine birds. Marine birds, including California brown pelican, would not be adversely affected by the proposed activities which include daytime and nighttime parachute drops, personnel insertion, and small boat activity. Five operations would occur under Alternative 1.

TAR 9—Photo Lab Training Area

The Photo Lab consists of roads, buildings, facilities, paved areas, and some non-native grassland. Mice and insects attract predators such as island fox, feral cat, ravens, and American kestrels. Recently shrikes have been observed using this site during winter months. Under Alternative 1, 32 operations are planned per year. These would include helicopter insertion, reconnaissance, tactical ambush, and silent raids. There would be no demolitions, and live-fire of 9mm rounds would be into bullet traps only. Due to the highly disturbed nature of the Photo Lab, no impacts to vegetation or wildlife or sensitive plant or wildlife species are anticipated.

There are no sensitive plant species in the immediate vicinity of the Photo Lab, and no significant impacts to sensitive plant species from activities within this TAR are anticipated. Wintering shrikes were observed to frequent the Photo Lab site beginning in 2000 but were not observed in subsequent years. Activities at the Photo Lab during the winter months could temporarily disturb shrikes using this area.

TAR 10—Demolition Range West

Tactical training, demolitions, immediate action drills, some OTB training and small arms fire are proposed on 1.5 ac of this 43.3-ac area. SEAL platoons are proposed to conduct patrols with immediate action live-fire evolutions and target assaults. Most ingress would be from other locations on the western shore. Proposed weapons would include small arms 5.56mm, 7.62mm, .50 cal surgical sniper; demolitions up to 300 lb (136 kg) NEW; flares, pyrotechnics, and tracers, with live-fire in a 180º arc toward the ocean. The Surface Danger Zone is 4,100 m, oriented on a 158-338 degree axis. With the exception of an area along the shoreline out to about 2,000 m, the entire SDZ lies over the water. Under Alternative 1, proposed approximate use is 20 times per year, divided between day and night use.

TAR 10 contains vegetation communities of maritime desert scrub-lycium phase, stabilized dune, a small portion of grassland, and a large previously disturbed area. This TAR is located within San Clemente sage sparrow habitat and the operations could potentially affect the species. This site and surrounding area supports high and medium density San Clemente sage sparrow habitat. Noise from weapons and demolition, human activity, and helicopters could disturb SCSS especially when bonding and establishing nests (late January through March), early in the breeding season. Fire and invasive species spread could affect habitat. Development of two small range buildings on this site would occupy about 0.25 ac, assumed to be in previously disturbed habitat. The potential for fire carrying from this TAR into adjacent contiguous areas of high and medium density SCSS habitat has been identified as a key issue. The SCI Draft Wildland Fire Management Plan (DoN 2005) has a series of increasing precautions and fire suppression measures related to increasing fire danger ratings, including a fully equipped and staffed fire truck in the vicinity of the TAR within line of sight visibility of the TAR and action area and ability to be on scene and pumping water within 10 minutes of an ignition report whenever any type of incendiary ordnance is used. The Fire Plan notes the slow growth and recovery of boxthorn and places a priority on preventing short-interval recurrences of fire that might result in replacement of shrub-dominated native vegetation by grasses or weeds (type conversion). Impacts on habitat are less than significant.

Monitoring of SCSS in the vicinity of TAR 4 during a period of training operations similar to those proposed for TAR 10, coupled with construction of the MOUT and related facilities has shown that the SCSS population there is healthy and comparable to other SCSS populations on the Island (as described below in Section 4.9.5). Most of the training activity and all of the demolition within TAR 10 would be in previously disturbed areas, so that effects on habitat would be less than significant. Based on the results of monitoring sage sparrow response to NSW training at TAR 4, it is assumed that low levels of take (up to 2 individuals per year) in the form of unintentional harassment of birds nesting in the area would occur but this would not likely be measurable because it is expected that population levels and reproductive parameters would stay remain with the range of other sage sparrows on SCI. Impacts to island night lizards would be similar to those described for TAR 1. No federally listed plant species occur in TAR 10; therefore, no effects to listed plant species are anticipated at this site.

TAR 11—Surveillance Training Area

The Surveillance Training Area contains an abandoned missile site and some small buildings, with steep, cactus-covered slopes overlooking the ocean and some disturbed grassland and maritime sage scrub. This site supports several species of rodents, which in turn attract predators such as hawks, ravens, island fox, and feral cats. Under Alternative 1, there would be 17 operations per year, with no live-fire and only smoke (no demolitions). Although smoke generators have the potential to cause fires, none are known to have done so on SCI. Activities would include helicopter insertion, reconnaissance, raids, and extraction. The endangered San Clemente Island broom (Trask's island lotus) occurs within TAR 11 and adjacent areas where they could be impacted by training activities, including foot traffic and fire. Island sagebrush, a sensitive species, is also frequent on the site. Impacts to these plant species from activities within this TAR would be less than significant with mitigation as described below (See discussion in 3.11.1.3.5 and Tables D-4 and D-10, in Appendix D). Impacts to wildlife habitat or sensitive wildlife would be less than significant due to the lack of sensitive species there.

TAR 12—Radar Site Training Area

The Radar Site Training Area consists of a small building containing a dummy missile, with camouflage netting over it. A gully cuts deeply through the site, and is filled with dense vegetation, including lemonadeberry and other woody vegetation, as well as cactus and grassland. Under Alternative 1, there would be 12 operations per year, with no live-fire and only smoke (no demolitions). Activities would include helicopter insertion, reconnaissance, raids, and extraction. A communication line would be installed and erosion control on the access road would be required. Gates and signs would be added. Due to the disturbed nature of this area, no impacts to wildlife habitat or sensitive wildlife are anticipated. No sensitive plant species are known or expected from TAR 12.

TAR 13—Randall Radar Site Training Area

The Randall Radar Site Training Area consists of very steep slopes covered with a variety of cactus and woody shrubs, as well as some grassland. Under Alternative 1, there would be 31 operations per year, with small arms (up to .45 cal) fire into bullet traps and small (5 lb or less) demolitions. Activities would include tactical weapons and light demolitions training with tactical maneuvering. Part of the demolitions area would be cleared for targets and a firebreak added. Due to the highly disturbed nature of this area and the nature of the activities, no impacts to vegetation, wildlife habitat or sensitive wildlife are anticipated. Two sensitive plant species occur on this TAR, where they could be temporarily affected by foot traffic or fire. Both species regenerate readily after fire and impacts would be less than significant.

TAR 14—VC-3 Onshore Parachute Drop Zone

The VC-3 Onshore Parachute Drop Zone is open grassland with some cactus and Australian saltbush, an introduced species. It is highly disturbed. The large rodent population attracts hawks, including northern harriers, white-tailed kites, and owls. Under Alternative 1, there would be 30 operations per year, including live-fire and demolitions up to 100 lb. Activities would include parachute drop, helicopter insertion, tactical patrol, and movement to other TARs. Due to the highly disturbed nature of this area, no impacts to vegetation, wildlife habitat or sensitive wildlife are anticipated. One population of Guadalupe Island lupine is present in the southwestern corner of TAR 14. Impacts to this population would be considered less than significant because of its out of the way location and small size relative to the overall population on the island.

TAR 15—VC-3 Airfield Training Area

The VC-3 abandoned airfield partially overlaps TAR 14, and is similar in habitat. Under Alternative 1, there would be 25 operations per year, with no live-fire and no demolitions. Activities would include insertion and extraction, SEAL team land raids, airfield takedown and direct action. Due to the highly disturbed nature of this area, no impacts to wildlife habitat or sensitive wildlife are anticipated. However, several sensitive plant species populations occur within TAR 15 including the Guadalupe Island lupine (same population discussed under the overlapping TAR 14) and several populations of federally listed endangered San Clemente Island larkspur are located outside the northeastern corner of the TAR, where they could be affected by fire. Impacts would be less than significant with mitigation including implementation of the SCI Fire Plan (DoN 2005) as described above in Section 3.11.1.3.1 (see also Table D-3, in Appendix D).

TAR 17—Eel Point Tactical Training Range

The proposed operation of strategic reconnaissance, OTB, direct action, and land demolition will occur on 1.5 ac of the 22 ac of TAR 17. Platoons would covertly swim up to the beach, maneuver across the beach and assault a target, then return to the beach under live-fire conditions. This action is proposed for approximately 31 times per year and would occur for a duration of about 2 hours, with equal day and night use. This TAR consists of maritime desert scrub-lycium phase and disturbed vegetation communities and most of the TAR contains high density San Clemente sage sparrow habitat. The potential adverse impacts to San Clemente sage sparrows would be similar to those described for TAR 10. SCI Indian paintbrush and SCI broom are listed plant species located near TAR 17. The known occurrence of SCI Indian paintbrush is located approximately 20 m from the boundary of TAR 17. There exists a potential for operations to impact these species from fire, but implementation of the Fire Management Plan (DoN 2005), as described under TAR 10, would limit the frequency and extent of fires and the exposure of these species. This TAR is located in high density island night lizard habitat, increasing the likelihood of injury or mortality to island night lizards incidental to operations, however impacts would be less than significant due to the light activity by small groups on foot.

TAR 18—Close Quarter Battle Training Complex

The close-quarter combat training area would be developed north of the runway in an area severely disturbed during construction of the runway. This area is nearly barren except for scattered individuals of native and exotic plant species that have colonized the site since the runway was constructed. There are no endangered, threatened, or sensitive plant species known or expected to occur on the site. However, one of only five known populations of southern island mallow (*Lavatera assurgentiflora* subsp. *glabra*) on SCI is confined to a localized area about 200 m west south west of the site. Prior to development as a TAR the site would need to be searched for this species and plans for operations on the site adjusted to avoid impacts if the species is found there. Except for the island night lizard, which is nearly ubiquitous on the island and may be present on the site, and the island fox, which may traverse the site, no endangered, threatened or sensitive plant or wildlife species are known or expected to use the site. The site lies outside of the Island Night Lizard Management Area and offers little in the way of resources for wildlife. A facility would be built on the site allowing realistic close-quarter combat training. Live-fire would be allowed within the closed facility. Impacts on the southern island mallow population would be avoided during development and operation of this facility. Construction and operation of the facility would have less than significant impacts on biological resources. Twenty five operations per year would occur under Alternative 1.

TAR 19—Simulated POW Camp and SAM Site

The proposed Prisoner of War (POW) holding camp and Surface-to-Air Missile (SAM) site for SEAL training will occur on the entire previously disturbed 3 ac TAR 19. Use includes 5.56mm and 9mm simunitions (non-lethal training rounds) and small demolition charges under 1 lb. Five small wood/metal structures are proposed to be constructed and clean-up procedures would be incorporated after each operation.

TAR 19, which is located in a large borrow pit several hundred yards east of the airfield control tower on the south side of the NALF runway and taxiway, consists entirely of previously disturbed soil with no vegetation and no listed plant or animal species with the possible exception of island night lizards. Impacts on vegetation and wildlife would be less than significant. Ten operations per year would occur under Alternative 1.

TARs 20, 21, and 22

These TARs are located within SHOBA and are described below in the section on NSW Direct Action activities.

3.11.9.19 NSW Direct Action

NSW Direct Action would increase to 163 operations per year under Alternative 1 compared to 156 operations in No Action, a 4.5 percent increase. The operations would be distributed among TAR 20, 21, and 22, which are designated as part of Alternatives 1 and 2 and are described below.

Vegetation and Wildlife. Increased use of ordnance, including flares, under this alternative, would incrementally increase direct and indirect impacts on vegetation and wildlife habitat, including the risk of wildfires in SHOBA, as described above, but would be considered a less than significant potential impact with implementation of the SCI Wildland Fire Management Plan (DoN 2005)

Endangered, Threatened, and Other Sensitive Species. Direct and indirect impacts to listed and sensitive plant and wildlife species as described above would increase incrementally under Alternative 1. Impacts would be considered less than significant with mitigation and implementation of the SCI Fire Plan.

TAR 20

About 28 percent of the NSW Direct Action exercises would take place in Pyramid Cove/TAR 20. Although this area has been repeatedly burned and is littered with debris from bombs and targets, it supports a small salt marsh and several sensitive species, including island night lizards, island fox, wintering snowy plovers, and loggerhead shrikes. Although small arms fire at targets and demolition explosions could cause direct mortality to any of these species, this would be very unlikely because individuals in the area would be expected to avoid the area of activity or take cover. Fire, trampling, litter, and explosions of bombs would contribute incrementally to habitat degradation within the target area. These impacts are expected to be less than significant, given the low probability of direct mortality and the existing condition of the habitat where the operation would take place.

TAR 21

Approximately 51 percent of the operations would take place in Horse Beach Cove/TAR 21. Snowy plovers winter here and two nesting attempts have been documented in the past decade (1997 and 1998). TAR 21 also includes a small salt marsh, San Clemente shrike wintering habitat (shrikes have recently been observed a short distance inland from the beach) and shrike nests active in 2003 are located about 2,950 and 3,940 ft. inland from the beach in Horse Beach Canyon. Island fox and island night lizards also occur here. As described above, numerous sensitive plant species occur in the canyon within less than 0.5 mile from its mouth. These include the SCI bush mallow, bright green dudleya, and SCI Indian paintbrush. Impacts are expected to be less than significant with mitigation.

TAR 22

About 21 percent of the operations would occur in the China Cove/TAR 22 area, which includes Impact Area IIA, shrike wintering habitat, snowy plover wintering habitat, and island fox and island night lizards. Stabilized dunes are present immediately above the beach. Nest sites used by shrikes in the past 5 years are present in China Canyon upstream from the NE corner of the TAR, the closest one about 1,640 ft. from the TAR boundary. This TAR is in Impact Area II and overlaps Impact IIA which receives most of the heavy ordnance delivered to SHOBA. Impacts would be less than significant with mitigation.

3.11.9.20 Bombing Exercises – Land

Under Alternative 1, BOMBEX activities would increase approximately 12 percent from 176 to 197 operations per year. As discussed under the No Action Alternative, most of the bombs used in this exercise are inert, and those that are not inert would be restricted to Impact Area IIA. Few personnel would be on the ground. Ordnance would be fired into Impact Area IIA, which is sparsely vegetated and surrounded by a firebreak. Thus, they are unlikely to start a fire that could spread into sensitive habitat areas.

Vegetation and Wildlife. Impacts are assumed to be qualitatively similar to, but slightly greater, than those discussed above under the No Action Alternative, due primarily to a slightly increased danger of fires from the increased explosive ordnance usage. However, impacts would remain less than significant given the factors mentioned above.

Endangered, Threatened, and Other Sensitive Species. Impacts to endangered and threatened species would remain less than significant as described under the No Action Alternative. Implementation of fire prevention, management, and suppression measures included in the San Clemente Island Wildland Fire Management Plan (DoN 2005) and Integrated Natural Resources Management Plan (INRMP) (DoN 2002) would further reduce the risk of fires spreading into endangered species habitat as discussed previously.

3.11.9.21 Combat Search and Rescue

Under Alternative 1, this operation would increase to 8 operations per year. Impacts on vegetation and wildlife and endangered, threatened, and other sensitive species however would be the same as discussed under the No Action Alternative and less than significant with mitigation.

3.11.9.22 Explosive Ordnance Disposal

Under Alternative 1, EOD activities would increase from 4 to 5 operations per year, a 25 percent increase compared to the No Action Alternative. However, the impacts of EOD under Alternative 1 would be less than significant as described under the No Action Alternative.

3.11.9.23 NALF Airfield Operations

Under Alternative 1, NALF airfield operations would increase by 5 percent over the No Action Alternative to 26,400. Impacts would be less than significant.

3.11.9.24 Missile Flight Tests

Under Alternative 1, the number of missiles tested would increase to 15 per year. Impacts would be as described above, and impacts to vegetation and wildlife and endangered, threatened, and sensitive species would be less than significant with mitigation. Implementation of the SCI Wildland Fire Management Plan (DoN 2005) would reduce the potential for fire to spread and affect sensitive resources.

3.11.10 Alternative 2

3.11.10.1 Naval Surface Fire Support

This operation under Alternative 2 would increase about 11 percent from 47 operations to 52 operations per year compared to the No Action Alternative for vegetation and wildlife as well as special status species. Impacts would be qualitatively similar to those discussed above under the No Action Alternative. The incremental increase from about 7,800 to about 8339 ship-to-shore rounds would not significantly increase the risk of fire or change the pattern of habitat disturbance.

3.11.10.2 Expeditionary Firing Exercise

EFEX operations in Alternative 2 would increase from 6 operations per year to 8 operations per year compared to the No Action Alternative. Impacts on terrestrial biological resources would be essentially the same as described for the No Action Alternative.

3.11.10.3 Battalion Landing

Under Alternative 2 there would be 2 battalion landings per year compared to one landing per year under Alternative 1. Increasing the frequency to twice a year substantially increases the effects of off road foot and vehicle traffic, including the likelihood of invasive species introductions, and increases the potential for fire, direct and indirect ordnance effects, and potential for impacts on nesting species during the nesting season.

3.11.10.4 Stinger Firing Exercise

This operation would occur 4 times per year under Alternative 2. Because this operation occurs on roads and in previously disturbed areas, impacts to terrestrial biological resources would be less than significant as described for Alternative 1.

3.11.10.5 Reconnaissance Mission

Under Alternative 2, Reconnaissance would increase to 12 operations per year. Impacts on vegetation and wildlife and on endangered, threatened, and other sensitive species would be less than significant as described for Alternative 1.

3.11.10.6 Helicopter Assault

Helicopter Assaults would increase to 12 per year under Alternative 2. Impacts on vegetation and wildlife and endangered, threatened, or other sensitive species would be less than significant as described under Alternative 1 due to the nature of the activity and of the affected areas.

3.11.10.7 Armored Operations

Under Alternative 2, the operation would increase to four times per year. Impacts would be similar to those described under Alternative 1.

3.11.10.8 Artillery Operations

Alternative 2 would be as described for Alternative 1 but operations would increase from 6 per year in Alternative 1 to 8 per year. Impacts would be similar to those described for Alternative 1.

3.11.10.9 Amphibious Assault

Amphibious Assaults Operations would increase to 3 times per year under Alternative 2. Impacts on vegetation and wildlife and endangered, threatened, or other sensitive species would be less than significant with mitigation as described under Alternative 1 due to the nature of the activity and of the affected areas.

3.11.10.10 Combat Engineering Operations

Combat Engineer Operations would increase to 2 times per year under Alternative 2. Impacts on vegetation and wildlife and endangered, threatened, or other sensitive species would be less than significant as described under Alternative 1 due to the nature of the activity and of the affected areas.

3.11.10.11 Amphibious Assault Vehicle and Expeditionary Fighting Exercise Operations

Amphibious Assault Vehicle (AAV) and Expeditionary Fighting Vehicle (EFV) Operations would increase to 8 operations per year under Alternative 2 (compared to 6 in Alternative 1). Impacts on vegetation and wildlife and endangered, threatened, or other sensitive species would be as described under Alternative 1.

3.11.10.12 Expeditionary Fighting Vehicle Company Assault

This exercise is part of Alternative 2 only and would involve landing a company of 46 EFVs with 225-300 Marines at West Cove or Horse Beach Cove, practicing land maneuvers through the AVMC to the vicinity of VC-3, where Marines would dismount and targets would be assaulted using blanks and smoke charges. The operation would involve live-fire on land within SHOBA including the EFV's 30 mm gun, 7.62 mm machine gun and small arms and would involve land-based live-fire and sea to land firing from the nearshore waters into SHOBA Impact Areas I and II. This operation would take place twice a year and would be a 1-day operation; activities would take place almost exclusively during the daytime.

Vegetation and Wildlife. Impacts to vegetation or wildlife at West Cove would be temporary and less than significant. Effects of tracked vehicles on vegetation and soils in AVMAs and AMPs would be as described previously.

Endangered, Threatened, and Other Sensitive Species. Impacts would be generally as described in Sections 3.11.1.2.4.9 and 3.11.1.2.4.11 for the AAV and EFV Exercise operations. However this operation would involve more vehicles (46 vehicles vs. 12) and Marines (225-300 vs. 100). The greater number of vehicles would increases the chance of disturbing or taking snowy plovers on the beach and would create greater soil disturbance and elevated noise and dust levels for a longer period of time along the AVMC. Areas used for amphibious assault operations would include the AVMAs and the AVMR, which are located in disturbed areas away from known populations of listed plant species; therefore, no direct effects to listed plant species are anticipated. The Old Rifle Range AVMA overlaps broadly with low density San Clemente sage sparrow habitat and maneuvers during the breeding season have the potential to disturb adults and possibly to directly impact nests, which are located near the ground in low shrubs. Indirect effects to nearby populations of listed species from dust, erosion, or invasive species caused by activities on the AVMAs, AVMR, and AFPs are possible. Effects to the island night lizard and the California brown pelican would be similar to those described previously for Artillery Operations and would be less than significant. There is a potential for effects of noise or collisions with SCI loggerhead shrike as described above under Armor Operations. Effects of Amphibious Assault Operations on endangered, threatened, and other sensitive species would be less than significant with mitigation.

California brown pelican is expected to easily avoid the amphibious vehicles without being adversely affected.

Because the EFVs would embark from naval shipping approximately 25 nm (46 km) offshore, it is likely that there would be no viable seeds of invasive species on their undersurfaces including their tracks, limiting the potential for introducing invasive plant species. Marines would be mounted aboard the EFVs until dismounting near VC-3 to attack their objectives. This would minimize the potential to spread invasive species seed through foot traffic and would concentrate it near VC-3 where it would be easier to focus monitoring and control efforts.

No listed plant species are known to occur in the immediate vicinity of West Cove, the AVMAs or AVMR. However, the endangered San Clemente Island bush mallow occurs on sandy flats a short distance inland from the beach in Horse Beach Cove, where it and its habitat could be affected by maneuvering vehicles or ordnance from EFVs firing from the nearshore waters.

3.11.10.13 Assault Amphibian School Battalion Operations

This operation is part of Alternative 2 only and would take place about 15 times a year commencing when the EFV becomes available (about 2009). Each operation would involve 5-6 EFVs and 50 USMC students plus instructors. The EFVs would be dropped off by LCACs about 2 nm (4 km) from shore near West Cove or Horse Beach Cove. The operation involves maneuvering and practice firing of the turret mounted machine gun and cannon on land in SHOBA and into SHOBA from the nearshore waters. There would be 3-5 days of live-fire and firing could take place during day or night. There would be travel and maneuvering via the AVMC, including AVMAs and AMP D to VC-3 for parking or bivouac. Because this is not a tactical operation, the vehicles could be parked in an administrative manner with instructor supervision. Impacts of the EFVs would be similar to those described in Section 3.11.1.2.4.11 except that more vehicles would be involved, the operations would be longer and would take place more frequently (up to 15 times per year).

Vegetation and Wildlife. Impacts to vegetation or wildlife at West Cove and Horse Beach Cove would be temporary and less than significant. Effects of tracked vehicles on vegetation and soils in AVMAs and AMPs would be as described previously.

Endangered, Threatened, and Other Sensitive Species. Impacts on endangered, threatened, or other sensitive species would be less than significant with mitigation as described above.

3.11.10.14 NSW Land Demolition

This operation under Alternative 2 would increase from 354 to 674 operations per year compared to the No Action Alternative. Therefore, impacts on vegetation and wildlife and endangered, threatened, and other sensitive species would be identical to those discussed under the No Action Alternative and would be less than significant.

3.11.10.15 Underwater Demolition

This operation would increase from 72 to 85 operations per year compared to the No Action Alternative. Impacts on vegetation and wildlife and endangered, threatened, and other sensitive species however would be less than significant.

3.11.10.16 Underwater Mat Weave

This operation would increase from 14 to 18 operations per year compared to the No Action Alternative. However, impacts on vegetation and wildlife and endangered, threatened, and other sensitive species would be less than significant.

3.11.10.17 Marksmanship – Small Arms Training

This operation would increase from 171 to 205 operations per year compared to the No Action Alternative. However, impacts on vegetation and wildlife and endangered, threatened, and other sensitive species would be less than significant or mitigable to less than significant.

3.11.10.18 Land Navigation

This operation would increase from 99 to 118 operations per year compared to the No Action Alternative. However, impacts on vegetation and wildlife and endangered, threatened, and other sensitive species would be less than significant.

3.11.10.19 NSWG-1 Unmanned Aerial Vehicle Operations

This operation under Alternative 2 would increase from 15 to 27 operations for year compared to the No Action Alternative., Impacts on terrestrial biological resources from UAV training in Alternative 2 would be less than significant.

3.11.10.20 NSWG-1 SEAL Platoon Operations

Under Alternative 2 the overall number of operations per year would increase from 340 to 668 operations per year compared to No Action Alternative., these operations would take place in specially designated TARs described under Alternative 1. The increase would occur in all aspects of the operations. Impacts on vegetation and wildlife and endangered, threatened, and other sensitive species would remain either less than significant or less than significant with mitigation as described above for Alternative 1.

3.11.10.21 NSW Direct Action

This operation under Alternative 2 would increase from the baseline level of 156 to 190 operations per year, a 22 percent increase. Of the 190 NSW Direct Action operations under Alternative 2, about 28% would take place in TAR 20, 51% in TAR 21, and 21% in TAR 22. However, as for Alternative 1 the impacts would be less than significant with mitigation.

3.11.10.22 Bombing Exercises – Land

Under Alternative 2, the number of operations would increase from 176 to 216 operations per year. Few personnel would be on the ground. As discussed under the No Action Alternative, most of the bombs used in this exercise are inert, and those that are not are restricted to Impact Area IIA. Use of live bombs in Impact Area II would be increased compared to the baseline and Alternative 1. The added ordnance may incrementally increase the risk of fire, but the probability of the fire affecting sensitive habitats is low because they are aimed at Impact Area IIA, which has limited vegetation and is separated from sensitive habitat areas by a fuelbreak.

Vegetation and Wildlife. Impacts are assumed to be similar to, but slightly greater, than those discussed above under the No Action Alternative and Alternative 1. However, impacts would remain less than significant.

Endangered, Threatened, and Other Sensitive Species. Impacts to endangered and threatened species would remain less than significant as described under the No Action Alternative. Implementation of fire prevention, management, and suppression measures included in the San Clemente Island Wildland Fire Management Plan (DoN 2005) and Integrated Natural Resources Management Plan (INRMP) (DoN 2002) would further reduce the risk of fires spreading into endangered species habitat as discussed previously.

3.11.10.23 Combat Search and Rescue

This operation would increase to 8 operations per year under Alternative 2. Impacts on vegetation and wildlife and endangered, threatened, and other sensitive species would be as described above for the No Action Alternative and would be less than significant with mitigation.

3.11.10.24 Explosive Ordnance Disposal

This operation under Alternative 2 would increase from 4 to 10 operations per year compared to the No Action Alternative; however, the impacts would remain less than significant as discussed under the No Action Alternative.

3.11.10.25 NALF Airfield Operations

Under Alternative 2, NALF airfield operations would increase by 9 percent over the No Action Alternative to 27,400. Impacts would be less than significant.

3.11.10.26 Missile Flight Tests

Under Alternative 2, the number of missiles tested would increase to 20 per year. Impacts would be as described above, and impacts to vegetation and wildlife and endangered, threatened, and sensitive species would be less than significant with mitigation. Implementation of the SCI Wildland Fire Management Plan (DoN 2005) would reduce the potential for fire to spread and affect sensitive resources.

3.11.11 Summary of Potential Effects by Resource

Many of the more than 40 operations evaluated above would occur in the same geographical locations on SCI, and some would take place simultaneously at different locations. This section takes a resource-by-resource approach and addresses the overall effects on vegetation and wildlife habitat, state and federally listed rare, threatened, or endangered plant and wildlife species, and other sensitive plant species (focusing on plants considered by the California Native Plant Society as Rare and Endangered in California and Elsewhere). The analysis in this section focuses on resources and operations areas so that the effects of different operations happening at the same place are taken into account. Because of the large amount of quantitative information referenced in this chapter, standard units are used without metric equivalents in order to facilitate presentation.

For the federally listed endangered and threatened plants and wildlife discussed in this analysis, the Navy is preparing a separate Biological Assessment addressing effects of no action and proposed action on SCI and will consult with USFWS in compliance with Section 7 of the Endangered Species Act.

3.11.12 Vegetation and Habitat

Plant Communities

Table D-1 (Appendix D) summarizes the amount of vegetation and habitat present within operations areas on SCI and discusses the potential effects of the combined operations in each operations area on vegetation and habitat. The habitat classification system is that developed by Sward and Cohen (1980) based on 1977 aerial photography and described under Plant Community Types in section 3.11.1.1 of this EIS/OEIS.

Fire. Fire would affect different vegetation types in different ways as described in Section 3.11.2.2.1 (above) and Table D-1 (Appendix D). In general, grasslands and other types dominated by non-woody vegetation can regenerate after fire more quickly and can tolerate more frequent fires than can vegetation dominated by woody species (shrubs and trees), which take longer to regenerate and require longer periods between fires to rebuild seed reserves or reserves in underground parts enabling the plants to resprout after burning. With an insufficient time interval between fires, woody vegetation is subject to conversion to a type dominated by shorter lived species such as introduced grasses or weeds (a process known as "type conversion").

Ordnance Use and Noise. Ordnance use effects on vegetation are described in Table D-1 (Appendix D). Large caliber ordnance can locally eliminate vegetation and disturb soils at the point of impact. Typically the areas exposed to impact from heavy ordnance have a long history of ordnance impact and support a low density of vegetation. The vegetation present would sustain minor effects from additional ordnance impacts. Within the impact areas, ordnance hits become less frequent at greater distance from frequently used targets and is less disturbed as a result.

Foot and Vehicle Traffic. General effects of foot and vehicle traffic on vegetation and habitat are discussed in Section 3.11.2.2.5 and for specific operations areas in Table D-1 (Appendix D).

Foot traffic has a moderate potential for localized physical disturbance of the vegetation and soils where traffic is frequent and concentrated. Occasional foot traffic can cause locally adverse effects under certain circumstances such as on sloping surfaces and when soils are wet. Occasional foot traffic spread over a large area (as in Battalion Landings) has a low potential for significant direct effects on vegetation because of the infrequency and dispersed nature of the traffic but has the potential to introduce or spread invasive plant species, a potentially significant indirect impact (see Table D-1 (Appendix D)).

Maneuvering of heavy wheeled and tracked vehicles, including tanks, and digging in of recoil spades on howitzers in AFPs and AMPs is expected to cause a reduction in vegetation cover in general, a reduction in native shrub cover and biomass, replacement of native shrubs with non-native grasses and weeds, and to maintain the vegetation and soils on site in disturbed, compacted condition, subject to wind and water erosion and establishment of invasive plant species.

Wetlands, Vernal Pools, and Other Aquatic Habitat

Three types of wetlands or waters of the United States have been identified on SCI as described in Section 3.11.1.1.2. These are vernal pools, which form in depressions created for the most part by artillery impacts or other military training activities, small salt marshes, and intermittent stream channels. Some vernal pools and ponds were evidently created as temporary water catchments by ranchers developing berms across shallow intermittent drainages.

Fire. Wetland vegetation is unlikely to sustain hot fires, nevertheless, vegetation of vernal pools and salt marshes on SCI is capable of burning or being singed, particularly if the fire is ignited in the dry season. In vernal pools most of the dominant species will resprout from underground roots or rhizomes or regenerate from seed if their tops are burned. The same is true for some salt marsh species, such as salt grass. Succulent species such as pickleweed are unlikely to burn because of their high water content.

Ordnance Use and Noise. Depressions created by ordnance, including bombs, skipped rounds or off-target rounds, often retain rainwater and surface runoff temporarily and may eventually be colonized by wetland species. Such depressions can develop into wetland if the combination of soils and topography allow water to be retained for a sufficiently long period each year to support wetland plant species and cause development of wetland soil characteristics. Many of the vernal pools identified on SCI have probably resulted from this type of disturbance (e.g., numerous tiny vernal pools in a portion of the VC-3 AVMA and overlapping TAR 15 formerly used as a bombing range). Ordnance hits in existing wetlands would displace soil and vegetation and may create a deeper depression, affecting water retention and vegetation development. Most of the wetlands identified on SCI are outside the impact areas and would be expected to be affected by ordnance rarely, if ever. Closer to target areas there is probably a balance between wetlands developing in depressions formed by ordnance impact and wetlands being disturbed by ordnance impact. The salt marsh plant communities in Impact Area I (and overlapping TARs 20 and 21) appear to be infrequently influenced by tidal activity and have limited wildlife value. Only a small portion of these habitats demonstrates hydrophytic vegetation, wetland hydrology, and hydric soils and is delineated as wetland. The salt marsh vegetation in TAR 20 is occasionally impacted by artillery and the salt marsh vegetation at both sites shows localized effects of fire.

Foot and Vehicle Traffic. Numerous small vernal pools exist in the IOA (Figure 3.11-3), with a limited number also present in the VC-3 AVMA, overlying TAR-15, and AFP-6. On SCI, these features are mostly a result of human activity and lack endemic species. Occasional dispersed foot traffic would have insignificant impacts on the vernal pools but may spread species of plants and invertebrates from pool to pool. Vehicle traffic within components of the AVMC such as AFP-6 could have adverse effects on vegetation and water quality of the vernal pool wetlands (which are very small, ranging in size up to about 0.01 acres (495 ft^2)) degrading them by crushing or uprooting plants and increasing turbidity of the water. Based on observations elsewhere, including tank ranges at Camp Pendleton, tracked and wheeled vehicle maneuvering has the potential to compact soils and to create depressions that can hold water (especially in soils having a moderate to high clay content). Such depressions can develop into wetlands if they stay wet for a sufficiently long period during most years. Tracked and wheeled vehicles have the potential to spread invasive species, an adverse impact, and also to introduce and spread dormant stages of invertebrates such as cysts of the endangered San Diego fairy shrimp (*Branchinecta sandiegoensis*), which exists at Camp Pendleton but not at SCI (Bitterroot Restoration 2002).

Vehicle traffic through intermittent drainages (on portions of the AVMC, including AVMAs, AMPs, and AFPs), which may include Jurisdictional Waters of the United States, would impact vegetation and displace soils, thereby increasing erosion and sedimentation and creating opportunities for invasive species establishment. The Navy will review impacts to jurisdictional waters of the US under Section 404 of the Clean Water Act and work with the Army Corps of Engineers on permitting requirements as appropriate.

3.11.13 San Clemente Island Indian Paintbrush

San Clemente Island Indian paintbrush is locally abundant in the western part of Impact Area I (in Horse Beach Canyon) and overlapping TAR 21. It is also present at the edges of Impact Area II. Most occurrences of Indian paintbrush are around the coastal areas of the southern two-thirds of the island. Direct impacts to SCI Indian paintbrush include possible mortality or damage to individual plants from ordnance or foot traffic. Indirect impacts could come from fire, including fire-mediated changes in habitat and from invasive species. Appendix Table D-2 summarizes the amount of San Clemente Island Indian paintbrush within operations areas on SCI and discusses the potential effects on the species.

Access. Many of occurrences of this species are in SHOBA Impact Areas I and II (15.5% of the SCI total are in Impact Area I; 0.9% are in Impact Area I), where future direct monitoring of the condition of the habitat or the recovery status of the individuals and occurrences within these impact areas and the overlying TARs 20, 21, and 22 would be precluded, as discussed in Section 3.11.2.2.2.

Fire. Fire could result in mortality to individual plants and to its seed bank. Because it may rely on connections to a host plant, repeated fires could affect this species by affecting the re-establishment of its host plants. Anecdotal evidence suggests that fire may help promote this species, which exhibits fire stimulated seedling establishment. A monitored population in Pyramid Cove peaked in 1984 after a 1983 fire and subsequently declined for several years. Too frequent fires, however, may inhibit its recovery and result in habitat type conversion. The effects on this species from disturbance would be difficult to assess given the observed wide variation in population numbers and trend on monitored sites where no apparent interference occurred (DoN 2002). However, overall, the numbers of San Clemente Island Indian paintbrush have increased following removal of feral goats from the island.

Implementation of the SCI Fire Management Plan (DoN 2005) would be expected to ultimately result in smaller fires that burn more frequently than at present, which can be expected to favor this species and other short-lived native perennial species.

Ordnance Use and Noise. Populations within SHOBA Impact Areas I and II could be impacted from firing exercises and from wildfire potentially ignited by ordnance. The potential for such impacts to listed plant species is greatest in Horse Beach Canyon where San Clemente Island Indian paintbrush are located within approximately 0.5 mile (0.8 km) from its mouth. The potential for direct ordnance impact to these occurrences is low due to distance of these populations from artillery targets and from the beach and by topographic shielding.

Foot and Vehicle Traffic. San Clemente Island Indian paintbrush has recently been discovered in two locations where they could be adversely affected by authorized off road vehicle maneuvering. These are located in the NALF AVMA and AFP-1. At the NALF AVMA location, six paintbrush individuals were found in a cluster with 3 other sensitive species, including southern Island tree mallow, SCI silvery hosackia (state-listed as endangered), and SCI milkvetch a (discussed in Table D-10). The NALF AVMA location is a short distance inland of the egress from TAR 5. At this location, surface disturbance of the AVMA by tracked vehicles in Alternatives 1 and 2 could lead to damage to or elimination of these plants from this area. Protection of the localized area containing the paintbrush can be addressed through development of the erosion control plan (AVMC-M-3), briefing of maneuver area boundaries prior to conducting operations in these areas (AVMC-M-4), and continuing to use the existing route for ingress and egress from the beach at West Cove (AVMC-M-9), as appropriate. Tracked vehicle use in this AVMA is also likely to spread an infestation of veldt grass (*Ehrharta calycina*) within the AVMA, where it could adversely affect these sensitive species, and southward on the Island if the current aggressive treatment of veldt grass is not effective. At AFP-1, an occurrence with 26 individuals was located near the center of the AFP. At this location, depending on the specifics of the site, protection of the localized area containing the paintbrush could potentially be addressed through development of the erosion control plan (AVMC-M-3) and/or briefing of maneuver area boundaries prior to conducting operations in these areas (AVMC-M-4).

Foot traffic could affect plants in TAR 21 and in the IOA. Foot traffic would have minor and temporary direct effects on individual plants. Repeated foot traffic could have localized direct and indirect effects on populations in areas subjected to heavy foot traffic (e.g., portions of TAR 21). Although paintbrush is present there it is not known to occur in areas where use would be concentrated.

In addition to the potential direct effects from foot traffic and vehicles, this species could be indirectly affected by establishment or spread of invasive species that may be introduced or spread through off-road foot and vehicle traffic (see also 3.11.2.2.5). Invasive species could affect SCI Indian paintbrush through competition, effects on host plants, or effects on fire frequency.

3.11.14 San Clemente Island Larkspur

SCI Larkspur is prevalent on the east side of the Island with numerous occurrences outside the TARs 14 and 15 and additional occurrences within the IOA. The species is not known from within Impact Areas I or II. Key potential effects are from fire, invasive species and foot traffic. Appendix Table D-3 summarizes the amount of San Clemente Island larkspur within operations areas on SCI and discusses the potential effects on the species.

Fire. This is a perennial herb that resprouts during favorable seasons from a storage root. These plants are normally dormant when a fire passes through, so are not directly affected by fire, but benefit from nutrient flush, canopy opening, and other aspects of altered competitive status (FMP BA DoN 2006). As identified in Table D-3 (Appendix D), less than significant effects on this species are expected from fire and the potential for adverse effect is reduced by implementation of the SCI Fire Management Plan (DoN 2005).

Ordnance Use and Noise. Several populations of San Clemente Island larkspur are located northeast of TAR 15 and four of the occurrences for the species are located on or very near the boundary to TAR 15. At TAR 15 there would be 30 operations per year, with live-fire and demolitions. Activities would include insertion and extraction, SEAL team land raids, airfield takedown and direct action, and UAV training and testing. The likelihood of direct ordnance impacts from activities at TAR 15 is remote because of the down slope occurrences of the plants from the TAR which is located on the plateau. There are no known extant populations of this species within SHOBA where they could be exposed to artillery.

Foot and Vehicle Traffic. A majority of occurrences of this species are located outside any areas subject to training activities. However, some historic populations are located within the boundaries of the IOA and at the northeastern edge of TAR 15 where they could be affected by foot traffic, invasive species, and dust or erosion that could originate from authorized maneuvers. Trampling effects on individual plants would be adverse, but temporary, and the affected plants would be expected to recover, even if individual stems are broken. Trampling effects on the habitat would also be expected to be minimal and dispersed over the terrain. Spread of invasive species from inadvertent introductions caused by vehicular or foot traffic could adversely affect this species given its proximity to TAR 15 (VC-3) and the IOA. The potential for impact from foot traffic is as described above in Section 3.11.2.2.5).

3.11.15 San Clemente Island Woodland Star

This species is known from canyon bottoms on the steep mainland-facing eastern escarpment in SHOBA (Junak and Wilken 1998; Junak 2005). The east side canyons have shown dramatic recovery since goats were removed (USFWS 1997c). There are no operations proposed for areas where this species is known to occur, therefore, no operations-related direct risks to the existing sites. For this reason it was not included in the quantitative analysis.

Fire. Populations of San Clemente Island woodland star is are located near the bottoms of deep canyons at the base of steep slopes along the eastern escarpment. These are relatively remote from likely sources of ignition. Moreover, it is unlikely that fire would burn during its season of growth when it would be most vulnerable to damage. The rest of the year it exists as a dormant underground organ that has the potential to survive fire (personal communication, Junak 2005; FMP BA DoN 2006).

Ordnance Use and Noise. No ordnance use or other focused training activities would occur within the areas that support occurrences of the San Clemente Island woodland star. There habitats are topographically protected from any ordnance use elsewhere in SHOBA.

Foot and Vehicle Traffic. Known populations of this species are in steep terrain that would be seldom if ever traversed by personnel in vehicles or on foot engaged in operations addressed in this BA therefore the potential for direct effects to known populations is very low. Indirect effects of foot and vehicle traffic, especially introduction of invasive plant species could affect the San Clemente Island woodland star as described above under San Clemente Island Indian paintbrush (Section 3.11.1.3.2).

3.11.16 San Clemente Island Broom

The San Clemente Island broom, also known as Trask's island lotus, is expanding in range since the removal of exotic herbivores. It is found currently in habitats that range from prickly pear patches to rocky grassland. It readily occupies disturbed areas and some occurrences are close to buildings, roads, and pipelines (DoN 2002), for example in Wilson Cove. Populations are found along the length of the island on both the eastern and western shores. There are occurrences within TAR 11 and additional ones in the vicinity. Fourteen occurrences are known from the IOA.The species is not known from within Impact Areas I or II. Appendix Table D-4 summarizes the amount of San Clemente Island broom within operations areas on SCI and discusses the potential effects on the species.

Fire. The Proposed Action could affect this species if fire, associated with operations, is allowed to burn SCI broom populations. The response to fire in is not well known but Burned plants of this short-lived subshrub are generally killed outright by fire but seedling establishment is fire-stimulated and the species also establishes after minor disturbances as do other members of this genus such as deerweed (*Lotus scoparius*). In the absence of fire or minor disturbance this species gradually declines.

At TAR 11 and in nearby areas, this species is relatively abundant as indicated in Appendix Table D-4, the site would experience approximately 20 operations per year involving mainly foot traffic in off-road areas. Although no live-fire or demolitions would occur, there is the potential for activities on the TAR, which include the use of helicopter operations, smoke generators, flares, pyrotechnics and all types of blanks, to start a fire. Implementation of conditions of the SCI Wildland Fire Management Plan (DoN 2005), including standby fire fighting equipment and wildland fire qualified crew under conditions of moderate or higher fire danger would minimize the potential for fire to spread into this population or into nearby populations offsite.

Ordnance Use and Noise. This species is located away from areas where it might be affected by ordnance use. There is no live-fire at TAR 11.

Foot and Vehicle Traffic. Direct vehicular impacts on this species are not expected. Foot traffic associated with training activities has the potential to directly damage individuals of this species in TAR 11 and in the IOA. In addition, this species could be indirectly affected by competition from or ecosystem changes caused by invasive plant species that may be introduced through off-road foot and vehicle traffic. Several populations of the San Clemente Island broom occur in the uplands near Wilson Cove where landings would occur and inadvertent introductions of invasive species could result.

3.11.17 San Clemente Island Bush Mallow

The bush mallow is most prevalent in the western part of Impact Area I in Horse Beach Canyon, where sixty eight percent of SCI occurrences have been documented, and at the edges of Impact Area II. Although recent surveys have documented several occurrences on the west side of the Island north of SHOBA, seventy percent of the total documented SCI occurrences of this species are in Impact Areas I and II. Appendix Table D-5 summarizes the amount of San Clemente Island bush mallow within operations areas on SCI and discusses the potential effects of operations on the species.

Access. Most of occurrences of this species are in SHOBA Impact Areas I and II (67.5% of the SCI total are in Impact Area I; 2.5% are in Impact Area I), where future direct monitoring of the condition of the habitat or the recovery status of the individuals and occurrences within these impact areas and the overlying TARs 20, 21, and 22 would be precluded, as discussed in Section 3.11.2.2.2.

Fire. Fire would impact the San Clemente Island bush mallow in a manner similar to San Clemente Island Indian paintbrush. Populations in the fire support area (e.g., Impact Area I) are scarred by fire but persist despite frequent burns (DoN 2002). The plant may naturally occur in recently disturbed (early-successional) situations and regenerates vigorously by sprouting after fire, as do other members of the genus. Junak (personal communication 2005) indicates that this plant is probably favored by fire. It spreads in recently burned areas and declines in areas overgrown by competing vegetation in the absence of fire.

Ordnance Use and Noise. The potential for effects to this listed species is greatest in Horse Beach Canyon, where San Clemente Island bush mallow occurrences extend up canyon beginning a short distance inland from the canyon mouth. Similar to San Clemente Indian paintbrush, the potential for direct ordnance impact from NSW activities on these occurrences is low due to distance of most of the occurrences from the beach and due to topographic shielding. Since less than 6 percent of the heavy ordnance incoming to SHOBA from naval artillery is directed at Impact Area I and no naval artillery targets are near Horse Beach Canyon the potential for direct ordnance impacts from naval artillery is low. However, accidental fire could adversely affect this species and its habitats if they occurred at brief return intervals (less than 5-10 years), as discussed in the Wildland Fire Management Plan BA (DoN 2005). Occasional fires (at intervals greater than 5-10 years) would be expected to have a renewing effect on this species. As described in Table D-5, fire ignited in TAR 21 is unlikely to spread up Horse Beach Canyon because it would be opposite the direction of down canyon winds that normally when fire danger is high.

Foot and Vehicle Traffic. The movements of platoon-sized groups (approximately 14 persons on foot) inland to a target in TAR 21 could trample individual plants. The species does not occur near roads and has not been documented in the Infantry Operations Area, so impacts from foot or vehicle traffic outside of TAR 21 are not expected. This species would be susceptible to competition or ecological change caused by invasive species as described above and its location in Horse Beach Canyon near Horse Beach Cove, where many landings would take place, may expose it to an elevated chance of being affected by invasive species.

3.11.18 Santa Cruz Island Rock Cress

Santa Cruz Island rock cress does not occur within operations areas on SCI and would not be directly affected by project activities. On SCI the distribution of this species is limited to the vicinity of Pyramid Head and OP-1 in SHOBA (Junak and Wilken 1998). One occurrence is located about 234 ft (70 m) east of AFP-1 outside the IOA boundary. Two occurrences are within about 125 ft (40 m) of the turn-around at the end of San Clemente Ridge Road near Pyramid Head. The species is not known from within Impact Areas I or II.

Fire. The Proposed Action and Alternative 1 could affect this species if fire management activities allowed fires to burn areas that support occurrences of this species. Its habitat of open ridge tops and rocky areas with little vegetation to carry fire is relatively fireproof, except in years when there is abundant grass cover to carry fire. An annual plant, it flowers and sets seed very early in the year, making it less likely to burn. However, seeds on the ground surface might be vulnerable to a grass fire. Its response to fire is not generally known, however, its recovery since a previous fire indicated the potential to tolerate at least some exposure to fire. Tolerable fire frequency is not known. However, implementation of the SCI Wildland Fire Management Plan (DoN 2005), as previously described, would limit the possibility of repeated fires at short intervals, until specific management recommendations with regard to fire can be made for this species.

Ordnance Use and Noise. All known occurrences of the Santa Cruz Island rock cress on SCI are found on sparsely vegetated ridge tops and saddles within SHOBA well outside the Impact Areas and are not vulnerable to habitat degradation or direct impacts from ordnance.

Foot and Vehicle Traffic. The habitat of the Santa Cruz Island rock cress is outside the IOA boundary but could be subject to occasional foot traffic. Because of its proximity to the Ridge Road, the IOA and AFP-1, there is some potential for this species to be affected by invasive species introduced or spread by foot and vehicle traffic within the operations areas. Mediterranean grass

(*Schismus arabicus*), an invasive non-native annual grass, has established and is starting to spread in the SHOBA area and has been documented at or very near AFP-1 (Junak 2003); This species, which has spread rapidly through the California deserts, is tolerant of arid habitats and could eventually carry fire into the habitat of the rock cress (Junak, personal communication 2005) if it were to spread into that habitat.

The Infantry Operations Area is not designated as part of the No Action Alternative, however artillery maneuvering and firing activity at AFP-1 is part of the No Action Alternative. Impacts of No Action are less than significant. Impacts of Alternative 1 and Alternative 2 would be less than significant with mitigation and completion and implementation of the SCI Wildland Fire Management Plan. Applicable Mitigation Measures include G-M-1, G-M-3, G-M-4, G-M-5, AVMC-M-1, AVMC-M-2, AVMC-M-3, AVMC-M-4, AVMC-M-5, AVMC-M-6, AVMC-M-7, and RC-M-1.

3.11.19 Island Night Lizard

All vegetation communities on SCI, with the exception of unstabilized dunes and canyon shrubland/woodland habitats, harbor island night lizard in varying densities (Mautz 2001). However, the highest densities are found associated with 4 habitat types as depicted in Figure 3.11-11. An estimated 20 million island night lizards inhabit SCI. The highest densities of lizards are found within *Lycium* phase maritime succulent scrub where few of the proposed operations would occur.

Potential effects to this species island wide from the Proposed Action include mortality or damage to habitat from fire, ordnance use, foot travel and vehicular travel. Appendix Table D-6 summarizes the occurrence of island night lizard within operations areas on SCI and discusses the potential effects on the species.

Fire. Island night lizards persist in large numbers in burned areas on SCI, including SHOBA, despite recurring fires. Unpublished studies by the Navy at one locale (summarized in a petition to delist the INL, DoN 2004b) indicate that repeated fires had no long-term effects on the island night lizard population within the burned area. Many individual island night lizards, as well as a variety of other species including land snails and arthropods, were observed to survive fire unharmed under loose rocks and stones as well as in crevices. Similarly, Cunningham et al. (2002) reported minimal long-term effects on populations of other lizard species following a catastrophic wildfire in Arizona. Because island night lizards are common and widely distributed on SCI, burned areas would become repopulated from surviving individuals and adjacent unburned areas once the vegetation and prey populations begin to recover, except that permanent alteration of habitat as a result of too frequent fires within impact areas may result in locally reduced island night lizard populations. Portions of SHOBA that have been repeatedly bombed and burned and are littered with debris from bombs and targets from a long history of military bombardment, support an observed abundance of island night lizards, including many found under ordnance debris.

Implementation of the Fire Management Plan (DoN 2005) is expected to create conditions conducive to long term stability of the island night lizard populations.

Ordnance Use and Noise. Firing exercises in SHOBA, small arms fire at targets, demolition explosions and other forms of ordnance use have the potential to injure or kill individual island night lizards. The frequency of this is likely to be low because of the propensity of this species to be in crevices and under rocks even when active. Ordnance use would contribute incrementally to habitat degradation within heavily used target areas; however the effect of this would be limited given the long history of similar uses where heavy ordnance would be used. The effects of exposure of island night lizards to noise from ordnance and other sources are not known but are not expected to be substantial given the persistence of island night lizards in the areas having a history of bombardment, noise, and habitat alteration.

Foot and Vehicle Traffic. Activity of personnel and vehicles in the tracked vehicle maneuver areas and near or in TARs may injure or kill individuals under inadequate cover. The tendency for this species to confine its activities to dense vegetation and rocks would help limit its exposure to some of these adverse effects. Vehicles operating in the AVMAs would alter vegetation that serves as cover for island night lizards. This would be a long-term impact on habitat in portions of the AVMC that currently support woody species such as boxthorn (e.g., Old Rifle Range AVMA). With the brief duration of noise and disturbance as vehicles and personnel are transiting an area, it is expected that island night lizards would rapidly resume normal behavioral activities. All off-road vehicle traffic would be confined to the AVMC (including AVMR, AVMAs, AMPs, and AFPs), which generally support low densities of the island night lizard. As a result, adverse impacts to the island night lizard would be limited.

Movement of personnel through INL habitat on foot has some potential to injure individual lizards; however this would not have an observable effect on the local population. Foot traffic would not be expected to adversely affect habitat except in localized areas where activities are concentrated and frequent.

Effects to listed species from off road travel are limited by the Navy's strict limitations of off road travel by rubber-tired and tracked vehicles. Off road vehicle travel is confined to authorized areas including the components of the proposed AVMC; these areas contain limited habitat for the island night lizard.

3.11.20 San Clemente Loggerhead Shrike

A number of activities in SHOBA, and island-wide, have the potential to adversely affect the San Clemente loggerhead shrike. Potential effects to this species include mortality and disturbance from fire, ordnance, disturbance from noise and from the activity of personnel and vehicles, and damage to habitat. Potential effects from fire, ordnance use and off-road foot and vehicle traffic have been addressed above under specific operations in this document. Appendix Table D-7 summarizes the occurrence of San Clemente loggerhead shrike within operations areas on SCI and discusses the potential effects of operations on the species.

Fire. Due to the large number of actions with the potential to start fires (e.g., artillery fire, tracer rounds, flares, explosives, small arms fire, motorized vehicles), the Proposed Action has the potential to result in direct injury or mortality to the loggerhead shrike and alteration of its habitat. As shown in Table 3.11-4, an increasing proportion of the shrike population is nesting outside of SHOBA (>67 percent in 2005, 2006, 2007), making the species increasingly less vulnerable to fire originating from ordnance use in SHOBA. Moreover, most nest sites within SHOBA are now outside firebreaks developed within the impact areas. Since 1997 there has been a dramatic increase in the number of shrikes in the wild (Table 3.11-4). Although the loss of an individual shrike would still represent an adverse effect, the significance of the effect diminishes as population growth and occupation of additional habitat continues. The number of unaffected shrikes and area of occupied habitat would potentially be greater, and therefore, the shrike would be better able to recover from the short-term effects of fire, provided an adequate amount of nesting habitat remained. Implementation of the Fire Management Plan (DoN 2005) in conjunction with continued implementation of the INRMP (DoN 2002) is expected foster conditions conducive to the continued recovery of the shrike.

A fire entering San Clemente loggerhead shrike habitat would cause temporary alteration of habitat and, if it occurred during the nesting season, could cause nest abandonment and possible loss of eggs or young. Although loss of trees and large shrubs can have a long-term negative impact for species such as shrikes that require them for foraging perches, cover, and nesting, there is no evidence or data for the actual burning of nesting habitat. Although these habitat components are in short supply on the island (the island woodland vegetation mapping unit comprises about 2 percent of the area on SCI), all documented fires that have approached nesting substrates have not actually burned the nesting substrates to our knowledge. This is because shrike nests are most commonly located deep in canyons in habitat that fire tends to skip over. Past fires have rarely approached active nests (USFWS 1997a). Fire impacts on shrike habitat have been in foraging areas primarily. The SCI Wildland Fire Management Plan has numerous provisions that add protection to shrike nesting habitat.

It is conceivable that repeated fires could alter the plant community such that shrike territories overall become less desirable for shrike use (Smith 2000). Although fire is known to reinvigorate vegetative growth (Carroll et al. 1993), repeated burning of the same area within a short period of time (1-2 years), could overwhelm the abilities of some native plant species, including species known to be inhabited by nesting shrikes, to recover from fire. Repeated fire after such a brief interval, which could be facilitated by operations-related ignition sources and abundant annual grasses, could lead to habitat type conversion (SCI Fire Management Plan BA DoN 2006) with long-term effects on shrikes. The SCI Fire Plan recognizes the potential problem of type conversion and avoiding circumstances that lead to type conversion is one of the key underpinnings of the plan.

Removal of heavy grass cover by fire opens habitat and improves foraging conditions for San Clemente loggerhead shrike and other predators that rely on sight to locate their ground-dwelling prey. Although concern has been expressed that such improvement would be very short term (i.e., the “barbecue effect”), Martin (Biologist, Institute of Wildlife Studies, pers. comm., 1999) observed nesting shrikes moving to a new area to forage shortly after it had burned. The shrikes continued to use the burned area through the remainder of the breeding season. From the standpoint of foraging shrikes, a mosaic of different aged burns in relatively small patches would probably be optimal, providing for a healthy and accessible prey base.

In summary, while periodic fires are believed to have been a natural occurrence on SCI and have ecological benefits, fires burning too frequently can have long-term deleterious effects on shrikes by reducing vegetation and viable habitat. One of the focal points of the Fire Management Plan (DoN 2005) is to avoid conditions that could lead to type conversion such as repeated fires with an interval between them too short to allow regeneration of woody plants.

Measures to prevent and reduce adverse effects, particularly from fire, are currently being implemented by the Navy. These measures include but are not limited to development and implementation of the Wildland Fire Management Plan as described in Section 3.11.1.3.1; including a review of the placement of firebreaks; maintenance of fuelbreaks, creation of a tiered system of increasing prevention measures and increasing on site and quick response fire fighting capabilities related to increasing fire danger (using an agreed-upon fire danger rating system), maintenance of an on-island firefighting helicopter on standby; post-exercise surveillance to detect incipient fires; and stepwise operational restrictions for SHOBA under increasingly high fire danger ratings. The Navy will continue to implement a number of the fire suppression activities, as detailed in the Re-initiation of Consultation on Naval Training Activities that Cause Fires on San Clemente Island, Los Angeles County, California (USFWS 2002), and subsequent agreements between the Navy and USFWS. However, the Navy plans to consult with Fish and Wildlife Service regarding implementation of the Fire Management Plan, which is designed to provide more comprehensive protection for resources while allowing greater operational flexibility and straightforward implementation. The Navy maintains effective fuelbreaks around Impact Areas I and II including a redesigned fuel break across China Canyon that promises to be more protective of shrikes and the Navy will assess, in coordination with USFWS, the utility of fuelbreaks in the vicinity of the training area at Horse Beach Canyon, in addition to continuing other fire management policies and practices described above and species monitoring and conservation activities.

Ordnance Use and Noise. Potential effects to shrikes from ordnance use include exposure to noise, a small chance of injury or mortality from direct hits, and the various potential effects from fire as discussed in the preceding section. Although loss or injury to an individual shrike would be an adverse effect and could represent a significant threat to a small population, if the success of the shrike recovery program continues, such a loss would likely impact a decreasing proportion of the overall population. A variety of types and sizes of ordnance is used on SCI. The risks to loggerhead shrikes associated with ordnance use are related to the distance of shrikes from the origin of live-fire and demolition, the types of explosives used and the seasonality, and frequency and duration of ordnance use.

The highest exposure of loggerhead shrikes to ordnance use is near the Impact Areas within SHOBA, particularly Impact Area II, where about 94 percent of heavy ordnance is used. SHOBA has a long history of naval bombardment in Impact Areas I and II. Compared to baseline, heavy ordnance use in SHOBA would stay the same or increase slightly for FIREX and EFEX. Use of live and inert munitions would increase for CAS, but the use of live bombs would be confined to Impact Area IIA, which is highly disturbed and farther removed from nesting shrikes than many of the naval artillery targets. Given the existing disturbed nature of the impact areas in SHOBA, a more than nominal increase in the level of impacts on vegetation and wildlife from direct hits is improbable.

Section 3.11.2.2.4 (above) discusses effects on shrikes of noise from naval artillery under FIREX; from land based artillery firing and tank firing under I MEF Battalion Landing; from aircraft overflight under CAS; and from tracked vehicle traffic under AAV and EFV operations.

Loggerhead shrikes may temporarily react to noise by becoming alert, sometimes by taking flight, and possibly by altering their foraging behavior, or they may not exhibit any reaction at all. Loggerhead shrikes, if flushed, are expected to fly low to the ground and between shrubs. This species is also likely to seek refuge upon experiencing disturbance by nearby low flying helicopters or those conducting specific operations nearby that involve hovering near the ground. Short-term disturbances are expected to have discountable effects. However, if the action occurs in the vicinity of nesting shrikes and is of extended duration, disturbance could cause adults to move off nests possibly alerting predators to their presence. Disturbances during temperature extremes, windy conditions, or for long periods could cause nest abandonment, reduced viability, or loss of eggs due to exposure, and chick mortality. Disturbances that cause nesting birds to flush during nighttime hours may expose nests to predation by nocturnal or crepuscular predators such as feral cat, rats, and island fox.

In a strict sense all of these things have some potential to harm shrikes by affecting their communication or behavior. However, shrikes have shown a remarkable ability to coexist with this environmental noise and successfully reproduce, so that it is unclear that the noise would have adverse effects on shrike recovery. During the lowest population levels of shrikes on record, the majority of the remaining active nests were in SHOBA near Impact Areas I and II.

Operations such as FIREX (80 5-inch/54 or 5-inch/62 rounds per day), EFEX (106 rounds over a 3-day period) and the Battalion Landing (200 rounds over 4 days) could place loggerhead shrikes under some degree of stress during the operation. These large rounds would be combined with other medium and small arms rounds, coming from various directions (for example, the Battalion Landing also includes 100 155mm artillery rounds, 147 81mm mortar shells, and over 100,000 rounds of small arms fire). This would have the effect of increasing the overall background levels of noise but would not increase peak noise levels. Because operations involving ordnance use in SHOBA happen routinely, species not in the immediate vicinity of target areas would be expected to acclimate to the noise and show little or no behavioral response to it because there would be no association between noise and other adverse effects (VanderWerf et al. 2000).

Foot and Vehicle Traffic. Potential effects from foot and vehicle traffic include disturbance, injury, or mortality to individuals and a remote chance of damage to nest sites or possible nest abandonment. There is also the potential that invasive species introduced or spread by foot or vehicle traffic could degrade the habitat of shrikes, for example by altering prey availability leading to reduced productivity, or by changing fire frequency, or where fire burns.

Operations that involve off-road foot travel may encounter nesting or foraging shrikes. Although foot travel is authorized throughout most of the island, there are no operations that direct foot travel toward canyon sites where shrikes nest. Recent establishment of shrike nests on the plateau (South of TAR 16 near Lemon Tank and Tota) has the potential to bring these nests in proximity to foot traffic associated with the Battalion Landing (Alternatives I and II) as discussed below. These sites have been relatively near the AVMC and AVMR, where they would be exposed to noise from vehicles using those routes as described in Section 4.9.3.2 under Battalion Landing. In addition, there have been 2 documented deaths of juvenile shrikes near the Ridge Road, apparently caused by being struck by vehicles. Because most foot travel does not occur in the canyons and areas where shrikes are known to nest, operations that involve off road foot travel are unlikely to encounter nesting or foraging shrikes. Although small (platoon-sized) groups can patrol on foot in a wide variety of locations on the Island, most of their activity would be within TARs or between TARs and not in southern canyons where shrikes have nested in recent years.

All off road foot traffic involving larger groups of personnel is expected to be confined to the IOA. Since 2001, individual shrike pairs have adopted habitats on the plateau south of TAR 16 for nesting using low shrubs such as coyote brush (*Baccharis pilularis*) for the nest sites. Three recent shrike nest sites have been located in coyote brush in close proximity to Ridge Road and the AVMR within the IOA. Nests in these sites have the potential to be adversely affected by foot traffic. A nesting shrike closely approached by a person on foot would be expected to flush if approached too closely and return to the nest and normal behavior soon after the person passes. Generally Marines in formation would be at right angles to the direction of travel with 16 ft (5 m) spacing between individuals. This means that one or two Marines would approach a nest bush and have the potential to cause a bird to flush. This would not be considered harassment unless it happened frequently (e.g., a whole line of individuals passing by the bush) or the presence of individuals in the vicinity of a bush was prolonged (e.g., a group of Marines taking a break or camping overnight). On SCI, biologists are prohibited from being within 50 m (162 ft) of a shrike nest except for the permit provision of allowing nest inspection for banding purposes twice (within about 5 days) during the nestling cycle. These activities generally take about 20 minutes each. During this time, the adults flush and remain agitated but return to the nest and normal behavior after the biologists depart. However, repeated episodes of such disturbance could have an adverse affect on reproduction or productivity. There would be a low potential for loss of nesting individuals from the activity of personnel. Since personnel on foot would generally avoid walking into shrubs, the chance of damage to shrubs on which loggerhead shrikes depend for nest sites and cover is very low. Close approach by personnel during daytime may cause shrike to alter its foraging behavior and temporarily move away or cause a shrike to flush from cover or from a nest possibly increasing susceptibility of the nest to predation. The latter effects appear very unlikely, given the low density of shrikes within the 8,815-ac of the IOA.

Except as specifically noted otherwise, the most likely adverse effects of Navy training activities on shrikes would be a diminished reproduction or production of offspring (rather than effects on adult survivorship). Recently completed modeling by Grant and Weise (2006) assessing the effects of take as a reduction of productivity by10% and 25% related to harassment showed little effect on shrike population levels or potential recovery of the population. A slightly higher effect was noted when the effect on reproduction was combined with a scenario in which adverse climatic conditions, which are known to adversely affect reproduction and over-winter survival, had more frequent recurrence (at 3-year intervals vs. 5-year intervals). On the other hand, take resulting in decreases in adult survivorship had a substantial effect on population levels.

Although breeding males tend to stay close to their nesting territories year-around, some loggerhead shrikes, especially juveniles, may spread out during winter to other areas of the island, including many areas within SHOBA where landings or small arms fire could occur and in the uplands such as the Photo Lab, VC-3, and Lemon Tank. The vicinity of Horse Beach Cove also supports wintering loggerhead shrikes, a short distance from the beach. Proposed activities may cause to wintering loggerhead shrikes to leave the area while the activity takes place. With an expanding shrike population there is a greater potential for shrikes to occupy areas where training activities take place, especially during winter, and for shrikes to respond to human activity moving away temporarily. This response would be an insignificant effect not reaching the level of take. Additionally, the potential exists for injury or mortality from bird- aircraft strikes, however the likelihood of this is remote because the shrikes fly low to the ground below the levels flown by aircraft or UAVs except at developed areas where the aircraft or UAVs land or take off (e.g., at NALF SCI or VC-3).

3.11.21 San Clemente Sage Sparrow

There are approximately 5,182 ac of San Clemente sage sparrow habitat mapped on SCI, with approximately 18 percent, 32 percent, and 50 percent categorized as high, medium, and low density habitat, respectively (Beaudry et al. 2004). TAR 4 (existing) and TARs 10 and 17 (proposed) are located within high and moderate density habitat for the sage sparrow. The IOA and the Old Rifle Range AVMA, both of which would be used during I MEF Battalion Landing(s) and other amphibious exercises associated with Alternatives 1 and 2 also contain small amounts of low density San Clement sage sparrow habitat. Appendix Table D-8 summarizes the occurrence of San Clemente sage sparrow within operations areas on SCI and discusses the potential effects on the species.

Fire. Accidental fires that impact sage sparrows are most likely to occur from ordnance use and from EOD ordnance detonation. A fire entering sage sparrow habitat could cause long-term damage and loss of breeding habitat if woody plants used for nesting and perching were severely damaged. Although fire is a natural process, and can increase vegetative productivity (Carroll et al. 1993), repeated burning of the same area within a short period of time (1-2 years), which could be facilitated by operations-related ignition sources and abundant annual grasses, could overwhelm the abilities of some native plant species to recover from fire and result in habitat type conversion (e.g., from shrubland to grassland). Fire in nesting habitat during nesting season could cause nest abandonment and/or mortality.

The potential for fire carrying from TARs 10 and 17 into adjacent contiguous areas of high and medium density SCSS habitat has been identified as a key issue. TARs 4, 10, and 17 are located in sage sparrow habitat and activities in these TARs have the potential to ignite fires. Several fires in TAR 4 have been attributed to tracer use in the adjacent rifle and pistol ranges. TAR 4 is located north of the runway and a fire initiated within this TAR would affect medium and low density habitat and would not be likely to spread south of the NALF air field. TARs 10 and 17 are located within the largest contiguous area of high and moderate density sage sparrow habitat and a fire ignited at either location, if left unchecked, could burn for a considerable distance through sage sparrow habitat, depending on wind direction, fuel moisture, and other factors and this has been identified as an important issue with regard to the establishment of these TARs.. Fire tends to burn more slowly through the boxthorn vegetation characteristic of sage sparrow habitat than it does through grassland. The SCI Draft Wildland Fire Management Plan (DoN 2005) has a series of increasing precautions and fire suppression measures related to increasing fire danger ratings, including a fully equipped and staffed fire truck in the vicinity of the TAR within line of sight visibility of the TAR and action area and ability to be on scene and pumping water within 10 minutes of an ignition report whenever any type of incendiary ordnance is used. The Wildland Fire Management Plan notes the slow growth and recovery of boxthorn and places a priority on preventing short-interval recurrences of fire that might result in replacement of shrub-dominated native vegetation by grasses or weeds (type conversion). In the vicinity of TAR 10 there are a number of abandoned road spurs leading to the shoreline from the main north-south road. Although these are earmarked for abandonment and restoration they do provide interruptions in woody fuel that could assist in containing a fire.

Additional key recommendations include improving the road network so that road design, construction, and maintenance would be to a standard that functions as a fuelbreak, is secure from erosion, and that will support a Type 3 equivalent fire engine for emergency response. For TAR 10, the road immediately south of the dunes should remain passable for a two-wheel drive vehicle. A staging area for a portable water tank and emergency vehicle should be located in the immediate vicinity of TAR 10. For TAR 17, the existing unpaved road to Seal Cove along the land management unit boundary should remain passable by two-wheel drive emergency vehicles to the canyon directly east of Eel Point.

Implementation of the Fire Management Plan (DoN 2005) is expected to minimize the chances of large scale fires in sage sparrow habitat.

Ordnance Use and Noise. Sage sparrows may temporarily react to noise from ordnance and from activity of vehicles and personnel by alerting, flying, and possibly altering their foraging behavior. Noise may affect individuals by causing them to temporarily alter their foraging patterns or disperse from the area. Sage sparrows would be expected to disperse by flying low to the ground and between shrubs and are also likely to seek refuge upon experiencing disturbance by low flying helicopters or those conducting specific operations that involve hovering near the ground in proximity to sage sparrows.

NSW small arms training takes place in the small arms range, a developed area nearly devoid of vegetation and wildlife. These exercises expend nearly a million rounds of ammunition per year, as well as a smaller number of flares, MK-131 charges, and grenade simulators. Because this operation takes place in the developed small arms range portion of SWAT-1, which is highly disturbed and in frequent use, little vegetation or wildlife habitat is present and no listed species would be expected to occur in the area at the time of the operation. Typical sound exposure levels for small arms are in the range of 90-115 dB at 50 ft (Table 3.11-13) attenuating with distance as described above in Section 3.11.2.2.4. Moderate and low density habitat for San Clemente sage sparrow surrounds the site, although this area does not support what has been described as “core” habitat for this species.

TAR 4, located in SWAT-1, is located in medium density sage sparrow habitat. TAR 10 and 17 are located in high density sage sparrow habitat. TAR 22 includes an area of low density sage sparrow habitat near its southern limit on SCI. Small arms fire and demolitions at these TARs have the potential to disturb sage sparrows, both of which produce peak sound exposure levels of approximately 90-115 dB at 50 ft, declining with distance. Injury or mortality to sage sparrows from small arms firing or detonations is very unlikely. Firing would be toward the ocean at TARs 10 and 17 and demolitions would be conducted within previously disturbed areas. Although the effect of exposure to instantaneous sounds at these levels is not known, evidence suggests that there would not be physiological damage and that actual effects could range from none, to interference with communications, to behavioral responses ranging from becoming alert (most likely) to flushing (unlikely). A monitoring study conducted by Beaudry et al. (2004) compared SCSS populations in a study plot that encompassed TAR 4 with populations in other plots established on the Island. The study indicated that this plot generally fell within the range of other plots on the Island and compared very favorably to the other plots with regard to most parameters measured, despite ongoing construction and military use since its establishment. This study has been continued in 2004 and 2005 (by Turner *et al*. 2005; Turner *et al*. 2006), who also noted nest productivity in their TAR 4 study plot similar in all parameters to measured values in the other study plots. The authors did note a variety of disturbances from ordnance use (Turner et al. 2005); and 3 fires attributed to live firing in late June 2005 (Turner et al. 2006)**.**

Foot and Vehicle Traffic. The I MEF Battalion Landings involve large numbers (up to 1,500) of troops walking over the IOA. The northern portion of the IOA contains low density sage sparrow nesting habitat and there is a low to remote potential for flushing birds from the nest or nest destruction given the low density of nests in this habitat. There is also a potential for habitat damage resulting from trampling of shrubs or introduction or spread of invasive plant species, as described.

Many operations, such as land navigation activities, search and rescue and EOD sweeps, and activities at the TARs involve off-road foot traffic and would generally consist of fewer than 20 people walking over an area, sometimes more than once in a given operation.

Effects to the sage sparrow from a small number of personnel on foot would be negligible unless the operations occurred in sage sparrow nesting habitat during the nesting season. Sage sparrows often place their nests in low brush or directly on the ground. If the exercise did take place during the sage sparrow nesting season, nests could be trampled (a remote possibility). Disturbance could cause adults to move off nests, possibly alerting predators to their presence. This would be more likely during daytime than at night. Damage to shrubs would be expected to be minimal from movements of Special Forces practicing Tactical Environmental Movement. This is because snapping twigs would be contrary to mission requirements for movements to be stealthy (quiet) and not to leave evidence such as broken branches that would allow the movements to be detected.

The Navy restricts vehicle traffic to existing roads and "two tracks" on SCI. The only area where off-road vehicle use is permitted is in the AVMR, AVMAs, AMPs, and AFPs, which are generally located in previously disturbed areas and not known to support habitat for the sage sparrow. An exception is the Old Rifle Range AVMA, which broadly overlaps low density sage sparrow habitat (Figure 3.11-17, above, and Appendix Table D-8). Vehicular activity in the AVMA area would degrade habitat by crushing woody plants, leading to a greater dominance by weedy, more fire-prone annual grasses and forbs; by spreading or introducing invasive plant species; and may crush nests, which are located in low shrubs near the ground. Use of the remainder of the AVMAs and AVMR is not expected to adversely impact sage sparrows.

3.11.22 Western Snowy Plover

Western Snowy Plover habitat occurs within operations areas on SCI at TARs 3, 5, 20, 21, and 22 (Figures 3.11-17 through 3.11-21, above, and Appendix Table D-9). The western snowy plover population at SCI is at its peak during the winter, and 27-41 sightings have been made during typical Island-wide winter surveys (November 2000 through December 2003), suggesting that SCI is a potentially important wintering habitat (Foster and Copper 2000 and Lynn et al. 2004a). The draft recovery plan for the western snowy plover (USFWS 2001b) identified five beaches on SCI as important for wintering snowy plovers: Pyramid Cove, Horse Beach, China Cove, West Cove, and Northwest Harbor. Wintering plovers are most frequently seen at Pyramid Cove, China Beach, and West Cove. Recent winter surveys (between November 2003 and February 2004) recorded 23 to 33 sightings of snowy plovers on SCI beaches (Lynn et al. 2004a).

While wintering plovers have been regularly observed at all of these beaches, nesting has only been documented on the beaches at West Cove and Horse Creek Cove. Breeding was last documented at West Cove in 1989. West Cove beach was formerly much wider; at the present time most potential snowy plover nesting habitat at this site is subject to inundation during high tides making it unsuitable for nesting. In Horse Cove beach, western snowy plovers have nested twice, once in 1996 and in 1997 (Foster and Copper 2001). Other the potential nesting beaches, including China Cove and Pyramid Cove, are very narrow, backed by escarpments and subject to periodic inundation by waves and tides, making them unsuitable for nesting by snowy plovers. The narrowness of the beaches also makes nests very vulnerable to predation by foxes, cats, and ravens which frequent the beaches while foraging. Although Northwest Harbor, West Cove, Pyramid Cove, China Cove and Horse Beach Cove constitute only about 5 percent (2.8 miles [4.6 km]) of the 55 miles (88.5 km) of SCI coastline, they are in some of the areas used most frequently for ongoing training, because sandy beaches are required for many of the training activities requiring movements from water to land or from land to water.

Fire. Fire ignited by firing exercises or vehicle traffic is not expected to directly impact this species because plover habitat, beaches and dunes, support little if any flammable material.

Ordnance Use and Noise. Although small arms fire, large ordnance, and demolition explosions could cause injury or mortality, this would be very unlikely because individuals in the area would be expected to move away from the area of activity. Disturbance of wintering snowy plovers would be short-term and not likely to adversely affect the local wintering population of snowy plovers. Disturbance of breeding birds is very unlikely given the sporadic and limited attempts in the past and the limitations of habitat identified above.

Foot and Vehicle Traffic. Potential impacts to western snowy plover from the Proposed Action include temporary disturbance, from foot traffic and activity of vehicles on the beach. Injury or mortality from foot or vehicular activity is so unlikely as to be discountable. Breeding of western snowy plovers on SCI is considered accidental and not to have the potential to increase appreciably due to scarcity of nesting habitat and large number of predators. Observations on SCI described previously have confirmed plover movement a short distance away from people or landing vehicles, including LCACs, followed by resumption of previous activities.

However, in the overall context of the listed population of western snowy plovers, SCI would appear to have very limited significance. The island has very limited potential to support a substantially larger population of snowy plovers due to lack of suitable breeding habitat.

Lack of sand replacement is associated with the construction of the nearby airfield which blocked the deposition of sand by wind at West Cove (Foster and Copper 2003). Ultimately, in addition to its effect on wildlife, erosion of the sandy beach could hinder or prevent use of the site for amphibious landings.

The Navy will continue monthly surveys for the western snowy plover at each beach where suitable nesting or wintering habitat exists. These beaches include Northwest Harbor, West Cove, Horse Beach Cove, China Cove, and Pyramid Cove. During April and May, beaches with potential snowy plover nesting habitat will be surveyed twice each month in an effort to locate any evidence of nesting behavior by snowy plovers. Results of surveys would be incorporated into planning for individual operations to reduce effects to breeding plovers, if present.

To reduce potential impacts to plovers, movement of troops and vehicles across beaches to the AVMR will be restricted to defined corridors to minimize adverse effects to the beach ecosystem. The corridors will be defined by SCORE in coordination with NRO and will be clearly delineated on maps in the SCORE Range Users Manual prior to operations involving a beach landing.

The implementation of these measures would reduce the potential effects on the western snowy plover as a result of military operations on SCI. However, because of the large number of training exercises that occur on an annual basis in habitat for this species, the potential still exists that a plover might be subject to harassment, injury, or mortality.

3.11.23 California Brown Pelican

Nearshore and Onshore Activities. Up to 27 and 15 operations per year would occur at the Underwater Demolition Ranges at TAR 2 and TAR 3, respectively, and would include detonations up to 500 lb. Bird Rock is located several hundred yards offshore of TAR 3 and is a roost site for California brown pelicans. Detonations have the potential to result in temporary disturbance and injury or mortality to pelicans that may be resting or foraging in the water near the planned shallow-water demolition exercises. However, in the thirty years that NSW has been conducting underwater command detonation training in Northwest Harbor, there has been no occurrence of injury to brown pelicans. Preliminary beach activities of BUD/S and SEAL team members associated with ordnance preparation for underwater explosives training attracts pelicans and other seabirds to surrounding beaches. Pelicans sit on the beaches, awaiting the underwater explosion. Once ordnance is detonated, pelicans opportunistically feed on surface prey. Should a situation arise that a pelican is flying over the submerged ordnance, detonation is held off until the pelican is out of the blast area.

Pelicans may be indirectly affected by loss of some of their prey items that may be injured or killed from the detonations. However the loss of some prey items is not expected to affect the long-term survival or reproduction of the pelican because of the limited areas that would be affected and the vast opportunities to forage elsewhere. In addition, pelicans may take advantage of the foraging opportunity provided by fish affected by underwater detonations.

Aircraft, ordnance, and other elements of training exercises have the potential to disturb roosting pelicans at Castle Rock and at Bird Rock. To minimize disturbance to California brown pelicans on Castle Rock and Bird Rock, the Navy would continue to implement the conditions contained in USFWS (2001a) that pertain to pelicans. These conditions include: (1) minimizing the potential for munitions to hit Castle Rock and the water immediately surrounding this rock, (2) routing helicopters and boats away from Castle Rock to the maximum extent practicable when transporting people to and from TAR 4, (3) maintaining a minimum distance from Castle Rock of 100 m for helicopters and 25 m for vessels when transporting people from shore, and (5) realigning the new rifle range away from Castle Rock.

The California brown pelican does not nest on SCI. Therefore, there would be no effect on breeding pelicans or to pelican nesting areas. The effects on brown pelican of the No Action Alternative, Alternative 1 or Alternative 2 would be less than significant with mitigation. Applicable mitigation measure is CBP-M-1.

3.11.24 Island Fox

Island fox is a small, very docile fox about the size of a house cat. The San Clemente Island subspecies is found only on SCI. It is widespread and relatively abundant on SCI. It uses a wide variety of habitats. Island fox was not included in the quantitative analysis because of the general occurrence of foxes island-wide and their wide-ranging habits.

Fire. Although fire can result in mortality to adults or young, island fox is expected “to be resilient to fire severity 3 or cooler due to wide distribution and improved foraging/travel conditions in grasslands” (DoN 2005). Severity 3 fires (where litter, duff, and grasses are burned to ash and shrubs are burned or singed with some resprouts) are consistent with SCI Fire Management Plan goals (DoN 2005). Some individuals would be expected to escape fire, and the recently burned habitat would be rapidly reoccupied as a prey base and cover develop.

Ordnance Use and Noise. Island foxes are present in the canyons in SHOBA where they have been subjected to noise from ordnance in Impact Areas I and II for many years. Between 1999 and 2002 foxes in SHOBA and elsewhere were subjected to various efforts intended to prevent them from affecting San Clemente loggerhead shrike survival.

Foot and Vehicle Traffic. Foot traffic is not likely to adversely affect the island fox. Individual foxes would avoid large groups of marching infantry associated with the Battalion Landing or platoon-sized groups on foot associated with many NSW and USMC operations. Contact with active dens by persons on foot would be infrequent because the dens tend to be located in rocky areas or areas with dense shrubs, which tend to be avoided by personnel on foot in favor of more passable terrain. The increased operational tempo associated with Alternatives 1 and 2 would increase the frequency of human interactions with foxes but would be expected to have less than significant effects because of the unlikelihood of harm or mortality to foxes associated with the interaction.

Collisions with vehicles has been an ongoing source of mortality of foxes and the Navy has posted signs and mowed and maintained vegetation along the sides of portions of Ridge Road to make it easier for drivers and foxes to have visual contact enabling them to avoid collisions. Use of tracked vehicles in the AVMC, particularly the AVMAs, could increase the potential for fox mortality somewhat, particularly at nighttime when the foxes may be active and visibility is limited. The increase of vehicular traffic on the main roads as well as the AVMC increases the risk of collision with foxes. Effects of tracked vehicle activity in the AVMC, especially the NALF and Old Rifle Range AVMAs and overlying AMPs, would also have long-term adverse effects on island fox habitat in an area that has high island fox populations.

The Conservation Agreement between the Navy and USFWS concerning the San Clemente Island fox (*Urocyon littoralis clementae*) dated 10 January 2003 contained some requirements related to fire management. Among other conservation measures, the Navy committed to take responsibility for the following:

- Promote recovery of native grassland and shrub communities and reduce the coverage of non-native annual grasses. The Navy has established the ability to propagate native plants through the operation of a viable native plant nursery and to enhance habitats by outplanting nursery grown plants in the field (see Dunn and Zink 2004; 2006). This method of habitat augmentation will continue. Further, with implementation of the San Clemente Island Integrated Natural Resources Management Plan (DoN 2002), and with the adoption and implementation of the San Clemente Island Fire Management Plan (DoN 2005), prescribed fire can be used to foster a mosaic of grassland and shrubs with consequential restoration of native vegetation to improve grassland habitats.
- In order to minimize collisions between SCI foxes and vehicles, vegetation along certain roadside edges will be cut in focal areas where foxes are hit by vehicles and maintained to increase visual contact with foxes. In addition to measures designed to control invasive species and maintain habitat quality, specifically applicable mitigation measures identified in this document include G-M-2, AVMC-M-2, AVMC-M-8, IF-M-1, IF-M-2, and IF-M-3.

3.11.25 San Clemente Island Bedstraw

This state-listed endangered subshrub is relatively widespread in canyons on both sides of the Island, especially in the southern half of the island. Eight of 224 documented occurrences (3.6 percent) are located in operations areas, including 2 in Impact Area I, 2 in Impact Area II/TAR 22, one in TAR 13, and 3 in the IOA.

Appendix Table D-10 summarizes the occurrence of State-listed and CNPS-listed sensitive plant species including SCI bedstraw within individual operations areas on SCI and provides a description of potential impacts of existing and proposed operations, and impact significance.

Access. Four of 224 documented occurrences of this species (1.8% of the SCI total) are in SHOBA Impact Areas I and II, where future direct monitoring of the condition of the habitat or the recovery status of the individuals and occurrences within these impact areas and the overlying TARs 20, 21, and 22 is precluded, as discussed in Section 3.11.2.2.2.

Fire. The FMP BA (DoN 2006) categorizes this species as moderately long-lived canopy species, placing it among species that “tolerate fire, but do not require it for establishment”. They “are sensitive to fire intensity because it affects sprouting ability.” Given that most of the populations of this species are in areas far removed from potential project-related sources of ignition, impacts of fire on this species are expected to be less than significant.

Ordnance Use and Noise. The few occurrences of this species in SHOBA are located in China and Horse Beach canyons away from target areas. At these locations, they are very unlikely to be affected by stray incoming ordnance as a result of the distance from the target areas and some topographic shielding.

Foot and Vehicle Traffic. According to Junak and Wilken (1998), plants were inaccessible at most sites found on San Clemente Island because they often occur on rock outcrops or cliff faces. For this reason, this species is unlikely to be affected by foot or vehicle traffic.

3.11.26 San Clemente Island Silvery Hosackia

Much of the distribution of the state-listed endangered SCI silvery hosackia (*Lotus argophyllus adsurgens*), also known as the SCI silvery lotus or SCI birds-foot trefoil, is within SHOBA, and over 119 of the 207 documented SCI occurrences (57.5%) of the species are in operations areas, mostly in Impact Area I and the IOA. Twelve percent of the documented SCI occurrences and six percent of the documented individuals are within Impact Area I, where it is relatively abundant on south facing slopes and ridge tops. Two occurrences are in the NALF AVMA, four are in AFP-1, and 92 occurrences (44% of the SCI total) and thirty percent of the documented individuals are in the IOA. Table D-10 summarizes the occurrence of SCI silvery hosackia within individual operations areas on SCI and provides a description of potential impacts of existing and proposed operations, and impact significance.

Access. Twenty seven of 207 documented occurrences of this species (13% of the SCI total) and 400 individuals (7.3 % of the documented SCI individuals) are in SHOBA Impact Areas I and II, where future direct monitoring of the condition of the habitat or the recovery status of the individuals and occurrences within these impact areas is precluded, as discussed in Section 3.11.2.2.2.

Fire. Given its abundance in SHOBA, this species is likely to be occasionally exposed to ordnance-caused fires. Its habitats are largely away from target areas and many of the locations are very sparsely vegetated and unlikely to carry fire under most conditions, making frequent fire unlikely. This species regenerates from seed after fire and is not likely to be adversely affected by fires with spacing of 5-10 years or more. It is unlikely that habitats currently supporting this species would burn more frequently. Impacts are expected to be less than significant.

Ordnance Use and Noise. Given its location away from target areas, this species might occasionally be directly hit by off-target rounds of incoming ordnance. This would be a localized impact confined to the site of impact (or explosion in the case of live ordnance). Given the relative abundance of this species within the SHOBA Impact Areas (especially Impact Area I) it is likely that individuals of the species would be occasionally impacted by incoming stray rounds;

however its abundance in the Impact Areas after decades of use as an impact area suggest the resilience of the species with regard to occasional ordnance impacts.

Foot and Vehicle Traffic. Maneuvering of tracked and wheeled vehicles and artillery pieces could affect recently discovered occurrences of San Clemente Island silvery hosackia in the NALF AVMA and in AFP 1 directly and by assisting the spread and establishment of invasive species, possibly leading to extirpation of these occurrences. The occurrence at the NALF AVMA, one of the northernmost on SCI, could potentially be protected by application of measures AVMC-M-3, AVMC-M-4, and AVMC-M-9 as described above (Section 3.11.3.2) under SCI Indian paintbrush, which is located in the same localized area as the silvery hosackia.

At AFP-1, there are 4 newly discovered occurrences with 289 individuals total in the east-central portion of the AFP (see Appendix D, Table D-10 and Figure D-5). These represent about 5 percent of the total known individuals of this plant. Some of these plants may be protected by terrain, limiting their accessibility to tracked and wheeled vehicles. Depending on the specifics of the site, additional protection of some or all of the silvery hosackia occurrences could potentially occur through development of the erosion control plan (AVMC-M-3) and/or briefing of maneuver area boundaries prior to conducting operations in these areas (AVMC-M-4).

Individuals could be impacted by foot traffic within the IOA, where 44 percent of the SCI occurrences and 30 percent of the SCI individuals of this species are located, but direct impacts would be dispersed, temporary, and less than significant. The indirect effects of invasive species establishment and spread resulting from foot travel through the IOA is a reasonably foreseeable indirect impact with the potential for serious adverse consequences on sensitive plant species because of the large number of infantry personnel coming ashore year after year under Alternatives I and II. The large size and remoteness of parts of the Infantry Operations Area will make beginning infestations of invasive species difficult to detect when they are localized and most treatable. The outcome of an invasive plant species introduction is not always predictable, however it is very well documented, especially on islands, that plant invasions can result in dramatic ecological changes affecting the survival of plant and wildlife species.

3.11.27 Other Sensitive Species

Table D-10 summarizes the occurrence of State-listed and CNPS-listed sensitive plant species within individual operations areas on SCI and provides a description of potential impacts of existing and proposed operations, and an assessment of impact significance for the No Action Alternative, Alternative 1, and Alternative 2. Species having a high proportion of their known occurrences in specific operations areas are discussed below:

- Aphanisma (*Aphanisma blitoides*)—46 of 175 SCI occurrences (26%) are in Impact Area I and overlapping TAR 21. This annual herb species is relatively abundant in these areas but is generally located away from targets and effects from ongoing activities are less than significant.
- SCI brodiaea (*Brodiaea kinkiensis*)—59 of 142 SCI occurrences are in the IOA (41.6 percent). This low perennial herb is found in grassland communities with clay soils, a habitat well represented in the IOA, where the species could be affected by dispersed foot traffic and possible establishment of invasive species. SCI brodiaea regenerates readily from underground bulbs ("corms") after fire and exists as dormant underground corms for several months of the year. Impacts associated with Alternatives 1 and 2 would be less than significant with mitigation.
- Thorne's royal larkspur (*Delphinium variegatum* ssp. *thornei)*—40 of 78 occurrences on SCI are in the IOA (51.3% of the SCI total). This species, like SCI brodiaea, is found in grasslands where it could be affected by dispersed foot traffic and possible

establishment of invasive species. It regenerates readily from underground storage roots after fire and exists as dormant underground storage roots for several months of the year. Impacts associated with Alternatives 1 and 2 would be less than significant with mitigation.

- Southern Island tree mallow (*Lavatera assurgentifolia* subsp. *glabra*)—Of 32 documented occurrences on SCI, five occurrences (15.6% of the island total) are clustered in the NALF AVMA near the egress from TAR 5, one occurrence at TAR 10 (3% of the SCI total), with several nearby occurrences, and nineteen occurrences (59.4% of the SCI total) in the IOA. This once-abundant shrub is now known on SCI from only about 276 individual plants. Impacts associated with Alternatives 1 and 2 would be less than significant with mitigation because direct impacts at the NALF AVMA can be avoided and the exposure of this large shrub to occasional foot traffic and possible indirect effects in TAR 10 and IOA would be less than significant with mitigation.
- Additional sensitive species with a large proportion of their SCI documented occurrences in the IOA include Guadalupe Island lupine (197 occurrences (55% of the SCI total) and 40,145 individuals (61% of the SCI total) and SCI milkvetch (98 occurrences (48% of the SCI total) and 7,651 individuals (35.5% of the SCI total). These species would be subject to direct and indirect effects of off-road foot travel under Alternatives 1 and 2 as described above. Impacts associated with Alternatives 1 and 2 would be less than significant with mitigation.

3.11.27.1 Mitigation Measures

As noted above in section 3.11.1.3, the Navy implements measures to avoid, minimize, or compensate for its effects on biological resources including listed species on SCI. Key management and monitoring activities include completion and implementation of the SCI Wildland Fire Management Plan; continued monitoring and management activities for all endangered species but with particular attention to San Clemente loggerhead shrike, San Clemente sage sparrow, island fox, and six federally-listed plant species; invasive species monitoring and control efforts; continued operation of the on-island nursery and restoration efforts being conducted by nursery staff; vegetation condition and trend assessment; and continued implementation of the SCI Integrated Natural Resources Management Plan (INRMP). The Navy proposes to continue these measures. Further, the Navy proposes to implement additional measures to mitigate the environmental effects of its activities. The following is a comprehensive list of current and proposed mitigation measures for SCI:

3.11.27.2 General Measures

G-M-1. Continue to control invasive exotic plant species on an island-wide scale, with an emphasis on the AVMC, the IOA, TARs, and other operations insertion areas such as West Cove, Wilson Cove and the airfield. A pretreatment survey to identify areas needing treatment, one treatment cycle, and a retreatment cycle (when necessary) will be planned each year to minimize the distribution of invasive species. The focus of the invasive exotic plant control program will continue to be the control of highly invasive exotic plants that have the potential to adversely impact habitat for federally listed species in known locations, and the early detection and eradication of new occurrences of such species. Where feasible, include future construction sites in a treatment and retreatment cycle prior to construction.

G-M-2. Continue feral cat and rat control efforts and monitoring level of feral cat and rat population (would benefit all endangered and threatened wildlife on SCI as well as the island fox). To reduce human-induced increases in the feral cat and rat populations, the Navy will ensure that personnel do not feed cats and that all trash, food waste, and training refuse are disposed of properly in animal proof containers.

G-M-3. Continue implementation of INRMP per funding availability, with review and revision per Chapter 22 on Natural Resources Management in the Chief of Naval Operations Instruction 5090.1B, Change 3, Environmental and Natural Resources Program Manual, dated 17 October 2002.

G-M-4. Continue to review and coordinate the dissemination of environmental conservation measures to island users. Conservation measures will be distributed to island military and civilian staff in accordance with commander's guidelines, and with Fleet operations.

G-M-5. Conduct any necessary Explosive Ordnance Disposal (EOD) ordnance detonations in or near endangered or threatened species habitat in a manner that minimizes the potential for wildfire without compromising personnel safety.

G-M-6. Coordinate range access to achieve optimal flexibility between training operations and NRO activities, according to range use instructions and with priority given to military training.

G-M-7. Locate SHOBA heavy ordnance targets with regard to proximity to sensitive resources, including San Clemente loggerhead shrike, sensitive plants (e.g., away from Horse Beach Canyon), and coastal salt marsh, to the extent feasible while meeting operational needs.

G-M-8. Conduct monitoring and control activities for non-native predators outside the impact area boundaries. Monitoring and control activities would include China Point Road between Impact Areas I and II. Monitoring and control activities may be intensified as needed to prevent elevated predation on listed species outside the Impact Area boundaries attributable to predator populations within the Impact Area boundaries. Access to conduct control efforts would not be limited within SHOBA outside the Impact Area I and II boundaries. (See also related measure **G-M-2)**.

G-M-9. Conduct monitoring and control activities for invasive non-native plant species outside of the impact area boundaries. Monitoring and control activities would include the China Point Road between Impact Areas I and II. Monitoring and control activities may be intensified as needed to prevent spread of invasive species and effects on listed species outside the Impact Area boundaries attributable to invasive species populations within the Impact Area boundaries. Access to conduct control efforts would not be limited within SHOBA outside the Impact Area I and II boundaries. (See also related measure **G-M-1)**.

3.11.27.3 AVMC, AVMR, AVMA, AFPs, AMPs, IOA, and Amphibious Landing Sites

AVMC-M-1. Complete survey for federally listed and sensitive plant species within the AVMC (including AVMAs, AFP-1, AFP-6, AMPs) and IOA. This survey was initiated in 2005 and was completed in 2007.

AVMC-M-2. Conduct periodic monitoring of the AVMC (AVMAs, AMPs, AFPs, AVMR) and IOA as part of vegetation/habitat and sensitive species survey updates for the INRMP.

AVMC-M-3. Develop an erosion control plan. Finalize AVMA, AMP, and AFP areas based on field review with soil erosion experts and military personnel, such that operational areas minimize inclusion of steep slopes and drainage heads. Develop, apply and maintain BMPs for erosion/sedimentation where appropriate, and provide for regular monitoring and control of invasive species (see additional description in Section 3.1.3.2).

AVMC-M-4. Military units will be briefed on maneuver area boundaries prior to conducting operations in these areas.

AVMC-M-5. Tracked vehicle travel or maneuvering will not be conducted outside the boundaries of the AVMC (including AFPs, AMPs, AVMAs, AVMR).

AVMC-M-6. Develop and implement a project to monitor for erosion, dust generation, and deposition of dust in adjacent habitats.

AVMC-M-7. Prior to coming to SCI, military and non-military personnel will be asked to conduct a brief check for visible plant material, dirt, or mud on equipment and shoes. Any visible plant material, dirt or mud should be removed before leaving for SCI. Wash tactical ground vehicles for invasive species prior to embarkation for SCI. Additional washing is not required for amphibious vehicles after 15 minutes of self-propelled travel through salt water prior to coming ashore on SCI.

AVMC-M-8. Continue to enforce the existing 35 mph speed limit on Ridge Road for shore installation and administrative traffic. Post signs, continue public awareness programs; mow roadside vegetation; and monitor roadways for kills of protected or conservation agreement species including San Clemente loggerhead shrike, San Clemente sage sparrow, and island fox.

AVMC-M-9. Tracked and wheeled vehicles will continue to use the existing route for ingress and egress to/from the beach at West Cove.

AVMC-M-10. For Horse Beach Cove Amphibious Landing and Embarkation Area at TAR 21, vehicles will use an ingress/egress route that avoids impact on wetlands and minimizes impacts on coastal dune scrub. This involves driving amphibious vehicles westward on the unvegetated beach and egressing from beach west of the mouth of Horse Beach Canyon.

3.11.27.4 Training Areas and Ranges (TARs)

TAR-M-1. Develop and implement a five-year monitoring plan with annual surveys for Threatened and Endangered plant species when they are known to occur within or adjacent to TARs outside of Impact Areas I and II.

3.11.27.5 Additional Species-Specific Measures

San Clemente sage sparrow

SCSS-M-1. Continue surveys and population analysis for the San Clemente sage sparrow including the populations within TARs 4, 10, and 17. This survey effort includes monitoring transects and breeding plots along the west shore and marine terraces between February through June of each year.

SCSS-M-2. Develop a sage sparrow management plan that includes objectives and management actions for the conservation of the sage sparrow on San Clemente Island. The goal of the management plan would be to provide for the long-term survival of the species on SCI in a manner that supports delisting from protection under the ESA while enabling military training requirements on San Clemente Island to be met.

San Clemente Loggerhead Shrike

SCLS-M-1. Continue the currently successful program of habitat restoration, predator management, monitoring, captive breeding, and re-introduction to benefit the San Clemente loggerhead shrike until such time that recovery objectives are identified and achieved.

SCLS-M-2. Evaluate nest success data for SCLS in sites nearest AFP-6, including those in Eagle and Cave Canyons, and compare it to other sites in and out of SHOBA with the objective of determining whether or not success rates are typical for the species**.**

Island Night Lizard

INL-M-1. Continue population monitoring at 3-year intervals and annual habitat evaluations while the delisting petition is being evaluated by USFWS.

California brown pelican

CBP-M-1. Ensure that California brown pelicans are not in proximity to over-blast pressure prior to underwater demolition activities.

Western Snowy Plover

WSP-M-1. Continue annual breeding and non-breeding season surveys for the western snowy plover at West Cove and Northwest Harbor.

Island Fox

IF-M-1. Continue educational work with on-Island civilian and military personnel to prevent feeding, handling of foxes.

IF-M-2. Continue feral cat control and education and enforcement of prohibitions concerning on-Island civilian and military personnel feeding, keeping, or otherwise encouraging the persistence of cats on SCI.

IF-M-3. Continue posting signs, mowing road verges, and education to help minimize the potential for vehicular collisions with foxes.

Santa Cruz Island Rock-Cress

RC-M-1. Investigate feasibility of establishing additional colonies in suitable habitat farther away from the IOA and AFP--1 using the on-island nursery to propagate from local seed.

3.11.28 Unavoidable Adverse Environmental Effects

Under the No Action Alternative significant impacts to vegetation and habitat are identified at TAR 4 and at the Horse Beach Cove Landing area (TAR 21). Under both Alternative 1 and Alternative 2, impacts to biological resources would be reduced to less than significant with mitigation.

3.11.29 Summary of Effects by Alternative

The following table provides a summary of the Effects on Biological Resources associated with the No Action Alternative, Alternative 1 and Alternative 2.

Table 3.11-18: Summary of Effects by Alternative

Terrestrial Biology	
Alternative	**NEPA (On-Land and U.S. Territorial Waters)**
No Action Alternative	San Clemente Island (SCI) supports five federally listed terrestrial animal species and 6 federally listed plant species, as well as about 30 additional plant species that are recognized as sensitive and are found only on SCI or on SCI and one or more of the other California Channel Islands. Navy actions to remove non-native grazing animals (successfully completed in the early 1990s), as well as a variety of additional monitoring and management activities directed by the Navy have resulted in recovery of habitat quality over much of the island and resulted in increases in the populations of many of the listed plant and wildlife species, most notably the San Clemente loggerhead shrike. Ongoing Navy activities are part of the No Action Alternative. These include Naval Surface Fire Support (ship to shore bombardment) into long-established Impact Areas I and II, land based artillery firing from an Artillery Firing Point into Impact Areas I and II, Naval Special Warfare (NSW) operations in designated areas (SWATs and existing TARs) established around the Island, Strike Warfare (Air to Ground weapons delivery) into Impact Areas I and II, Amphibious Landings and Raids, Combat Search and Rescue (CSAR), and Explosive Ordnance Disposal (EOD) activities. Additionally, activities at the NALF Airfield, and Research, Development, Test, and Evaluation (RDT&E) activities, including Missile Flight Testing, are included in the No Action Alternative. Most of these activities tend to focus on certain established areas with a long history of similar uses (e.g., SHOBA Impact Areas I and II, SWATs and established TARs, including sandy beaches) although some activities (CSAR) can occur anywhere on the island but have a minimal and temporary effect. Impacts to biological resources from the No Action Alternative are generally less than significant and are associated with access, fire, ordnance use and noise, and foot and vehicle traffic, especially where activities are concentrated. Localized adverse effects on vegetation and habitat were predicted to result from continuation of intensified activities at TAR 4 and TAR 21. Ongoing Navy natural resources management activities are generally maintaining the Island's biological resources, including endangered and threatened species, in a stable or increasing trend, balancing localized effects of the ongoing military uses. Ongoing natural resources management and monitoring activities, including continued monitoring and management for endangered, threatened, and sensitive wildlife and plant species; invasive species monitoring and control efforts; operation of the island native plant nursery; habitat restoration efforts by nursery staff; vegetation condition and trend assessment; continued implementation of the Integrated Natural Resources Management Plan (INRMP); and completion and implementation of the SCI Wildland Fire Management Plan are part of the No Action Alternative.
	EO 12114 (Non-U.S. Territorial Waters)
	Effects on birds, including the California brown pelican, resulting from training and testing activities conducted offshore in non-U.S. Territorial Waters would be less than significant due to the temporary and localized nature of these activities, the very low

	average density of birds offshore, and the mobility of birds enabling them to depart from areas where naval activity is taking place. The likelihood of adverse effects to endangered or threatened bird species, including the California brown pelican, is so remote as to be discountable for the reasons given above.

NEPA (On-Land and U.S. Territorial Waters)	
Alternative 1	Under Alternative 1, three Authorized Vehicle Maneuver Areas (AVMAs), four Artillery Maneuvering Points (AMPs), and two Artillery Firing Points would be established, in which off-road maneuvering of tracked and wheeled vehicles, including artillery, would be authorized. The AVMAs and overlapping AMPs would encompass about 1,087 acres in the plateau area of SCI. Nineteen new Training Areas and Ranges (TARs) totaling about 1,800 acres would be established for Naval Special Warfare and other activities, including amphibious landings, demolitions, and covert activities by platoon-sized NSW or SEAL groups. Live fire activities would be limited to certain specific TARs. Alternative 1 would include one USMC battalion-sized landing per year involving approximately 1,500 troops, landings at multiple locations and coordinated activities of tracked and wheeled vehicles, helicopters, and close air support, with live fire in SHOBA. An Infantry Operations Area of 8,815 acres, which is overlapped by virtually all of the AVMAs, AMPs, AFPs, and several TARs, would be established where maneuvering of large numbers of troops on foot would be permitted. Compared to No Action, there would be increased frequency of most operations and increased ordnance use associated with Alternative 1. Impacts on biological resources would be principally associated with establishment and use of the AVMAs, AMPs, and AFPs by tanks, amphibious tracked vehicles, trucks, and artillery; as well as increased tempo of operations and ordnance use, including increased frequency of amphibious landings and raids, insertions and extractions, introduction of the USMC battalion sized landing, and intensified activities of platoon-sized NSW groups at existing and newly established TARs. The effects of these activities would be less than significant with mitigation, given continuation of the successful natural resource monitoring and management activities described above under the No Action Alternative and implementation of the measures identified below under Mitigation.
	EO 12114 (Non-U.S. Territorial Waters)
	Effects on birds, including the California brown pelican, resulting from training and testing activities conducted offshore in non-U.S. Territorial Waters would be less than significant as described above under the No Action Alternative.
NEPA (On-Land and U.S. Territorial Waters)	
Alternative 2 (Preferred Alternative)	Under the Preferred Alternative, AVMAs, AMPs, AFPs, and new TARs would be established and used as described above for Alternative 1. No new types of operations would be introduced but the frequency of certain operations would increase, in some cases approximately doubling the frequency proposed for Alternative 1. For example, compared to Alternative 1, amphibious landings and raids would increase from 34 to 66 operations per year, USMC battalion landings would increase from one to two per year, NSW UAV/UAS operations would increase from 15 to 27 per year, SEAL Platoon

<table>
<tr><td></td><td>operations would increase from 512 to 668 operations per year. The effects of these activities would be less than significant with mitigation, given continuation of the successful natural resource monitoring and management activities described above under the No Action Alternative and implementation of the measures identified below under Mitigation.</td></tr>
<tr><td></td><td>EO 12114
(Non-U.S. Territorial Waters)</td></tr>
<tr><td></td><td>Effects on birds, including the California brown pelican, resulting from training and testing activities conducted offshore in non-U.S. Territorial Waters would be less than significant as described above under the No Action Alternative.</td></tr>
<tr><td colspan="2">Mitigation Measures,
Including Current Measures and Additional Measures Associated with Alternatives 1 and 2</td></tr>
<tr><td>Mitigation Measures</td><td>The Navy has proposed thirty one specific measures to avoid, minimize, or compensate for adverse impacts on biological resources including threatened, endangered, and sensitive species and their habitats. The measures, described in Section 3.11.4, include measures to control invasive non-native plant and animal species that adversely affect sensitive plant and endangered wildlife species; surveys and monitoring of vegetation, sensitive plant and wildlife species in operations in the AVMA,s AMPs and AFPs; developing and implementing an erosion control plan for AVMAs, AMPs, and AFPs, confining vehicle traffic to authorized maneuver areas and roads; measures to minimize transport of plant matter or soil that may contain invasive species to SCI on vehicles and personnel; measures to minimize vehicle caused mortality to wildlife including island foxes, and measures to minimize the effects of vehicles egressing from amphibious landing areas at West Cove and Horse Beach Cove. Species-specific measures are also proposed to foster conservation of and minimize impacts to endangered or threatened species including San Clemente sage sparrow, San Clemente loggerhead shrike, island night lizard, California brown pelican, western snowy plover, island fox, and Santa Cruz Island rock-cress.</td></tr>
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3.12 Cultural Resources

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3.12 CULTURAL RESOURCES

Cultural resources are districts, buildings, sites, structures, areas of traditional use, or objects with historical, architectural, archaeological, cultural, or scientific importance. Cultural resources include archaeological resources (prehistoric and historic), historic architectural resources, and traditional cultural resources.

Archaeological resources include prehistoric and historic locations or sites where human actions have resulted in detectable changes. Archaeological resources can have a surface component, a subsurface component, or both. Historic archaeological resources are those resources dating from after European contact. They may include subsurface features such as wells, cisterns, or privies. Other historic archaeological resources include artifact concentrations and building remnants (e.g., foundations). Submerged cultural resources include historic shipwrecks and other submerged historic materials, such as sunken airplanes and prehistoric cultural remains.

Architectural resources are elements of the built environment. These resources include existing buildings; dams; bridges; and other structures of historic, engineering, or artistic significance. Factors in determining a resource's significance are its age, integrity, design, and association with important events or persons. To receive protection under federal cultural resources laws, architectural resources generally must be at least 50 years old or of exceptional importance. Cold War-era military facilities may meet the exception criteria. For example, certain facilities associated with Cold War missile and torpedo programs have been designated as significant architectural resources.

Traditional cultural resources are resources associated with beliefs and cultural practices of a living culture, subculture, or community. These beliefs and practices must be rooted in the group's history and must be important in maintaining the cultural identity of the group. Archaeological sites, locations of traditional events, sacred places, and resource collection areas, including hunting or gathering areas, may be traditional cultural resources.

Several federal laws and associated regulations require that potential effects on cultural resources be considered during the planning and implementation of federal undertakings. These laws and regulations stipulate a process of compliance, define the responsibilities of the federal action proponent, and prescribe the relationships among other involved agencies (e.g., State Historic Preservation Officer [SHPO], Advisory Council on Historic Preservation [ACHP]). The primary laws that apply to the treatment of cultural resources during environmental analysis are the National Historic Preservation Act (NHPA) (16 United States Code [U.S.C.], Section [§] 470 et seq.), especially Sections 106 and 110; the Archaeological Resources Protection Act (ARPA) of 1979 (16 U.S.C. § 470), which prohibits the excavation and removal of items of archaeological interest from federal lands without a permit; the Antiquities Act of 1906 (16 U.S.C. § 431); and the Native American Graves Protection and Repatriation Act (NAGPRA) (25 U.S.C. § 3001 et seq.), which requires federal agencies to return Native American cultural items to the native groups with which they are associated, and which specifies procedures to be followed if such items are discovered on federal land.

Cultural resources of particular concern are those properties listed in or eligible for listing in the National Register of Historic Places (NRHP). Section 106 of the NHPA requires federal agencies to consider the effects of their actions on significant cultural properties. The implementing regulations for Section 106 (36 Code of Federal Regulations [C.F.R.] Part 800) specify a consultation process to assist in satisfying this requirement. To be considered significant, cultural resources must meet one or more of the eligibility criteria established by the National Park Service (NPS) and listed in Department of the Interior regulations (36 C.F.R. § 60.4). Sites not yet evaluated may be considered to be eligible; potentially eligible resources are afforded the same regulatory consideration as listed properties. In some cases, cultural resources that are not eligible for inclusion in the NRHP may still require some level of management, protection, or mitigation. Whether prehistoric, historic, or traditional, sites listed in the NRHP are referred to as historic properties.

3.12.1 Affected Environment

3.12.1.1 SOCAL OPAREAs

Cultural resource concerns for the offshore southern California (SOCAL) Operating Areas (OPAREAs) include effects on historical sites and prehistoric resources. Terrestrial cultural resource concerns are confined to SCI. No traditional cultural resources have been identified in the SOCAL OPAREAs.

3.12.1.1.1 Existing Conditions

The potential for prehistoric cultural resources in the sea ranges of the SOCAL OPAREAs is limited to shorelines inundated by rising sea levels over the last 12,000 years and, perhaps, isolated artifacts from Native American activities in or on the water. Numerous historic shipwrecks and downed aircraft are present in the SOCAL OPAREAs, most of them located near the coast or the offshore islands. Little is known about the number and locations of shipwrecks in the open ocean portions of the SOCAL OPAREAs, but Navy training is not expected to substantially affect offshore or open ocean underwater cultural resources because training and testing would not disturb bottom sediments.

A number of data sources were reviewed to obtain information about marine resources in shallow waters. Sources include a U.S. Minerals Management Service (MMS) study (PS Associates 1987) and the California State Lands Commission (SLC) shipwreck database (http://shipwrecks.slc.ca.gov/). Additional data included information at the National Park Service Channel Islands National Park, the National Archives Branch at Laguna Niguel, the National Maritime Museum Library in San Francisco, Scripps Institution of Oceanography, the National Oceanic and Atmospheric Administration Shipwreck Chart, and the database held by the Space and Naval Warfare Systems Center in San Diego.

The inventory of submerged historic cultural resources developed from these sources included 68 submerged cultural resources in the waters around SCI. Of the resources with locations indicated, 22 are within 12 nautical miles (nm) (22 kilometers [km]) of SCI and seven are outside of this territorial limit (Figure 3.12-1). The vessels reported to be there include boats and ships used as pleasure craft, sport fishers, commercial fishers, cargo vessels, and military vessels. Submerged aircraft are also reported to exist off SCI. The area around SCI is known to contain sunken military targets and other military hardware. Civilian shipwrecks are primarily the result of grounding, swamping, collision, and explosion. Included in the inventory are 35 named shipwrecks, 14 unknown or unidentified vessels, 17 aircraft, an anchor, and the abandoned Sea Lab. An unidentified vessel could be one of the named wrecks whose exact location was not provided in the vessel’s loss report. The potential for long-term preservation of archaeological resources in the waters surrounding SCI is low because the intertidal areas are high-energy environments.

3.12.1.1.2 Current Mitigation Measures

The Navy has no current mitigation measures that apply specifically to underwater cultural resources in the SOCAL OPAREAs. The Navy's general instructions and training activity planning and review processes serve to ensure that known cultural sites and resources are adequately protected. The general instructions inform personnel of their responsibilities, and the planning process assures that effects on cultural sites and resources are minimized.

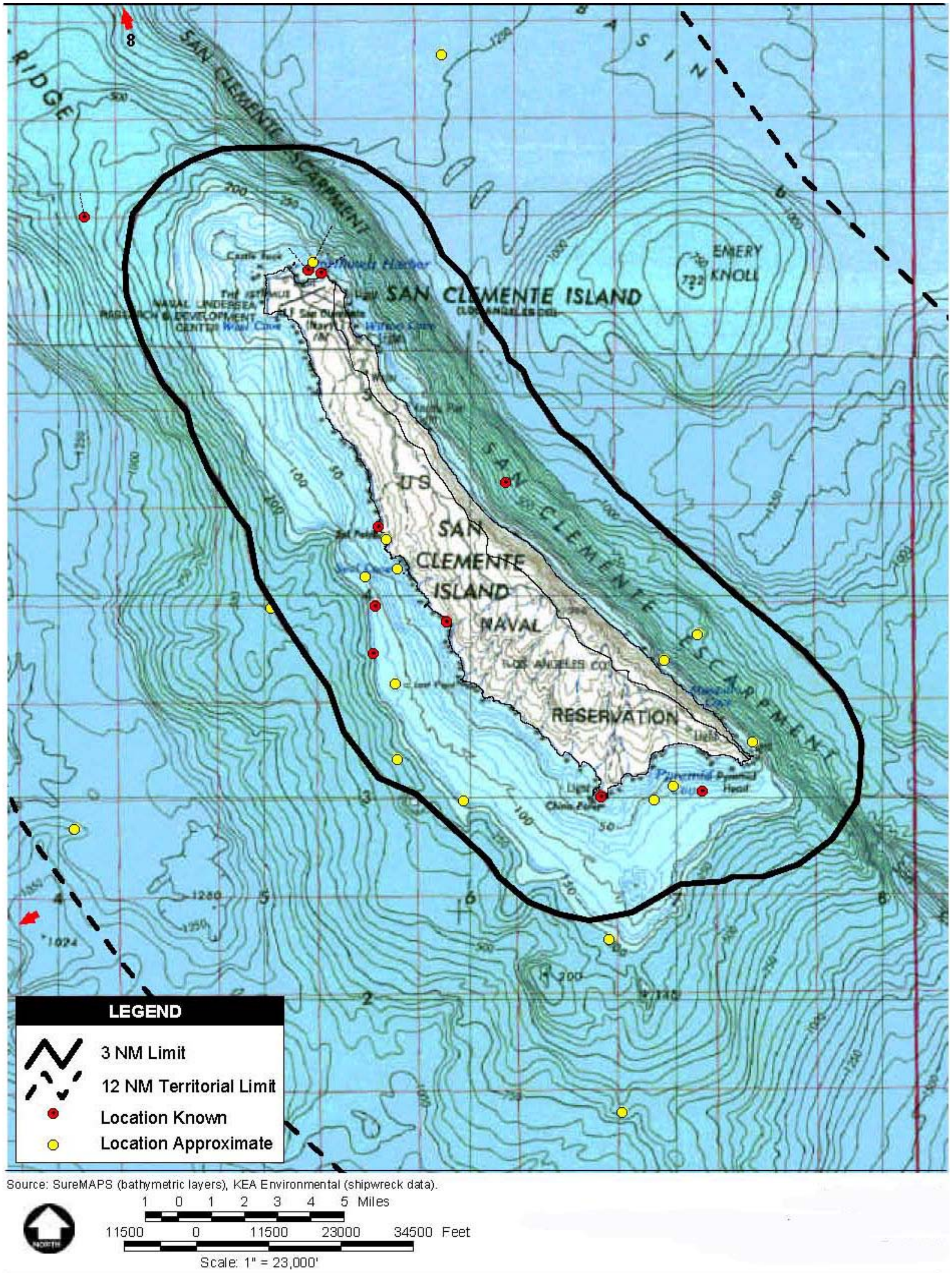

Figure 3.12-1: San Clemente Island Submerged Cultural Resources

3.12.1.2 San Clemente Island

SCI is the southernmost of the eight Channel Islands. Located in Los Angeles County, SCI is 55 nm (102 km) south of Long Beach and 68 nm (126 km) west of San Diego. Santa Catalina Island, to the north, is the closest neighboring island. SCI is arid, having no known permanent springs, although small catchments do hold some water.

In the prehistoric period, SCI appears to have been inhabited by some of the most politically complex hunter-gatherers in the world. Archaeologists have discovered evidence of a Native American culture with a strong maritime adaptation dating back about 9,000 years (Raab et al. 1994). These inhabitants hunted, fished, gathered shellfish, and participated in an elaborate trading network between the islands and the mainland.

The arrival of Spanish explorers in the 1600s had a devastating effect on mainland native American groups. Their communities were decimated by disease, and the survivors were relocated to villages next to Catholic missions. As the mission system changed the face of southern California's economy, it destroyed the elaborate social and trade networks upon which the native inhabitants of SCI depended. By the mid-1820s, nearly all of the original inhabitants were moved to the mainland.

SCI has been in federal ownership since the Treaty of Guadalupe Hidalgo ended the war with Mexico in 1848. Although it was government property, SCI was subsequently used by sea otter and seal hunters, smugglers, and fishermen, such as the Chinese fishermen who set up abalone camps along its shores. After the Civil War, sheep ranching was the primary activity on SCI. The Navy acquired SCI from the Department of Commerce in 1934 for the development of fleet training facilities.

The Navy initially used SCI for an emergency landing strip, a safe harbor for seaplanes, and a gunnery range. Development of SCI increased substantially during World War II, when several buildings and an airfield were constructed at mid-island, along with buildings and a pier at Wilson Cove. Portions of SCI and its offshore waters also served as targets during training and large-scale amphibious landing exercises. Military activity continued during the Cold War, and several new facilities were constructed, including a new airfield on the northern end of SCI.

3.12.1.2.1 Existing Conditions

Archaeological Resources

Prehistoric archaeological evidence on the Channel Islands spans approximately 11,000 years (Erlandson et al. 1996) ending with Spanish contact. The earliest explorers were in the area during the 1500s, but Spanish colonization did not begin in California until 1769. Prehistoric archaeological sites on SCI can include middens (enriched soil deposits resulting from human activity), stone tools, grinding stones, bone or shell ornaments and tools, hearths, and deposits of shell or other food-related debris. Less frequently, a prehistoric site will include items such as basketry, cordage, or mortuary remains.

Archaeological surveys on SCI have focused on its northern half, where most of the training activities occur. Approximately 51 percent of SCI has been covered by intensive pedestrian surveys. The earliest surveys were made by students from San Diego Mesa College (Axford 1975, 1976, 1977, 1978, 1984, 1987). In the 1980s, Navy personnel began surveying SCI for cultural resources (Yatsko 1985-2003). Since the 1980s, the Navy also has contracted with private firms for cultural resources investigations of SCI (Apple and Allen 1996; Apple et al. 1997; Berryman 2003; Byrd and Andrews 2001; Byrd and O'Neill 2001; Byrd and Hale 2003; Gross et al. 1996). In 1991-1992, the Navy conducted probabilistic surveys to characterize resources across SCI in conjunction with California State University, Northridge (Yatsko and

Raab 1997). Pedestrian surveys of TARs 20, 21, and 22 in the Shore Bombardment Area (SHOBA), in the southern part of SCI, identified 34 cultural sites (Apple et al. 2003).

Estimates based on a large-scale probabilistic survey indicate that over 7,500 archaeological sites may exist on SCI. Surveys have identified over 3,500 archaeological sites (Department of the Navy [DoN], 2007). Most of the recorded sites are prehistoric. Many are small middens of shellfish, fish, and sea mammal remains, along with tools used to process these and other resources. Historic sites are primarily the remains of abalone camps along the western shore and remnants of the sheep ranching efforts. These sites are often comprised of rock features, with associated domestic debris such as glass or ceramics. Data for 2,559 of the recorded sites have been compiled in an island-wide database, and official state designations (trinomials) have been assigned to 1,686 of the sites. Approximately 1,400 of the sites have site protection signs posted to identify them as avoidance areas (DoN, 2007).

Based on the substantial body of available survey data, the known and predicted archaeological site densities on SCI were mapped (Figure 3.12-2). Known site densities are based on survey results. Predicted site densities are based on survey data and geographic provinces. Although the site densities in portions of SCI are high, the archaeological sites are typically relatively small and discrete, leaving wide areas between them.

Prehistoric Archaeological Resources

The relative scarcity of terrestrial subsistence resources and the contrasted abundance of marine resources on prehistoric SCI undoubtedly contributed to the development of one of the earliest identified maritime cultural adaptations in the Southern California Bight (SCB). The economies of SCI’s prehistoric population were based heavily upon these maritime resources. Recent research indicates that SCI was occupied by maritime-adapted groups nearly 9,000 years ago (Raab et al. 1994).

Prehistoric archaeological sites are located all over SCI, but the greatest site densities are found on the western coastal terraces. Most sites are small- to moderate-size middens, but several very large and complex sites exist. These sites are found primarily on the central plateau and the lower coastal terraces on the western side of SCI. In addition to food remains and food-processing items such as ground stones, some of the sites contain trade goods from the mainland or other Channel Islands. Some of SCI’s archaeological sites have been evaluated for eligibility for the NRHP. Test excavations and evaluations have been conducted at 163 sites (Table 3.12-1). Of these sites, 139 (85 percent) are considered eligible for the NRHP.

In addition to NHPA Section 106 compliance excavations, a number of academic investigations have been jointly conducted by the Navy and cooperating colleges and universities, including summer field school excavations at Eel Point and other important sites (Chiswell n.d.; Meighan 2000; Yatsko 1987, 1989, 1991, 1992; Raab and Yatsko 1990; Raab 1991). Several master’s theses and senior papers focused on various aspects of SCI’s past have also been produced (Ghirardelli 1984; Rechtman 1985; Foley 1987; Noah 1987; Titus 1987; Eisentraut 1988; Howard 1991; Huey 1992; Bruce 1994; Hale 1995; Porcasi 1995; Andrews 1996; Fiore 1998; Vance 2000; Strauss 2001; Ehringer 2003; Storey 2002; King 2005). A number of doctoral dissertations have also been written (Salls 1988; Scalise 1994; Berryman 1995; Garlinghouse 2000; Yatsko 2000; Taskiran 2001).

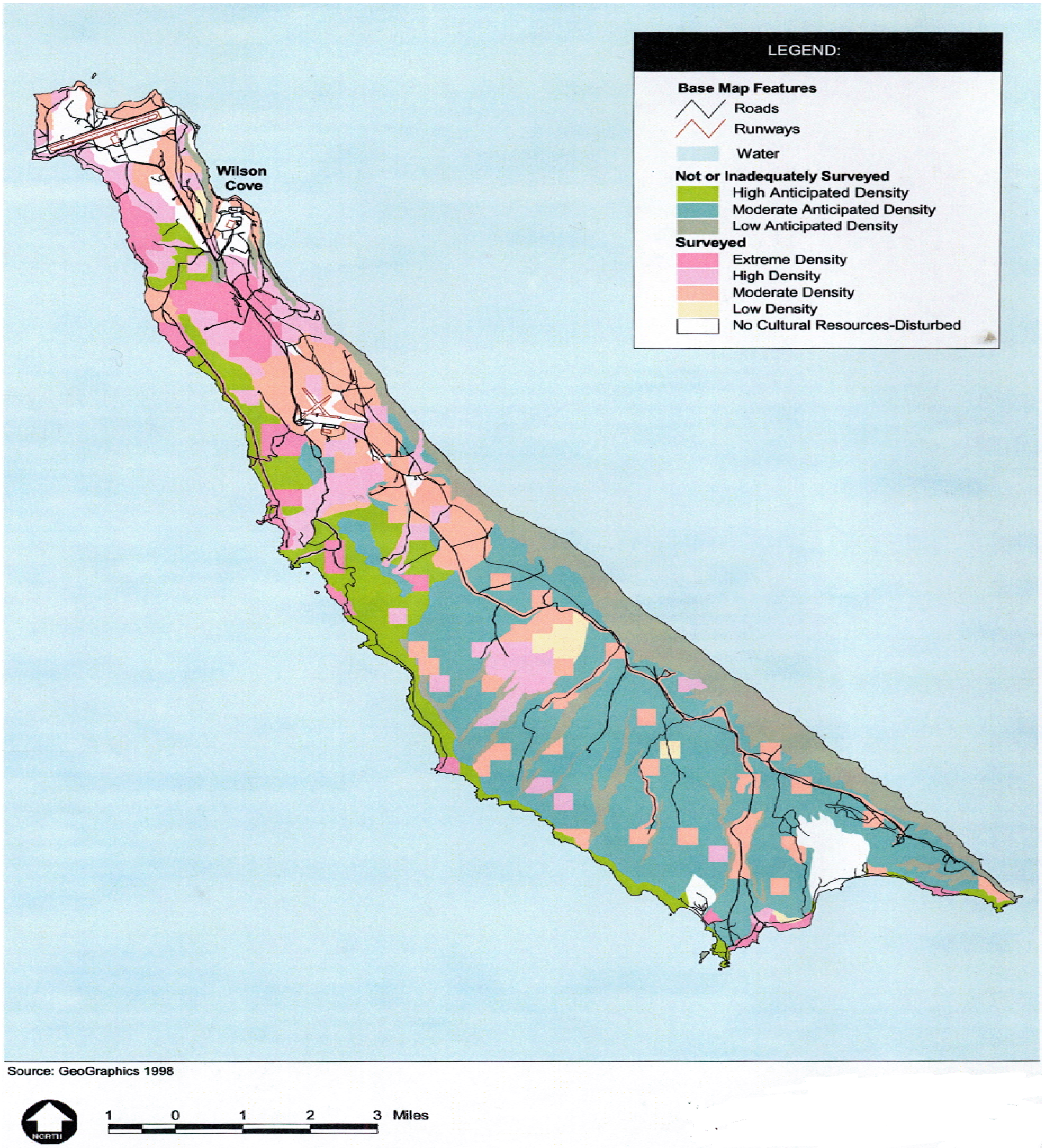

Figure 3.12-2: Cultural Resources Site Density on SCI

Table 3.12-1: San Clemente Island Cultural Resource Assessments and Excavations

References (by date)	Number of Sites	Sites Recommended Eligible for NRHP
UCLA Field School (n.d.)	11	7
Clewlow 1983	5	5
Noah 1989	1	1
Huey 1992	1	1
Strudwick and Gallegos 1994	1	1
Berryman 1995	32	25
NCPA Field School (n.d.)	14	13
Hildebrandt and Jones 1996	4	2
Perry and Gallegos 1997	1	1
Doolittle et al. 1997	9	8
York and Wahoff 1997	6	6
Yatsko and Raab 1997	24	24
Raab et al. 1997	15	9
Byrd et al. 1998	3	3
Byrd (editor) 2000a	4	3
Byrd (editor) 2000b	3	3
Yatsko 2000	18	18
Byrd and Andrews 2002	5	5
Berryman and Cheever 2002	2	1
Byrd et al. 2003	4	3
Total	**163**	**139 (85%)**
Note: n.d. - no date.		

Historic Archaeological Resources

The SCI archaeological database described above includes 28 identified historic cultural resources. These resources are primarily associated with Chinese abalone processing on SCI or with sheep ranching. A geographic history (Bruce 1994) and an overview of the history and historical archaeology of SCI (Hatheway and Greenwood 1981) have summarized the major periods of activity. Throughout the historic period, the human population of SCI has been small, and archaeological remains from this period are limited. Few investigations have focused on the historic archaeological resources of SCI (Rechtman 1985; Berryman 1995; Storey 2002).

Historic Architectural Resources

Architectural resources on SCI are primarily related to military activities, and date to World War II and the Cold War. A few structures predate SCI's military development, including three cement water tanks and a dam from the sheep ranching era.

Based on a review of the property records for SCI, there are 58 pre-World War II and World War II-era (1935-1945), 172 Cold War (1946-1989), and 46 modern (1989-1998) buildings and structures. Another 143 structures (dams, tanks, etc.) of undetermined age also are present on SCI. One World War II dam has been inventoried (Apple and Allen 1996). A Cold War antenna complex, a missile launch complex, and two World War II gun range targets also were evaluated and determined not to be eligible for the NRHP (JRP Historical Consulting Services 1997).

In 1998, another inventory and evaluation program was conducted for Wilson Cove, the main developed area on SCI (Manley and Van Wormer 1998). None of the buildings or structures evaluated were determined to be eligible for the NRHP (JRP Historical Consulting Services 1997; Manley and Van Wormer 1998). SCI Cold War buildings and structures are included in a statewide Defense Department Cold War study (JRP Historical Consulting Services 2000). This study identified one NRHP-eligible Cold War-era historic property, the NOTS Pier Historic District. A subsequent Section 106 consultation was conducted of an adverse effect on this district, the demolition and replacement of its principal contributing element, (NOTS) Pier. This consultation resolved the adverse effect through a comprehensive Historic American Building Survey (HABS) / Historic American Engineering Record (HAER) documentation that procedurally removed the NRHP-eligibility of this property.

Traditional Cultural Resources and Native American Issues

SCI has been in the stewardship of the U.S. government since 1848; access since then has been limited. Archaeological evidence exists of some historic Native American use of SCI, but no traditional cultural resources have been identified. No federally recognized Native American tribes are affiliated with SCI, although Native Americans of Gabrielino descent have expressed interest and concern about island resources.

3.12.1.2.2 Current Mitigation Measures

Current Conditions and Stipulations

Avoidance of adverse effect is the preferred treatment for cultural resources. There are several existing cultural resource measures for site avoidance in place at SCI. These measures include:

1. All Proposed Actions except those on existing ranges are reviewed by the Natural Resources Office (NRO) for their effects on cultural resources;
2. Ongoing mitigation focuses on treating adverse effects;
3. Vehicles are required to stay on established roads or within the Assault Vehicle Maneuver Corridor (AVMC) (includes the Assault Vehicle Maneuver Areas [AVMAs] and Assault Vehicle Maneuver Road [AVMR]);
4. Unauthorized collection of archaeological material is not allowed;
5. No digging is permitted;
6. Archaeological sites in areas of high use are posted with archaeological site protection signs; and
7. U.S. Marine Corps amphibious training is restricted to designated shore landing areas, and foot traffic is limited to the Infantry Operations Area.

The Navy uses environmental planning, and project design and redesign to avoid or minimize impacts on resources. When avoidance is not feasible, however, eligible resources must receive appropriate mitigation. For archaeological sites considered important for their potential to provide information, this usually involves data recovery. Mitigating impacts on built resources typically involves HABS/HAER documentation. The character of treatment is determined through consultation with SHPO and ACHP on adverse effect under 36 C.F.R. Part 800.

Programmatic Agreement

Under 36 (C.F.R.) § 800.14, an agency may develop procedures to implement Section 106 of the NHPA and develop a Programmatic Agreement (PA) to govern implementation of the program. NHPA Section 106 compliance on SCI will be governed by a PA. The Draft PA (DoN, 2007) stipulates qualifications of personnel, development of an Integrated Cultural Resources Management Plan (ICRMP), determination of an Area of Potential Effects, evaluation of resources to ensure that authorizations for ground-disturbing activities include appropriate measures to protect archaeological resources, emergency procedures, and annual reporting.

The draft PA identifies SHOBA Impact Areas I and II in the southern portion of SCI as areas exempt from compliance with Section 106 due to their degree of disturbance and the safety risk to personnel that would be required to survey these areas. The PA defines dispersed pedestrian troop movements as having no potential for affecting cultural resources. Attachment B to the Draft PA contains detailed instructions for construction, repair, maintenance, and modifications of facilities on SCI, to ensure that impacts on historic properties are minimized. Attachment C to the Draft PA contains detailed procedures for marking known cultural resources sites on SCI with signs to help prevent disturbance of these sites.

Two of the 21 Draft PA Stipulations are particularly relevant when addressing environmental impacts:

- 7A—this portion of Stipulation 7 addresses SCI lands that are exempt from compliance with Section 106, specifically Impact Areas I and II in SHOBA. The PA stipulates that training and support activities within or affecting Impact Areas I and II are not subject to consideration of effect under Section 106, and are exempt from protocols that are typical for compliance with 36 C.F.R. Part 800.
- 9F—Stipulation 9 pertains to the types of undertakings that do and do not require review beyond that done in conjunction with the Commander, Navy Region Southwest Site Approval and Operational Request review process. Stipulation 9F states that dispersed personnel movements are considered to have no adverse effect on archaeological properties. This stipulation does not apply to areas of troop concentrations (designated bivouacs or troop assemble areas, etc.).

Integrated Cultural Resources Management Plan

To ensure that cultural resources are managed in a planned and coordinated manner, the Navy is preparing a San Clemente Island Range Complex (SCIRC) ICRMP. The ICRMP is a plan for overall management of cultural resources at a federal installation. The 18 required elements of an ICRMP are:

- Summarize known resources
- Analyze context
- Identify areas not inventoried
- Prioritize goals
- Identify actions that may affect cultural resources
- Establish procedures to protect cultural resources
- Identify unique resource issues at the installation
- Provide preservation and mitigation strategies
- Coordinate between the installation, regulatory agencies, and the public
- Provide for permanent storage of records
- Establish standard operating procedures for routine occurrences
- Provide procedures for documentation of historic properties that will be altered or destroyed
- Provide for consultation with interested groups and individuals
- Establish procedures for unanticipated discoveries
- Identify procedures for properly maintaining collections
- Provide for sharing appropriate cultural resource information
- Provide for enforcement of cultural resources laws and regulations
- As appropriate, provide for public access

Several of these elements already have been addressed in the current Cultural Resources Management Plan for SCI, and some are being addressed in this Environmental Impact Statement (EIS) / Overseas Environmental Impact Statement (OEIS). Other elements remain to be included in the SCI resource management effort and will be addressed in the ICRMP, which will provide for overall management of cultural resources.

3.12.2 Environmental Consequences

3.12.2.1 Approach to Analysis

Federal laws and regulations have established the requirements for identifying, evaluating, and mitigating impacts on cultural resources. Pertinent provisions of NHPA, ARPA, and NAGPRA address management and treatment of cultural resources. Provisions of NHPA will be addressed in more detail below. ARPA provides for site protection through penalties for non-compliance with its statutes and provides for authorizing archaeological investigations. NAGPRA contains requirements for repatriation of Native American human remains and associated funerary objects found on federal lands.

Under NHPA, resource significance is determined on the basis of NRHP criteria (36 C.F.R. § 60.4) in consultation with SHPO. A project affects a resource's significance when it alters the characteristics of the property that qualify it as significant under NRHP criteria. Effects may include:

- Physical destruction or damage to all or part of the resource;
- Alteration of a property in a way that is inconsistent with the Secretary's Standards for the Treatment of Historic Properties (36 C.F.R.Part 68);
- Introduction of visual, atmospheric, or audible elements that alter the setting and diminish the integrity of the property's significant features;
- Neglect of a resource, resulting in its deterioration or destruction; and
- Any change that could adversely affect the qualities that make the property significant.

Under NHPA, assessing impacts involves identifying activities that could directly or indirectly affect significant resources, identifying known or expected significant resources in the area of potential effects, and determining the level of impacts on the resources. Possible findings include no effect, no adverse effect, or an adverse effect on significant resources (36 C.F.R. § 800.4-9). To facilitate management of cultural resources on SCI, the Navy is entering into a PA under 36 C.F.R. § 800.14. The Draft PA provides alternatives to the standard procedures for complying with Section 106 of the NHPA. Under the Draft PA, the Navy must still consult with SHPO if there is a finding of adverse effect, and negotiate a Memorandum of Agreement (MOA) for resolution of the adverse effect.

Under the National Environmental Policy Act of 1969 (NEPA), impacts on cultural resources are explicitly identified as attributes that must be addressed to determine the significance of a project's anticipated environmental effects. The potential for adverse effects on cultural resources is considered in this NEPA assessment. An adverse effect on a historic property, however, does not necessarily equate to a significant impact under NEPA. Under NEPA, a significant impact can be mitigated to less than significant through data recovery or other treatment measures. In assessing impacts on cultural resources under NEPA, 40 C.F.R. § 1508.27 defines significance in terms of context and intensity. These elements include consideration of the impacts on the community, the importance of a site, unique characteristics, and the severity of the impact.

To facilitate effects assessments, undisturbed areas not previously surveyed will be inventoried, and training plans will be reviewed and redesigned to avoid cultural resources, if feasible. If avoidance is not feasible, sites will be evaluated under the existing SCI protocol. If an eligible site would be adversely affected by training activities, appropriate treatment will be identified through consultation. For archaeological resources, treatment typically will consist of data recovery.

Impacts on cultural resources can be either direct or indirect. Direct impacts on archaeological resources usually result from ground disturbance. Architectural resources may be directly impacted by modifications to the structure. Indirect impacts on significant cultural resources can involve alterations in its setting, increased access leading to vandalism, or changes in land status without adequate protection of the resources. Impacts on traditional Native American properties can be determined through consultation with the affected Native American groups.

3.12.2.2 No Action Alternative

3.12.2.2.1 SOCAL OPAREAs

Training in the offshore SOCAL OPAREAs encompasses the air, ocean surface, and subsurface. No traditional cultural resources or prehistoric resources are known to exist within the SOCAL OPAREAs, but a few shipwrecks exist in the area. Submerged cultural resources, such as shipwrecks, are not affected by surface vessels because surface vessels do not come in contact with or otherwise disturb benthic resources. Submerged cultural resources are not affected by the occasional transit of submarines because these subsurface vessels avoid underwater obstacles such as shipwrecks.

Under the No Action Alternative, the Navy continues its existing training and Research, Development, Test, and Evaluation (RDT&E) programs. Effects of offshore training activities on cultural resources are limited to training expendables (e.g., targets, sonobuoys, bombs, missiles, and other ordnance) falling into the ocean and settling on submerged resources. These effects on historic resources are negligible because there are few underwater cultural resources, and they are widely dispersed. In the waters surrounding SCI where such resources are relatively dense, for example, there are 44 known sites distributed over 2,620 square nautical miles (nm2) of ocean, or about one site for every 60 nm2. The probability of an expendable landing on a resource is very low and, in any case, the settling of small amounts of debris on submerged resources will have no more adverse effect than the gradual accumulation of natural sediments on such resources.

The Camp Pendleton Amphibious Assault Area (CPAAA), including the Camp Pendleton Amphibious Vehicle Area (CPAVA), does not include any land area. Prehistoric cultural resources in the CPAAA/CPAVA, if any, are limited to small, isolated artifacts in nearshore sediments. Submerged historic resources, such as shipwrecks, are not likely to be affected by amphibious training activities. No such resources are known to be in areas proposed for amphibious landing exercises.

Offshore RDT&E activities include Ship Torpedo Tests, Unmanned Underwater Vehicle Tests, Sonobuoy Quality Assurance/Quality Control Tests, Ocean Engineering, Marine Mammal Mine Shape Location / Research, Naval Undersea Warfare Center (NUWC) Acoustic Tests, and Surface Ship Radiated Noise Measurement Tests. Submerged resources are not affected by test expendables because they occur at a very low density and expendables are unlikely to land on any resources.

3.12.2.2.2 San Clemente Island

Live-Fire Activities in SHOBA

Impact Areas I and II within SHOBA have been subjected to repeated bombardment for decades. The integrity of any cultural resources in these areas has been severely degraded. Safety concerns over unexploded ordnance (UXO) preclude these areas from being assessed for cultural resources. This limitation is acknowledged in Stipulation 7A of the Draft PA.

Thus, Naval Surface Fire Support (NSFS), Expeditionary Firing Exercises (EFEX), Bombing Exercises (BOMBEXs), and Explosives Ordnance Disposal (EOD) training in Impact Areas I and II are excluded from cultural resources impact assessment under NHPA. Under Stipulation 7A of the Draft PA, Impact Areas I and II are not subject to consideration of effect under Section 106, and are exempt from procedures and protocols typical for compliance with 36 C.F.R. Part 800. EFEXs outside of Impact Areas I and II, Artillery Firing Point (AFP) 1, and Observation Posts (OPs) 1 and 3 are located in areas with no cultural resources. EFEX events at AFP-1 and AFP-6 may affect archaeological resources by disturbing surface soils.

Cultural resources in SHOBA, outside of Impact Areas I and II, could have been affected by past training activities and may continue being affected under the No Action Alternative. These resources have not been evaluated for eligibility for listing in the NRHP, so the level of effects has not been determined. Unevaluated resources are treated, for purposes of impact assessment, as potentially eligible resources. Consultation is required to address the effects of the Proposed Action on these resources.

Stingers are shoulder-launched missiles fired toward the ocean from positions onshore in SHOBA. Stinger training is consistent with a "no adverse effect" determination for historic properties because participant vehicles are restricted to roads and dispersed pedestrian activities are not considered to be an adverse effect under Stipulation 9F of the Draft PA.

EOD training may occur in SHOBA, outside of the Impact Areas, in response to the identification of UXO. Disposal actions are individually reviewed for safety risk. Personnel safety is the primary concern. Within these constraints, disposal activities seek to avoid adverse effects on cultural resources.

In summary, training in portions of SHOBA able to be assessed for cultural resources (i.e., excluding the Impact Areas) consists primarily of dispersed pedestrian activities, which are deemed to have no substantial effect on cultural resources. Training other than pedestrian activities can affect cultural resources in SHOBA, and does require consultation with SHPO. For sites determined to be eligible to the NRHP, resource management measures (e.g., avoidance, data recovery) can result in a determination of "no effect."

Amphibious Warfare

Troops conducting amphibious landings at Wilson Cove, West Cove, and Eel Cove use existing roads to access VC-3 (see Figure 2-3). Air operations, air-to-ground weapons delivery, and artillery firings associated with Expeditionary Assaults are conducted in SHOBA. Tracked and amphibious vehicles use the AVMC. Vehicles are restricted to existing roads and approved travel corridors.

There are no cultural resources in the two AVMAs located in the northern portion of SCI. Thirty-two archaeological sites in the AVMA that encompassed the Old Airfield VC-3 are posted with site protection signs to facilitate avoidance. Amphibious landings are considered to have no adverse effect under Stipulation 9F of the Draft PA. Thus, no cultural resources are affected by these training activities.

Naval Special Warfare (NSW)

NSW training mostly occurs in well-defined, well-used areas that lack cultural resources, and where no historic properties are affected. Land demolitions occur on the demolition range in Special Warfare Training Area (SWAT) 2 (see Figure 2-2). Small arms training occurs on the Small Arms Range in SWAT 2. The nearshore waters used for Underwater Demolitions, Mat Weave, and Obstacle Loading are located within 100 feet [30 meters] of shore, where no historic properties are affected. These training activities do not affect cultural resources. Land Navigation

Field Training occurs all over SCI, but is limited to pedestrian activity. Under Stipulation 9F of the Draft PA, pedestrian activities are considered to have no adverse effect.

Naval Special Warfare Group ONE (NSWG-1) platoon-level training incorporates many of the activities discussed above. These activities occur in the areas described above and the TARs described below. SHPO concurred that, based on the Navy's commitment to avoid sites, training on TARs 1, 4, 10, 16, and 17 would not affect historic properties (Letter of Daniel Abeyta to Jan Larson, December 21, 1999).

TAR 2—Graduation Beach Underwater Demolition Range

Training and improvements at TAR 2 could affect a small midden that was evaluated as eligible for the NRHP (Doolittle et al. 1997). A site protection sign would be placed at the site to facilitate avoidance. Facilities would be sited to avoid the resource.

TAR 3—BUD/S Beach Underwater Demolition Range

The activities described for TAR 2 are also proposed at TAR 3, with the addition of parachute drops. No cultural resources would be affected by the use of TAR 3. Ancillary improvements would occur in areas that are disturbed or of moderate site density, where archaeological resources could be impacted. These facilities would be located and designed, however, to avoid impacts on cultural resources.

TAR 5—West Cove Amphibious Assault Training Area

No historic properties would be affected by training activities at TAR 5. Training activities would avoid any cultural resources located in this TAR.

TAR 6—White House Training Area

No alterations of the buildings or structures are planned, nor are any improvements proposed at TAR 6. Training activities would avoid the archaeological site located at the TAR.

TAR 7—Saint Offshore Parachute Drop Zone

No submerged cultural resources were identified in the records search for TAR 7. Based on its location and the depth of the water, TAR 7 would have low cultural resources sensitivity. No live-fire or explosive demolitions would occur in this offshore area.

TAR 8—Westside Nearshore Parachute Drop Zone

Activities described for TAR 7 are also proposed in TAR 8. No submerged cultural resources were identified in the records search for TAR 8. Based on its location and the relatively shallow water, TAR 8 could contain submerged historical resources. No live-fire or explosive demolitions are planned for this area, so no impacts on submerged resources would occur.

TAR 9—Photo Lab Training Area

TAR 9 is located in an area of extremely high site density, and planned improvements could affect eight archaeological sites. Ground-disturbing activities would be sited to avoid the cultural resources.

TAR 11—Surveillance Training Area

No archaeological sites are present in TAR 11. The existing building would not be substantially affected.

TAR 12—Radar Site Training Area

The Cold War-era facilities located within the Radar Site Training Area would not be substantially affected by training activities. A previously recorded archaeological site located within the TAR would be avoided during training. Planned ancillary improvements would occur in areas of moderate to low archaeological site density; these improvements would be located and designed to avoid impacts on cultural resources.

TAR 13—Randall Radar Site Training Area

Activities would include tactical land demolitions and close quarter combat. A demolition area would need to be cleared for target placement and a firebreak. A Cold War-era bunker (Control Station Randall Facility) and a camera shelter located at TAR 13 have been recommended as not eligible for the NRHP (JRP Historical Consulting Services 1997). Proposed training activities would not substantially affect a known archaeological site located at TAR 13. The demolition area and firebreak would be sited to avoid the resource.

TAR 14—VC-3 Onshore Parachute Drop Zone "Twinky"

Numerous cultural resources are present at TAR 14: a dam, a reservoir, and 33 archaeological sites, of which 23 are within the TAR 14/TAR 15 overlap. The "Twinky" Drop Zone is off the northern end of the northwest/southeast abandoned runway at VC-3. Possible impacts include damage from equipment drops and land demolitions. To avoid affecting historic properties, these activities would be sited in areas without cultural resources.

TAR 15—VC-3 Airfield Training Area

TAR 15 is a large area encompassing 62 archaeological sites (23 are also within the TAR 14/15 overlap) and 18 buildings and structures, some dating to before World War II. Although the structures would not be affected by training, the archaeological sites could be affected by proposed demolitions at TAR 15. To avoid affecting archaeological sites, demolitions would be sited in areas without cultural resources.

TAR 18—Close Quarter Battle Training Complex

The area is disturbed by runway construction. No cultural resources are present within TAR 18, and therefore no cultural resources would be affected.

TAR 19—Simulated POW Camp and SAM Site

The area is disturbed by runway construction and recent quarrying activities. There are no cultural resources present within TAR 19. Therefore, no cultural resources would be affected.

TAR 20—Pyramid Cove Training Area

TAR 20 is within Impact Area I, and is thus exempt from consideration under NHPA per Stipulation 7A of the Draft PA.

TAR 21—Horse Beach Cove Training Area

TAR 21 is inside Impact Area I is exempt from consideration under NEPA per Stipulation 7A of the Draft PA.

TAR 22—China Cove Training Area

Training events in TAR-22, inside Impact Area II, are exempt from consideration under NEPA per Stipulation 7A of the Draft PA.

In summary, NSW training under the No Action Alternative does not affect cultural resources.

Strike Warfare

BOMBEXs are addressed above under SHOBA. Combat Search and Rescue (CSAR) training occurs island-wide, and includes helicopters, vehicles, and foot traffic. Pedestrian activities are deemed to have no adverse effect under Stipulation 9F of the Draft PA. Air operations and vehicle travel on established roads have no adverse effect on historic properties because they do not disburb soils in which cultural resources may be located.

Other Island Operations

EOD training outside of SHOBA is similar to that in SHOBA. Activities are less frequent, however, and are only conducted at VC-3. Ordnance disposal actions at VC-3 are sited to avoid cultural resources. EOD activities occur island-wide in response to the identification of UXO. Disposal actions are individually reviewed for safety risk. Personnel safety is the primary concern. Within these constraints, disposal activities seek to avoid adverse effects on historic properties.

Operations at NALF consist of takeoffs and landings, and associated ground vehicle travel on developed and paved portions of the site. No historic properties are affected by these activities.

Research, Development, Test and Evaluation (RDT&E)

Ground support activities for missile flight tests (placing targets and range instrumentation, and EOD cleanup) can affect cultural resources adjacent to the Missile Impact Range (MIR). To facilitate avoidance, site protection signs are located at the sites adjacent to the MIR.

Summary

Based on the analysis presented above, SCI components of the No Action Alternative have no substantial effect on cultural resources in most areas of SCI. Live-fire activities in those portions of SHOBA able to be assessed for cultural resources do require consultation with SHPO prior to a determination under NHPA, and can require additional management measures for these resources.

3.12.2.3 Alternative 1

3.12.2.3.1 SOCAL OPAREAs

Under Alternative 1, the number of Navy training events in the offshore SOCAL OPAREAs would increase (See Table 2-7). The nature of the training activities, however, would not change substantially. Aerial, surface, and subsurface training activities would not affect submerged cultural resources resting on or buried in bottom sediments. Impacts on cultural resources in the offshore SOCAL OPAREAs thus would not differ substantially from those described under the No Action Alternative.

3.12.2.3.2 San Clemente Island

Live-Fire Activities in SHOBA

Under Alternative 1, the tempo of some training activities in SHOBA would increase, but the general nature of those activities would not change. Impacts under Alternative 1 generally would be the same as described under the No Action Alternative. Live fire activities could affect cultural resources in those portions of SHOBA able to be assessed for cultural resources impacts, and would require consultation with SHPO. The proposed increase in live-fire activities in SHOBA over the No Action Alternative, estimated at about 11 percent, would increase the degree of any impacts on cultural resources, which would influence the determination of effect and necessary management measures and actions under NHPA.

One new training activity in SHOBA under Alternative 1 would be a battalion-size amphibious landing. The air operations, air-to-ground weapons delivery, and artillery impacts in SHOBA associated with this activity would be consistent in nature and intensity with the overall use of SHOBA.

In summary, training in portions of SHOBA capable of being assessed for cultural resources (i.e., excluding Impact Areas I and II) consists primarily of dispersed pedestrian activities, which are deemed to have no substantial effect on cultural resources. Except for an 11 percent increase in impacts associated with live fire exercises, no substantial effects on cultural resources are expected from the increases in training tempo.

Amphibious Warfare Training

Under Alternative 1, the I MEF proposes to modify its activities and add new types of amphibious training. Personnel movements would occur within the Infantry Operating Area.

Most activities associated with the amphibious training activities would not affect cultural resources because dispersed pedestrian activity is considered to have no adverse effect under Stipulation 9F of the Draft PA. Vehicles are restricted to developed routes within the AVMR and the AVMAs. Live fire directed into the Impact Areas would be precluded from consideration under the current NEPA analysis, as discussed above, and Stipulation 7A of the Draft PA.

Troops conducting amphibious landings at Wilson Cove, Northwest Harbor, West Cove, and SHOBA would use existing roads to access VC-3. Air operations, air-to-ground weapons delivery, and artillery firings are conducted in SHOBA (see discussion above). All vehicles would be restricted to existing roads and approved travel corridors (e.g., AVMC). Tracked and amphibious vehicles would use the AVMC. Amphibious landings would be consistent with a "no adverse effect" determination under Stipulation 9F of the Draft PA. No cultural resources would be affected by this training operation.

There are no cultural resources in the two AVMAs located in the northern portion of SCI. Cultural resources are present in the AVMA that encompasses the Old Airfield VC-3. Thirty-two archaeological sites within the undisturbed portions of the Old Airfield VC-3 operations area could be affected. Until consultation for effect is conducted on the Draft PA, site protection signs would be used to facilitate avoidance of the resources in this area.

Naval Special Warfare (NSW)

Under Alternative 1, the tempo of some NSW training activities would increase; NSW land training activities would increase by an estimated 50 percent compared with the No Action Alternative. However, the general nature of those activities would not change. Impacts under Alternative 1 generally would be the same as described under the No Action Alternative.

Cultural resource impacts in TARs 1, 4, 10, 16, and 17 were previously analyzed under NEPA (DoN 1998). The anticipated impacts of the Proposed Action in the remaining TARs are expected to be the same as the No Action Alternative. Pedestrian activities in the TARs are not considered an adverse effect under NEPA and Stipulation 9F of the Draft PA.

If a potentially eligible resource were identified during training, the CNRSW would be notified, and the resource would be assessed under the Draft PA. If the resource was found to be eligible, appropriate mitigation would be identified through consultation with SHPO, ACHP, and interested parties.

Strike Warfare

BOMBEXs would increase by about 12 percent under Alternative 1, compared with the No Action Alternative. All of these activities would occur, however, in SHOBA's Impact Areas I and II, where cultural resources effects cannot be assessed and are not required to be assessed (see "Live Fire Activities in SHOBA" section above). As discussed under the No Action Alternative, CSAR training activities have no effect on terrestrial cultural resources.

Other Island Operations

As discussed under the No Action Alternative, EOD activities have no substantial effect on cultural resources; a 25 percent increase in this activity under Alternative 1 would result in a negligible change in effects. Increased aircraft landings and takeoffs at NALF under Alternative 1 would have no effect on cultural resources because there are no exposed cultural resources.

Research, Development, Test and Evaluation (RDT&E)

Ground support activities for missile flight tests (placing targets and range instrumentation, and EOD cleanup) could affect cultural resources adjacent to the Missile Impact Range (MIR). To facilitate avoidance, site protection signs would be located at the sites adjacent to the MIR.

Summary

Based on the analysis presented above, the SCI components of Alternative 1 would have no effect on cultural resources on most areas of SCI. Live fire activities in those portions of SHOBA able to be assessed for cultural resources and Amphibious Warfare activities near 32 archaeological sites within the undisturbed portions of the Old Airfield VC-3 operations area would require SHPO consultation prior to a determination under NHPA. Impacts on archaeological sites in TAR 20, TAR 21, and TAR 22 from NSW training activities could require mitigation measures. Section 3.12.3 discusses measures in place to mitigate the impact on these cultural resources.

3.12.2.4 Alternative 2

3.12.2.4.1 SOCAL OPAREAs

Under Alternative 2, the number of events would increase by about 26 percent over the No Action Alternative (See Table 2-8). The nature of the training activities, however, would not change substantially. Aerial, surface, and subsurface training activities would have no effect on submerged cultural resources resting on or buried in bottom sediments, regardless of the level of training activity.

The Shallow Water Training Range (SWTR) Extension would encompass several known or approximate locations of shipwrecks, including three to the east of SCI and eight on the western side. Construction of the SWTR Extension (installation of cables, hydrophones, and sensors on the ocean floor) would have no effect because the Navy would take care to avoid known cultural resource sites in the siting of new facilities. Use of the SWTR Extension would not affect submerged cultural resources, for the reasons explained above.

Installation of the shallow water minefield requires the mooring of mineshapes to a flat sandy bottom area of the ocean floor. Submerged cultural resources would be avoided.

3.12.2.4.2 San Clemente Island

Live-Fire Activities in SHOBA

The impacts of training activities on SCI's cultural resources under Alternative 2 would be similar in nature to those described for the No Action Alternative. The proposed increase in live fire activities, estimated to be about 21 percent, would increase the degree of impacts on cultural resources outside of Impact Areas I and II, which would influence the determination of effect under NHPA. Consultation with SHPO would be necessary.

One new training activity in SHOBA under Alternative 2 would be a battalion-size amphibious landing. This activity is described below under USMC Amphibious Training; under Alternative 2, two such exercises would occur per year. The air operations, air-to-ground weapons delivery, and artillery impacts in SHOBA would be consistent in nature and intensity with the overall use of this area.

In summary, training activities in portions of SHOBA capable of being assessed for cultural resources (i.e., excluding Impact Areas I and II) consist primarily of dispersed pedestrian activities, which are deemed to have no substantial effect on cultural resources. Except for live fire activities, no substantial effects on cultural resources able to be assessed would result from the increases in training tempo.

Amphibious Warfare Training

Under Alternative 2, the I MEF proposes to modify its activities and add new types of amphibious training. Personnel movements would occur within the Infantry Operating Area.

Most activities associated with the amphibious training activities would not affect cultural resources because dispersed pedestrian activity is considered to have no adverse effect under Stipulation 9F of the Draft PA. Vehicles are restricted to developed routes within the AVMR and the AVMAs. Live fire directed into SHOBA's Impact Areas would be precluded from consideration under NEPA and Stipulation 7A of the Draft PA, as discussed above.

Troops conducting Amphibious Landings at Wilson Cove, Northwest Harbor, West Cove, and SHOBA would use existing roads to access VC-3. Air operations, air-to-ground weapons delivery, and artillery firings would be conducted in SHOBA. All vehicles would be restricted to existing roads and approved travel corridors. Tracked and amphibious vehicles would use the AVMC. Amphibious landings would be consistent with a "no adverse effect" determination under Stipulation 9F of the Draft PA. No known cultural resources would be affected by this training.

Cultural resources at the Old Airfield could be impacted by off-road activities in AVMA. There are no cultural resources in the two AVMAs located in the northern portion of SCI. Cultural resources are present in the AVMA that encompasses the Old Airfield VC-3. Thirty-two archaeological sites within the undisturbed portions of the Old Airfield VC-3 operations area could be affected. Until consultation for effect is conducted on the Draft PA, site protection signs would be used to facilitate avoidance of the resources in this area.

Naval Special Warfare (NSW)

Under Alternative 2, the tempo of some NSW training activities would increase over baseline (No Action Alternative) levels, but the general nature of those activities would not change. NSW land training, overall, would increase by about 61 percent.

Although the tempo of training activities would be incrementally higher under Alternative 2 than under Alternative 1, the impacts of the Proposed Action in the remaining TARs would be generally the same as discussed under the No Action Alternative, based on the nature of those activities and existing mitigation measures.

Pedestrian activities in the TARs are not considered an adverse effect under NEPA and Stipulation 9F of the Draft PA. Proposed training other than pedestrian activities could affect archaeological sites in TAR 20, TAR 21, and TAR 22, as discussed under the No Action Alterantive. Site protection signs would be placed to reduce the likelihood of disturbance of these sites during training.

Strike Warfare

BOMBEXs would increase by about 23 percent under Alternative 2, compared with the No Action Alternative. All of these activities would occur, however, in SHOBA Impact Areas I and II, where cultural resources effects cannot be assessed and are not required to be assessed (see "Live Fire Activities in SHOBA" section above). As discussed under the No Action Alternative, CSAR training activities have no effect on terrestrial cultural resources.

Other Island Operations

This activity would increase by 150 percent under Alternative 2 (from 4 to 10 operations per year). EOD training outside of SHOBA is conducted only at VC-3. Ordnance disposal actions at VC-3 are sited to avoid known cultural resources. Because of the low number of these activities per year and the precautions taken, their effects on cultural resources would be negligible.

Increased aircraft landings and takeoffs at NALF under Alternative 2 would have no effect on cultural resources because landings and takeoffs occur on paved surfaces devoid of cultural resources.

Research, Development, Test and Evaluation (RDT&E)

Ground support activities for missile flight tests (placing targets and range instrumentation, and EOD cleanup) could affect cultural resources adjacent to the Missile Impact Range (MIR). To facilitate avoidance, site protection signs would be located at the sites adjacent to the MIR.

Summary

Based on the analysis presented above, the SCI components of Alternative 2 would have no effect on cultural resources on most areas of SCI. Live fire activities in those portions of SHOBA able to be assessed for cultural resources and Amphibious Warfare activities near 32 archaeological sites within the undisturbed portions of the Old Airfield VC-3 operations area would require consultation prior to a determination under NHPA. Impacts on archaeological sites in TAR 20, TAR 21, and TAR 22 from NSW training activities would require mitigation measures. Section 3.12.3.2.1 discusses measures in place to mitigate the anticipated impacts on these cultural resources.

3.12.3 Mitigation Measures

3.12.3.1 SOCAL OPAREAs

No substantial impacts on cultural resources from the proposed activities were identified. Therefore, no additional mitigation measures are necessary or appropriate.

3.12.3.2 San Clemente Island Ranges

The Navy is preparing an ICRMP and a PA that will enhance the management and protection of cultural resources on SCI, and ensure compliance with all federal laws pertaining to cultural resources.

3.12.3.2.1 USMC Amphibious Training

To reduce adverse effects on archaeological sites, detonations will be restricted to designated areas. Until SHPO consultation for effect is conducted on the Draft PA, site protection signs will be used to facilitate avoidance of the 32 archaeological sites within the undisturbed portions of the Old Airfield VC-3 operations area. In addition, Officers in Charge of the Exercise will be aware of these restricted areas and plan training activities accordingly.

3.12.3.2.2 Naval Special Warfare (NSW)

To avoid affecting archaeological sites, detonations will be restricted to designated areas that do not contain cultural resources. Site protection signs will be used to facilitate avoidance of sites outside of the Impact Areas at TARs 20, 21, and 22. Signage as an avoidance measure resulting in a no effect determination for historic properties has been deemed appropriate through consultation with SHPO on other TARS on SCI (Daniel Abeyta to Jan Larson, letter, December 21, 1999).

Mitigation measures for adverse effects on archaeological sites within the TARs in SHOBA would involve a change in use, avoidance, or evaluation and consultation for resolution of adverse effect. At NRHP-eligible sites and unevaluated sites at risk for adverse effects, site protection signs will be used to facilitate avoidance. Ground-disturbing activities such as target placement will be directed away from the sites through site protection signs. Under the Draft PA, once a site is determined to be eligible for the NRHP, SHPO will be consulted to resolve potential adverse effects and identify appropriate treatments stipulated to address identified, unavoidable adverse effects.

3.12.3.2.3 Other Island Operations

Ordnance disposal training at VC-3 would occur in designated areas without cultural resources.

3.12.4 Unavoidable Adverse Environmental Effects

Delivery of high-explosive ordnance to Impact Areas I and II in SHOBA would unavoidably degrade, damage, or destroy any prehistoric archaeological resources located in these areas. The Proposed Action would have no other known unavoidable effects on cultural resources. Few ground-disturbing activities are proposed, and these activities can be undertaken so as to avoid the locations of known cultural resources. Training activities can be designed or adjusted to avoid or minimize effects on known cultural resources. The potential for the Proposed Action to have unavoidable environmental effects on as-yet undiscovered cultural resources cannot be evaluated.

3.12.5 Summary of Effects by Alternative

Table 3.12-1 summarizes effects and mitigation measures for the No Action Alternative, Alternative 1, and Alternative 2.

Table 3.12-2: Summary of Cultural Resources Effects

Alternative	NEPA (On-Land and U.S. Territorial Waters)	EO 12114 (Non-U.S. Territorial Waters)
No Action Alternative	• The Navy is preparing an ICRMP and a PA to comply with Section 106 of the NHPA • Terrestrial archaeological sites are not substantially affected by current training activities. • Buildings and structures are not substantially affected by current training activities. • Compliance with existing SCI cultural resources avoidance conditions substantially reduces effects. • Ground-disturbing activities in areas with cultural resources require additional mitigation measures. • Impacts on submerged cultural resources do not occur due to the type of training activities and the low density of submerged cultural resources.	• Impacts on cultural resources do not occur due to the type of training activities and the low density of submerged cultural resources.
Alternative 1	• Effects generally are the same as described for the No Action Alternative. An increased tempo of events, Battalion-sized Amphibious Landings, Off-Road Vehicle Areas, and TARs would not substantially affect SCI cultural resources if avoidance conditions and stipulations are followed and sites that cannot be avoided are addressed through additional mitigation measures. • Impacts on submerged cultural resources	• Submerged cultural resources would not be impacted because of the type of training activities and the low density of submerged cultural resources within the area of effect.

Alternative	NEPA (On-Land and U.S. Territorial Waters)	EO 12114 (Non-U.S. Territorial Waters)
	would be the same as under the No Action Alternative.	
Alternative 2 (Preferred Alternative)	• Effects generally are the same as described for the No Action Alternative. An increased tempo of events, Battalion-sized Amphibious Landings, Off-Road Vehicle Areas, and TARs would not substantially affect SCI cultural resources if avoidance conditions and stipulations are followed and sites that cannot be avoided are addressed through additional mitigation measures. • Impacts on submerged cultural resources would be the same as under the No Action Alternative.	• Submerged cultural resources would not be impacted because of the type of training activities and the low density of submerged cultural resources within the area of effect.
Mitigation	• No mitigation measures for submerged cultural resources are necessary or appropriate. • To reduce adverse effects on archaeological sites, detonations will be restricted to designated areas. Officers in Charge of the Exercise will be aware of these restricted areas and plan training activities accordingly. • Site protection signs will be used to facilitate avoidance of the 32 archaeological sites within the undisturbed portions of the Old Airfield VC-3 operations area and sites outside of the Impact Areas at TARs 20, 21, and 22. Officers in Charge of the Exercise will be aware of these restricted areas and plan training activities accordingly. • Ordnance disposal training at VC-3 will occur in designated areas without cultural resources. • Ground-disturbing activities such as target placement will be directed away from cultural sites through site protection signs. • Under the Draft PA, once a site is determined to be eligible for the NRHP, SHPO will be consulted to resolve potential adverse effects and identify appropriate treatments stipulated to address identified, unavoidable adverse effects	• No mitigation measures for submerged cultural resources are necessary or appropriate.

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3.13 Traffic

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3.13 TRAFFIC

Traffic issues relate to the movement and circulation of vehicles, vessels, and/or aircraft within an organized framework. This section addresses air traffic and marine traffic in and in the vicinity of the Southern California (SOCAL) Range Complex.

Because San Clemente Island (SCI) is an island, there is no connection to a road network in a regional context. The paved and unpaved road network on SCI is in poor condition; however, repaving, road repairs, and regrading are planned to support all alternatives. These proposed activities have the potential to affect various resources such as terrestrial flora and fauna and are addressed elsewhere in this Environmental Impact Statement/Overseas Environmental Impact Statement (EIS/OEIS). However, because SCI is utilized exclusively for military activities by military vehicles, traffic concerns are not raised by any of the alternatives including the Proposed Action.

3.13.1 Definition of Resource

3.13.1.1 Air Traffic

Air traffic refers to movements of aircraft through airspace (Figure 3.13-1). Safety and security factors dictate that use of airspace and control of air traffic be closely regulated. Accordingly, regulations applicable to all aircraft are promulgated by the Federal Aviation Administration (FAA) to define permissible uses of designated airspace, and to control that use. These regulations are intended to accommodate the various categories of aviation, whether military, commercial, or general aviation. The regulatory scheme for airspace and air traffic control varies from highly controlled to uncontrolled. Less controlled situations include flight under Visual Flight Rules (VFR) or flight outside of U.S. controlled airspace, such as flight over international waters off the coast of California. Examples of highly controlled air traffic situations are flights in the vicinity of airports, where aircraft are in a critical phase of flight, either take-off or landing, and flight under Instrument Flight Rules (IFR), particularly flight on high or low altitude airways.

The system of airspace designation makes use of various definitions and classifications of airspace in order to facilitate control. “Controlled airspace” is a generic term that covers different classes of airspace.

- “Victor Routes” are the network of airways serving commercial aviation operations up to 18,000 feet (ft) Mean Sea Level (MSL).
- Class A extends from 18,000 ft MSL up to and including 60,000 ft MSL and includes designated airways for commercial aviation operations at those altitudes.
- Class B airspace extends from the ground to 10,000 ft MSL surrounding the nation’s busiest airports.
- Class C and D airspace are defined areas around certain airports, tailored to the specific airport.
- Class E is controlled airspace not included in Class A, B, C, or D.
- Class G is uncontrolled airspace (i.e., not designated as Class A-E).

The project study area does not include Santa Barbara or Santa Catalina Islands; the Navy does not conduct and is not proposing military activities on these islands.
The project study area does not include San Nicolas Island; the Navy activities conducted on San Nicolas Island are addressed in the Point Mugu Sea Range EIS/OEIS.

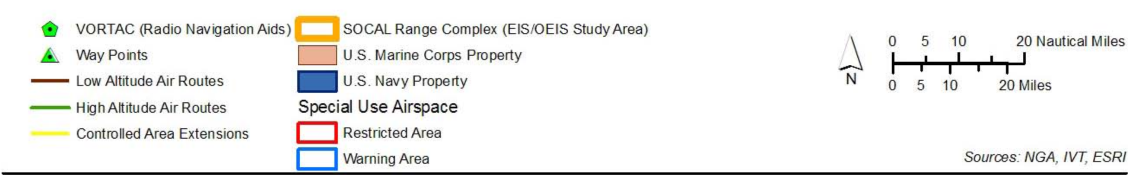


Figure 3.13-1: Air Routes in Vicinity of SOCAL Range Complex

Special Use Airspace (SUA) refers to areas with defined dimensions where flight and other activities are confined due to their nature and the need to restrict or limit nonparticipating aircraft. SUA is established under procedures outlined in 14 (C.F.R). Part 73. The majority of SUA is established for military flight activities and may be used for commercial or general aviation when not reserved for military activities. There are multiple types of SUA. One type of SUA, of particular relevance to the SOCAL Range Complex, is a Warning Area, which is defined in 14 C.F.R. Part 1 as follows:

> "A warning area is airspace of defined dimensions, extending from 3 nautical miles outward from the coast of the United States that contains activity that may be hazardous to nonparticipating aircraft. The purpose of such warning areas is to warn nonparticipating pilots of the potential danger. A warning area may be located over domestic or international waters or both."

Warning areas are established to contain a variety of hazardous aircraft and non-aircraft activities, such as aerial gunnery, air and surface missile firings, bombing, aircraft carrier operations, surface and subsurface operations, and naval gunfire. When these activities are conducted in international airspace, the FAA regulations may warn against, but do not have the authority to prohibit, flight by non-participating aircraft.

A Restricted Area is a type of SUA within which non-military flight activities are closely restricted. The SOCAL Range Complex contains one restricted area over San Nicolas Island; R2535 A/B. Other types of SUA found within the SOCAL OPAREAs include Missile Ranges (MISRs) and Tactical Maneuvering Areas (TMAs).

3.13.1.2 Marine Traffic

Ocean traffic is the transit of commercial, private, or military vessels at sea, including submarines. The ocean traffic flow in congested waters, especially near coastlines, is controlled by the use of directional shipping lanes for large vessels, including cargo, container ships, and tankers. Traffic flow controls are also implemented to ensure that harbors and ports-of-entry remain as uncongested as possible. There is less control on open-ocean traffic involving recreational boating, sport fishing, commercial fishing, and activity by naval vessels. In most cases, the factors that govern shipping or boating traffic include the following: adequate depth of water, weather conditions (primarily affecting recreational vessels), availability of fish, and water temperature. Higher water temperatures will increase recreational boat traffic, jet skis, and diving activities.

3.13.2 Affected Environment

3.13.2.1 SOCAL OPAREAs

3.13.2.1.1 Existing Conditions

Air Traffic

The SOCAL Range Complex contains three warning areas (W): W-290, W-291, and a small portion of W-289 (See Figure 3.13-1). Each extends from the surface to 80,000 ft above MSL. All three warning areas can be activated by the FAA at the Navy's request when operations that would pose a hazard to non-participating aircraft are being conducted. Other SUAs within W-291 warning areas include nine TMAs and two MISRs. Military pilots travel under an IFR from local air bases until they reach W-291 and proceed under a VFR to their instructed TMA or MISR operating area. Activation by the FAA is performed by notifying the controlling air traffic agency of the change in status in the area. This allows the agency to issue notices to pilots to alter their courses to avoid military activities.

Military Aviation

Military aircraft routinely operate in international airspace in W-291. These aircraft take off from military airfields in California and Arizona, including the airfield at SCI, or from aircraft carriers operating offshore. Military aircraft take off from mainland airfields normally with an IFR clearance from FAA Air Traffic Control. After entering W-291, flights proceed via VFR, using a "see-and-avoid" rule to remain clear of other air traffic. In the Fleet Area Control and Surveillance Facility (FACSFAC) San Diego annual utilization report for Fiscal Year (FY) 2006, there were 35,556 air operations in W-291, exclusive of air operations that utilize the Naval Auxiliary Landing Field (NALF) at SCI (see below). During FY06, W-291 airspace was released to the controlling agency, Los Angeles Air Route Traffic Control Center (ARTCC), for 251 hours of public use.

The NALF at SCI is located within W-291 airspace. To support the safe and efficient air traffic movement to/from NALF SCI, Class D airspace has been established. It consists of a 5 nm (9-kilometer (km) radius circle centered on NALF SCI and includes the airspace from the surface to 2,700ft MSL. All aircraft entering this airspace, or operating within it, must maintain radio contact with the NALF SCI control tower. An aircraft operation at NALF SCI is defined as an aircraft event that involves a take-off, a landing, a low approach to the airfield, or a touch-and-go landing. Thus, a single sortie from the airfield could generate several reportable "operations." The baseline level of aircraft operations at NALF is 25,120 operations.

Commercial and General Aviation

Aircraft operating under VFR can fly along the coast between San Diego and Orange County and out to Santa Catalina Island largely unconstrained, except by safety requirements and mandated traffic flow requirements. Aircraft operating under IFR clearances, authorized by the FAA, normally fly on the airway route structures (See Figure 3.13-1). In southern California these routes include both high and low altitude routes between San Diego and Los Angeles and to Santa Catalina Island. There are two Control Area Extensions (CAEs) from southern California through nearby W-291 to facilitate easier access to air routes out to Hawaii and other transpacific locations. These routes allow general aviation and commercial air travel to coexist with military operations. CAE 1177 extends from Santa Catalina Island southwest between W-291 and the Pt. Mugu Sea Range. CAE 1156 extends west from San Diego through the northern portion of W-291. When W-291 is active, CAE 1156 is normally closed. CAE 1177, the more important route through the coastal warning areas, is closed only when weapons hazard patterns extend into the area, and this closure is fully coordinated with the FAA. When W-291 is active, aircraft on IFR clearances are precluded from entering W-291 by the FAA. However, since W-291 is located entirely over international waters, non-participating aircraft operating under VFR are not prohibited from entering the area. Examples of aircraft flights of this nature include light aircraft, fish spotters, and whale watchers which occur under VFR throughout W-291 on a variable basis.

Marine Traffic

A significant amount of ocean traffic, consisting of both large and small vessels, transits through the SOCAL Range Complex. For commercial vessels, the major trans-oceanic routes to the southwest pass north and south of SCI (Figure 3.13-2). The approach and departure routes into San Diego and the ports of Los Angeles-Long Beach Harbor pass to the east of SCI and Santa Catalina Island. Naval vessels operate within and transit through the SOCAL Range Complex. There is no exact definition for a small craft, however, NOAA defines a small craft for purposes of weather warnings as conditions exceeding sustained winds of 21 to 33 knots, potentially in combination with wave heights exceeding 10 feet (or wave steepness values exceeding local thresholds) (NOAA 2007). Due to deep water dangers and suitability of small crafts in the open ocean, a very small volume of small craft traffic, primarily recreational, occurs throughout the SOCAL OPAREAs; the majority of all small craft traffic occurs within 3 nm of shore.

Military

The types of Navy vessels that operate in the SOCAL OPAREAs range from small work boats to major Navy combatants such as aircraft carriers, cruisers, and submarines. The activity level of ships and boats is characterized as a ship or boat event. They include operational, training, post-maintenance, and Research, Development, Test, and Evaluation (RDT&E) events. During FY06, Naval vessels accumulated 1,472 annual days at sea for all ship classes. Based on these days at sea, vessels accumulated a total of 35,328 annual hours at sea. (FACSFAC 2007). Some of these events may occur simultaneously, as the vessels operate together or separately in one of the many training areas available.

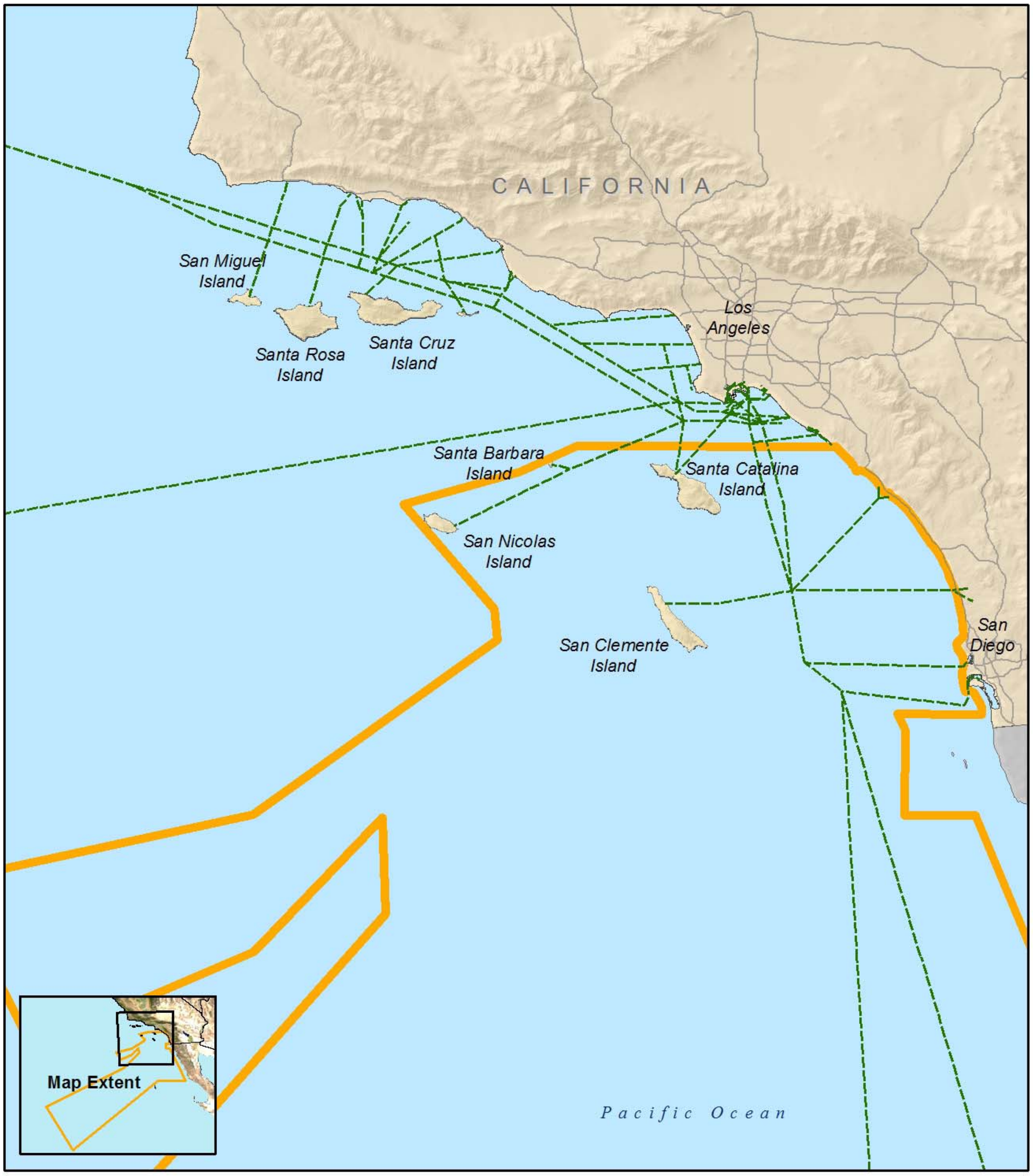
Civilian

Commercial

The vessel traffic approaching ports is managed by the Vessel Traffic Service (VTS), which is operated jointly by the U.S. Coast Guard and the Marine Exchange. The Marine Exchange maintains statistics on the vessel traffic in its Area of Responsibility (AOR). Estimates for the number of commercial shipping vessels that transit near SCI are based on 1996 data from the Marine Exchange of Los Angeles-Long Beach Harbor. A Ship Traffic Study, Southern California Operations Area, Status Report (NAWCWPNS Point Mugu 1996) was commissioned by the Navy at (NAS) Point Mugu to quantify the number of commercial vessels that transit the Point Mugu Sea Range, which is located north of SCI and comprises approximately 36,000 square miles of ocean area centered on San Nicolas Island. The report indicated that from January through September of 1995 there were 3,583 departures/approaches by vessels to and from the ports of Los Angeles and Long Beach. Reporting on the vessel traffic statistics for 2002, the Marine Exchange had recorded 5,396 arrivals for the Los Angeles/Long Beach Harbor complex which represented a 5% decrease over the 2001 totals of 5,662. The year 2003, however, produced 5,696 arrivals for LA/LB Harbor, which represents a 6% increase over the previous year (Marine Link 2004). San Diego does not have a local VTS; however, the Port of San Diego summary of marine operations (2002) identifies between 119 passenger vessels voyages and 380 commercial vessels for December 2002 entering the port on an annual basis.

Recreational and Fishing

Recreational craft operate from ports at San Diego, Oceanside, Dana Point, Newport Beach, Long Beach, Los Angeles, and from other locations all along the coast of southern California. The Coast Guard has indicated that there are no precise estimates for recreational or commercial fishing or boating activity in the SOCAL OPAREAs. Recreational activities in the SOCAL OPAREAs include; fishing, diving, surfing, yachting, and sailing. Diver and surfer boat traffic can be occasionally found around certain shallow water areas around SCI and Cortes bank. Dive boats can also be found at Tanner bank (See Figure 3.14-2 in Socioeconomics). Other activities such as fishing, yachting and sailing can be found sporadically around the SOCAL OPAREAs.



The project study area does not include Santa Barbara or Santa Catalina Islands; the Navy does not conduct and is not proposing military activities on these islands.
The project study area does not include San Nicolas Island; the Navy activities conducted on San Nicolas Island are addressed in the Point Mugu Sea Range EIS/OEIS.

--- Approximate Shipping Route
SOCAL Range Complex (EIS/OEIS Study Area)

N
0 10 20 40 Nautical Miles
0 10 20 40 Miles

Sources: National Waterway Network, US Army Corps of Engineers, ESRI

Figure 3.13-2: SOCAL Range Complex Shipping routes

3.13.2.1.2 Current Mitigation Measures

The Navy strives to ensure that it retains access to ocean training areas and SUA as necessary to accomplish its mission, while facilitating joint military-civilian use of such areas to the extent practicable and consistent with safety. These goals of military access, joint use, and safety are promoted through various coordination and outreach measures, including:

- Notice to Airmen (NOTAMs) advising of the status and nature of activities being conducted in W-291 and other components of SUA in the SOCAL Range Complex. NOTAMs are available via the internet at https://www.notams.jcs.mil (DoD 2007).
- Return of SUA to civilian FAA control when not in use for military activities. According to FAA and DoD policy, SUA, including Warning Areas, should be made available for use by nonparticipating aircraft when all or part of the airspace is not needed by the using agency. To accommodate the joint use of SUA, a Letter of Agreement (LOA) or a Letter of Procedure (LOP) is drafted between the controlling agency and the using agency. In the case of W-291 and other warning areas within the SOCAL OPAREAs, an LOA is in place between Los Angeles ARTCC (FAA) and FACSFAC San Diego (Navy). Through the LOA, the Navy establishes the activation/deactivation procedures for the SUA and may outline periods when the FAA, with the Navy's concurrence, may route IFR traffic through the active SUA. The LOA defines the conditions and procedures to ensure safe and efficient joint use of waning areas.
- Publication of Notices to Mariners (NOTMAR) and other outreach. The Navy provides information about potentially hazardous activities planned for the SOCAL OPAREAs, for publication by the U.S. Coast Guard in NOTMAR. Most such activities occur in the vicinity of SCI. To ensure the broadest dissemination of information about hazards to commercial and recreational vessels, the Navy provides detailed schedules of its activities planned near SCI on a dedicated website: www.scisland.org (DoN 2007).

3.13.3 Environmental Consequences

3.13.3.1 Approach to Analysis

The traffic analysis addresses air and ocean traffic in the SOCAL Range Complex. The principal issue is the potential for existing or proposed military air or vessel traffic to affect existing transportation and circulation conditions. Impacts on traffic were assessed with respect to the potential for disruption of transportation pattern and systems, and changes in existing levels of transportation safety.

Factors used to assess the significance of impacts on air traffic include consideration of an alternative's potential to result in an increase in the number of flights such that they could not be accommodated within established operational procedures and flight patterns; a requirement for an airspace modification; or an increase in air traffic that might increase collision potential between military and non-participating civilian operations. The Proposed Action and alternatives do not include proposed airspace modifications and would not change the existing relationship of the Navy's SUA with federal airways, uncharted visual flight routes, and airport-related air traffic operations.

Factors used to assess the significance of impacts on ocean vessel traffic include the extent or degree to which an alternative would seriously disrupt the flow of commercial surface shipping or recreational fishing or boating. A serious disruption occurs when a vessel is unable to proceed to its intended destination due to exclusion from areas in the SOCAL OPAREAs. However, the need to use alternative routes during the time of exclusion does not constitute a serious disruption.

3.13.3.2 No Action Alternative

3.13.3.2.1 SOCAL OPAREAs

Both military and non-military entities have been sharing the use of the airspace and ocean surface comprising the SOCAL Range Complex for more than 50 years. Military, commercial, and general aviation activities have established an operational coexistence consistent with federal, state, and local plans and policies and compatible with each interest's varying objectives. Activities under the No Action Alternative include activities that are and have been routinely conducted in the area for decades.

Air Traffic

The FAA has established Warning Areas for military operations, in this case, W-289, W-290, and W-291. When military aircraft are conducting operations that are not compatible with civilian activity, the military aircraft are confined to the designated warning area, which is specifically designed for this purpose. Limitations are communicated to commercial airlines and general aviation by NOTAMs, published by the FAA. Under the No Action Alternative, there are no adverse effects on commercial or general aviation activities.

Marine Traffic

Military use of the offshore ocean is also compatible with civilian use. Where naval vessels are conducting operations that are not compatible with other uses, they are confined to operating areas away from shipping lanes to allow traffic to flow freely. When operations must occur within shipping or high traffic areas, these operation areas are communicated to all vessels and operators by NOTMARs, published by the Coast Guard.

3.13.3.3 Alternative 1

3.13.3.3.1 SOCAL OPAREAs

Air Traffic

The FAA has established Warning Areas for military operations, in this case, W-289, W-290, and W-291. Offshore activities proposed under Alternative 1 would have all the components of the No Action Alternative, but the training tempo would increase by about 24 percent resulting in more air traffic. The traffic control procedures implemented under this alternative would be the same as those described above under the No Action Alternative. No additional impacts on the FAA's capabilities would be created. The remoteness of the offshore use areas, the use of LOA's to better orchestrate traffic, and public notification procedures would substantially reduce possible congestion during these activities.

Marine Traffic

Military use of the offshore ocean is also compatible with civilian use. Where naval vessels are conducting operations that are not compatible with other uses, they are confined to operating areas away from shipping lanes and near other recreational use areas. These hazardous operations are communicated to all vessels and operators by NOTMARs, published by the Coast Guard. Despite an increase in training tempo, commercial and recreational interests will not be affected by operational increases.

The Shallow Water Training Range (SWTR) installation will be found remotely in the SOCAL OPAREAs to the west of SCI and will not have any considerable impacts on marine traffic. Any traffic conflicts that could occur will be remedied by use of public notification procedures.

3.13.3.4 Alternative 2

3.13.3.4.1 SOCAL OPAREAs

Air Traffic

The FAA has established Warning Areas for military operations, in this case, W-289, W-290, and W-291. Offshore events proposed under Alternative 2 would have all the components of Alternative 1, but the number of annual events would increase by about 26 percent over the No Action Alternative. The traffic control procedures implemented under this alternative would be the same as those described above under the No Action Alternative. No additional impacts on the FAA's capabilities would be created. The remoteness of the offshore use areas, the use of LOA's to better orchestrate traffic, and public notification procedures would substantially reduce possible congestion during these activities.

Marine Traffic

Military use of the offshore ocean is also compatible with civilian use. Where naval vessels are conducting operations that are not compatible with other uses, they are confined to operating areas away from shipping lanes and other recreational use areas. These hazardous operations are communicated to all vessels and operators by NOTMARs, published by the Coast Guard. Despite an increase in training tempo, commercial and recreational interests will not be affected by operational increases.

The Shallow Water Training Range (SWTR) installation will be found remotely in the SOCAL OPAREAs to the west of SCI and will not have any considerable impacts on marine traffic. Any traffic conflicts that could occur will be remedied by use of public notification procedures.

3.13.4 Mitigation Measures

Current mitigation measures are presented in Section 3.13.3.1.2. No adverse effects on air or marine traffic were identified. Therefore, no additional mitigation measures are necessary.

3.13.5 Unavoidable Adverse Environmental Effects

No unavoidable consequences to air or marine traffic were identified.

3.13.6 Summary of Effects by Alternative

Table 3.13-1: Summary of Traffic Effects

Alternative	NEPA (On-Land and U.S. Territorial Waters)	EO 12114 (Non-U.S. Territorial Waters)
No Action Alternative	• The FAA has established W-289, W-290, and W-291 as restricted airspace for military operations. When military aircraft are conducting operations that are not compatible with civilian activity, the military aircraft are confined to the warning areas to prevent accidental contact. • Hazardous air operations are communicated to commercial airlines and general aviation by NOTAMs, published by the FAA. There are no additional impacts on the FAA's capabilities, no expected decrease in aviation safety, and no adverse effect on commercial or general aviation activities. • Military use of the offshore ocean is also compatible with civilian use. Where naval vessels are conducting operations that are not compatible with other uses, such as weapons firing, they are confined to operating areas away from shipping lanes and other recreational use areas. • Hazardous marine operations are communicated to all vessels and operators by NOTMARs, published by the Coast Guard.	• The FAA has established W-289, W-290, and W-291 as restricted airspace for military operations. When military aircraft are conducting operations that are not compatible with civilian activity, the military aircraft are confined to the warning areas to prevent accidental contact. • Hazardous air operations are communicated to commercial airlines and general aviation by NOTAMs, published by the FAA. There are no additional impacts on the FAA's capabilities, no expected decrease in aviation safety, and no adverse effect on commercial or general aviation activities. • Military use of the offshore ocean is also compatible with civilian use. Where naval vessels are conducting operations that are not compatible with other uses, such as weapons firing, they are confined to operating areas away from shipping lanes and other recreational areas. • Hazardous marine operations are communicated to all vessels and operators by NOTMARs, published by the Coast Guard.
Alternative 1	• Impacts on traffic under Alternative 1 would be the same as the No Action Alternative.	• The FAA has established W-289, W-290, and W-291 as restricted airspace for military operations. When military aircraft are conducting operations that are not compatible with civilian activity, the military aircraft are confined to the warning areas to prevent accidental contact. • Hazardous air operations are communicated to commercial airlines and general aviation by NOTAMs, published by the FAA. There are no additional impacts on the FAA's capabilities, no expected decrease in aviation safety, and no adverse effect on commercial or general aviation activities. • Military use of the offshore ocean is also compatible with civilian use. Where naval vessels are conducting operations that are not compatible with other uses, such as weapons firing, they are confined to operating areas

Alternative	NEPA (On-Land and U.S. Territorial Waters)	EO 12114 (Non-U.S. Territorial Waters)
		away from shipping lanes and other recreational areas. • Hazardous marine operations are communicated to all vessels and operators by NOTMARs, published by the Coast Guard.
Alternative 2 (Preferred Alternative)	• Impacts on traffic under Alternative 2 would be the same as the No Action Alternative.	• The FAA has established W-289, W-290, and W-291 as restricted airspace for military operations. When military aircraft are conducting operations that are not compatible with civilian activity, the military aircraft are confined to the warning areas to prevent accidental contact. • Hazardous air operations are communicated to commercial airlines and general aviation by NOTAMs, published by the FAA. There are no additional impacts on the FAA's capabilities, no expected decrease in aviation safety, and no adverse effect on commercial or general aviation activities. • Military use of the offshore ocean is also compatible with civilian use. • Where naval vessels are conducting operations that are not compatible with other uses, such as weapons firing, they are confined to operating areas away from shipping lanes and other recreational areas. • Hazardous marine operations are communicated to all vessels and operators by NOTMARs, published by the Coast Guard.
Mitigation Measures	• NOTAMs and NOTMARs • Return of SUA to civilian FAA control when not in use for military activities	• NOTAMs and NOTMARs Return of SUA to civilian FAA control when not in use for military activities

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3.14 Socioeconomics

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3.14 SOCIOECONOMICS

Socioeconomics comprise the basic attributes and resources associated with the human environment, particularly population and economic activity. This section addresses the socioeconomics effects on commercial and recreational fishing, commercial shipping, tourism, housing and the economy, as well as diving, boating and surfing.

3.14.1 Affected Environment

3.14.11 SOCAL OPAREAs

3.14.1.1.1 Existing Conditions

Military Activity

Navy activities in southern California make a substantial contribution to the social and economic well-being of California. The Department of the Navy (including Marine Corps activities in the San Diego area) supports the largest concentration of naval forces in the world. Most of the ships and units that train in the southern California (SOCAL) Range Complex are home-ported in San Diego, and their social and positive economic impact are felt in the cities, towns, and countryside of southern California. However, the Proposed Action does not include an increase in personnel stationed in the San Diego area.

Civilian Activity

Commercial Shipping

Ocean shipping is a significant component in the southern California regional economy. Key ports in southern California include Los Angeles, Long Beach, and, to a lesser degree, San Diego. Los Angeles and Long Beach were ranked first and second among U.S. ports with respect to total cargo imported and exported in 2005; San Diego was ranked 28th (DoT 2007).

The location of San Clemente Island (SCI) creates a separation zone within the SOCAL Range Complex. Most vessels entering or leaving the Ports of Los Angeles or Long Beach travel northwest or south and bypass SCI without incident or delay. Shipping to and from the south would include an inshore route to the east of SCI within the SOCAL Range Complex. Ships traveling between Los Angeles/Long Beach and Hawaii via the most direct route would pass to the north of the SOCAL Range Complex (Figure 3.13-2 in Traffic Section). Vessels coming or going from the Port of San Diego generally travel along shipping routes north or south near the coast which includes inshore waters of the SOCAL Range Complex but would bypass SCI to the east.

Commercial Fishing

Commercial fishing takes place throughout the SOCAL Operating Areas (OPAREAs) from near shore waters adjacent to the mainland and offshore islands, to the offshore banks (e.g., Tanner and Cortes Banks), and waters in between. The California Department of Fish and Game (CDFG) maintains commercial catch block data for waters in the northern part of the study area (see Figure 3.7-1 in Fish Section), and all statements referring to catch are for that part of the study area for which data are available. For the period 2002 to 2005, the most commonly harvested commercial species in the SOCAL OPAREAs were squid, tuna (albacore, yellowfin, bluefin, skipjack, and other), swordfish, Pacific/Jack Mackerel, and Pacific sardine (see Table 3.7-1). During 2002, the SOCAL OPAREAs accounted for 36.7 percent of all California fish landings and 33.6 percent of invertebrate landings. In 2003, 2004, and 2005, the figures were 38 percent and 7.6 percent, 24.4 percent and 14.2 percent, and 26.8 percent and 46.3 percent, respectively.

Water depths in the SOCAL OPAREAs reach a maximum depth of >3 miles (mi) (>5 kilometers [km])) below sea level. Pelagic species account for approximately 98 percent of the average annual catch in pounds within the SOCAL OPAREAs (Table 3.14-1). Flatfish, demersal fish, and other fish associated with the bottom account for only about 2 percent of the average annual catch of fish. This may be attributable to the small area occupied by shallow shelves within the SOCAL OPAREAs. Pelagic species encompass the majority of commercial catch of average annual pounds of catch. The average annual catch of pelagic, flatfish, demersal and all other fish amounts to 50,901,141 average annual catch (in pounds) and $6,870,514 (in dollar value).

The average annual catch of crustaceans is about half lobster (average 431,805 pounds lbs per year) and half crab and shrimp (average 317,735 lb per year). The catch of crustaceans in the SOCAL OPAREAs was worth approximately $4,314,628 per year. In comparison, the annual catch of squid was worth approximately $7,186.356 and urchins were worth about $1,860,552 whereas other invertebrates (e.g., snails, sea cucumbers) were worth about $210,000 per year (Table 3.14-1).

Table 3.14-1: Average Annual Commercial Landing of Fish and Invertebrates and Value within the SOCAL Range Complex (2002-2005)

Type		Average Annual Catch (Pounds)	Value (Dollars)
Fish		Average Annual Catch (Pounds)	Average Value (Dollars)
	Tuna (yellowfin, skipjack, bluefin, and albacore)	1,034,430	$488,040
	Sardine. Pacific	39,306,962	$1,713,688
	Swordfish	358,655	$1,500,446
	All Other Fish	10,201,094	$3,168,340
Invertebrates	**Total Fish**	**50,901,141**	**$6,870,514**
	Lobster	431,805	$3,078,629
	Crab	200,845	$213,198
	Other Crustaceans (shrimp)	116,890	$1,022,801
	Sea Urchins	2,588,887	$1,860,552
	Squid	37,312,687	$7,186,356
	Other Invertebrates	209,776	$210,634
	Total Invertebrates	**40,860,579**	**$13,572,170**
	Totals	**91,761,720**	**$20,442,684**

Source: CDFG 2007

Recreation and Tourism

Recreational and tourist areas within the SOCAL Range Complex include Point Loma, the International Artificial Reef, Tanner and Cortes Banks, and the waters around SCI, San Nicolas Island, and Santa Catalina Island. Recreational diving, spear fishing, and surfing are very popular off of Point Loma (Global Security 2007). These recreational activities can also occasionally be found off of SCI and Tanner and Cortes Banks. The International Artificial Reef, located in approximately 165 feet (ft) (50 meters [m]) of water to the southwest of the Imperial Beach Pier, is a popular destination. The proximity of rocky and sedimentary habitats to the major recreational fishing centers in San Diego Bay makes this area particularly popular with sport fishers. Kelp bass, sheephead, sculpin, and rockfish are popular recreational species. No naval operations occur on land at Santa Catalina Island or San Nicolas Island. Santa Catalina and San Nicolas Islands are within the study area; however, no operations occur on land at either island. Naval operations are conducted offshore of the islands to avoid potential contact with non-participants.

The SOCAL Range Complex marine environments are popular locations for recreational activities including sightseeing, whale watching, sport fishing, boating, diving, and surfing. Whale watching takes place primarily from December through March, for the annual gray whale southward migration and the northward migration. Though tourist day trips typically stay closer to the mainland, these activities can occur throughout the SOCAL Range Complex.

Charter and privately operated boats enter the SOCAL OPAREAs and SCI waters for salt-water sport fishing (see Figure 3.14-1), recreational diving, surfing, and other boating activities. Salt-water sport fishing, surfing, and recreational diving are centered primarily around SCI itself, and secondarily in the shallower waters over the Tanner/Cortes Banks. Due to distance from shore, Tanner and Cortes banks are inherently more hazardous due to their open-ocean diving conditions. Therefore, the near shore waters off SCI are a more popular destination than the more remote banks. This makes them suitable primarily for skilled divers, a more limited market for charter operators.

SCI’s relatively warm waters, good underwater visibility, and largely pristine diving conditions make it a popular destination. Charter dive trips to specific sites are often published and booked as many as 6 months in advance. Most dive charters are scheduled for weekends, though not all. Diving occurs year-round, though the number of trips to SCI and the banks appear to peak during lobster season (October-March).

Fishing destinations are generally more fluid, in response to changing fishing conditions, but a number of charter boats fish SOCAL Range Complex waters on a routine basis. Sport fishermen pursue various fish species with hook and line; some divers also spearfish or take invertebrates (mainly lobster) by hand within the SOCAL OPAREAs.

Surfing can also be found in the offshore OPAREAs and near shore SCI areas. In the winter months, when large Northern Pacific ocean swell is generated, some charter and private vessels travel out to Cortes bank to surf the waves created by the rapidly rising seamounts. Also, surfers can venture year-round to the breaks off of SCI to surf the island’s south points (China and Pyramid Points) and up the west shore of the island depending on the swell direction of the season. Although both areas within the SOCAL OPAREAs are accessed throughout the year, due to the difficulty in access and a rare culmination of conditions necessary for surfing these spots, these areas are rarely accessed.

Other limited surf spots and dive sites occur throughout the nearshore areas, for diving, at various shipwrecks and reefs and, for surfing, off of Point Loma and around Santa Catalina Island.

Figure 3.14-1: Sport Fishing, Surfing, and Diving Areas

Population and Housing

With the exception of SCI, Santa Catalina Island, Santa Barbara Island, and San Nicolas Islands, the SOCAL Range Complex consists of open water areas with no permanent population centers or housing. The population of SCI is addressed in Section 3.14.1.2.1. The population of Santa Catalina and San Nicolas Islands are not addressed in this analysis because the islands would not be affected by the Proposed Action; all operations occur offshore of the islands. Santa Barbara Island has no residents or housing and will not be addressed in this analysis.

3.14.1.1.2 Current Mitigation Measures

Long-range advance notice of scheduled operations times are made available to the public and the commercial fishing community via the internet http://www.scisland.org/schedules. The Navy reports their latest operations schedules to the appropriate agency to make the schedule available to the public through Notice to Airmen (NOTAMs) and Notice to Mariners (NOTMARs) for their area to allow the public to plan accordingly. The local 11th District USCG Notice to Mariners may be found at: http://www.navcen.uscg.gov/lnm/d11/default.htm. The FAA Notice to Airmen may be found on the FAA website: http://www.faa.gov/airports_airtraffic/air_traffic/publications/notices/. These sites provide commercial fishermen, recreational boaters and other area users notice that the military will be operating in a specific area and will allow them to plan their own activities accordingly. Military actions may temporarily relocate civilian and recreational activities. Schedules will be updated when changes occur up until the day of the operation. If operations are cancelled at any time, this information will be posted and the area will again be identified as clear for public use (U.S. Navy 2007). To minimize potential military/civilian interactions, the Navy will continue to publish scheduled operation times and locations up to 6 months in advance when possible.

3.14.1.2 San Clemente Island

3.14.1.2.1 Existing Conditions

Military Activity

Military support facilities on SCI are staffed by government contractors or Navy civilian or military personnel. The mission of the island and its personnel is to operate facilities and provide services, arms, and material support to fleet tactical training and Research, Development, Testing, and Evaluation (RDT&E) activities. All employment on the island is directly or indirectly related to Navy activities.

Civilian Activity

Recreation and Tourism

All activities onshore at SCI are military in nature; therefore, no public recreation or tourism exists on SCI. Some recreation and tourism activities can occur near SCI but not on the island itself.

Population and Housing

No permanent resident population exists on SCI. Most of the on-island living quarters are located in the Wilson Cove area, and range from trailers to permanent Bachelor Enlisted Quarters (BEQs). Visitor facilities are limited to 20 individuals. No children live on SCI. Military support facilities are staffed by civilian and Navy personnel on temporary assignments who are not recorded as residents during census counts. While the number of personnel on SCI varies based on mission needs, the constant population is approximately 500 (consisting of Navy personnel, civil service employees, and contractors). During major training exercises, the on-island number of personnel can exceed 1,000 or more for short periods. The primary socioeconomic impact of this workforce is on San Diego County, where most have their residences.

3.14.1.2.2 Current Mitigation Measures

There are no populations located on SCI. Therefore, mitigation measures related to the socioeconomic effects on SCI are not necessary.

3.14.2 Environmental Consequences

3.14.2.1 Approach to Analysis

This analysis investigates the potential for activities associated with the considered alternatives to noticeably affect (either adversely or beneficially) socioeconomic activity on SCI or within the SOCAL OPAREAs. Typical socioeconomic analysis considerations include an action's impacts on employment, population, income, economic growth, and associated effects such as the need for schools, roads, or other infrastructure improvements. Such changes, if they occur, have the potential to affect the local or regional environment. Other potentially affected socioeconomic activities specific to the SOCAL OPAREAs and San Diego and Orange Counties include commercial sea and air transport, commercial and sport fishing, recreational diving, and other ocean-based tourism.

Within the boundaries of the SOCAL Range Complex, all military and civilian activities and their potential socioeconomic impacts are considered. All activities onshore on SCI are military in nature; therefore the action alternatives will not influence existing or future population or activities associated with the human environment. Routine public access onshore is not permitted, and this situation would not change under any of the alternatives considered. Therefore, on-island public access is not a socioeconomic consideration. Assessed herein are only changes in operations or related expenditures for military facilities construction, equipment, or supplies on SCI that are directly associated with the proposed alternatives and that would affect the socioeconomics of the SOCAL Range Complex area. Also, the Proposed Action primarily involves training activities; it does not involve major construction projects.

Implementation of any of the alternatives, including the Proposed Action, would not produce a direct increase in personnel or employment opportunities within the SOCAL Range Complex or at SCI. However, any indirect socioeconomic impacts attributable to proposed activities that produce substantial shifts in population or employment trends or adversely affect regional spending and earning patterns must also be considered. The magnitude of potential impacts depends in large part on the location of the Proposed Action. Potential effects on socioeconomic activities or on population, employment, housing, and public service provision within the SOCAL Range Complex area are addressed for each alternative.

3.14.2.2 No Action Alternative

3.14.2.2.1 SOCAL OPAREAs

Civilian activities currently conducted in the SOCAL OPAREAs include commercial shipping, commercial fishing, sport fishing/diving, and tourist-related activities. These activities make an appreciable contribution to the overall economy of southern California. Temporary range clearance procedures for safety purposes do not adversely affect these economic activities because displacement is of short duration. The Navy has performed military operations within this region in the past and has only temporarily limited fishing or recreational uses in the SOCAL OPAREAs. When range clearance is required it is posted on the San Clemente Island website (www.scisland.org) and issued to the public and a NOTMAR is issued. These measures provide mariners with Navy use areas in advance, which allows non-participants to select an alternate destination without appreciable affect to their activities. To help manage competing demands and maintain public access in the SOCAL OPAREAs, the Navy conducts its offshore operations in a manner that minimizes restrictions to commercial fisherman (DoN 2007). Only specific areas around SCI have been deemed an Exclusive Use Zone, a Security Zone, or a Restricted Area. (See Table 3.16-1 in Public Safety).

Many different types of commercial fishing gear are used in the SOCAL Range Complex; drift gillnets, longline gear, troll gear, trawls, seining, and traps or pots occur. Damage to fishing gear from Navy mine warfare operations in the Kingfisher Range or hydrophones in SOAR are rare. Trawling or trolling is used for flatfish and demersal species which account for only 1 percent of the fishing in the entire SOCAL Range Complex.

3.14.2.2.2 San Clemente Island

All training on SCI only affects military personnel; as a result, socioeconomic impacts do not and will not occur.

3.14.2.3 Alternative 1

3.14.2.3.1 SOCAL OPAREAs

The increase in operations over the SOCAL OPAREAs amounts to 24 percent in the offshore areas. The increased training tempo associated with increase in range clearance will not cause a considerable impact due to advanced public notification and primarily short-term duration of military activities. To minimize potential military/civilian interactions, the Navy will continue to publish scheduled operation times and locations up to 6 months in advance. This ensures that commercial and recreational users are aware of the Navy’s plans, and allows users to plan their activities to avoid the scheduled activity (DoN 2007).

3.14.2.3.2 San Clemente Island

Operations on SCI will increase by 45 percent. All training on SCI only affects military personnel; as a result socioeconomic impacts do not and will not occur as a result of the Proposed Action.

3.14.2.4 Alternative 2

3.14.2.4.1 SOCAL OPAREAs

The increase in operations over the SOCAL OPAREAs amounts to 26 percent of all operations in the offshore areas. The increased training tempo associated with range clearance will not cause a considerable impact due to advanced public notification and primarily short-term duration of military activities. To minimize potential military/civilian interactions, the Navy will continue to publish scheduled operation times and locations up to 6 months in advance. This ensures that commercial and recreational users are aware of the Navy’s plans, and allows users to plan their activities to avoid the scheduled activity (DoN 2007).

The Navy’s proposed mine training range is proposed for Tanner Bank. The minefield would be a maximum of three by three nautical miles. Due to the small size of the minefield and the limited use of trawling and trolling in the SOCAL Range Complex effects are expected to be minimal.

Shallow Water Training Range (SWTR) installation is not expected to affect fishing interests in the SOCAL Range Complex because areas with known fishing activity will have an additional protective device installed surrounding or overlaying a sensor. These mechanical protective devices would be 3-4 ft (.9144 to 1.2192 m) around or rectangular with a shallow height. This would ensure that minimal effects are encountered due to Navy operations.

3.14.2.4.2 San Clemente Island

Operations on SCI will increase by 62 percent. All training on SCI only affects military personnel; as a result socioeconomic impacts do not and will not occur as a result of the Proposed Action.

3.14.3 Mitigation Measures

Current mitigation measures are discussed under Sections 3.14.1.1.2 and 3.14.1.2.2. In addition, the Navy plans to use protective devices surrounding and/or overlaying equipment placed on the ocean bottom. These devices serve to both protect the equipment and prevent entanglement with fishing gear.

3.14.4 Unavoidable Adverse Environmental Effects

The Proposed Action could result in periodic shifts in the locations that civilian users could access. However, due to mitigation measures the Navy does not foresee unavoidable effects.

3.14.5 Summary of Effects by Alternative

Table 3.14-2: Summary of Socioeconomic Effects

Alternative	NEPA (On-Land and U.S. Territorial Waters)	EO 12114 (Non-U.S. Territorial Waters)
No Action Alternative	• Only military populations are found at SCI, socioeconomic effects would not have any impact on population centers. • Activities would have no impact on jobs, housing, infrastructure, recreation, or commercial needs at SCI. • No adverse socioeconomic impacts would occur as a result of continuing present operations.	• No adverse socioeconomic impacts would occur as a result of the No Action Alternative.
Alternative 1	• Only military populations are found at SCI, socioeconomic effects would not have any impact on population centers. • Activities would have no impact on jobs, housing, infrastructure, recreation, or commercial needs at SCI. • Activities may temporarily impact recreational and/or commercial users; however, notices will be posted and alternative locations will be available which limits longterm effects. • No adverse socioeconomic impacts would occur as a result of implementation of the proposed action.	• Effects generally are the same as described for the No Action Alternative.
Alternative 2 (Preferred Alternative)	• Effects generally the same as described for Alternative 1.	• Effects generally are the same as described for the No Action Alternative. • No adverse socioeconomic impacts would occur as a result of implementation.
Mitigation Measures	• NOTAMs and NOTMARs are published with the appropriate agencies. • SWTR installation will include protective covers in areas where commercial fishing is present.	• All NOTAMs and NOTMARs are published with the appropriate agencies. • SWTR installation will include protective covers in areas where commercial fishing is present.

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3.15 Environmental Justice and Protection of Children

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3.15 ENVIRONMENTAL JUSTICE AND PROTECTION OF CHILDREN

3.15.1 Environmental Justice

Executive Order 12898 (EO 12898), *Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations*, was issued on February 11, 1994. This EO requires each Federal agency to identify and address, as appropriate, disproportionately high and adverse human health or environmental effects of its programs, policies and activities on minority populations and low-income populations in the United States and its territories and possessions. The Environmental Protection Agency (EPA) and the Council on Environmental Quality (CEQ) have emphasized the importance of incorporating environmental justice review in the analyses conducted by Federal agencies under the National Environmental Policy Act (NEPA) and of developing protective measures that avoid disproportionate environmental effects on minority and low-income populations. Objectives of this EO as it pertains to this Environmental Impact Statement (EIS) include development of Federal agency implementation strategies, identification of minority and low-income populations where proposed Federal actions have disproportionately high and adverse human health or environmental effects.

3.15.2 Protection of Children

The President issued Executive Order 13045 (EO 13045), *Protection of Children from Environmental Health Risks and Safety Risks*, in 1997. This order requires each Federal agency "(a) shall make it a high priority to identify and assess environmental health risks and safety risks that may disproportionately affect children; and (b) shall ensure that its policies, programs, activities, and standards address disproportionate risks to children that result from environmental health risks or safety risks."

3.15.3 Affected Environment

3.15.3.1 SOCAL OPAREAs

The SOCAL EIS/OEIS OPAREAs, consist of open water; therefore, no permanent human populations exist.

3.15.3.2 San Clemente Island

Military support facilities on SCI are staffed by visiting civilian and Navy personnel on assignments who are not recorded as residents during census counts. Therefore, there are no data pertinent to ethnicity or income for persons working on the islands. Except for summer camping visits to San Clemente Island (SCI) by Boy Scout and Girl Scout groups, there are no children on SCI. Visits by the scouts are controlled, and their activities are supervised by authorized adult leaders at all times.

3.15.4 Environmental Consequences

3.15.4.1 Approach to Analysis

Environmental factors related to Environmental Justice or Protection of Children would be identified and assessed for disproportionate effects on minority populations, low-income populations, or populations of children.

3.15.4.2 No Action Alternative

3.15.4.2.1 SOCAL OPAREAs

As noted in Section 3.15.3.1, no permanent human populations exist in the SOCAL OPAREAs. Therefore, no disproportionately high and adverse human health or environmental effects on minority or low-income populations would occur with implementation of the No-Action

Alternative; nor would implementation of the proposed action have the potential for causing environmental health risks or safety risks to children.

3.15.4.2.2 San Clemente Island

As noted in Section 3.15.3.2, the only residents on SCI are temporary military and contractor personnel. The small number of potentially affected individuals, their temporary residential status, and their direct or indirect employment by the Federal government make it unlikely they would be considered low-income or otherwise disproportionately susceptible to adverse socioeconomic or environmental impacts. Therefore, there would be little or no harmful effect associated with the No Action Alternative.

As visits by scouts to SCI are controlled, and scheduled and sited to avoid military training activities, ongoing activities would not affect transient populations of children on the island. In addition, no public health or safety impacts have been identified with regard to ongoing operations at SCI. Therefore, there would be no impact related to protection of children under the No Action Alternative.

3.15.4.3 Alternative 1

3.15.4.3.1 SOCAL OPAREAs

As noted previously, no permanent human populations exist in the SOCAL OPAREAs. Therefore, no disproportionately high and adverse human health or environmental effects on minority or low-income populations would occur with implementation of Alternative 1; nor would implementation of the proposed action have the potential for causing environmental health risks or safety risks to children.

3.15.4.3.2 San Clemente Island

As noted under the No Action Alternative, the small number of potentially affected individuals, their temporary residential status, and their direct or indirect employment by the Federal government make it unlikely they would be low-income or otherwise disproportionately susceptible to adverse socioeconomic or environmental impacts. Therefore, no harmful effects relevant to EO 12898 through implementation of Alternative 1 are present.

As visits by scouts to SCI would be controlled, and scheduled/sited to avoid military training activities, proposed activities would not affect transient populations of children on the island. In addition, no public health or safety impacts have been identified with regard to ongoing operations at SCI. Therefore, no potential impacts related to EO 13045 by implementing Alternative 1 would be found.

3.15.4.4 Alternative 2

3.15.4.4.1 SOCAL OPAREAs

As noted previously, no permanent human populations exist in the SOCAL OPAREAs. Therefore, no disproportionately high and adverse human health or environmental effects on minority or low-income populations would occur with implementation of Alternative 2; nor would implementation of the proposed action have the potential for causing environmental health risks or safety risks to children.

3.15.4.4.2 San Clemente Island

As noted under the No Action Alternative, the small number of potentially affected individuals, their temporary residential status, and their direct or indirect employment by the Federal government make it unlikely they would be low-income or otherwise disproportionately susceptible to adverse socioeconomic or environmental impacts. Therefore, no effects associated with EO 12898 with the implementation of Alternative 2 would have an adverse effect.

As visits by scouts to SCI would be controlled, and scheduled/sited to avoid military training activities, proposed activities would not affect transient populations of children on the island. In addition, no public health or safety impacts have been identified with regard to ongoing operations at SCI. Therefore, potential impacts related to EO 13045 under Alternative 2 would be minimized.

3.15.5 Mitigation Measures

Due to the absence of impacts related to Environmental Justice or Protection of Children, no mitigation measures are necessary.

3.15.6 Unavoidable Adverse Environment Effects

No unavoidable adverse environmental effects were identified.

3.15.7 Summary of Effects by Alternative

Table 3.4-22 summarizes the Environmental Justice (EO 12898) and Protection of Children (EO 13045) effects of the No Action Alternative, Alternative 1, and Alternative 2.

Table 3.15-1: Summary EO 12898 and EO 13045 Effects

Alternative	NEPA	EO 12114
No Action Alternative	**Environmental Justice** • No permanent human populations exist in the SOCAL OPAREAs. Therefore, no disproportionately high and adverse human health or environmental effects on minority or low-income populations would occur. • The only residents on SCI are temporary military and contractor personnel. Their direct or indirect employment by the Federal government makes it unlikely they would be considered low-income or otherwise disproportionately susceptible to adverse socioeconomic or environmental impacts. Therefore, there would be little or no harmful effect. **Protection of Children** • No human populations exist in the SOCAL OPAREAs. Therefore, no disproportionate risks to children that result from environmental health risks or safety risks need to be addressed. • As visits by Boy Scouts and Girl Scouts to SCI would be controlled, and scheduled/sited to avoid military training activities, proposed activities would not affect transient populations of children on the island.	**Environmental Justice** • No permanent human populations exist in the SOCAL OPAREAs outside of territorial waters. Therefore, no disproportionately high and adverse human health or environmental effects on minority or low-income populations would occur. **Protection of Children** • No human populations exist in the SOCAL OPAREAs outside of territorial waters. Therefore, no disproportionate risks to children that result from environmental health risks or safety risks need to be addressed.
Alternative 1	**Environmental Justice** • Impacts would be the same as under the No Action Alternative **Protection of Children** • Impacts would be the same as under the No Action Alternative	**Environmental Justice** • Impacts would be the same as under the No Action Alternative **Protection of Children** • Impacts would be the same as under the No Action Alternative
Alternative 2 (Preferred Alternative)	**Environmental Justice** • Impacts would be the same as under the No Action Alternative **Protection of Children** • Impacts would be the same as under the No Action Alternative	**Environmental Justice** • Impacts would be the same as under the No Action Alternative **Protection of Children** • Impacts would be the same as under the No Action Alternative
Mitigation Measures	• None necessary	• None necessary

3.16 Public Safety

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3.16 PUBLIC SAFETY

Public safety issues include potential hazards inherent in flight operations, vessel movements, torpedo drops, mine laying, shore bombardment, underwater demolition, and onshore small arms firing. It is the policy of the Navy to observe every possible precaution in the planning and execution of all activities that occur onshore or offshore to prevent injury to people or damage to property.

3.16.1 Affected Environment

3.16.1.1 SOCAL OPAREAs

Military, commercial, institutional, and recreational activities take place in the Southern California (SOCAL) Operating Areas (OPAREAs). The Federal Aviation Administration (FAA) has established Warning Areas for military aircraft operations; however, most of the airspace and seaspace is available for co-use most of the time. Only hazardous activities require exclusive use of an area. The periods of use are scheduled and broadcast by the Navy through its Southern California Offshore Range (SCORE) web page and through Notices to Mariners (NOTMARs) and Notices to Airmen (NOTAMs).

The public typically accesses the offshore ocean areas for recreational purposes such as sport fishing, sailing, boating, tourist-related activities (sightseeing and whale watching), diving, and swimming. Warning Area 291 (W-291) is a Special Use Airspace lying over international waters where the Navy conducts hazardous activities, including missile firings, naval gunfire, and air-to-surface ordnance deliveries. Commercial and recreational vessels generally are allowed to operate in the SOCAL OPAREAs. During training events or exercises in these offshore areas, weapons deliveries are delayed or cancelled if the range is not clear. Prior to issuing a “Green Range,” Navy personnel must ensure that the hazard footprint of the ordnance being fired is clear of non-participating surface vessels, divers, and aircraft.

Due to San Clemente Island's (SCI’s) remote location, nearshore recreation in its vicinity is usually limited to military personnel and contractors stationed at SCI. Chartered and privately operated boats enter the nearshore areas of SCI occasionally for tourism and recreation. SCI’s relatively warm waters, good underwater visibility, and largely pristine diving conditions make it a popular destination. A review of scuba diving charter advertisements shows dive trips scheduled as often as weekly by some operators. Most dive charters are scheduled for weekends. Diving occurs year-round, though the number of trips to SCI appears to peak during lobster season (October to March). Navy hazardous activities in the nearshore waters of SCI include airborne mine-laying training with wholly inert mine shapes, underwater demolition training, naval gunfire at targets in the Shore Bombardment Area (SHOBA), and air-to-surface munitions delivery in SHOBA.

Several exclusive use, security, and danger zones have been established around SCI (Figure 3.16-1, Table 3.16-1). These coastal areas are identified and described in 33 Code of Federal Regulations (C.F.R.) Parts 110, 165, and 334, as being restricted to naval vessels only or as presenting a hazard to mariners. The security zone, restricted anchorage, and restricted area around Wilson Cove are continuously restricted and regularly monitored.

Figure 3.16-1: SCI Exclusive Use, Security, and Danger Zones

Table 3.16-1: San Clemente Island Exclusive Use, Security, and Danger Zones

Area	Description	Public Use
Wilson Cove		
Exclusive Use Zone (33 C.F.R. 110.218)	Located immediately offshore of Wilson Cove and used extensively by Navy ships for anchorage adjacent to the port facilities at Wilson Cove.	Anchoring is restricted to Navy vessels.
Security Zone (33 C.F.R. 165.1131)	Extends to the northeast from Wilson Cove for approximately 2 nm (4 km) from the coast and to the southeast for approximately 3 nm (6 nm) along the coast.	Entry prohibited except for Navy vessels, those vessels authorized by the Navy, and emergencies
Southeast Restricted Area (33 C.F.R. 334.920)	Covers the ocean areas near NOTS Pier and extends offshore for about 2 nm (4 km).	
West Cove		
Restricted Area (33 C.F.R. 334.921)	Extends to sea approximately 5 nm (9 km) to the southwest from the West Cove area, over the area where the underwater cables are laid to the acoustic sensors on the SOAR range.	When not in use by the Navy, available for public boating, diving, and fishing. No anchorage allowed in the West Cove restricted area. The public is informed of danger zone activities through the San Clemente Island website, NOTMARs and NOTAMs.
Danger Zone (33 C.F.R. 334.960)	An approximately 1 nm by 3 nm (2 km by 6 km) rectangle for intermittent firing events, located 0.5 nm (0.9 km) offshore south of West Cove.	
Other		
Northwest Danger Zone (33 C.F.R. 334.961)	Extensive firing and demolition activities occur in this zone, located approximately 3 nm (6 km) off the northwestern end of SCI.	
SHOBA Danger Zone (33 C.F.R. 334.950)	Activities include naval gunfire, air-to-ground munitions delivery, and laser employment. Covers the entire southern third of SCI on both coasts.	
NOTES: nm - nautical miles, km - kilometer, C.F.R. - Code of Federal Regulations.		

Other designated zones are not continuously restricted. When not in use by the Navy, these areas are accessible by boaters, divers, and fisherman, with nearshore anchorages available. NOTMARs and NOTAMs are issued about the hazards of operating vessels or aircraft in the vicinity of SCI.

There are two possible mooring locations on the northern end of SCI. One is in Northwest Harbor and the other is in Wilson Cove (about 5 [mi] south of Northwest Harbor on the eastern side of SCI). These buoys are normally for military use only.

3.16.1.1.1 Current Mitigation Measures

Navy activities in the SOCAL OPAREAs comply with numerous established safety procedures to ensure that neither participants nor non-participants engage in activities that would endanger life or property.

FACSFAC / SCORE Safety Procedures

Fleet Area Control and Surveillance Facility (FACSFAC) and SCORE have published safety procedures for activities on the offshore and nearshore areas (Department of the Navy [DoN] 1997b, 1999, 2004). These guidelines are directive for range users.

- Commanders are responsible for ensuring that impact areas and targets are clear prior to commencing activities that are hazardous.

- On the Southern California Anti-Submarine Warfare Range (SOAR), the use of underwater ordnance must be coordinated with submarine operational authorities. The coordination also applies to towed sonar arrays and torpedo decoys.
- Aircraft or vessels expending ordnance shall not commence firing without permission of the scheduling authority for their specific range.
- Firing units and targets must remain in their assigned areas, and units must fire in accordance with current safety instructions.
- Except for SHOBA, ships are authorized to fire their weapons only in offshore areas and only at specific distances from land, depending on the caliber and range of the weapons fired. The larger the caliber, the farther offshore that the firing must take place.
- The use of pyrotechnic or illumination devices and marine markers such as smoke or dye markers is allowed only in assigned areas, to avoid the launch of Search and Rescue forces when not required. Aircraft carrying ordnance to or from ranges shall avoid populated areas to the maximum extent possible.
- Aircrews operating in W-291 are aware that non-participating aircraft are not precluded from entering the area, and may not comply with a NOTAM or radio warning that hazardous activities are scheduled or occurring. Aircrews are required to maintain a continuous lookout for non-participating aircraft while operating under visual flight rules in W-291.

Navy Standard Operating Procedures (SOPs)

In addition to the FACSFAC and SCORE procedures, the Navy has instituted the following standard operating requirements for use of the SOCAL Range Complex.

Aviation Safety

Aircraft in W-291 fly under Visual Flight Rules and under visual meteorological conditions. This means that the commanders of military aircraft are responsible for the safe conduct of their flight. Prior to releasing any weapons or ordnance, the impact area must be clear of non-participating vessels, people, or aircraft. The Officer Conducting the Exercise is ultimately responsible for the safe conduct of range training. A qualified Safety Officer is assigned to each training event or exercise, and can terminate activities if unsafe conditions exist. Aircraft entering the SCI Air Traffic Area are required to be in radio contact with SCORE or the SCI control tower. Section 3.13.1 describes the role of the Federal Aviation Administration in coordinating the use of controlled airspace.

Submarine Safety

Submarines routinely operate in the SOCAL OPAREAs. The SOAR range has an array of 84 hydrophones to track submarines, torpedoes, and simulated submarine targets. To be tracked accurately on SOAR, vehicles are equipped with pingers (noise makers), whose noise is picked up by the hydrophone array. This technology allows for geospatial (i.e., location) tracking. The submarines on SOAR can communicate with SCORE via an underwater telephone system installed on the range, and by radio if the vessel is on the surface or has an antenna extended above the surface.

To enhance the safety of submarines while on the range, minimum vertical and horizontal separation distances are specified. Vertical separation of at least 100 feet (ft) (30.5 meter [m]) is required between the top of a submarine's sail and the depth of a surface ship's keel, or of a towed sonar array or helicopter dipping sonar. If a submarine (or submarine simulated target, the MK-30) is at periscope depth, at least a 1,500-yard (yd) (1,372-m) horizontal separation from surface ships is maintained by directing surface ships to alter their courses. Other vessels are allowed to approach no closer than 1,500 yd (1,372 m).

When two submarines are on the range, vertical separation is maintained by operating the submarines at different depths. Exercise torpedoes fired at submarines are programmed to run at preset depths to ensure sufficient vertical clearance between the torpedoes and the target submarine.

Surface Ship Safety

Surface ships conduct anti-submarine training against submarines and simulated submarine targets (the MK-30 or MK-39) in the SOCAL OPAREAs. During these exercises, surface ships maintain radio contact with SCORE. Prior to launching a weapon, ships are required to obtain a “Green Range,” which indicates that all safety criteria have been satisfied, and that the weapons and target recovery conditions and recovery helicopters and boats are ready to be employed.

Missile Exercise (MISSILEX) Safety

Safety is the top priority and paramount concern during SCORE missile exercises. These exercises can be surface-to-surface, subsurface-to-surface, surface-to-air, or air-to-air. A Missile Exercise (MISSILEX) Letter of Instruction is prepared prior to any missile firing exercise. This instruction establishes precise ground rules for the safe and successful execution of the exercise. Any MISSILEX participant who observes an unsafe situation can communicate a “Red Range" order over any voice communication systems. SCORE is in radio contact with participants at all times during a MISSILEX.

3.16.1.2 San Clemente Island

SCI is a central feature of the SOCAL Range Complex. SCI’s distance from the mainland and its complete Navy ownership make SCI and adjacent waters ideal for fleet training, weapon and electronics systems testing, and research and development activities. This isolation from the mainland is the key to conducting activities in a way that minimizes hazards to the public. Onshore hazardous activities include onshore weapons firing and demolition training, small arms and artillery firing in SHOBA, and naval gunfire at targets in SHOBA.

3.16.1.2.1 Existing Conditions

Public Access and Proximity

SCI is owned by the Navy. No public use is allowed. Access to SCI is granted for military activities and for pre-approved, non-military uses such as scientific research. A scheduled contract aircraft shuttle transports personnel between NASNI and SCI. When not in use by the Navy, the nearshore areas (e.g., Pyramid Cove or Horse Beach Cove) are available to civilian vessels. Nearshore ocean areas may be within the designated or actual hazard footprint of onshore training activities; the Navy has identified these areas and taken steps to control access to them when necessary (see Figure 3.16-1).

Training Ranges

Live Fire Activities in the Shore Bombardment Area (SHOBA)

SHOBA is the only range on the west coast available for naval surface vessel live firing. SHOBA also hosts artillery firing and aircraft bombing exercises, several of which involve the use of laser-guided weapons. SHOBA is used for the full range of naval ordnance. A Ready Service Locker (RSL) and an 81-millimeter (mm) mortar are located at Observation Post 1 (OP-1), and an RSL is being requested for OP-3.

Small Arms and Demolition Ranges

SCI features small arms ranges (rifle, pistol, and automatic weapons), a hand grenade range, and a demolition range. The rifle range is located north of the runway, adjacent to the Basic Underwater Demolition School (BUD/S) Camp and Maritime Operations (MAROPS) facilities. It is a 64-position, 300-yd (274-m) range, and is approved for small arms and automatic weapons. The hand grenade range is located immediately east of the rifle range. In addition, there is an old, approved machine gun range at Eel Point. The machine gun range was first approved for 0.50 caliber weapons in 1970 and was used by Naval Special Warfare (NSW) units. The range was later approved for M-79 grenade launchers, M-66 Light Anti-Armor-Weapon (LAAW) rockets, and all types of hand grenades. The Eel Point range is the subject of a current NSW proposal for reactivation, and is undergoing separate National Environmental Policy Act (NEPA) review.

NSW demolitions occur at the Underwater Demolition Team Land Training Site (the “donut”), located northeast of the rifle range. It was sited for 500-pound (lb) (227-kilogram [kg]) high explosives (net explosives weight) prior to 1975, and approval was later extended to automatic weapons firing. Two nearshore areas of Northwest Harbor are approved for underwater demolition: BUD/S Beach and Graduation Beach, which are active demolition training sites.

Munitions/Ordnance Storage

Ammunition and explosives are stored in bunkers and magazines on SCI. The types and amounts of materials that may be stored are determined by Department of Defense (DoD) safety regulations. Explosive Safety Quantity Distance (ESQD) arcs prescribe the minimum safe separation between the storage facilities and inhabited buildings. The Navy has established ESQD arcs for ordnance storage lockers used for SCI training activities.

The procedures for handling and storing munitions are found in Naval Sea Systems Command (NAVSEA) Ordnance Pamphlet (OP) 5, Ammunition and Explosives Ashore, Safety Regulations for Handling, Storing, Production, Renovation, and Shipping. RSLs are located in the BUD/S camp area north of the Naval Air Landing Facility (NALF) runway, at the Missile Assembly Building at NOTS Pier, and at Observation Point 1 in SHOBA. There are six munitions storage bunkers or magazines in the Mill's Circle area south of the VC-3 airfield. Each bunker is approved for up to 90,000 lb (40,823 kg) net explosive weight (n.e.w.) of ordnance.

Red Label areas are ordnance loading pads that are required for loading and off-loading explosives from cargo aircraft. The storage and Red Label areas on SCI are approved for explosives. Table 3.16-2 summarizes the storage capabilities of the ordnance storage locations.

Table 3.16-2: Ordnance Storage Facilities

Type	Capacity (lb)	ESQD Arc Distance (ft)
BUD/S Camp RSL 1	2,000	1,250
BUD/S Camp RSL 2	2,000	1,250
Missile Assembly Building RSL	1,000	1,250
Magazine 60320	90,000	1,795
Magazine 60321	90,000	1,795
Magazine 60322	90,000	1,795
Magazine 60323	90,000	1,795
Magazine 60324	90,000	1,795
Magazine 60325	90,000	1,795
NALF Red Label Area	10,000	1,250
VC-3 Red Label Area	5,000	1,250
OP-1 RSL	2,000	1,250

Source: SCI Explosive Safety Instructions

Transportation of Munitions

Ordnance arrives on SCI by either aircraft or ship. There are two Red Label areas where aircraft can off-load ordnance. The Red Label, or hazardous cargo area, at the airfield provides an approved area for the off-loading of ordnance from aircraft. This area is located at the western end of the NALF SCI airfield where the parallel taxiway joins the runway. The fixed-wing Red Label area is approved for up to 10,000 lb (4,538 kg) of explosives, n.e.w. Another Red Label area for rotary-wing aircraft is located at the eastern end of the VC-3 old airfield ramp. This area is approved for up to 5,000 lb (2,269 kg) of explosives, n.e.w.

After off-loading from aircraft, ordnance is transported to storage locations or directly to a designated range for use. The route from the airfield to the BUD/S camp is around the runway on Perimeter Road. The route to the storage magazines and SHOBA is south on Perimeter Road to Ridge Road. A bypass on Ridge Road allows munitions trucks traveling from the airfield to the magazine or SHOBA to avoid Wilson Cove. If ordnance is off-loaded from a barge, ship, or boat in Wilson Cove, the route to the storage areas or ranges is along Wilson Cove Road North to Ridge Road. The transportation of ordnance through Wilson Cove requires convoys to pass through SCI's only built-up area where there are large numbers of personnel and structures.

3.16.1.2.2 Current Mitigation Measures

Munitions Safety

In all cases where munitions are expended on SCI, a qualified Range Safety Officer (RSO) is on duty. In addition, there are RSOs on duty at the Range Operations Center at SCORE. Safety of participants is the primary consideration for all activities on weapons ranges on SCI. The fundamental guidance adhered to by units operating on SCI is that the range must be able to contain the hazard footprints of the weapons employed. The locations of firing points, impact areas, and surface danger zones form a ground footprint on SCI and in the nearshore waters. RSOs ensure that these areas are clear of personnel during activities. After every live-fire event, each participating unit ensures that all weapons are safe and cleared of rounds. The RSOs are also responsible for the emergency medical evacuation of people from the range in case of mishap.

Laser Safety

A comprehensive safety program exists for the use of lasers. Lasers are used for precision range finding and by target designation systems for guided munitions. Procedures are required to protect individuals from the hazard of severe eye injury due to the nature of the laser light. The completion of a laser safety course, protective goggles, a medical surveillance program, and mishap reporting procedures are required by all units conducting laser training. Laser safety requirements for aircraft include a dry run to ensure that target areas are clear. In addition, during actual laser use, the aircraft run-in headings are restricted to preclude inadvertent lasing of areas where personnel may be present.

Lasers are used occasionally on the nearshore and onshore ranges for both precision distance range finding and target designation for guided munitions. Strict precautions and written instructions are in place and observed by laser users to ensure no personnel suffer eye injury due to the light energy. When laser training occurs in SHOBA, the SHOBA land area is considered a Laser Hazard Area.

Electromagnetic Radiation Safety

Communications and electronic devices such as radar, electronic jammers, and other radio transmitters produce Electromagnetic Radiation (EMR). Equipment that produces an electromagnetic field has the potential to generate hazardous levels of EMR. An EMR hazard exists when transmitting equipment generates electromagnetic fields that induce currents or voltages great enough to trigger electro-explosive devices in ordnance, harm people or wildlife, or create sparks that can ignite flammable substances in the area. This radiation can cause health hazards to people or cause explosive hazards to ordnance or fuels. Hazards are reduced or eliminated by establishing minimum distances from EMR emitters for people, ordnance, and fuels.

EMR is expressed in milliwatts per square centimeter. Its effects are directly proportional to the frequency of the source of EMR. For example, the lower the frequency of the EMR source, the lower the acceptable power density threshold before a potential hazard to human health exists. Likewise, the higher the frequency of the EMR source, the higher the acceptable power density threshold before health effects occur.

Hazards of Electromagnetic Radiation to Personnel, Hazards of Electromagnetic Radiation to Ordnance (HERO), and Hazards of Electromagnetic Radiation to Fuel have been determined for EMR sources based on frequency and power output. Site-specific studies are needed to determine actual required separation distances. A study published in March 1996 by the Naval Surface Warfare Center, Dahlgren Division, was completed on the hazards of EMR for ordnance on SCI (DoN 1996). The report provides data on the status of HERO from stationary EMR sources on SCI, suggests emission controls for mobile sources aboard boats or in vehicles, and cautions on the use of ground-penetrating radar in areas known to contain unexploded ordnance. The report finds that no emissions from stationary sources exceed the Maximum Allowable Environment for HERO-susceptible ordnance. For HERO-unsafe ordnance, the report recommends emission controls for the Very High Frequency transmitter in Building 60212 and the High Frequency transmitters in Buildings 60226 and 60502. The required separation distances from Buildings 60226 and 60502 are 1,000 and 200 ft. (305 m and 61 m), respectively, for HERO-unsafe ordnance.

Because of programmed improvements in both communications and radar tracking systems and the increased use of the Electronic Warfare Range, the electronic emissions environment on SCI is periodically reviewed. Navy personnel typically use low-power communications equipment (e.g., two-way radios, cellular telephones) during training.

3.16.2 Environmental Consequences

3.16.2.1 Approach to Analysis

Public safety impacts are considered significant if the general public is substantially endangered as a result of Navy activities on the ranges. For each training activity or group of similar activities, an estimate of risk to the general public was formulated, based on the Navy's current set of safety procedures for island and range activities. Activities in the SOCAL Range Complex are conducted in accordance with guidance provided in FACSFAC San Diego Instruction 3550.1, *SCORE User's Manual*. The instruction provides operational and safety procedures for all normal range events. Its emphasis is on providing the necessary information to range users so that they can operate safely and avoid affecting non-military activities such as shipping, recreational boaters, divers, and commercial or recreational fishermen. Several factors were considered in evaluating the effects of the Navy's proposed activities on public safety. These factors include proximity to the public, ownership, access control, scheduling, public notification of events, frequency of events, duration of events, range safety procedures, operational control of training events, and safety history.

For terrestrial training activities, wildfires are a potential safety hazard. The primary cause of wildfires during military training on SCI is ordnance. The primary threat of wildfires is not to the public, however, but to terrestrial biological resources. Range safety procedures prohibit public access to ranges during live-fire events.

3.16.2.2 No Action Alternative

3.16.2.2.1 SOCAL OPAREAs

Public Safety

Fleet training will continue to occur in the SOCAL OPAREAs. Most offshore activities expend torpedoes, sonobuoys, or targets from ships, submarines, or aircraft. Both high explosive and non-explosive practice ordnance are used in offshore activities. While activities are in progress, an RSO is always on duty. The RSO can halt an activity if a potentially unsafe condition arises. Range Safety officials ensure that weapons platforms (e.g., ships, aircraft, submarines), targets, and weapons (e.g., naval guns, missiles, bombs) are operated safely, and that air operations and other hazardous fleet training activities are safely executed in controlled areas.

The U.S. Navy's standard range safety procedures are designed to avoid risks to the public and to Navy activities. When aircraft or surface vessels fire ordnance, range procedures and safety practices ensure that there are no vessels or aircraft in the intended path or impact area of the ordnance. Before any training event is allowed to proceed, the target area is determined to be clear using ship sensors, visual surveillance of the range from aircraft and range safety boats, and radar and acoustic data.

The hazard footprint of the ordnance to be used is based on the range of the weapon, and includes a large safety buffer to account for the item going off-target or functioning prematurely. For activities with a large hazard footprint (e.g., MISSILEXs), special sea and air surveillance measures are taken to search for, detect, and clear the area of intended activities. Aircraft are required to make a preliminary pass over the intended target area to ensure that it is clear of boats, divers, or other non-participants. Aircraft carrying ordnance are not allowed to fly over surface vessels.

Target areas will be cleared of personnel prior to conducting training, so the only public health and safety issue will be if an activity exceeded the safety area boundaries. Risks to public health and safety are reduced, in part, by providing termination systems on some of the missiles. In those cases where a weapon system does not have a flight termination capability, the target area will be determined to be clear of unauthorized vessels and aircraft, based on the flight distance the vehicle can travel, plus a 5-mile (mi) area beyond the system performance parameters.

In addition, all training activities must comply with DoD Directive 4540.1, "Use of Airspace by U.S. Military Aircraft and Firing Over the High Seas" (DoD 1981) and OPNAVINST 3770.4A, "Use of Airspace by U.S. Military Aircraft and Firing Over the High Seas" (DoN 1981), which specify procedures for conducting aircraft operations and for firing missiles and projectiles. The missile and projectile firing areas are to be selected "so that trajectories are clear of established oceanic air routes or areas of known surface or air activity" (DoD 1981).

Demolition activities are conducted in accordance with Commander Naval Surface Force, U.S. Pacific Fleet (COMNAVSURFPAC) Instruction 3120.8F (DoN 1993). COMNAVSURFPAC Instruction 3120.8F specifies detonation procedures for underwater ordnance to avoid endangering the public or affecting other non-military activities, such as shipping, recreational boating, diving, and commercial or recreational fishing.

Many offshore activities use mid-frequency sonar. The effect of sonar on humans varies with the frequency of sonar involved. Of the three types of sonar (high-, mid-, and low-frequency), mid-frequency and low-frequency have the greatest potential to affect humans (low-frequency sonar is not used in the SOCAL OPAREAs). The Naval Submarine Medical Research Laboratory and the Navy Experimental Diving Unit researched mid-frequency sonar to determine permissible limits of exposure to mid-frequency sonar. This research determined that an unprotected diver could safely operate for over 1 hour at a distance of 1,000 yd (914 m) from the Navy's most powerful sonar. At this distance, the sound pressure level will be approximately 190 decibels (dB). At 2,000 yd (1,829 m), or approximately1 nm (2 km), an unprotected diver could operate for over 3 hours. Exposure to mid-frequency sonar in excess of 190 dB can cause slight visual-field shifts, fogging of the faceplate, spraying of water within the mask, and general ear discomfort.

Recreational diving within the SOCAL OPAREAs occurs primarily at known dive sites. The locations of popular dive sites are well documented, dive boats are typically well marked, and diver-down flags are visible from the ships conducting the training, so negative interactions between Navy training activities in offshore areas and scuba divers are unlikely.

The Navy temporarily limits public access to areas where there is a risk of injury or property damage. The Navy notifies the public of hazardous activities through the use of NOTAMs and NOTMARs and the SCORE website. Prior public notification of Navy training activities, use of known training areas, avoidance of non-military vessels and personnel, and the remoteness of the offshore training areas from coastal population centers reduce the potential for interaction between the public and Navy vessels. To date, these conservative safety strategies have been successful.

Public Health

Management of hazardous materials and hazardous wastes during Navy training exercises in the SOCAL OPAREAs is addressed in Section 3.3. No substantial releases of these materials to the environment are anticipated.

Materials expended on the sea ranges during U.S. Navy training exercises include liquid and soluble constituents of concern that quickly disperse in the water column. These materials also include solid constituents of concern that quickly settle to the ocean floor and soon become buried in sediment, coated by corrosion, or encrusted by benthic organisms. Because of the very small quantities of these materials relative to the extent of the sea ranges, the volume of the ocean, and the remoteness of the sea ranges relative to human populations, their concentrations in areas of potential human contact generally are undetectable. This issue is analyzed in detail in Section 3.4, Water Resources.

With regard to EMR hazards, SOPs are in place to protect Navy personnel and the public. These procedures include setting the heights and angles of EMR transmissions to avoid direct exposure, posting warning signs, establishing safe operating levels, and activating warning lights when radar systems are operational. Sources of EMR include radar, navigational aids, and Electronic Warfare (EW). These systems are the same as, or similar to, civilian navigational aids and radars at local airports and television weather stations throughout the United States. EW systems emit EMR similar to that from cell phones, hand held radios, commercial radio, and television stations. Measures also are in place to avoid excessive exposure from EMR emitted by military aircraft.

3.16.2.2.2 San Clemente Island

Live Fire Activities in the Shore Bombardment Area (SHOBA)

Most of the training in SHOBA takes place onshore, although some activities involve weapons firing by aircraft or from ships in nearby waters. The boundaries and extent of the nearshore SHOBA Danger Zone are published in 33 C.F.R. § 334.950.

Explosive Ordnance Disposal (EOD) activities have no public safety impacts because there is no routine public access to SCI. Ground access in SHOBA's two Impact Areas is hazardous because of the potential for military activities and the presence of unexploded ordnance. For the remaining SHOBA activities that expend munitions from aircraft or surface vessels, the Navy uses advance notice and scheduling, and strict on-scene procedures are in place to prevent firing of weapons without first ensuring that the firing danger area is clear of civilian vessels, aircraft, or other non-participants. Aircraft are required to make a preliminary pass over the target prior to dropping any ordnance. If the target area is not clear, they are precluded from dropping their ordnance. This requirement applies to both non-explosive practice weapons and high explosive bombs. The public is notified of the location, date, and time of hazardous activities via NOTAMs, NOTMARs, and the SCORE website.

To ensure that no unauthorized personnel have access to SHOBA during hazardous activities, ground access is strictly controlled. This control is accomplished by locked gates and visual confirmation that the area is clear of personnel. For NSW activities, the RSO ensures the area is clear. For other ground activities, SCORE or the Naval Gunfire Liaison Officer does so.

In the history of SHOBA, there have been no recorded accidents resulting in injury to personnel or property damage. During an exercise, helicopters are on standby to fight any wildfires resulting from training activities. These procedures to protect the public from harm and the limits on public access onshore at SCI ensure that the effects of SHOBA training and testing activities on public safety will be negligible.

Amphibious Warfare Training

U.S. Marine Corps (USMC) amphibious activities vary from small boat raids to major events with several Landing Craft Air Cushion (LCACs), Landing Craft Utility (LCUs), Amphibious Assault Vehicles (AAVs), or Expeditionary Fighting Vehicles (EFVs) coming ashore simultaneously on different beach areas. A portion of the Marines may be airlifted to SCI landing zones by helicopter. High explosive ordnance is not expended in the over-the-beach portion of the amphibious assaults. During the time that the LCACs, LCUs, AAVs, or EFVs are transiting toward the shore from the larger amphibious assault ships, the transit lanes are temporarily cleared of private vessels to minimize any hazard to the public. Prior notification of activities, avoidance of non-military vessels, and low frequency of activities tend to prevent interaction between civilian vessels and the amphibious vehicles.

Naval Special Warfare (NSW)

Access control is the key to reducing the risk to the public due to the hazardous nature of NSW training. These training activities use demolition explosives, both on land and underwater; small arms firing on static ranges; land navigation training; and Sea, Air, Land (SEAL) platoon-sized events using high explosive ordnance in authorized areas. Because there is no general public access to SCI, the activities occurring on SCI pose no risk to public safety. For those activities with an offshore or nearshore component, the Navy ensures that the danger area is clear of civilian boats, divers, or aircraft before any hazardous operation commences. Activities are cancelled or delayed if there is any doubt about the safety of the public or the participants. During the use of high explosive ordnance at any of the NSW training areas, the designated RSO is responsible for the safety of the participants and non-participants. RSOs are trained to evaluate the potential hazards of activities by a formal risk assessment process. They also provide range safety briefings and debriefings prior to and after training events. Radio communications are used extensively during exercises to avoid unsafe situations. The area used for training is isolated by the use of security guards, if necessary.

Due to the strictly controlled nature of the NSW training on SCI, this training will have no effect on public safety.

Strike Warfare

Bombing Exercises occur on land exclusively in SHOBA; these activities are described above. Combat Search and Rescue (CSAR) training occurs over and on SCI, where public access is prohibited. No public health or safety effects result from these activities.

Other Island Operations

Other Island Operations include EOD training and NALF operations. These activities occur in areas that are closed to the general public. The explosive destruction of munitions is hazardous, but the areas in which these activities occur are very isolated. These activities typically do not pose a public safety concern.

Operations at NALF are generally restricted to military aviation and contract flights to bring personnel to SCI and return them to the mainland. A few non-military general aviation flights occur at the airfield, but only for official business with prior permission granted. NALF is an emergency airfield for general aviation traffic if a suitable alternate airfield is not available. Due to the remoteness of SCI from major air traffic routes and the mainland, military flight operations at NALF do not affect the major civil airway structure on the mainland. Most of SCI's air traffic operates at low altitudes, so the trans-Pacific air routes between SCI and Santa Catalina Island are not affected by NALF airfield operations.

Research, Development, Test and Evaluation (RDT&E)

SCI and adjacent waters accommodate a variety of Research, Development, Test, and Evaluation (RDT&E) activities. Most tests are benign activities that can be executed on a co-use basis with other users. The major RDT&E events that have public safety implications are tests involving Tomahawk missiles, Standard missiles, Joint Stand-Off Weapons (JSOW), Unmanned Aerial Vehicles (UAVs), and sonobuoys. In these test scenarios, each system has a ground hazard footprint and may also require a large amount of cleared airspace.

Before any missile is fired or any ordnance is dropped, the Navy ensures that no civilian boats are in the hazard footprint of the weapon to be fired. The events are scheduled well in advance, and temporary access restrictions are announced by NOTMARs and NOTAMs, which are also posted on the SCORE website. In addition, there is extensive coordination with the FAA to ensure that no aircraft under FAA control are at risk. For long-range missile systems, such as the Tomahawk, chase aircraft follow the missile during flight so that, if a malfunction occurs, the missile can be destroyed in flight by the Safety Observer in the chase aircraft. If the Navy cannot confirm that the airspace or sea area covered by the hazard footprint is clear of non-participants, the test is either delayed or canceled.

Sonobuoys are tested exclusively in SCI's Underwater Range (SCIUR) east of Wilson Cove. The same procedures as described above are used for this operation. The Navy ensures that the designated sonobuoy target area is clear of boats, aircraft, divers, or other non-participants. UAVs are flown from SCI only after extensive coordination with SCI Air Traffic Control and the FAA.

3.16.2.3 Alternative 1

3.16.2.3.1 SOCAL OPAREAs

Offshore activities proposed under Alternative 1 would have all the components of the No Action Alternative, but the training tempo would increase by about 24 percent and new weapons platforms and systems would be employed. The safety procedures implemented under this alternative would be the same as those described above under the No Action Alternative. The remoteness of the offshore areas, the use of temporary access restrictions, and public notification procedures would substantially reduce potential safety risks during these activities.

Public Safety

Several training activities would experience increases from current levels in support of the Fleet Response Training Plan (FRTP). Only the number of training activities would increase; no new types of training would be introduced. Increases in the number of individual training exercises would incrementally increase the potential for conflicts with non-participants. Given the Navy's comprehensive, conservative safety procedures and its excellent safety record for these activities, however, the actual risk to public safety from training activities would remain very low.

Public Health

Management of hazardous materials and hazardous wastes in conjunction with U.S. Navy training exercises in the SOCAL OPAREAs is addressed in Section 3.3. No substantial releases of these materials to the environment are anticipated.

The quantities of materials expended on the sea ranges during Navy training exercises would increase moderately under Alternative 1, compared with the quantities expended under the No Action Alternative. The natures of these materials and their environmental fates are described in Section 3.16.2.2.1. This issue is analyzed in detail in Section 3.4, Water Resources.

3.16.2.3.2 San Clemente Island

The overall tempo of training activities on SCI, aside from NALF airfield operations, would increase by about 45 percent relative to that of the No Action Alternative. NALF operations would increase by about 5 percent under Alternative 1, relative to the No Action Alternative.

Activities in Shore Bombardment Area (SHOBA)

SHOBA training under Alternative 1 would have all the components of the No Action Alternative, but at an increased rate and with the addition of Training Areas and Ranges (TARs) 20, 21, and 22. Training events in each of these TARs would employ high explosive ordnance under highly controlled conditions. Temporary access restrictions to the nearshore waters of these TARs are proposed to ensure public safety. If the nearshore waters were not clear of non-participants, the Navy would delay the training until the areas were clear. A combination of controlled access, public notification of hazardous activities, and adherence to range safety procedures would substantially limit the public safety risks of these activities.

Amphibious Training

Under Alternative 1, one Battalion-size landing of about 1,500 personnel, lasting up to 4 days and employing the full combined arms team used by the USMC, would occur each year. Marine forces would come ashore over 2 days, with the force landing at West Cove, Northwest Harbor, Wilson Cove, or SHOBA. About 20 ships and amphibious vehicles would be involved on the busiest training day. Although the number of ships and amphibious vehicles would be larger than for most SCI activities, they would be spread over a large area of ocean. The only live-firing during the exercise would occur in SHOBA. Once the Marines were on shore, temporary access restrictions to the nearshore waters would be lifted.

Exercises of this magnitude would be scheduled well in advance. Website notification, NOTAMs, and NOTMARs would be published, and temporary access restrictions would be announced on the SCORE website (www.scisland.org). The extensive planning, scheduling, briefing, command and control, and training for these exercises would substantially reduce the potential for any public safety effects. Due to the highly controlled nature of these amphibious exercises and the Navy's procedures for informing the public of the scheduled activities, effects on public safety would be negligible.

Naval Special Warfare (NSW)

Alternative 1 would include all NSW training activities described under the No Action Alternative, plus 19 new TARs. All of the new TARs would be located on land, except for TARs 7 and 8, which are water drop zones (no live firing is proposed in TARs 7 and 8). When not in use, TARs 7 and 8 would be open for use by the public. The expenditure of high explosive ordnance in the on-land TARs would be tightly controlled. The TARs are outside of the traditional live-fire area of SHOBA, so special procedures would be developed to ensure safety. These procedures would include (1) scheduling, (2) advance notification to island personnel, (3) range surveillance 30-60 minutes prior to initiation, (4) visual confirmation by the RSO that the area is clear of all non-participants, (5) ensuring weather conditions allow clear visibility of all targets and impact areas, (6) ensuring all unit members have been pre-briefed and trained for their roles, (7) designating a safe area for non-participants, (8) ensuring proper range guards and road barricades are in place, and (9) briefing all personnel on fire-fighting equipment and location. Because the general public does not have access to SCI, the effects of these activities on public safety would be negligible with the continued implementation of established Navy safety procedures.

Other Island Operations

Under Alternative 1, Other Island Operations would include the same activities as considered under the No Action Alternative, but with small increases in their total number. The effects would be similar to those described under the No Action Alternative.

Under Alternative 1, airfield operations would increase by about 5 percent over the No Action Alternative. The conditions and types of operations at NALF SCI would be the same as described under the No Action Alternative. Since the existing air traffic control safety infrastructure at NALF SCI could adequately accommodate this increase in operations, effects on public safety would be negligible.

Research, Development, Test and Evaluation (RDT&E)

Under Alternative 1, RDT&E activities would have all the components of the No Action Alternative, but UAVs would not be tested. The Mine Shape Drop tests and the Land Attack Standard Missile (LASM) tests require temporary exclusive use of the range to expend these munitions. The Mine Shape Drop tests have a very small hazard footprint, and the RSO can easily determine if the target area is clear of civilian boats, divers, or aircraft.

LASMs can have very large hazard footprints (up to 100 mi [161 km] in length). The test planning process for this activity would include a substantial public safety effort and hazard analysis. Specific test plans and safety annexes would be developed prior to each test event and reviewed by multiple Navy commands. A test would not proceed unless the safety implications of the tests were fully resolved. Navy surface ships and aircraft would observe the hazard area to ensure that no civilian boats or aircraft were endangered. Systems tests requiring large hazard footprints are infrequent, and these systems would not be fired unless the Navy was confident that the test area was clear of public vessels and aircraft. Due to the Navy's attention to safety for the testing of new systems with large hazard footprints, the effects of increased RDT&E activities on public safety would be negligible.

3.16.2.4 Alternative 2

3.16.2.4.1 SOCAL OPAREAs

Offshore events proposed under Alternative 2 would have all the components of Alternative 1, but the number of annual events would increase by about 26 percent over the No Action Alternative. The safety procedures implemented under this alternative would be the same as those described above under the No Action Alternative. The remoteness of the offshore areas, the use of temporary access restrictions, and public notification procedures would substantially reduce potential safety risks during these activities.

Public Safety

Several training activities would experience increases from current levels in support of the FRTP. Only the number of training activities would increase; no new types of training would be introduced. Increases in the number of individual training exercises would increase the potential for conflicts with non-participants. Given the Navy’s safety procedures and its excellent safety record for these activities, however, the actual potential for public safety impacts from training activities would remain very low.

The installation of the SWTR is a temporary activity confined to Navy land and sea training areas. Only authorized Navy and contractor personnel would be allowed in the vicinity of work areas. The Navy would use standard noticing procedures to ensure that members of the general public did not approach vessels engaged in installation activities. No effects on public health or safety are anticipated.

Public Health

Management of hazardous materials and hazardous wastes in conjunction with Navy training exercises in the SOCAL OPAREAs is addressed in Section 3.3. No substantial releases of these materials to the environment are anticipated.

The quantities of materials expended on the sea ranges during Navy training exercises would increase substantially under Alternative 2, compared with the quantities expended under the No Action Alternative. The natures of these materials and their environmental fates are described in Section 3.16.2.2.1. This issue is analyzed in detail in Section 3.4, Water Resources.

3.16.2.4.2 San Clemente Island

The overall tempo or training activities on SCI would increase by about 62 percent relative to that of the No Action Alternative.

Live Fire Activities in the Shore Bombardment Area (SHOBA)

SHOBA training under Alternative 2 would have all the components of Alternative 1. Alternative 2 would involve more events, however, with increases mostly in naval gun fire, air strikes, close air support, and NSW activities. The safety procedures described under the No Action Alternative also would be included under Alternative 2. Therefore, effects of SHOBA activities on public safety would be negligible.

Amphibious Warfare Training

Under Alternative 2, two USMC Battalion Landings would occur per year, rather than one per year as described under Alternative 1 (this activity does not occur under the No Action Alternative). Effects on public safety would be negligible, however because this activity occurs in areas from which the public is excluded.

Naval Special Warfare (NSW)

The tempo of NSW activities under Alternative 2 would be substantially greater than under the No Action Alternative. These increases in activities would not measurably increase public safety risks, however, because the public is generally excluded from the areas where the activities take place and the Navy's safety procedures (described under the No Action Alternative) would ensure that non-participants were not endangered.

Other Island Operations

Components of other island operations under Alternative 2 would be the same as those described for Alternative 1 but the anticipated number of events would increase substantially. These activities generally do not affect public safety, and increasing their tempo would not affect public safety. For example, EOD operations would increase from 4 per year under the No Action Alternative to 10 per year under Alternative 2, but these on-island disposal operations pose no risk to public health or safety under any scenario.

Under Alternative 2, airfield operations would increase by about 9 percent over the No Action Alternative. The types of activities at NALF SCI would be the same as under the No Action Alternative. The existing air traffic control safety infrastructure at NALF SCI could adequately accommodate this increase in activities, so effects on public safety would be negligible.

Research, Development, Test and Evaluation (RDT&E)

Alternative 2 consists of the same RDT&E events as Alternative 1, with minor increases in the numbers of events. Public notification, temporary access restrictions, and the remoteness of these test events are key factors in ensuring that the general public would not be at risk.

3.16.3 Mitigation Measures

Current mitigation measures are addressed in Sections 3.16.1.1.1 and 3.16.1.2.2. No additional mitigation measures have been identified as necessary or appropriate.

3.16.4 Unavoidable Adverse Environmental Effects

No unavoidable adverse environmental effects were identified.

3.16.5 Summary of Effects by Alternative

Table 3.16-3 summarizes the effects of and mitigation measures for the No Action, Alternative 1, and Alternative 2.

Table 3.16-3: Summary of Public Safety Effects

Alternative	NEPA (On-Land and U.S. Territorial Waters)	EO12114 (Non-U.S. Territorial Waters)
No Action Alternative	• Range clearance procedures are implemented prior to activities for both on-island and water range areas. Activities will not proceed unless the range is clear of non-participants. Therefore, there is no risk to public safety.	• Range clearance procedures are implemented prior to activities for range areas in non-U.S. Territorial Waters. Activities will not proceed unless the range is clear of non-participants. Therefore, there is no risk to public safety.
Alternative 1	• Impacts on Public Safety under Alternative 1 would be the same as the No Action Alternative.	• Impacts on Public Safety under Alternative 1 would be the same as the No Action Alternative.
Alternative 2 (Preferred)	• Impacts on Public Safety under Alternative 2 would be the same as the No Action Alternative.	• Impacts on Public Safety under Alternative 2 would be the same as the No Action Alternative.
Mitigation Measures	• FACSFAC and SCORE have published safety procedures for activities on the offshore and nearshore areas. These guidelines are directive for range users. • Aircraft in W-291 fly under Visual Flight Rules and under visual meteorological conditions. • To enhance the safety of submarines while on the range, minimum vertical and horizontal separation distances are specified. • Prior to launching a weapon, ships are required to obtain a “Green Range,” which indicates that all safety criteria have been satisfied, and that the weapons and target recovery conditions and recovery helicopters and boats are ready to be employed. • A Missile Exercise (MISSILEX) Letter of Instruction is prepared prior to any missile firing exercise. This instruction establishes precise ground rules for the safe and successful execution of the exercise. • Procedures are required to protect individuals from the hazard of severe eye injury due to the nature of the laser light. • Hazards of Electromagnetic Radiation to Personnel, Ordnance and Fuel have been determined for EMR sources based on frequency and power output.	• FACSFAC and SCORE have published safety procedures for activities on the offshore and nearshore areas that are directive for range users. • Aircraft in W-291 fly under Visual Flight Rules and under visual meteorological conditions. • To enhance the safety of submarines while on the range, minimum vertical and horizontal separation distances are specified. • Prior to launching a weapon, ships are required to obtain a “Green Range,” which indicates that all safety criteria have been satisfied, and that the weapons and target recovery conditions and recovery helicopters and boats are ready to be employed. • A Missile Exercise (MISSILEX) Letter of Instruction is prepared prior to any missile firing exercise. This instruction establishes precise ground rules for the safe and successful execution of the exercise. • Procedures are required to protect individuals from the hazard of severe eye injury due to the nature of the laser light. • Hazards of Electromagnetic Radiation to Personnel, Ordnance and Fuel have been determined for EMR sources.

Southern California Range Complex

Draft Environmental Impact Statement/
Overseas Environmental Impact Statement

Volume 2 of 2: Chapters 4-9 and Appendices A-F

April 2008

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United States Navy Pacific Fleet
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Southern California Range Complex

Draft
Environmental Impact Statement /
Overseas Environmental Impact Statement

Lead Agency:
Department of the Navy
Action Proponent:
United States Pacific Fleet

Cooperating Agency:
Department of Commerce
National Oceanographic and Atmospheric Administration
National Marine Fisheries Service

Volume 2
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Appendices A-F

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4 Cumulative Impacts

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4 CUMULATIVE IMPACTS

4.1 PRINCIPLES OF CUMULATIVE IMPACTS ANALYSIS

The approach taken to analysis of cumulative impacts (or cumulative effects)[1] follows the objectives of the National Environmental Policy Act (NEPA) of 1969, Council on Environmental Quality (CEQ) regulations and CEQ guidance. CEQ regulations (40 Code of Federal Regulations [CFR] §§ 1500-1508) provide the implementing procedures for NEPA. The regulations define "cumulative effects" as:

> ". . . the impact on the environment which results from the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions regardless of what agency (Federal or non-Federal) or person undertakes such other actions Cumulative impacts can result from individually minor but collectively significant actions taking place over a period of time." (40 CFR 1508.7).

CEQ provides guidance on cumulative impacts analysis in *Considering Cumulative Effects Under the National Environmental Policy Act* (CEQ 1997). This guidance further identifies cumulative effects as those environmental effects resulting "from spatial and temporal crowding of environmental perturbations. The effects of human activities will accumulate when a second perturbation occurs at a site before the ecosystem can fully rebound from the effects of the first perturbation." Noting that environmental impacts result from a diversity of sources and processes, this CEQ guidance observes that "no universally accepted framework for cumulative effects analysis exists," while noting that certain general principles have gained acceptance. One such principal provides that "cumulative effects analysis should be conducted within the context of resource, ecosystem, and community thresholds—levels of stress beyond which the desired condition degrades." Thus, "each resource, ecosystem, and human community must be analyzed in terms of its ability to accommodate additional effects, based on its own time and space parameters." Therefore, cumulative effects analysis normally will encompass geographic boundaries beyond the immediate area of the Proposed Action, and a time frame including past actions and foreseeable future actions, in order to capture these additional effects. Bounding the cumulative effects analysis is a complex undertaking, appropriately limited by practical considerations. Thus, CEQ guidelines observe, "[i]t is not practical to analyze cumulative effects of an action on the universe; the list of environmental effects must focus on those that are truly meaningful."

4.1.1 Identifying Geographical Boundaries for Cumulative Impacts Analysis

Geographic boundaries for analyses of cumulative impacts in this Draft Environmental Impact Statement (EIS) / Overseas Environmental Impact Statement (OEIS) (hereafter referred to as "EIS/OEIS") vary for different resources and environmental media. For air quality, the potentially affected air quality regions are the appropriate boundaries for assessment of cumulative impacts from releases of pollutants into the atmosphere. For wide-ranging or migratory wildlife, specifically marine mammals and sea turtles, any impacts from the Proposed Action or alternatives might combine with impacts from other sources within the range of the population. Therefore, identification of impacts elsewhere in the range of a potentially affected population is appropriate. For terrestrial biological resources, San Clemente Island (SCI) is the appropriate geographical area for assessing cumulative impacts. For all other ocean resources, the ocean ecosystem of the Southern California Bight (SCB) is the appropriate geographic area for analysis

[1] CEQ Regulations provide that the terms "cumulative impacts" and "cumulative effects" are synonymous (40 CFR § 1508.8(b)); the terms are use interchangeably.

of cumulative impacts. The following table identifies the geographic scope of this cumulative impacts analysis, by resource area.

Table 4-1: Geographic Areas for Cumulative Impacts Analysis

Resource	Area for Impacts Analysis
Geology and Soils	SCI
Air Quality	South Coast Air Basin San Diego Air Basin South Central Coast Air Basin
Hazardous Materials and Hazardous Wastes	SCI and SCB
Water Resources	SCI and SCB
Marine Plants and Invertebrates	SCB
Fish	SCB
Sea Turtles	Pacific Range
Marine Mammals	Pacific Range
Sea Birds	SCB
Terrestrial Biological Resources	SCI
Cultural Resources	SCI and SCB
Traffic	SCB
Socioeconomics	SCB
Environmental Justice	SCB
Public Safety	SCB

4.1.2 Past, Present, and Reasonably Foreseeable Future Actions

Identifiable present effects of past actions are analyzed, to the extent they may be additive to impacts of the Proposed Action. In general, the Navy need not list or analyze the effects of individual past actions; cumulative impacts analysis appropriately focuses on aggregate effects of past actions. Reasonably foreseeable future actions that may have impacts additive to the effects of the Proposed Action also are to be analyzed.

4.2 ENVIRONMENT POTENTIALLY AFFECTED BY CUMULATIVE IMPACTS

4.2.1 Air Basins

Three air basins, the South Coast Air Basin (SCAB), South Central Coast Air Basin (SCCAB), and San Diego Air Basin (SDAB), are potentially affected by the Proposed Action.

4.1.2.1 South Coast Air Basin

The South Coast Air Basin (SCAB) is comprised of Orange County and substantial portions of Los Angeles, Riverside, and San Bernardino Counties, and includes the largest urban area in the western United States. With 15 million inhabitants, the SCAB encompasses 43 percent of California's population, and accounts for 40 percent of all vehicle miles traveled, and one-third of all air pollutants emitted in the State (California Air Resources Board [CARB] 2006). Motor vehicles are the largest category of emission sources of carbon monoxide (CO), nitrogen oxides (NO_x), and reactive organic gases (ROG). A heavy concentration of industrial facilities, several major airports, two major shipping ports, and a dense freeway and surface street network are located in the SCAB.

The SCAB, which includes waters contiguous to SCI, is classified as: a severe non-attainment area for the 8-hour National Ambient Air Quality Standard (NAAQS) for ozone (O_3), a serious non-attainment area for CO, a maintenance area for nitrogen dioxide (NO_2); a serious non-attainment area for particulate matter under 10 microns (PM_{10}), and a non-attainment area for particulate matter under 2.5 microns ($PM_{2.5}$)..It should be noted, however, that in its Draft Final 2007 Air Quality Management Plan (AQMP), the South Coast Air Quality Management District states it is seeking re-designation as an extreme non-attainment area for the 8-hour NAAQS for O_3 (SCAQMD Air Quality Management Plan [2007]).

Air quality in surrounding Air Basins can be affected and even dominated by pollution transported from the SCAB. Offshore winds cause pollution from the SCAB to impact offshore ocean areas, as winds sweep pollutants out over the sea. Further, pollution from the SCAB can impact San Diego when onshore winds blow these pollutants into San Diego. Pollution from the SCAB is also transported over the ocean into Ventura County (i.e., the SCCAB) by wind blowing to the northwest from the SCAB.

4.1.2.2 San Diego Air Basin

The San Diego Air Basin (SDAB) is comprised of San Diego County., and encompasses 8 percent of the state's population; with a growth rate of 54 percent since 1981, San Diego is one of the fastest growing areas of the State. SDAB accounts for about 9 percent of vehicle miles driven in California, and includes industrial facilities, an international airport, and a significant seaport. Presently, 7 percent of California's air pollution is generated within the SDAB (CARB 2006).

Air quality in the SDAB is impacted by transport of air pollutants from the SCAB. The quality of the air in SDAB also is impacted by pollution from Tijuana, a city of over 1.2 million inhabitants immediately adjacent to the City of San Diego. For regulatory purposes, the SDAB includes only the County of San Diego but Tijuana and San Diego in fact lie within the same geographically bounded air basin, and each city's emissions affect both cities.

The SDAB is classified as a basic non-attainment area for the 8-hour ozone NAAQS, and a maintenance area for CO.

4.1.2.3 South Central Coast Air Basin

The SCCAB encompasses Ventura, Santa Barbara, and San Luis Obispo Counties on California's central coast. Four percent of the State's population lives within the SCCAB. Power plants, oil extraction and refining, transportation, and agricultural operations are the major sources of air pollution in the SCCAB. Motor vehicles in the basin account for about 4 percent of vehicle miles driven in California (CARB 2007).

4.2.2 Southern California Bight

The SCB is the ocean area bounded on the north, east, and southeast by a long curve of the California coastline extending from Point Conception in Santa Barbara County, southeast 357 miles (mi) (578 kilometers [km]) to Cabo Colnett, Baja California in Mexico. The western border of the SCB is marked by the California Current, which flows southeastward along the coast, continuing the clockwise transport of water in the North Pacific Ocean.

Oceanography

Water current regimes in the SCB are complex and variable on seasonal and longer time scales. In general, because of the eastward indentation of the coast, a surface counterclockwise gyre, the Southern California Eddy, breaks off the California Current and carries water northward through the central SCB (Jones 1971; Hickey 1979). Closer to the shore along the continental shelf, prevailing onshore winds reverse this flow, resulting in a net along-shore surface flow toward the southeast (Lentz and Winant 1979). There is also a very-nearshore circulation pattern caused by surf along the beaches (Jones, 1971). Below about 500 feet (ft), there is a northwestward current flow inshore of the California Current. This water is of equatorial Pacific origin and has higher temperature, salinity, and phosphate concentrations and a lower oxygen concentration than the deep water in the California Current located at the same depth but farther offshore (Jones 1971). Surface waters in the bight maintain an annual temperature range of 13° to 20°C. Temperature drops with increasing water depth to about 4°C in the deeper basins. Dissolved oxygen concentration also tends to decrease with depth.

An important feature throughout the SCB is that deep water is close to shore. The bathymetry underlying the SCB includes an alternating series of 2,000- to 8,000-ft-deep basins and surfacing mountains that form 9 offshore islands or island groups and several large submerged banks and seamounts. Nearshore, 12 large canyons influence movement of sediments and other materials deposited on the bottom. There are also 32 canyons on the continental slope bordering the United States (U.S.) (Emery 1960). Offshore, there are 18 marine basins, 3 of which (Santa Monica, San Pedro, and Santa Barbara) are essentially devoid of oxygen and are virtually devoid of higher life forms. These canyons and deep basins are important sites of accumulation of fine-grained sediments and particulate materials from land runoff, ocean discharges, and ocean dumping.

El Nino

Many environmental changes in the SCB are connected with long-term, low-frequency, inter-annual oceanographic patterns. Displacement of cool surface waters—and their inhabitants—by clear, nutrient-poor warm water is correlated with periodic warm-water events off the coast of Peru and in the tropical Pacific. These are the El Niño events, which occur several times per decade (e.g., 1976, 1979, 1982-84, 1986-87, 1991-92, 1993, 1994, 1997-98, 2002-03, 2006-07 (NOAA 2007)) and are characterized by warm water, a deeper surface-mixed layer, elevated sea levels, increased abundance of southern planktonic and pelagic organisms, alterations of benthic community structure, and degeneration of coastal kelp beds (Jackson, 1986).

Bays and Wetlands

The most important bays in the SCB are Santa Monica Bay, San Pedro Bay, San Diego Bay, and Todos Santos Bay in Baja, California. There are at least 26 wetland systems in coastal lagoons and at the mouths of transient streams and rivers in the U.S. portion of the SCB (Zedler 1984). The total area of these coastal wetlands is only about 129 square miles (mi^2), an estimated 25 percent of the area they encompassed when the first Europeans arrived in Southern California in the late 1500s.

Drainage Basin

The onshore mainland drainage basin of the SCB is bordered on the north by the Santa Monica, San Gabriel, and San Bernardino Mountains; and on the east by coastal ranges that continue southward down the length of the Baja Peninsula. Because of the semiarid nature of the drainage basin and the highly seasonal pattern of annual precipitation, most of the rivers draining into the bight are small and are dry for much of the year. From north to south, the major rivers in the drainage basin are the Santa Clara, Los Angeles, San Gabriel, Santa Ana, Santa Margarita, San Luis Rey, San Diego, and Tijuana rivers. Much of the Los Angeles and San Gabriel River beds and other major drainages are lined with concrete.

Fresh water enters the Southern California Bight from a variety of sources. Riverine runoff from rain and melting snow is seasonal. Surface and subterranean runoff including storm drain inputs (non-point sources), and discharges of waste water also are transported into the bight. The volumes of water entering the bight from wastewater discharges are comparable to those from riverine and storm drain inputs. Because stormwater flow is more variable than wastewater flow, in dry seasons and years wastewater flow far exceeds that of storm water. Wastewater flows are strictly regulated to protect water quality; however, non-point source runoff is more difficult to regulate. Such flows may contain chemical contaminants and pathogens.

Habitats and Other Natural Resources

Natural habitats and resources characteristic of the SCB include abundant deep water close to shore, extensive coastal and offshore oil reserves, commercially or recreationally valuable fish and shellfish stocks, wildlife breeding and overwintering areas, kelp beds, beach and water recreation areas, and a temperate climate. These habitats and resources are described in detail in Chapter 3, and are briefly summarized here.

As a result of the local oceanographic regime, particularly the Southern California Eddy, the SCB bight is an enclave of communities of marine life specific to the area (although diminished during El Niño years). Numerous types of marine mammals are present, including both regional and migratory populations. Four species of sea turtles may be present, at least periodically. Numerous sea birds are present in the bight, and Channel Islands provide breeding habitat for some species of sea birds. Commercially exploitable stocks of fish spawn and grow primarily in the bight. Deeper waters of the bight host a diversity of mesopelagic fishes that spend parts of their life cycles in surface waters. The benthic fauna of the continental shelf, especially polychaetes and crustaceans, are diverse and constitute an important food source for many fish species. Rocky intertidal and subtidal areas, which cover large areas of the shoreline of the bight, host diverse epifauna (snails, mussels, crabs, etc.) and attached seaweeds.

Beds of the giant kelp *Macrocystis pyrifera*, which attach to the bottom and can grow to over 164 ft in length, extend along the coast of the bight. There are 33 locations in the bight between Point Conception and San Diego where kelp beds are found at least periodically at water depths ranging from 20 to 65 ft. From the 1930s to 1979, individual kelp beds occupied up to 2,720 acres (ac), with the total area occupied by kelp beds in the range of 12,000 to 15,000 ac (Foster and Schiel 1985). The size and distribution of kelp beds varies spatially and temporally in response to changes in natural and anthropogenic conditions. Natural changes in surface water temperature and nutrient concentrations associated with El Niño events, and possibly with longer-term ocean warming trends, have resulted in declining kelp beds in some areas, and winter storms can devastate large kelp beds. These storms probably are the most important factor influencing the condition and extent of kelp beds, but human activities—such as kelp harvests, boat traffic, and possibly wastewater discharges--have also affected local giant kelp beds.

The SCB is contains undersea oil deposits. Oil and tar continuously ooze from undersea seeps, periodically creating large marine oil slicks.

Frequent brush fires on land, fed by northeasterly Santa Ana winds, deposit ash and soot onto the sea.

4.2.3 Anthropogenic Activities

Fishing

Commercial and recreational fishing constitutes a significant non-military use of the ocean areas of the SOCAL Range Complex. As discussed in Section 3.7, the California Department of Fish and Game (CDFG) maintains commercial landings statistics for statistical blocks that are 5 degrees latitude by 5 degrees longitude in area (about 81 square nautical miles [nm^2]) for nearshore areas and larger for offshore waters. Commercial landings were obtained for CDFG statistical blocks within the SOCAL Range Complex (Figure 3.8-1). The annual catch of fish and invertebrates in the SOCAL Range Complex from 2002 to 2005 amounted to approximately 64,000 pounds (see Table 3.7-7). In 1993, landings data represented approximately 50 percent of the actual catch, and landings in other years have represented approximately 80 percent or more of the actual catch. Pelagic species account for approximately 97 percent of the average annual catch within the SOCAL Range Complex. Flatfish, demersal fish, and other fish associated with the bottom account for only about 3 percent of the average annual catch of fish. Other commercial fishing targets include crustaceans (lobster and half spot prawns) and squid.

Fishing can adversely affect fish habitat and managed species. Potential impacts of commercial fishing include over-fishing of targeted species and by-catch, both of which negatively affect fish stocks. Mobile fishing gears such as bottom trawls disturb the seafloor and reduce structural complexity. Indirect effects of trawls include increased turbidity, alteration of surface sediment, removal of prey (leading to declines in predator abundance), removal of predators, ghost fishing (i.e., lost fishing gear continuing to ensnare fish and other marine animals), and generation of marine debris. Lost gill nets, purse seines, and long-lines may foul and disrupt bottom habitats. Recreational fishing also has the potential to affect fish habitats because of the large number of participants and the intense, the concentrated use of specific habitats.

Removal of fish by fishing can have a profound influence on individual populations. In a recent study of retrospective data, Jackson et al. (2001) analyzed paleoecological records of marine sediments from 125,000 years ago to present, archaeological records from 10,000 years before the present, historical documents, and ecological records from scientific literature sources over the past century. Examining this longer term data and information, they concluded that ecological extinction caused by overfishing precedes all other pervasive human disturbance to coastal ecosystems including pollution and anthropogenic climatic change.

Natural stresses include storms and climate-based environmental shifts, such as algal blooms and hypoxia. Disturbance from ship traffic and exposure to biotoxins and anthropogenic contaminants may stress animals, weakening their immune systems, and making them vulnerable to parasites and diseases that would not normally compromise natural activities or be fatal.

Commercial and Recreational Marine Traffic

A significant amount of ocean traffic, consisting of both large and small vessels, transits through the SCB. The Port of Los Angeles is the busiest port in the U.S. (by volume of cargo). The Port of Long Beach is the second-busiest U.S. port. Taken together, these two ports (which are contiguous) would constitute the fifth-busiest port in the world. The Port of San Diego also is an important commercial cargo port. Cruise ships make daily use of these port facilities. In 2006, San Diego recorded 219 cruise ship calls (619,000 passengers) while Los Angeles recorded 1.2 million cruise passengers served. Together, these three port recorded about 8500 vessel (cargo and cruise ship) calls in 2006. For commercial vessels, the major trans-oceanic routes to the southwest pass north and south of SCI (Figure 3.14-2). The approach and departure routes into San Diego and the ports of Los Angeles-Long Beach pass between SCI and Santa Catalina Island.

Commercial vessels are sources of pollutants introduced into the waters and air basin of the SCB. Additionally, commercial vessels are a source of ship strikes on marine mammals, and are implicated, for example in the deaths of three blue whales in the Santa Barbara Channel in September 2007. (Information about ship strikes and other marine mammal stranding events, and about introduction of pollutants into the bight, is provided below).

A very substantial volume of small craft traffic, primarily recreational, occurs throughout southern California. The region's estimated 40,000 recreational boats are concentrated primarily in marinas on Santa Monica Bay, Alamitos Bay, Long Beach Marina, Huntington Harbor, Balboa-Newport Harbors, San Diego Bay, and Mission Bay; and secondarily in marinas at Oceanside and Dana Point, and in Oxnard, Ventura, and Santa Barbara. Because pleasure boats are sources of fuel leaks and toxins from antifouling paints, they constitute a potential environmental concern that has not been quantified. (Information about pollutants and hazardous wastes introduced into the SCB is provided below).

Oil Extraction

Oil extraction has occurred for eight decades offshore of the coast near Goleta, Carpinteria, Ventura, Oxnard, Santa Monica, Redondo Beach, Wilmington, San Pedro, Long Beach, Seal Beach, and Huntington Beach. Offshore oil extraction from shore-based facilities began near the turn of the century along the Santa Barbara Channel and slightly later in southern Los Angeles and Orange Counties. Oil production from offshore platforms began 35 years ago on nearby shelves (1 to 3 mi from shore) and now extends nearly to the shelf break. An extensive shore-based infrastructure exists to support offshore oil production activities, including pipelines, refineries, and oil terminals.

Seventy-nine offshore oil production leases occupying a total of about 400,000 acres are active in the Santa Barbara Channel / Santa Maria Basin area. California has a long-standing moratorium on new oil drilling platforms within the State's 3-mi jurisdictional limit. A federal moratorium on new oil drilling platforms is in place; however, periodically and as recently as 2006, legislation has been proposed to rescind a 25-year-old moratorium on oil and gas development off all of the nation's coastlines. Within federal waters offshore of southern California lie 36 undeveloped federal oil leases. Developing these leases could result in several new oil platforms off of the coast. No specific proposals for new oil platforms are now under consideration.

Oil extraction carries risks of accidental oil spills. In 1969, an industrial accident (pressurized “blowout”) on an offshore oil rig caused 3 million gallons of oil to be discharged into the Santa Barbara Channel. Long-term environmental impacts of this event have dissipated.

Natural seeps along the coasts of Santa Barbara, Ventura, Los Angeles, and Orange Counties intermittently or continuously discharge large quantities of oil and tar to nearshore waters of the SCB. Fischer (1978) estimated that as few as 2,000 and as many as 30,000 metric tons (10 million galllons) of oil enter the Santa Barbara Channel each year from natural seeps. (By comparison, the 1989 Exxon Valdez oil spill in Prince William Sound, Alaska, leaked 11 million gal of oil into marine waters.) The intertidal zone at Goleta is chronically contaminated with oil and tar from this seep. One hundred years ago, the U.S. Fish Commission steamer Albatross dispatched an observer to report on a huge fish kill extending from Santa Barbara to San Diego. He counted thousands of pelagic and demersal fish on the Santa Monica Bay beaches, many of them smelling of petroleum, and suggested that the event was caused by seepage from offshore "oil springs" (Eichbaum et al. 1990).

Liquid Natural Gas Terminals

Liquid Natural Gas (LNG) facilities have been proposed at several locations on the Pacific coast of North America in recent years in response to the quickly escalating domestic demand for this fuel. Sites under consideration range from British Columbia to Mexico, with at six locations under consideration within the SCB (see Table 4-2).

Table 4-2: LNG Projects and Proposals

SCB LNG Projects and Proposals[A]	
Proposed LNG Terminals	**Location**
Cabrillo Deepwater Port LNG Facility	Offshore Ventura County
Clearwater Port LNG Project	Offshore Ventura County
Long Beach LNG Facility	Long Beach Harbor
Ocean Way LNG Terminal	Offshore Long Beach

SCB LNG Projects and Proposals[A]	
Esperanza Energy LLC	Offshore Long Beach
Terminal GNL Mar Adento de Baja	Offshore Tijuana, Mexico
Moss Maritime LNG	Offshore Rosarito, Mexico
Notes: (a) Excerpted from CA Energy Commission: http://www.energy.ca.gov/lng/projects.html	

Potential environmental impacts include those associated with additional ship traffic generally, and potential releases of LNG. Releases of LNG can result from equipment leaks or spills during operations. Releases can be accidental (e.g., ship collision), or intentional (i.e., from sabotage or terrorist acts). Most accident scenarios are complex, or multi-stage events with cascading impacts. For example, a spill followed by a pool fire, or a leak followed by a vapor cloud ignition. The rate at which the LNG is released, the total size of the release, wind speed and direction, and the location of the nearest ignition source are all important factors in determining the consequences of the release.

Ocean Pollution

Environmental contaminants in the form of waste materials, sewage, and toxins are present in, and continue to be released into, the oceans off southern California. Polluted runoff, or non-point source pollution, is considered the major cause of impairment of California's ocean waters. Stormwater runoff from coastal urban areas and beaches carries waste such as plastics and Styrofoam into coastal waters. Sewer outfalls also are a source of ocean pollution in southern California. Sewage can be treated to eliminate potentially harmful releases of contaminants; however, releases of untreated sewage occur due to infrastructure malfunctions, resulting in releases of bacteria usually associated with feces, such as *Escerichia coli* and *enterococci*. Bacteria levels are used routinely to determine the quality of water at recreational beaches, and as indicators of the possible presence of other harmful microorganisms.

In the past, toxic chemicals have been released into sewer systems in southern California. While such dumping has long been forbidden by law, the practice left ocean outflow sites contaminated. In a 1994 report, the U.S. Geological Survey identified elevated levels of dichloro-diphenyl-trichloroethane (DDT) and polychlorinated biphenyls (PCBs), both classified as persistent organic pollutants, in a 17 square-mile area of ocean near Palos Verdes, south of Santa Monica Bay. Sewage treatment facilities generally do not treat or remove persistent organic pollutants. Plastic and Styrofoam waste in the ocean chemically attracts hydrocarbon pollutants such as PCBs and DDT, which accumulate up to 1 million times more in plastic than in ocean water. Fish, other marine animals, and birds consume these wastes containing elevated levels of toxins. DDT mimics estrogen in its effects on some animals, possibly causing the development of female characteristics in male hornyhead turbots and English sole, according to a study by the Southern California Coastal Water Research Project. The California Office of Environmental Health Hazard Assessment currently has consumption warnings for several species including white croaker, corbina, sculpin, rock fish and kelp bass, primarily due to concerns about DDT and PCBs in the southern California region.

Regulatory activities have made progress in reducing both non-point source pollution such as runoff, and point source pollution such as that which may emanate from sewer outfall sites. In 2000, California received federal approval of its Coastal Nonpoint Source Pollution Control Program from the U.S. Environmental Protection Agency and the National Oceanic and Atmospheric Administration (the agencies that administer the Clean Water Act and Coastal Zone Management Act, respectively). The program includes the coordinated participation of the

Coastal Commission, the State Water Resources Control Board, and the Regional Water Quality Control Boards. The current plan covers the years 2003 to 2008.

Pollution from vessels is a source of ocean contamination. Sewage, sludge, blackwater, graywater, bilge water, plastics and other trash components and waste materials are routinely discharged from vessels into coastal and ocean waters in southern California. In 2003, the California Legislature passed legislation (Assembly Bills (AB) 121 and 906), which prohibits certain waste discharges from large passenger vessels (cruise ships) into State waters.

Coastal Development

Coastal development intensifies use of coastal resources, resulting in potential impacts on water quality, wildlife and fish habitat, air quality, and intensity of land and ocean use. Coastal development is therefore closely regulated in California. (See Section 6.1.1 for a detailed discussion of regulation of activities in the coastal zone.) New development in the coastal zone may require a permit from the California Coastal Commission, or a local government to which permitting authority has been delegated by the Coastal Commission. A Coastal Development Permit is generally required for any project in the Coastal Zone that includes:

- the placement of any solid material or structure;
- a change in land use density or intensity (including any land division);
- change in the intensity of water use or access to water; or
- removal of major vegetation.

Some types of development are exempt from coastal permitting requirements, including in many cases, repairs and improvements to single-family homes, certain "temporary events," and, under specified conditions, replacement of structures destroyed by natural disaster.

Local Coastal Programs (LCPs) identify the locations, types, densities and other ground rules for future development in the coastal-zone portions of the 73 cities and counties along the coast. Each LCP includes a land-use plan and its implementing measures (e.g., zoning ordinances). Prepared by local government and approved by the Coastal Commission, these programs govern decisions that affect the conservation and use of coastal resources. While each LCP reflects the unique characteristics of individual local coastal communities, regional and statewide concerns must also be addressed in conformity with the goals and policies of the State Coastal Act.

LCPs are basic planning tools used by local governments to guide development in the coastal zone, in partnership with the Coastal Commission. LCPs contain the ground rules for future development and protection of coastal resources in the 73 coastal cities and counties, including Los Angeles, Orange, and San Diego Counties. The LCPs specify appropriate location, type, and scale of new or changed uses of land and water. Each LCP includes a land use plan and measures to implement the plan (such as zoning ordinances). Following adoption by a city council or county board of supervisors, an LCP is submitted to the Coastal Commission for review for consistency with Coastal Act requirements.

Coastal development in southern California is both intensive and extensive, and the coast adjacent to the SOCAL Range Complex is densely populated. This development has impacted and continues to impact coastal resources in EIS Study Area including through: point source and non-point source pollution; intensive boating and other recreational use; intensive commercial and recreational sport fishing; intensive ship traffic using major port facilities at Los Angeles, Long Beach, and San Diego; and offshore oil and gas facilities (both existing and proposed). Regulation of these activities through the Coastal Development programs discussed above serves primarily to limit new development; however, the coastal zone is already fully developed in many areas, with associated ongoing impacts.

Scientific Research

There are currently 30 scientific research permits and General Authorizations for research issued by the National Marine Fisheries Service (NMFS) for cetacean work in the wild in the North Pacific. The most invasive research involves tagging or biopsy while the remainder focuses on vessel and aerial surveys and close approach for photo-identification. Species covered by these permits and authorizations include small odontocetes, sperm whales and large mysticetes. One permit issued to the Office of Protected Resources of NMFS allows for responses to strandings and entanglements of listed marine mammals. NMFS has also issued General Authorizations for commercial photography of non-listed marine mammals, provided that the activity does not rise to Level A Harassment of the animals. These authorizations are usually issued for no more than 1 or 2 years, depending on the project.

The impacts of this type of research are largely unmeasured. However, given the analysis and scrutiny given to permit applications, it is assumed that any adverse effects are largely transitory (e.g., inadvertent harassment, biopsy effects, etc.). Data to assess population level effects from research are not currently available, and even if data were available it is uncertain that research effects could be separately identified from other adverse effects on cetacean populations in southern California waters.

Commercial and General Aviation

Southern California is served by several large commercial airports. Los Angeles International (LAX), Long Beach International (Long Beach), John Wayne International (Santa Ana), and Lindbergh Field (San Diego) are situated on or nearby the coastline, while Los Angeles / Ontario International Airport is situated in San Bernardino County, approximately 50 miles west of LAX. The following airport traffic statistics, developed by Airports Council International (ACI 2006), provide data on “total movements” (landing plus takeoff of one aircraft equals a “movement”) at these five airports:

Table 4-3: Landings / Takeoffs (Total Movements) at Five Regional Airports,2006

Airport	Total Movements (2006)	National Rank	% Increase Over 2005
LAX	656,842	4	1%
Long Beach	369,738	24	4.7%
Santa Ana	347,194	27	(0.8%)
San Diego	220,839	52	0.3%
Ontario	136,261	85	4.9%

The City of San Diego operates two general aviation airports: Montgomery Field, located in northeastern San Diego, and Brown Field, located in southern San Diego near the border with Mexico. San Diego County operates eight general aviation airports. Two general aviation airports are located in Orange County. Los Angeles County operates numerous general aviation airports, including the airport at Avalon, Santa Catalina Island. Numerous municipal landing fields are located in the region.

Aircraft operating under visual flight rules (VFR) can fly along the coast between San Diego and Orange County and out to Santa Catalina Island largely unconstrained, except by safety requirements and mandated traffic flow requirements. Aircraft operating under IFR clearances, authorized by the FAA, normally fly on the airway route structures. In southern California these routes include both high- and low- altitude routes between San Diego and Los Angeles and to Santa Catalina Island. There are two Control Area Extensions (CAE) from southern California through or nearby W-291 to facilitate access to the airways to Hawaii and other trans-Pacific locations. CAE 1177 extends from Santa Catalina Island southwest between W-291 and the Pt. Mugu Sea Range. CAE 1156 extends west from San Diego through the northern portion of W-291. When W-291 is active, CAE 1156 is normally closed. CAE 1177, the more important route through the coastal Warning Areas, is closed only when weapons hazard patterns extend into the area, and this closure is fully coordinated with the FAA. When W-291 is active, aircraft on IFR clearances are precluded from entering W-291 by the FAA. However, since W-291 is located entirely over international waters, nonparticipating aircraft operating under VFR are not prohibited from entering the area. Examples of aircraft flights of this nature include light aircraft, fish spotters, and whale watchers.

Air Quality Factors

In their emission inventories by category (California Air Resources Board (ARB) 2000) for 2004 and 2020, the SCAB, SDAB, and the SCCAB include emissions from aircraft, ships, and commercial boats. Emission estimates are based on emissions from onshore or nearshore operations (for example, operations within Los Angeles Harbor for ship emissions). These emissions would account for a small percentage of the overall air emissions budgets for each of the air basins. These emissions are generally not included in the SIP emissions budget and in air quality planning because they are assumed to have a negligible effect on the ambient air quality, and because reductions in emissions from these sources would not generate a great improvement in the ambient air quality.

4.2.4 San Clemente Island

SCI is the southernmost of the eight California Channel Islands. It lies 55 nm south of Long Beach and 68 nm west of San Diego. The island is approximately 21 nm long and is 4-1/2 nm across at its widest point. Since 1934, the island has been owned and operated by the U.S. Navy as a training site. Presently, and for the foreseeable future, only activities in support of military training are or will be permitted to occur on SCI. Impacts from these activities generally are confined to the island and its immediate nearshore vicinity. Table 4-4 identifies past and present projects undertaken by the Navy at SCI. These activities are addressed, as appropriate in separate environmental analyses, and impacts from these activities generally are temporary and localized.

Table 4-4: Past, Present, and Planned Projects on San Clemente Island

Number	Project Title	Description
1	Southern California Anti-Submarine Warfare Range (SOAR) Cable Refurbishment	Refurbishment of underwater cable arrays and associated range equipment at SOAR involving the installation of hydrophones, array cables, and associated hardware within the existing coverage of the range. The area of SOAR proposed under this activity is located off of West Cove, in the northwestern portion of SCI. The offshore area proposed for range refurbishment extends seaward from West Cove.
2	Wilson Cove Moorings	Installation of 3 Class "E" 50,000 lb moors, and four 9,000 12,000 lb moors, removal of an existing moor at Wilson Cove at SCI, and repair of two existing moors.
3	Commercial Cell Towers Installation	Construction of three cell towers on SCI has been completed.
4	Waste Water Treatment Plant Upgrades	Construction of an effluent outfall extension to an existing Waste Water Treatment Plant and discharge pipe to allow for an increase in capacity and increase in permit requirements.
5	Tomahawk Missile Launch Facility	Construction of an underwater launch facility for the launch of Tomahawk cruise missiles (one per year) on flight tracks over the Point Mugu Sea Range near NOTS Pier at SCI. The missiles would be recovered after landing by parachute on San Nicolas Island.
6	P-763 - MOUT Facility	Construction of building shells for a variety of building types from residential to business to industrial for urban special operations training at San Clemente Island.
7	P-740 Bachelors Quarters	Construction of two 45-unit bachelors quarters buildings (MILCON Projects P740 and P471) and demolition of five bachelor quarters existing buildings (60111, 60116, 60121, 60133, and 60153) at San Clemente Island.
8	P- 493 Ridge Road	Road improvements phased over five years consisting of re-surfacing and widening, construction of an extended Assault Vehicle Maneuver Road, and quarrying and laydown area to provide materials for and facilitate road projects.
9	SCI Runway Upgrades	Repair of runway, taxiway, and parking apron and provision of various lighting and electrical repairs to support safe aircraft operations at the NALF at SCI.
10	Various Maintenance Projects	Maintenance projects such as hangar door replacement, concrete replacement, exterior painting of buildings, and replacement of lighting fixtures.
11	Live-Fire Training Areas and MOUT Facility	Development of three live-fire training areas on SCI and the construction of a Military Operations on Urban Terrain (MOUT) facility. Training activities include direct action, live-fire over-the-beach tactical training, small arms firing, and land demolition.
12	Tomahawk Land Attack Missile Testing in the SCI Missile Impact Range	Testing of live and inert warheads at the Missile Impact Range (MIR) and the use of an underwater translator launch site for missiles off the eastern side of SCI.
13	Joint Standoff Weapon	Live-fire testing (scheduled from 1996 to 2007) for the JSOW program at the SCI MIR. The JSOW is launched from an aircraft.
14	Land Attack Standard Missile (LASM)	Inert testing of LASM launched from ships positioned 75 nm west of SCI with missile termination at the MIR. Testing involved four non live-fire launches and was completed in 2000.

Number	Project Title	Description
16	Distributed Explosive Technology (DET)	One-time operational test of DET (used to clear bottom-laid and submerged mines) in littoral waters in Horse Beach Cove off of SCI.
17	Surface Ship Radiated Noise Measurement (SSRNM) Array	Installation of hydrophone array with tri-moor configuration 5000 yds off eastern shore of SCI, for use in measuring sound from transiting ships
18	Modular Housing	Construction of two single-story modular buildings to be used as temporary military housing
19	Unmanned Aerial Vehicle (UAV) Infrastructure Construction	Construction of three buildings (60,000 sf), water and fuel storage facilities, and road improvements for use as UAV training center.
20	Storage Facility Construction	Construction of storage facility near Northern Light pier .
21	Antennae Installation	Install antennae and construct associated small shelter near airfield.
22	Building Demolition	Demolish 17 structures at Wilson Cove (site preparation for boat facility construction).
23	Boat Facility Construction	Construct boat maintenance facility and boat storage facility (2 structures) at Wilson Cove
24	Missile Launches	Two launches at VC-3, proposed to occur in the July to October 2007 timeframe. The missile booster impact would occur at the MIR. The missile would then fly pre-planned waypoints over the island at an altitude of approximately 330 ft (91 m) above ground level and over the ocean and then return and impact into the MIR. It is estimated that the first and second missile launches would fly over the ocean at a distance of 21 miles (18 nm) and 31 miles (27 nm), respectively, from the SCI shoreline.

4.2.5 Habitats of Migratory Marine Animals

Migratory or wide-ranging marine mammals and sea turtles that may be present in the SOCAL Range Complex may be affected by natural events and anthropogenic activities that occur in areas far removed from southern California, on breeding grounds, migration routes, wintering areas, or other habitats within a species' range. Events and activities that affect the habitats of these marine species outside the SCB / SOCAL Range Complex include:

- Disease
- Natural toxins
- Weather and climatic influences
- Navigation errors
- Natural predation
- Fishing
- Hunting (including sea turtle egg predation)
- Ocean pollution
- Habitat modification or destruction
- Ship traffic

These stressors on marine habitats and associated effects on marine mammals and sea turtles are discussed in detail in Sections 4.3.8 and 4.3.9, below.

4.3 CUMULATIVE IMPACT ANALYSIS

4.3.1 Geology and Soils

The Proposed Action would affect marine geology and sediments in the SOCAL Range Complex chiefly by depositing training debris on bottom sediments and disturbing previously disturbed surface soils in existing training areas on SCI. These effects were determined to be less than significant in the context of the existing environment.

Cumulative impacts on marine geology and sediments would consist of the effects of the Proposed Action in concert with other projects, actions, and processes that deposit sediment or debris, or disturb ocean bottom sediments. Relevant effects would include debris contributions from recreational and commercial fishing, offshore oil and gas development, dredging and sand replenishment projects, and other ocean industries. The effects of these activities on the geology and soils within the SOCAL Range Complex are known only in a very general sense.

Commercial ocean industries, such as fishing, are dispersed over broad areas of the ocean, as are the effects of the Proposed Action. Dredging mostly occurs in nearshore areas, whereas most of the Navy training takes place in remote areas of the open ocean. No major offshore oil and gas or LNG facilities are located in the SOCAL Range Complex, and no permit applications for such facilities are under consideration by State or federal agencies. Cumulative development projects along the southern California coast would contribute to increased rates of sediment discharge into nearshore waters, but no substantial changes in bottom contours or sediment deposits are expected. In summary, cumulative effects on marine geology and sediments in the open-ocean portions of the SOCAL Range Complex are less than significant.

SCI's nearshore ocean bottom sediments would be disturbed by projects such as the SOAR Cable Refurbishment, SWTR installation, new moorings at Wilson Cove, and an underwater missile launch facility, in addition to the effects of the Proposed Action. These areas would soon be returned to their previous condition by wave action and currents, but the new structures would permanently alter the bottom topography. The new structures would occupy very small portions of the nearshore ocean bottom. The cumulative impact of these projects, in conjunction with the Proposed Action, would be insignificant.

Cumulative impacts on terrestrial SCI geology and soils would consist of the effects of the Proposed Action in concert with other Navy actions that disturbed surface soils, such as new construction (see Table 4-4, above). New or expanded training activities that would increase foot traffic could trample and eliminate vegetation and compact surface soils, which in turn could increase surface runoff during rain storms. New construction could remove ground cover, disturb surface soils, alter surface drainage patterns, and, by increasing the ground coverage of impervious surfaces, increase the volume of surface water flows during storms.

While each new activity or construction project on SCI could contribute locally and incrementally to increased runoff and erosion, the cumulative effects would be negligible. Construction projects would include drainage improvements, road improvements, and revegetation of exposed soils, and impacts would predominantly occur in areas of existing development. In addition, Best Management Practices (BMPs) for soil-disturbing activities would be implemented for any construction activity. Foot traffic would be directed to existing roads and trails to the extent practicable.

4.3.2 Air Quality

Activities affecting air quality in the region include, but are not limited to, mobile sources such as automobiles and aircraft, and stationary sources such as power generating stations, manufacturing operations and other industry, and the like. In CARB emission inventories by category (CARB 2000) for 2004 and 2020, the SCAB, SDAB, and SCCAB include emissions from aircraft, ships, and commercial boats. These emissions are included in the mobile source category. Traditionally, the emission estimates are based on emissions from onshore or nearshore operations (for example, operations within Los Angeles Harbor for ship emissions). Emission estimates for these sources are summarized in Table 4-2.

These emissions would account for a small percentage of the overall air emissions budgets for each of the air basins. They do not include marine vessel emissions for vessels operating outside of U.S. territorial waters. These emissions are generally not included in the SIP emissions budget and in air quality planning because they are assumed to have a negligible effect on the ambient air quality, and because reductions in emissions from these sources would not generate a great improvement in the ambient air quality.

Table 4-5: Emissions Estimates for Aircraft and Marine Vessels (CARB 2000)

	South Central Coast		South Coast		San Diego	
	2004	2020	2004	2020	2004	2020
Aircraft						
ROG	2	2	8	9	3	3
CO	16	18	56	76	20	21
NOx	1	1	16	28	5	6
PM10	<1	<1	1	1	2	2
Marine Vessels						
ROG	5	2	39	19	10	5
CO	23	19	192	166	72	67
NOx	4	4	57	87	7	7
PM10	1	1	6	9	1	2

Units: Tons per day

Source: California Air Resource Board, Air Emissions Inventories, Emissions by Category, 2004 and 2020. www.arb.ca.gov.

As indicated by the data in Table 4-5, above, the trends in southern California in all three of the Air Basins onshore indicate that air quality is improving. For example, the number of exceedances of the NAAQS for ozone in the SCAB decreased from a high of 187 in 1981 to 60 in 1998. Likewise, in the SDAB there has been a decrease from a high of 88 exceedances of the one-hour ozone standard in 1980 to 9 in 1998, and the number of exceedances in the SCCAB has decreased from 85 in 1981 to 6 in 1998. These trends indicate that progress is being made toward attainment of the NAAQS for ozone without imposing emission limitations on offshore emissions from ships and aircraft. Accordingly, cumulative impacts on air quality would be less than significant.

4.3.3 Hazardous Materials and Wastes

The primary impact of cumulative hazardous materials use in the SOCAL Range Complex would be to increase the amounts of hazardous constituents that are released to the environment. Hazardous materials settling out of the water column would contribute to contamination of ocean bottom sediments. Relevant activities would include releases of hazardous constituents from fishing vessels, other ocean vessels, wastewater treatment plant outfalls, and non-point source pollution from terrestrial sources. The effects of these activities in the SOCAL Range Complex are known only in a very general sense.

Commercial ocean industries, such as fishing and ocean transport, are dispersed over broad areas of the ocean. Discharges of hazardous constituents from non-point source runoff and treatment plant outfalls mostly effect the waters within 3 nm of the coast, whereas most of the Navy activities occur beyond the 12 nm limit of federal waters. The quantities of contaminants released, however, would be cumulatively insignificant relative to the volume of the water and the area of bottom sediments affected. The use of hazardous materials by the Navy under the Proposed Action, when added to that of other projects, would not significantly impact resources in the SOCAL Range Complex.

The primary impact of hazardous materials on SCI would be to contribute contaminants to surface soils and to surface runoff into the ocean. Construction projects and maintenance activities on SCI beyond those included in the Proposed Action could also contribute minor amounts of hazardous contaminants to surface soils. The contributions of these other projects would be very minor, however, in comparison to the effects of the training and testing activities. Thus, the cumulative impacts would be substantially the same as the impacts described for the Proposed Action.

The primary impact of increased hazardous waste generation resulting from the Proposed Action would be a need for increased hazardous waste storage, transport, and disposal ashore. Other offshore and SCI Navy activities would also contribute to the Navy's overall hazardous waste streams. The Navy's hazardous waste management system and procedures are adequate to accommodate these increases. Other hazardous waste generators in the region, along with the Navy, would require the services of hazardous waste transporters and treatment, storage, and disposal facilities. While the costs for hazardous waste transport, treatment, storage, and disposal could increase substantially in response to increased cumulative demand, the hazardous waste management industry in the region has sufficient physical capacity to respond to this increased demand. Accordingly, cumulative impacts on hazardous waste management would be less than significant.

4.3.4 Water Resources

The Proposed Action would release water pollutants to the marine environment. It also would release chemical contaminants to surface soils; these contaminants could migrate into groundwater aquifers or via surface flows to the marine environment. These effects of the Proposed Action, however, have been determined not to be significant.

Cumulative impacts on ocean water quality would consist of the effects of the Proposed Action in concert with other marine projects, actions, and processes that contributed to water pollutants. Such activities would include recreational and commercial fishing, offshore oil and gas development, and other ocean industries. The effects of these activities on the SOCAL Range Complex are known only in a very general sense.

Commercial ocean industries, such as fishing and ocean transport, are dispersed over broad areas of the ocean, as are the effects of the Proposed Action. Most of the Navy training takes place in remote areas of the open ocean. No major offshore oil and gas facilities are located in the SOCAL Range Complex, and no permit applications for such facilities are under consideration by State or federal agencies. In summary, cumulative effects on marine water quality in the SOCAL Range Complex are expected to be less than significant.

Cumulative impacts on terrestrial SCI water quality would consist of the effects of the Proposed Action in conjunction with other Navy on-island actions that contributed contaminants to surface soils. On-island maintenance activities would involve the use of potential water pollutants, but facilities and procedures in compliance with federal and state regulations would limit the release of such contaminants to *de minimis* amounts. New construction similarly would require the use and application of potential water pollutants, but construction procedures in compliance with federal and state regulations would limit any releases of contaminants. A proposed increase in the capacity (and thus discharge volume) of SCI's wastewater treatment plant would require a discharge permit; the permitting process would assure that ocean water quality objectives would continue to be met. Overall, the cumulative effects would be similar to the effects anticipated for the Proposed Action, and would be less than significant.

4.3.5 Acoustic Environment (Airborne)

The Proposed Action activities in the SOCAL Range Complex were deemed to have insignificant effects on the marine (airborne) noise environment, due in large part to the absence of human sensitive receptors on these sea ranges. Commercial ship and aircraft traffic, oil and gas development, and recreational activities all would contribute occasional, short-term noise to small portions of the ocean operating area of the SOCAL Range Complex. The airborne noises they generate would consist chiefly of short-term intrusive noise events in different locations at different times, similar to those of the Proposed Action. Thus, little or no overlap in location or time of discrete noise events would be expected. Peak and average community noise levels would remain largely unchanged. Additionally, human noise receptors would still be absent. Accordingly, cumulative impacts on the marine noise environment would be less than significant.

Cumulative noise sources on SCI would include range operations, training, and maintenance activities not included in the Proposed Action, along with numerous planned construction projects. Noise from these activities generally would consist of short-term, intrusive noise events in different locations. Because these activities would occur relatively near to each other, some potential exists for an additive effect and a modest increase in average hourly noise levels during the day. The only noise-sensitive receptors, however, would be military personnel and their civilian contractors; members of the general public would not be exposed to this cumulative noise environment.

The noise-sensitive receptors most likely to be exposed to cumulative noise from on-island and nearshore Navy activities would be fishermen, fishing and dive charters, and other commercial and recreational vessels in the nearshore waters around SCI. While these individuals could be exposed to high noise levels from naval training activities, especially the use of live ordnance on SCI, they generally would not be exposed to high noise levels from on-island construction projects. Both distance attenuation and topographic shielding generally would substantially reduce the noise level between its source and the closest receptors. Projects such as the SOAR Cable Refurbishment, new moorings at Wilson Cove, and an underwater missile launch facility would generate very little atmospheric noise, and any construction noise would be short in duration. Thus, the cumulative noise environment would be similar to that for the Proposed Action alone, which has been determined to have less than significant impacts.

Proposed upgrades of SCI's NALF would increase total air operations, expanding the +65-decibel noise contour over portions of the ocean. The increase would be modest and the effected area would be small, however, and the exposure of any one vessel to aircraft noise while traversing the area would be short. In addition, little or no overlap between aircraft noise from NALF and noise from noise-intensive training activities such as ordnance delivery would occur, however, because the air field is located on the northern end of SCI and these noise-intensive training activities are concentrated in SHOBA on the southern end of the island.

In the area of airborne sound, the primary impacts of proposed Navy activities are geographically isolated from population centers and otherwise will not affect natural resources. There would be no significant cumulative impact from these proposed activities.

4.3.6 Marine Plants and Invertebrates

Potential cumulative impacts on marine plants and invertebrates in the SOCAL Range Complex include releases of chemicals into the ocean, introduction of debris into the water column and onto the seafloor, and mortality and injury of marine organisms near the detonation or impact point of ordnance or explosives. The presence of persistent organic compounds such as DDT and PCBs are of particular concern. In light of these concerns, Navy activities would have small or negligible potential impacts. There would be no long-term changes to species abundance or diversity, no loss or degradation of sensitive habitats, and no effects to threatened and endangered species. None of the potential impacts would affect the sustainability of resources, the regional ecosystem, or the human community.

4.3.7 Fish

Potential cumulative impacts of Navy training exercises include release of chemicals into the ocean, introduction of debris into the water column and onto the seafloor, mortality and injury of marine organisms near the detonation or impact point of ordnance or explosives, and, physical and acoustic impacts of vessel activity. The overall effect on fish stocks would be negligible additions to impacts of commercial and recreational fishing in the SOCAL Range Complex.

Due to the wide geographic separation of most of the operations, Navy activities would have small or negligible potential impact, and their potential impacts are not additive or synergistic. Relatively small numbers of fish would be killed by shock waves from mines, inert bombs, and intact missiles and targets hitting the water surface. These and several other types of activities common to many exercises or tests have less-than-significant effects on fish: aircraft, missile, and target overflights; muzzle blast from 5-in naval guns; releases of munitions constituents; falling debris and small arms rounds; entanglement in military-related debris; and chaff and flares. There would be no long-term changes in species abundance or diversity, no loss or degradation of sensitive habitats, and no effects to threatened and endangered species. None of the potential impacts would affect Essential Fish Habitat, sustainability of resources, the regional ecosystem, or the human community.

4.3.8 Sea Turtles

Four species of sea turtles, leatherback, loggerhead, olive ridley, and green, may occur in the SOCAL Range Complex. Each of these species is globally distributed, and each is listed as threatened or endangered.

Distribution and Conservation Status

Olive ridley turtles are globally distributed in the tropical regions of the South Atlantic, Pacific, and Indian Oceans. In the South Atlantic Ocean, they are found along the Atlantic coasts of West Africa and South America. In the Eastern Pacific, they occur from Southern California to Northern Chile. Olive ridleys often migrate great distances between feeding and breeding grounds. In two separate satellite telemetry studies, both male and female olive ridleys leaving the breeding and nesting grounds off the Pacific coast of Costa Rica migrated out to the deep waters of the Pacific Ocean. Both sexes migrated to waters deeper than 9800 ft (3000 m). The results did not indicate a directed migration to a specific foraging area, instead it appears the olive ridley forages opportunistically in deep ocean waters (Plotkin et al. 1994). Olive Ridley populations are listed as endangered or threatened worldwide (NOAA 2007).

The green turtle is globally distributed and generally found in tropical and subtropical waters along continental coasts and islands between 30° North and 30° South. Nesting occurs in over 80 countries throughout the year (though not throughout the year at each specific location). Green turtles are thought to inhabit coastal areas of more than 140 countries. In the eastern North

Pacific, green turtles have been sighted from Baja California to southern Alaska, but most commonly occur from San Diego south. In the central Pacific, green turtles occur around most tropical islands, including the Hawaiian Islands. Green turtle populations are listed as endangered or threatened throughout their range (NOAA 2007).

Leatherback turtles are globally distributed. Leatherback turtle nesting grounds are located around the world, with the largest remaining nesting assemblages found on the coasts of northern South America and west Africa. The U.S. Caribbean, primarily Puerto Rico and the U.S. Virgin Islands, and southeast Florida support minor nesting colonies, but represent the most significant nesting activity within the United States. Adult leatherbacks are capable of tolerating a wide range of water temperatures, and have been sighted along the entire continental coast of the United States as far north as the Gulf of Maine and south to Puerto Rico, the U.S. Virgin Islands, and into the Gulf of Mexico. The Pacific Ocean leatherback population is generally smaller in size than that in the Atlantic Ocean. Leatherback turtles are endangered throughout their range (NOAA 2007).

Loggerheads turtles are circumglobal, occurring throughout the temperate and tropical regions of the Atlantic, Pacific, and Indian Oceans. Loggerheads are the most abundant species of sea turtle found in U.S. coastal waters.

In the eastern Pacific, loggerheads have been reported as far north as Alaska, and as far south as Chile. In the U.S., occasional sightings are reported from the coasts of Washington and Oregon, but most records are of juveniles off the coast of California. The west coast of Mexico, including the Baja Peninsula, provides critically important developmental habitats for juvenile loggerheads. The only known nesting areas for loggerheads in the North Pacific are found in southern Japan. Loggerhead turtles are threatened throughout their range (NOAA 2007).

Impacts on Sea Turtles

Incidental take in fishing operations, or bycatch, is one of the most serious threats to sea turtle populations. In the Pacific, NMFS requires measures (e.g., gear modifications, changes to fishing practices, and time/area closures) to reduce sea turtle bycatch in the Hawaii- and California-based pelagic longline fisheries and the California/Oregon drift gillnet fishery.

Marine debris affects marine turtles, which commonly ingest or become entangled in marine debris (e.g., tar balls, plastic bags, plastic pellets, balloons, and ghost fishing gear) as they feed along oceanographic fronts, where debris and their natural food items converge. Marine pollution from coastal runoff, marina and dock construction, dredging, aquaculture, oil and gas exploration and extraction, increased underwater noise, and boat traffic can degrade marine habitats used by marine turtles. Turtles swimming or feeding at or just beneath the surface of the water are vulnerable to boat and vessel strikes, which can result in serious propeller injuries and death. Disease**,** specifically fibropapillomatosis (FP), is a major threat to green turtles in some areas of the world. In addition, scientists have documented FP in populations of loggerhead, olive ridley, and flatback turtles. The effects of FP at the population level are not well understood. How some marine turtle species function within the marine ecosystem is still poorly understood. Global warming could potentially have an extensive impact on all aspects of a turtle's life cycle, as well as impact the abundance and distribution of prey items. Loss or degradation of nesting habitat resulting from erosion control through beach nourishment and armoring, beachfront development, artificial lighting, and non-native vegetation is a serious threat affecting nesting females and hatchlings (NOAA 2007).

Cumulative Impacts

Sea turtles are generally uncommon in the SOCAL Range Complex and do not nest there, but may forage in or transit through the area. Temporary disturbance incidents associated with SOCAL Range Complex activities could result in an incremental contribution to cumulative impacts on sea turtles. The mitigation measures identified in Section 3.8.1.1.2 would minimize any potential adverse effects on sea turtles. The impacts of the No Action and Proposed Action alternatives are not likely to affect the species' or stock's annual rates of recruitment or survival. Therefore, the incremental impacts of the No Action and Proposed Action alternatives would not present a significant contribution to the effects on sea turtles when added to effects on sea turtles from other past, present, and reasonably foreseeable future actions.

4.3.9 Marine Mammals

Risks to marine mammals emanate primarily from ship strikes, exposure to chemical toxins or biotoxins, exposure to fishing equipment that may result in entanglements, and disruption or depletion of food sources from fishing pressure and other environmental factors. Potential cumulative impacts of Navy activities on marine mammals would result primarily from possible ship strikes and sonar use.

Stressors on marine mammals and marine mammal populations can include both natural and human-influenced causes listed below and described in the following sections:

Natural Stressors

- Disease
- Natural toxins
- Weather and climatic influences
- Navigation errors
- Social cohesion

Human-Influenced Stressors

- Ship strikes
- Pollution and ingestion
- Noise

Natural Stressors

Significant natural causes of mortality, die-offs, and stranding discussed below include disease and parasitism; marine neurotoxins from algae; navigation errors that lead to inadvertent stranding; and climatic influences that impact the distribution and abundance of potential food resources (i.e., starvation). Stranding also is caused by predation by other species such as sharks (Cockcroft et al. 1989; Heithaus, 2001), killer whales (Constantine et al. 1998; Guinet et al. 2000; Pitman et al. 2001), and some species of pinniped (Hiruki et al.,\ 1999; Robinson et al. 1999).

Disease

Like other mammals, marine mammals frequently suffer from a variety of diseases of viral, bacterial, and fungal origin (Visser et al., 1991; Dunn et al., 2001; Harwood, 2002). Gulland and Hall (2005, 2007) provide a summary of individual and population effects of marine mammal diseases.

Marine Neurotoxins

Some single-celled marine algae common in coastal waters, such as dinoflagellates and diatoms, produce toxic compounds that can bio-accumulate in the flesh and organs of fish and invertebrates (Geraci et al., 1999; Harwood, 2002). Marine mammals become exposed to these compounds when they eat prey contaminated by these naturally produced toxins (Van Dolah, 2005).

Weather Events and Climate Influences

Severe storms, hurricanes, typhoons, and prolonged temperature extremes may lead to local marine mammal strandings (Geraci et al. 1999; Walsh et al. 2001). Storms in 1982-1983 along the California coast led to deaths of 2,000 northern elephant seal pups (Le Boeuf and Reiter 1991). Seasonal oceanographic conditions in terms of weather, frontal systems, and local currents may also play a role in stranding (Walker et al. 2005).

The effect of large-scale climatic changes to the world's oceans and how these changes impact marine mammals and influence strandings are difficult to quantify, given the broad spatial and temporal scales involved, and the cryptic movement patterns of marine mammals (Moore 2005; Learmonth et al. 2006). The most immediate, although indirect, effect is decreased prey availability during unusual conditions. This, in turn, results in increased search effort required by marine mammals (Crocker et al. 2006), potential starvation if not successful, and corresponding stranding due directly to starvation or succumbing to disease or predation while in a weakened, stressed state (Selzer and Payne 1988; Geraci et al. 1999; Moore, 2005; Learmonth et al. 2006; Weise et al. 2006).

Navigational Error

Geomagnetism- Like some land animals and birds, marine mammals may be able to orient to the Earth's magnetic field as a navigational cue, and areas of local magnetic anomalies may influence strandings (Bauer et al., 1985; Klinowska 1985; Kirschvink et al. 1986; Klinowska 1986; Walker et al., 1992; Wartzok and Ketten 1999).

Echolocation Disruption in Shallow Water- Some researchers believe stranding may result from reductions in the effectiveness of echolocation in shallow water, especially in the pelagic species of odontocetes who may be less familiar with coastlines (Dudok van Heel, 1966; Chambers and James, 2005). For an odontocete, echoes from echolocation signals contain important information on the location and identity of underwater objects and the shoreline. The authors postulate that the gradual slope of a beach may present difficulties to the navigational systems of some cetaceans, since live strandings commonly occur along beaches with shallow, sandy gradients (Brabyn and McLean 1992; Mazzuca et al. 1999; Maldini et al. 2005; Walker et al. 2005). A factor contributing to echolocation interference in turbulent, shallow water is the presence of microbubbles from the interaction of wind, breaking waves, and currents. Additionally, ocean water near the shoreline can have an increased turbidity (e.g., floating sand or silt, particulate plant matter) due to the run-off of fresh water into the ocean, either from rainfall or from freshwater outflows (e.g., rivers and creeks). Collectively, these factors can reduce and scatter the sound energy in echolocation signals and reduce the perceptibility of returning echoes of interest.

Social Cohesion

Many pelagic species such as sperm whales, pilot whales, melon-head whales, and false killer whales, and some dolphins occur in large groups with strong social bonds between individuals. When one or more animals strand due to any number of causative events, then the entire pod may follow suit out of social cohesion (Geraci et al. 1999; Conner 2000; Perrin and Geraci 2002; NMFS, 2007).

Table 4-6: Marine Mammal Unusual Mortality Events in the Pacfic Attributed to or suspected from Natural Causes 1978-2005

Year	Species and number	Location	Cause
1978	Hawaiian monk seals (50)	NW Hawaiian Islands	Ciguatoxin and maitotoxin
1983	Multiple pinniped species	West coast of U.S., Galapagos	El Nino
1984	California sea lions (226)	California	Leptospirosis
1987	Sea otters (34)	Alaska	Saxitoxin
1995	California sea lions (222)	California	Leptospirosis
1997-98	California sea lions (100s)	California	El Nino
1998	California sea lions (70)	California	Domoic acid
1998	Hooker's sea lions (60% of pups)	New Zealand	Unknown, bacteria likely
2000	California sea lions (178)	California	Leptospirosis
2000	California sea lions (184)	California	Domoic acid
2000	Harbor seals (26)	California	Unknown; Viral pneumonia suspected
2002	Multispecies (common dolphins, California sea lions, sea otters) (approx. 500)	California	Domoic acid
2002	Hooker's sea lions	New Zealand	Pneumonia
2003	Multispecies (common dolphins, California sea lions, sea otters) (approx. 500)	California	Domoic acid
2003	Beluga whales (20)	Alaska	Ecological factors
2003	Sea otters	California	Ecological factors
2004	California sea lions (405)	Canada, U.S. West Coast	Leptospirosis
2005	California sea lions; Northern fur seals	California	Domoic acid

Note: Data from Gulland and Hall (2007); citations for each event contained in Gulland and Hall (2007)

Anthropogenic Stressors

During the past few decades there has been an increase in marine mammal mortalities associated with a variety of human activities (Geraci et al. 1999; NMFS, 2007). These activities include fisheries interactions (bycatch and directed catch), pollution (marine debris, toxic compounds), habitat modification (degradation, prey reduction), ship strikes (Laist et al., 2001), and gunshots.

<u>Fisheries Interaction: By-Catch, Directed Catch, and Entanglement</u>

The incidental catch of marine mammals in commercial fisheries is a significant threat to the survival and recovery of many populations of marine mammals (Geraci et al. 1999; Baird, 2002; Culik 2002; Carretta et al., 2004; Geraci and Lounsbury 2005; NMFS, 2007). Interactions with fisheries and entanglement in discarded or lost gear continue to be a major factor in marine mammal deaths worldwide (Geraci et al. 1999; Nieri et al., 1999; Geraci and Lounsbury 2005; Read et al., 2006; Zeeber et al., 2006). For instance, baleen whales and pinnipeds have been found entangled in nets, ropes, monofilament line, and other fishing gear that has been discarded out at sea (Geraci et al., 1999; Campagna et al., 2007).

Bycatch- Bycatch is the catching of non-target species within a given fishing operation and can include non-commercially used invertebrates, fish, sea turtles, birds, and marine mammals (NRC, 2006). Read et al. (2006) attempted to estimate the magnitude of marine mammal bycatch in U.S. and global fisheries. Within U.S. fisheries, between 1990 and 1999 the mean annual bycatch of marine mammals was 6,215 animals. Eighty-four percent of cetacean bycatch occurred in gill-net fisheries, with dolphins and porpoises constituting most of the cetacean bycatch (Read et al., 2006). Over the decade there was a 40 percent decline in marine mammal bycatch, primarily due to effective conservation measures that were implemented during this time period.

Read et al. (2006) extrapolated data for the same period (1990-1999) and calculated an annual estimate of 653,365 of marine mammals globally, with most of the world's bycatch occurring in gill-net fisheries. With global marine mammal bycatch likely to be in the hundreds of thousands every year, bycatch in fisheries will be the single greatest threat to many marine mammal populations around the world (Read et al. 2006).

Entanglement- Entanglement in active fishing gear is a major cause of death or severe injury among the endangered whales in the action area. Entangled marine mammals may die as a result of drowning, escape with pieces of gear still attached to their bodies, or manage to be set free either of their own accord or by fishermen. Many large whales carry off gear after becoming entangled (Read et al. 2006). When a marine mammal swims off with gear attached, the result can be fatal. The gear may become too cumbersome for the animal, or it can be wrapped around a crucial body part and tighten over time. Stranded marine mammals frequently exhibit signs of previous fishery interaction, such as scarring or gear attached to their bodies. For stranded marine mammals, death is often attributed to such interactions (Baird and Gorgone, 2005). Because marine mammals that die due to fisheries interactions may not wash ashore and not all animals that do wash ashore exhibit clear signs of interactions, data probably underestimate fishery-related mortality and serious injury (NMFS, 2005a).

An estimated 78 baleen whales were killed annually in the offshore southern California/Oregon drift gillnet fishery during the 1980s (Heyning and Lewis 1990). From 1998-2005, based on observer records, five fin whales (CA/OR/WA stock), 12 humpback whales (ENP stock), and six sperm whales (CA/OR/WA stock) were either seriously injured or killed in fisheries off the west coast of the U.S. (California Marine Mammal Stranding Network Database 2006).

Ship Strike

Ship strikes of marine mammals are another cause of mortality and stranding (Laist et al., 2001; Geraci and Lounsbury, 2005; de Stephanis and Urquiola, 2006). An animal at the surface could be struck directly by a vessel, a surfacing animal could hit the bottom of a vessel, or an animal just below the surface could be cut by a vessel's propeller. The severity of injuries typically depends on the size and speed of the vessel and the size of the animal (Knowlton and Kraus, 2001; Laist et al., 2001; Vanderlaan and Taggart, 2007).

The growth in commercial ports and associated commercial vessel traffic is a result of the globalization in trade. The Final Report of the NOAA International Symposium on "Shipping Noise and Marine Mammals: A Forum for Science, Management, and Technology" stated that the worldwide commercial fleet has grown from approximately 30,000 vessels in 1950 to over 85,000 vessels in 1998 (NRC, 2003; Southall, 2005). It is unknown how international shipping volumes and densities will continue to grow. However, current statistics support the prediction that the international shipping fleet will continue to grow at the current rate or at greater rates in the future. Shipping densities in specific areas and trends in routing and vessel design are as, or more, significant than the total number of vessels. Densities along existing coastal routes are expected to increase both domestically and internationally. New routes are also expected to develop as new ports are opened and existing ports are expanded. Vessel propulsion systems are also advancing toward faster ships operating in higher sea states for lower operating costs; and container ships are expected to become larger along certain routes (Southall, 2005).

While there are reports and statistics of whales struck by vessels in U.S. waters, the magnitude of the risks that commercial ship traffic poses to marine mammal populations is difficult to quantify or estimate. In addition, there is limited information on vessel strike interactions between ships and marine mammals outside of U.S. waters (de Stephanis and Urquiola, 2006). Laist et al. (2001) concluded that ship collisions may have a negligible effect on most marine mammal populations in general, except for regionally-based small populations where the significance of low numbers of collisions would be greater, given smaller populations or populations segments.

U.S. Navy vessel traffic is a small fraction of the overall U.S. commercial and fishing vessel traffic. While U.S. Navy vessel movements may contribute to the ship strike threat, given the lookout and mitigation measures adopted by the U.S. Navy, probability of vessel strikes is greatly reduced. Furthermore, actions to avoid close interaction of U.S. Navy ships and marine mammals and sea turtles, such as maneuvering to keep away from any observed marine mammal and sea turtle are part of existing at-sea protocols and standard operating procedures. Navy ships have up to three or more dedicated and trained lookouts as well as two to three bridge watchstanders during at-sea movements who would be searching for any whales, sea turtles, or other obstacles on the water surface. Such lookouts are expected to further reduce the chances of a collision.

Ingestion of Plastic Objects and Other Marine Debris and Toxic Pollution Exposure

For many marine mammals, debris in the marine environment is a great hazard. Not only is debris a hazard because of possible entanglement, animals may mistake plastics and other debris for food (NMFS, 2007g). Sperm whales have been known to ingest plastic debris, such as plastic bags (Evans et al. 2003; Whitehead 2003). While this has led to mortality, the scale on which this is affecting sperm whale populations is unknown, but Whitehead (2003) suspects it is not substantial at this time.

High concentrations of potentially toxic substances within marine mammals along with an increase in new diseases have been documented in recent years. Scientists have begun to consider the possibility of a link between pollutants and marine mammal mortality events. NMFS takes part in a marine mammal bio-monitoring program not only to help assess the health and contaminant loads of marine mammals, but also to assist in determining anthropogenic impacts on marine mammals, marine food chains, and marine ecosystem health. Using strandings and bycatch animals, the program provides tissue/serum archiving, samples for analyses, disease monitoring and reporting, and additional response during disease investigations (NMFS, 2007).

The impacts of these activities are difficult to measure. However, some researchers have correlated contaminant exposure with possible adverse health effects in marine mammals (Borell 1993; O'Shea and Brownell 1994; O'Hara and Rice 1996; O'Hara et al. 1999).

The manmade chemical PCB (polychlorinated biphenyl), and the pesticide DDT (dichlorodiphyenyltrichloroethane), are both considered persistent organic pollutants that are currently banned in the United States for their harmful effects in wildlife and humans (NMFS, 2007c). Despite having been banned for decades, the levels of these compounds are still high in marine mammal tissue samples taken along U.S. coasts (Hickie et al. 2007; Krahn et al. 2007; NMFS, 2007c). Both compounds are long-lasting, reside in marine mammal fat tissues (especially in the blubber), and can have toxic effects such as reproductive impairment and immunosuppression (NMFS, 2007c).

In addition to direct effects, marine mammals are indirectly affected by habitat contamination that degrades prey species availability, or increases disease susceptibility (Geraci et al., 1999).

U.S. Navy vessel operation between ports and exercise locations has the potential to release small amounts of pollutant discharges into the water column. U.S. Navy vessels are not a typical source, however, of either pathogens or other contaminants with bioaccumulation potential such as pesticides and PCBs. Furthermore, any vessel discharges such as bilgewater and deck runoff associated with the vessels would be in accordance with international and U.S. requirements for eliminating or minimizing discharges of oil, garbage, and other substances, and not likely to contribute significant changes to ocean water quality or to affect marine mammals.

Anthropogenic Sound

As one of the potential stressors to marine mammal populations, noise and acoustic influences may disrupt marine mammal communication, navigational ability, and social patterns, and may or may not influence stranding. Many marine mammals use sound to communicate, navigate, locate prey, and sense their environment. Both anthropogenic and natural sounds may interfere with these functions, although comprehension of the type and magnitude of any behavioral or physiological responses resulting from man-made sound, and how these responses may contribute to strandings, is rudimentary at best (NMFS, 2007). Marine mammals may respond both behaviorally and physiologically to anthropogenic sound exposure, (e.g., Richardson et al., 1995; Finneran et al., 2000; Finneran et al., 2003; Finneran et al., 2005). However, the range and magnitude of the behavioral response of marine mammals to various sound sources is highly variable (Richardson et al., 1995) and appears to depend on the species involved, the experience of the animal with the sound source, the motivation of the animal (e.g., feeding, mating), and the context of the exposure.

Marine mammals are regularly exposed to several sources of natural and anthropogenic sounds. Anthropogenic noise that could affect ambient noise arises from the following general types of activities in and near the sea, any combination of which can contribute to the total noise at any one place and time. These noises include: transportation; dredging; construction; oil, gas, and mineral exploration in offshore areas; geophysical (seismic) surveys; sonar; explosions; and ocean research activities (Richardson et al., 1995). Commercial fishing vessels, cruise ships, transport boats, recreational boats, and aircraft, all contribute sound into the ocean (NRC, 2003; NRC, 2006). Several investigators have argued that anthropogenic sources of noise have increased ambient noise levels in the ocean over the last 50 years (NRC 1994, 1996, 2000, 2003, 2005; Richardson et al., 1995; Jasny et al., 2005; McDonald et al., 2006). Much of this increase is due to increased shipping due to ships becoming more numerous and of larger tonnage (NRC, 2003; McDonald et al., 2006). Andrew et al. (2002) compared ocean ambient sound from the 1960s with the 1990s for a receiver off the California coast. The data showed an increase in ambient noise of approximately 10 decibel (dB) in the frequency range of 20 to 80 Hertz (Hz) and 200 and 300 Hz, and about 3 dB at 100 Hz over a 33-year period.

Sound emitted from large vessels, particularly in the course of transit, is the principal source of noise in the ocean today, primarily due to the properties of sound emitted by civilian cargo vessels (Richardson et al., 1995; Arveson and Vendittis, 2000). Ship propulsion and electricity generation engines, engine gearing, compressors, bilge and ballast pumps, as well as hydrodynamic flow surrounding a ship’s hull and any hull protrusions, contribute to a large vessels’ noise emissions in the marine environment. Prop-driven vessels also generate noise through cavitation, which accounts much of the noise emitted by a large vessel depending on its travel speed. Military vessels underway or involved in naval operations or exercises, also introduce anthropogenic noise into the marine environment. Noise emitted by large vessels can be characterized as low-frequency, continuous, and tonal. The sound pressure levels at the vessel will vary according to speed, burden, capacity, and length (Richardson et al., 1995; Arveson and Vendittis, 2000). Vessels ranging from 135 to 337 meters generate peak source sound levels from 169 - 200 dB between 8 Hz and 430 Hz, although Arveson and Vendittis (2000) documented components of higher frequencies (10-30 kHz) as a function of newer merchant ship engines and faster transit speeds. Given the propagation of low-frequency sounds, a large vessel in this sound range can be heard 139-463 kilometers away (Ross 1976 in Polefka 2004). U.S. Navy vessels, however, have incorporated significant underwater ship quieting technology to reduce their acoustic signature (as compared to a similarly-sized vessel) and thus reduce their vulnerability to detection by enemy passive acoustics (Southall, 2005).

Airborne sound from a low-flying helicopter or airplane may be heard by marine mammals and turtles while at the surface or underwater. Due to the transient nature of sounds from aircraft involved in at-sea operations, such sounds would not likely cause physical effects but have the potential to affect behaviors. Responses by mammals and turtles could include hasty dives or turns, or decreased foraging (Soto et al., 2006). Whales may also slap the water with flukes or flippers, swim away from the aircraft track.

Naval sonars are designed for three primary functions: submarine hunting, mine hunting, and shipping surveillance. There are two classes of sonars employed by the U.S. Navy: active sonars and passive sonars. Most active military sonars operate in a limited number of areas, and are most likely not a significant contributor to a comprehensive global ocean noise budget (ICES 2005b).

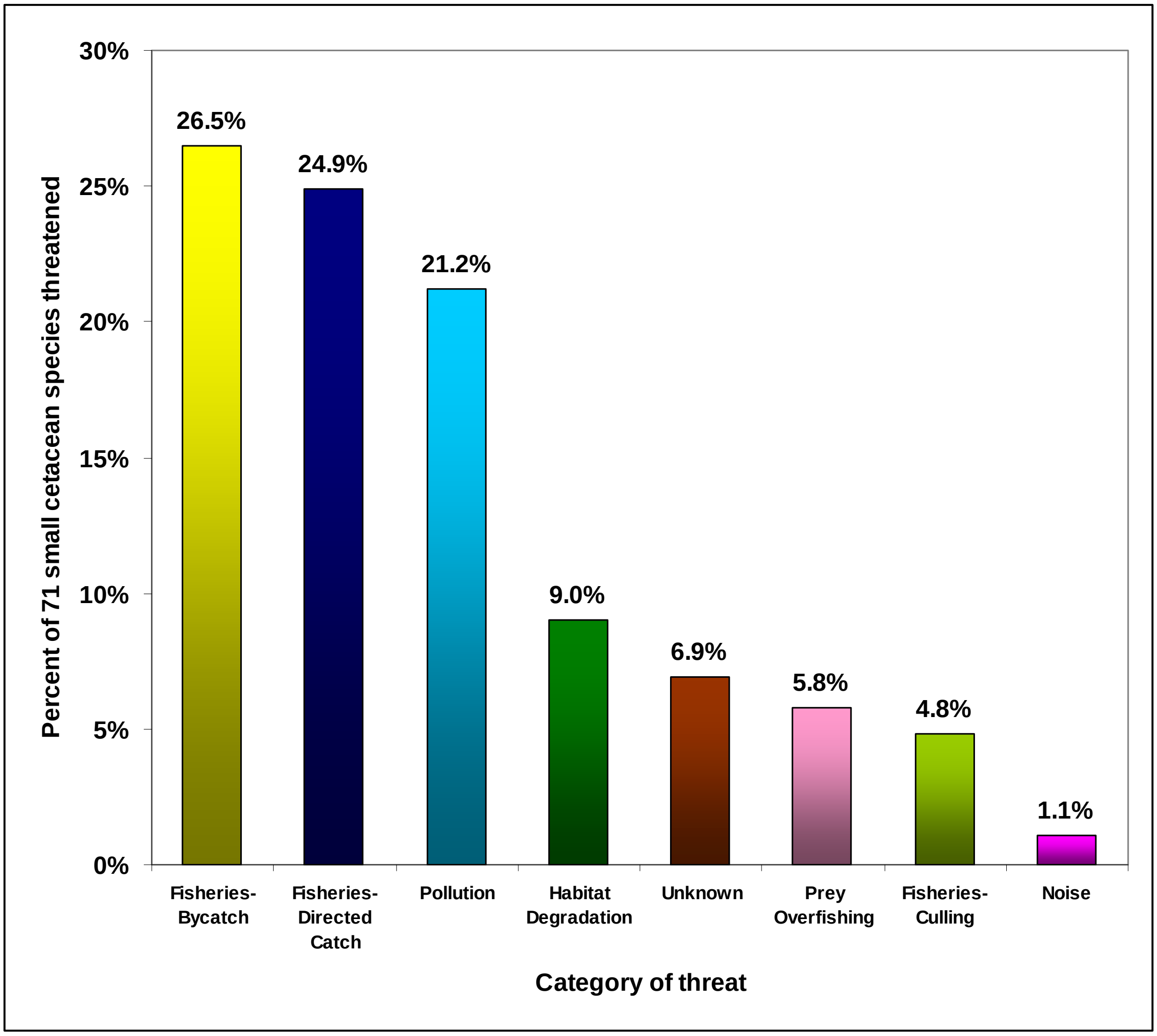

Figure 4-1: Human Threats to World-wide Small Cetacean Populations

Source: Culik 2002

Cumulative Impacts

Both natural and human-induced factors affect the health of marine mammal populations. Temporary disturbance incidents associated with Navy activities on the SOCAL Range Complex could result in an incremental contribution to cumulative impacts on mammals. The mitigation measures identified in Section 3.9.9 would be implemented to minimize any potential adverse effects to marine mammals from Navy activities. Impacts of the alternatives including the Proposed Action are not likely to affect the species through effects on annual rates of recruitment or survival. Therefore, the incremental impacts would not present a significant contribution to the effects on marine mammals when added to effects from other past, present, and reasonably foreseeable future actions.

4.3.10 Sea Birds

Seabird populations within the SOCAL Range Complex are affected by direct and indirect perturbations to breeding and foraging locations on the coastal mainland and offshore islands. The single greatest concern is the loss of suitable habitat for nesting and roosting seabirds throughout coastal California due to land development and human encroachment. Historically, seabird populations have sustained numerous impacts from pollution and human activities within the SCB from a variety of sources, including the discharge of hazardous chemicals and sewage. Though the Proposed Action does not directly reduce available seabird habitat within the SOCAL Range Complex, current seabird populations residing within the Range Complex become more susceptible to potential impacts due to the concentrated nature of those populations. By default, open space within military installations in coastal locations has become vital to the persistence of seabird breeding and roosting populations.

Land range operations could affect breeding seabirds if the operational footprint encompassed nesting areas during breeding seasons. Current data on breeding seabird populations that overlap with training operations in or near coastal areas, San Clemente, or Santa Catalina Islands are either unavailable or incomplete, making a comprehensive effects analysis difficult. Though most offshore operations take place in oceanic waters well offshore, are of short duration, and have a small operational footprint, the importance of avoiding sensitive seabird colonies and reducing disturbance should be paramount when accessing new or ongoing training activities.

Training activities concentrated in or near coastal areas or offshore islands, or taking place at regular intervals, would disturb local seabird roosting colonies. The coastal and offshore island areas within the SOCAL Range Complex provide suitable seabird habitat adjacent to training areas, allowing potentially affected seabirds adequate alternative locations to avoid interactions with training operations. Continued expansion of commercial and private aircraft and ocean-going vessels through the Range Complex, together with increased SOCAL Range Complex training activities, elevates the potential for direct and indirect impacts on isolated seabird populations. The control of non-native plants and animals within coastal areas and on islands must continue to be addressed by land owners to ensure further degradation of seabird populations does not occur. Large-scale effects on seabird populations such as global warming, reduced fish populations, and development in other regions or countries are not well defined for individual species but have been attributed to the overall decline of seabirds.

The Proposed Action would not significantly impact any individual seabird population, its overall foraging success, or breeding opportunities within the SOCAL Range Complex. Terrestrial Biological Resources

The analysis for cumulative impacts to terrestrial biology focuses on fire, invasive species, erosion, and habitat degradation.

4.3.11 Terrestrial Biological Resources

Fire

Numerous activities having the potential to ignite wildfires have been described previously in this EIS/OEIS. These activities have a cumulative contribution to wildfire risk, and various measures identified in this document are intended to address the cumulative impacts of wildfire. The analyses of the individual activities that contribute to wildfire risk concluded that impacts of the individual operations on sensitive species could be mitigated to a less than significant level. This mitigation would be accomplished by implementing the SCI Wildland Fire Management Plan, which builds on recently implemented measures that have been reducing the frequency and size of operations-related fires. After mitigation, there would remain some potential for fire impacts associated with each operation. These remaining potential impacts on sensitive species, including the San Clemente loggerhead shrike, were judged to be less than significant individually. With implementation of the SCI Wildland Fire Management Plan, cumulative impacts of fire would be less than significant.

Invasive Species, Erosion, and Habitat Degradation

Several activities contribute cumulatively to habitat degradation, including disturbance to soils and vegetation, spread of invasive non-native species, erosion and sedimentation, and impacts on native plant species. Although individual impacts may be less than significant, collectively they have the potential to be significant over time and space. Some potential effects of invasive species are difficult to foresee (such as leading to a change in fire frequency or intensity). It is clear, however, that the potential for damage associated with introduction or spread of invasive plant species is high and increases over time with repeated training missions, especially exercises that cover a very large area. This is due to the difficulty in effectively monitoring for invasive establishment and achieving timely control. The Navy is addressing these effects in several important ways including implementation of the SCI Integrated Natural Resources Management Plan (INRMP), the SCI Wildland Fire Management Plan, and continued development and implementation of measures to prevent the establishment of invasive plant species by minimizing the potential for introductions of seed or other plant parts (propagules) of exotic species and finding and eliminating incipient populations before they are able to spread. Key measures include:

- Minimizing the amount of seed or propagules of non-native plant species introduced to the island through continued efforts to remove seed and soil from all vehicles, including contractor vehicles, coming to the island by pressure washing on the mainland, and stepped up efforts to ensure that imported construction materials such as sand, gravel, aggregate, or road base material are weed free.
- Regular monitoring and treatment to detect and eliminate exotic species, focusing on areas where equipment and construction materials come ashore (Wilson Cove vicinity, including equipment yards and construction laydown areas, vicinity of beaches where amphibious landings area conducted) and areas within which there is movement of equipment and personnel and soil disturbance which favor the spread and establishment of invasive species (e.g., along roadsides, disturbed areas, including the Assault Maneuver Corridor, and TARs).
- Effective measures to foster the reestablishment of native vegetation in areas where non-native vegetation is present.
- No living plant material would be brought to the island from the mainland (in order to avoid introduction of inappropriate genetic strains of native plants or exotic species, including weeds, insects and invertebrates such as snails).
- Continued operation of an on-island nursery to produce all plant material to be used on the island and continued exclusive use of on-island sources of indigenous plants for use in restoration. Because of the site–to-site variability in some of the native species, location-specific sources should be used in propagating many of the native species for use in restoration.
- Measures to correct developing erosion problems, such as correcting drainage from roads and culvert outlets where they contribute to concentration of flow potentially leading to gullying and measures designed to stop the progression of existing gullies associated with developed sites and roads.
- Maintenance of an up-to-date inventory of sensitive plant and wildlife species locations and consulting the inventory in all environmental reviews.

Navy projects at SCI other than the Proposed Action, such as those identified in Table 4-4, also could impact terrestrial biological resources. Any such project at SCI would be required to be in compliance with the established INRMP, SCI Wildland Fire Management Plan, and U.S. Fish and

Wildlife Service Biological Opinions issued after Endangered Species Act Section 7 consultation addressing direct, indirect, and cumulative impacts. As identified in Section 3.11, there are numerous potential impacts of the Proposed Action on terrestrial biology on SCI. These impacts have the potential for significant cumulative impact on such resources. Mitigation measures identified in this EIS/OEIS, considered together with any additional mitigation or conservation measures that might be appropriate after Section 7 consultation, however, will substantially mitigate direct, indirect, and cumulative effects of the Proposed Action.

4.3.12 Cultural Resources

This EIS/OEIS determined that the Proposed Action would have little or no potential to impact underwater cultural resources, primarily because most of the Proposed Action's activities were on or above the surface and cultural resources, if any, are on the ocean bottom. Project activities would not generally disturb areas where cultural resources are known or expected to be present. For the same reason, most other ongoing and anticipated ocean activities such as commercial ship traffic, fishing, oil and gas development, or scientific research, would not substantially affect underwater cultural resources.

This EIS/OEIS also examined the potential for impacts on cultural, archaeological, and historic sites on SCI. Due to the large number of known and estimated cultural sites on SCI and the widespread use of the island for training of ground combat forces, Naval Special Warfare, and missile operations, the Proposed Action could increase the potential for significant impacts. Mitigation strategies developed under the Draft Programmatic Agreement with the State Historic Preservation Office, such as avoidance or data recovery, should reduce impacts to a level less than significant. Any activities with the potential for significant impacts on cultural resources will require Section 106 consultation, and would be mitigated as required.

Other on-island construction projects and activities with the potential to disturb cultural resources would be required to evaluate their potential effects and, if necessary, implement mitigation measures similar to those described for the Proposed Action. Where avoidance was practiced, no cumulative effect would result because no contact with the resource would occur. Where data recovery was practiced, the cumulative effect would be that more cultural sites underwent data recovery and removal than would occur under the Proposed Action alone.

4.3.13 Traffic (Airspace)

The region that includes the SOCAL Range Complex is one of the busiest areas of the world in terms of air traffic. The Proposed Action does not propose any expansion of military Special Use Airspace, and would not produce any significant regional cumulative traffic impacts. While hazardous activities in W-291 are in progress, vessel traffic, forewarned through publication of the related Notice to Mariners (NOTMAR), would avoid the affected area. Although the resultant detour might be inconvenient, it would not preclude the affected vessel from arriving at his destination. Similarly for air traffic, when hazardous activities within W-291 close Control Area Extension (CAE) 1156, commercial and general aviation air traffic, operating under Instrument Flight Rules enroute to or from San Diego, would be routed to the north to transit CAE 1177. Although this slight detour might be inconvenient, it would not pose an increased safety hazard nor impose an additional burden on the air traffic control system. Coordination with the Federal Aviation Administration on all matters affecting airspace would significantly reduce or eliminate the possibility of indirect adverse impacts and associated cumulative impacts on civil aviation and airspace use.

4.3.14 Socioeconomics

Implementation of the Proposed Action would not produce any significant regional employment, income, housing, or infrastructure impacts. Effects on commercial and recreational fishermen, divers, and boaters would be short-term in nature and produce some temporary access limitations. Some offshore operations, especially if coincident with peak fishing locations and periods, could cause temporary displacement and potential economic loss to individual fishermen. However, most offshore operations are of short duration and have a small operational footprint. Effects on fishermen are mitigated by a series of Navy initiatives, including public notification of scheduled activities, near-real time schedule updates, prompt notification of schedule changes, and adjustment of hazardous operations areas. In selected instances where safety requires exclusive use of a specific area, fishermen may be asked to relocate to a safer nearby area for the duration of the exercise. These measures should not significantly impact any individual fisherman, overall commercial revenue, or public recreational opportunities. Therefore, the Proposed Action would not result in significant cumulative socioeconomic impacts.

4.3.15 Environmental Justice and Protection of Children

The Proposed Action would not affect minority or low-income populations, nor would children be exposed to increased noise levels or safety risks.

4.3.16 Public Safety

Environmental pollution (e.g., air pollutants, water pollutants, EMR) would have little potential to affect public health because they would be dispersed over large areas of ocean with few human receptors. Project activities (e.g., ship movements, live-firing of weapons) would have little potential to effect public safety because of the general absence of non-participating individuals. The same factors - the dispersed nature of the activities and general absence of non-participants within the area of effect at the time of the activity - would limit the public health and safety impacts of other ongoing or anticipated activities in the SOCAL Range Complex.

Impacts of the Proposed Action on public health and safety on SCI were determined to be minimal: (a) the public is generally excluded from SCI, and (b) danger zones and exclusion zones have been established in SCI's nearshore waters to assure that non-participants are not exposed to hazardous on-island activities. Other construction, maintenance, and training activities on the island would likewise be isolated from the public. Projects such as the SOAR Cable Refurbishment, SWTR instrumentation, and new moorings at Wilson Cove are not expected to pose any risks to individuals in public use areas around the island. An underwater missile launch facility proposed near NOTS Pier on SCI would be within a restricted zone, and would thus pose no risk to the public.

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5 Mitigation Measures

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5 MITIGATION MEASURES

As part of the Navy's commitment to sustainable use of resources and environmental stewardship, the Navy incorporates measures that are protective of the environment into all of its activities. These include employment of best management practice, standard operating procedures (SOPs), adoption of conservation recommendations, and other measures that mitigate the impacts of Navy activities on the environment. Some of these measures are generally applicable and others are designed to apply to certain geographic areas during certain times of year, for specific types of Navy training. Mitigation measures covering habitats and species occurring in the Southern California (SOCAL) Range Complex have been developed through various environmental analyses conducted by the Navy for land and sea ranges and adjacent coastal waters.

The Navy has implemented a variety of marine mammal mitigation measures over the last two decades. This following discussion briefly describes the genesis and status of those mitigation measures.

Since the 1990s, the Navy has developed and implemented mitigation measures either as a result of environmental analysis or in consultation with regulatory agencies for research, development, test and evaluation activities (RDT&E) and training exercises. These measures included visual detection by trained lookouts, power down and shut down procedures, the use of passive sensors to detect marine mammals, and avoidance of marine mammals.

In December 2000, the Navy issued a memorandum entitled "Compliance with Environmental Requirements in the Conduct of Naval Exercises or Training at Sea" (Department of the Navy [DoN] 2000). This memorandum clarified Navy policy for continued compliance with certain environmental requirements including preparation of environmental planning documents, consultations pursuant to the Endangered Species Act (ESA), and applications for "take" authorizations under the Marine Mammal Protection Act (MMPA).

In 2003, the Navy issued the Protective Measures Assessment Protocol (PMAP) that implemented Navy-wide mitigation measures for various types of routine training events. Following the implementation of PMAP, the Navy agreed to additional mitigation measures as part of MMPA authorization and ESA consultation processes for specific training exercises from 2004-2007.

Finally, as authorized by the MMPA, the Secretary of Defense has approved two National Defense Exemptions (NDE) from the requirements of the MMPA for certain military readiness activities that employ mid-frequency active sonar (MFAS). The NDE includes mitigation measures that must be observed for use of MFAS during major Navy training exercises and on established Navy ranges and OPAREAs. These measures were designed to strike a reasoned balance between environmental protection, military readiness activities and, ultimately, the Navy's mission of National security. The NDE is in effect through January 2009.

In order to make the findings necessary to issue the MMPA authorization, it may be necessary for the National Marine Fisheries Service (NMFS) to require additional mitigation or monitoring measures beyond those addressed in this Environmental Impact Statement (EIS)/ Overseas Environmental Impact Statement (OEIS) (hereafter referred to as "EIS/OEIS"). These could include measures considered, but eliminated in this EIS/OEIS, or as yet undeveloped measures. In addition to commenting on this EIS/OEIS, the public will have an opportunity to provide information to NMFS through the MMPA process, both during the comment period following NMFS' Notice of Receipt of the application for a Letter of Authorization (LOA), and during the comment period following publication of the proposed rule. NMFS may propose additional mitigation or monitoring measures in the proposed rule. Measures not considered in the EIS, but required through the MMPA process, may require evaluation in accordance with the National Environmental Policy Act (NEPA). As appropriate, NMFS may consider tiering off this EIS should subsequent environmental analysis of mitigation measures be warranted during the MMPA process.

Additionally, the Navy is engaging in consultation processes under the ESA with regard to listed species that may be affected by the activities described in this EIS/OEIS. Those processes could lead to adoption of additional mitigation measures by the Navy.

The Navy also will consider public comments on proposed mitigation measures described in this EIS/OEIS.

This Section describes mitigation measures applicable to Navy activities in the SOCAL Range Complex.

5.1 GEOLOGY AND SOILS

Existing plans and policies are in place to limit the effects of construction and training on the environment at San Clemente Island (SCI) on an island-wide basis. Specific to earth resources, the Integrated Natural Resources Management Plan (INRMP) identifies erosion as a primary management issue and presents policies to reduce the impacts of erosion on the island. The INRMP notes that "erosion and sedimentation continue, arising from inadequately constructed or maintained roads, or from ongoing damage instigated by past overgrazing by feral goats, exterminated around 1991" (DoN 2002). Policies and SOPs relation to geology and soils include:

- Managing and limiting construction activities, including road construction, through an established site approval process.
- Limiting vehicle travel to existing roads: on SCI, off-road vehicle use is not permitted except in designated off-road areas or on established trails approved by the Navy's regional Natural Resources Office (NRO).
- Prohibiting tracked vehicular maneuvering outside the boundaries of the Armored Vehicle Maneuver Corridor (AVMC). Additionally, tracked vehicle maneuvering and camping are prohibited inside marked environmentally sensitive areas.

Additionally, because SCI is managed as a federal property, island operations comply with the Federal Soil Conservation Act; thus the Navy is required to control and prevent erosion by conducting surveys and implementing conservation measures (Soil Conservation Act, 16 U.S.C. § 5901). In accordance with this mandate, the Navy is studying sedimentation and erosion associated with watersheds on SCI.

Protective measures proposed to minimize erosion effects on terrestrial biological resources are presented in Section 3.11.3. These include development and implementation of a program to monitor for erosion, dust generation, and deposition of dust in adjacent habitats. It is recommended that such a program include monitoring and provide a means for adaptive management of erosion associated with the existing roads and ranges. Specifically, an annual review of the erosion conditions of the Missile Impact Range (MIR), firebreak road, and camera locations would be conducted under coordination with the NRO. Examples of control measures to be considered include placing riprap in problem areas to provide energy dissipation of concentrated runoff from the MIR or the firebreak road or placement of water bars to prevent runoff from concentrating to the point where erosion could occur. A representative from NRO would be consulted to ensure that any proposed erosion control efforts would not adversely affect cultural resources.

5.2 AIR QUALITY

Emissions that may affect air quality are heavily regulated under the Clean Air Act and its implementing regulations, through a comprehensive Federal / State regulatory process (see Section 3.2). Consistent with these regulatory requirements and processes, the Navy has implemented comprehensive air quality management programs to ensure compliance.

5.3 HAZARDOUS MATERIALS AND WASTES

Releases or discharges of hazardous wastes or materials are heavily regulated through a comprehensive Federal / State regulatory process (see Section 3.3.2). Consistent with these regulatory requirements and process, the Navy has implemented comprehensive management programs to ensure compliance.

Shipboard and shore management of hazardous materials and waste is governed by Navy regulations. Environmental compliance policies and procedures applicable to operations ashore and afloat are defined in Navy instructions. These instructions reinforce regulatory prohibitions of the Clean Water Act against discharge of harmful quantities of hazardous substances into or upon U.S. waters out to 200 nm (371 km). These instructions include stringent hazardous waste discharge, storage, dumping, and pollution prevention requirements. Navy ships are required to conduct activities at sea in a manner that minimizes or eliminates any adverse impacts on the marine environment from hazardous materials or wastes.

The Navy has an active Pollution Prevention Program that applies to all aspects of its activities. It is Navy policy to conduct its facility management and acquisition programs so as to reduce to the maximum extent possible the quantity of toxic chemicals entering the environment. The Pollution Prevention Program is a comprehensive set of practices that reduce the volumes of wastes to be treated or transferred to the environment. The fundamental tenet of the Navy's Pollution Prevention Program is the reduction of hazardous materials and wastes at their source. This results in less hazardous waste for all waste streams. Pollution prevention practices include:

- Raw material substitution,
- Product reformulation,
- Process redesign or modification,
- Improved operation and maintenance, and
- Aggressive recycling programs.

5.4 WATER RESOURCES

Environmental compliance policies and procedures applicable to operations ashore are identified in Navy instructions that include directives regarding hazardous materials and waste management, pollution prevention, and recycling. Measures about management of hazardous materials and wastes at SCI, as discussed in Section 3.4.3.2.1 *et seq*., provide protections for surface waters and ocean waters. In addition to preventive measures, implementation of the Installation Restoration Program at SCI also provides protection to these water resources from consequences of past practices. With regard to reducing or avoiding water quality degradation from the expenditure of training materials, management practices include activities to remove training debris including unexploded ordnance from land ranges. Certain features of the training materials themselves are designed to reduce pollution, as required by Navy and Department of Defense (DoD) regulations (see Section 3.4.3.1.6).

5.5 ACOUSTIC ENVIRONMENT (AIRBORNE SOUND)

The Navy has developed detailed SOPs regarding sound in the ocean environment, particularly with respect to sonar and explosive sources. These measures are discussed in detail below in Section 5.8 with regard to potential effects of sound on marine mammals and sea turtles.

Military personnel who might be exposed to sound from military activities are required to take precautions, such as the wearing of protective equipment, to reduce or eliminate potential harmful effects of such exposure. With regard to potential exposure of non-military personnel in ocean areas (such as fishermen in the vicinity of SCI) precautions are taken pursuant to SOPs to prevent such exposure. These include advance notice of scheduled operations to the public and the commercial fishing community via the worldwide web, Notices to Mariners (NOTMARs), and Notices to Airmen (NOTAMs). In addition, range safety SOPs ensure that civilians are excluded from, and if necessary removed from areas of military operations, or that military activities do not occur when civilians are present. These procedures have proven effective at minimizing potential military / civilian interactions in the course of active training or other military activities.

5.6 MARINE PLANTS AND INVERTEBRATES

In order to reduce or eliminate potential effects of Navy activities on marine plants and invertebrates, buffer zones have been designated for training events using both explosive and non-explosive ordnance. Lookouts are posted to visually survey for floating kelp, plants, or algal mats. For training activities using explosive ordnance, the intended impact area shall not be within 600 yards (yds) (585 meters [m]) of known or observed live hard-bottom communities, kelp beds, floating plants, or algal mats. For training events using non-explosive ordnance, intended impact area shall not be within 200 yds (183 m) of known or observed live hard-bottom communities, kelp beds, floating plants, or algal mats. For air-to-surface missile exercises, the buffer zone is extended to 1,800 yds (1646 m) around hard bottom communities, kelp forests, floating plants, and algal mats, for both explosive and non-explosive ordnance

5.7 FISH

Mitigation measures for activities involving underwater detonations, implemented for marine mammals and sea turtles, also offer protections to habitats associated with fish communities. No additional mitigation measures are proposed or warranted because no substantial effects on fish or fish habitat were identified.

5.8 SEA TURTLES AND MARINE MAMMALS

As discussed in Section 3.8 and 3.9, the comprehensive suite of protective measures and SOPs implemented by the Navy to reduce impacts to marine mammals also serves to mitigate potential impacts on sea turtles. In particular, personnel and watchstander training, establishment of turtle-free exclusion zones for underwater detonations of explosives, and pre- and post-exercise surveys, all serve to reduce or eliminate potential impacts of Navy activities on sea turtles that may be present in the vicinity.

Effective training in the SOCAL Range Complex dictates that ship, submarine, and aircraft participants utilize their sensors and exercise weapons to their optimum capabilities as required by the mission. This section is a comprehensive list of mitigation measures that would be utilized for training activities analyzed in the SOCAL EIS/OEIS in order to minimize potential for impacts on marine mammals and sea turtles in the SOCAL Range Complex.

This section includes protective and mitigation measures that are followed for all types of exercises; those that are associated with a particular type of training event; and those that apply to a particular geographic region or season. For major exercises, the applicable mitigation measures are incorporated into a naval message which is disseminated to all of the units participating in the exercise or training event and applicable responsible commands. Appropriate measures are also provided to non-Navy participants (other DoD and allied forces) as information in order to ensure their use by these participants.

5.8.1 General Maritime Measures

5.8.1.1 Personnel Training – Watchstanders and Lookouts

The use of shipboard lookouts is a critical component of all Navy protective measures. Navy shipboard lookouts (also referred to as "watchstanders") are highly qualified and experienced observers of the marine environment. Their duties require that they report all objects sighted in the water to the officer of the deck (OOD) (e.g., trash, a periscope, marine mammals, sea turtles) and all disturbances (e.g., surface disturbance, discoloration) that may be indicative of a threat to the vessel and its crew. There are personnel serving as lookouts on station at all times (day and night) when a ship or surfaced submarine is moving through the water.

- All commanding officers (COs), executive officers (XOs), lookouts, OODs, junior OODs (JOODs), maritime patrol aircraft aircrews, and Anti-submarine Warfare (ASW)/Mine Warfare (MIW) helicopter crews will complete the NMFS-approved Marine Species Awareness Training (MSAT) by viewing the U.S. Navy MSAT digital versatile disk (DVD). MSAT may also be viewed on-line at https://mmrc.tecquest.net. All bridge watchstanders/lookouts will complete both parts one and two of the MSAT; part two is optional for other personnel. This training addresses the lookout's role in environmental protection, laws governing the protection of marine species, Navy stewardship commitments and general observation information to aid in avoiding interactions with marine species.
- Navy lookouts will undertake extensive training in order to qualify as a watchstander in accordance with the Lookout Training Handbook (Naval Education and Training Command [NAVEDTRA] 12968-B).
- Lookout training will include on-the-job instruction under the supervision of a qualified, experienced watchstander. Following successful completion of this supervised training period, lookouts will complete the Personal Qualification Standard Program, certifying that they have demonstrated the necessary skills (such as detection and reporting of partially submerged objects). Personnel being trained as lookouts can be counted among those listed below as long as supervisors monitor their progress and performance.
- Lookouts will be trained in the most effective means to ensure quick and effective communication within the command structure in order to facilitate implementation of protective measures if marine species are spotted.

5.8.1.2 Operating Procedures & Collision Avoidance

- Prior to major exercises, a Letter of Instruction, Mitigation Measures Message or Environmental Annex to the Operational Order will be issued to further disseminate the personnel training requirement and general marine species protective measures.
- COs will make use of marine species detection cues and information to limit interaction with marine species to the maximum extent possible consistent with safety of the ship.
- While underway, surface vessels will have at least two lookouts with binoculars; surfaced submarines will have at least one lookout with binoculars. Lookouts already posted for safety of navigation and man-overboard precautions may be used to fill this requirement. As part of their regular duties, lookouts will watch for and report to the OOD the presence of marine mammals and sea turtles.

- On surface vessels equipped with a multi-function active sensor, pedestal mounted “Big Eye” (20x10) binoculars will be properly installed and in good working order to assist in the detection of marine mammals and sea turtles in the vicinity of the vessel.
- Personnel on lookout will employ visual search procedures employing a scanning methodology in accordance with the Lookout Training Handbook (NAVEDTRA 12968-B).
- After sunset and prior to sunrise, lookouts will employ Night Lookouts Techniques in accordance with the Lookout Training Handbook. (NAVEDTRA 12968-B)
- While in transit, naval vessels will be alert at all times, use extreme caution, and proceed at a “safe speed” so that the vessel can take proper and effective action to avoid a collision with any marine animal and can be stopped within a distance appropriate to the prevailing circumstances and conditions.
- When whales have been sighted in the area, Navy vessels will increase vigilance and take reasonable and practicable actions to avoid collisions and activities that might result in close interaction of naval assets and marine mammals. Actions may include changing speed and/or direction and are dictated by environmental and other conditions (e.g., safety, weather).
- Naval vessels will maneuver to keep at least 460 m (1,500 ft) away from any observed whale and avoid approaching whales head-on. This requirement does not apply if a vessel’s safety is threatened, such as when change of course will create an imminent and serious threat to a person, vessel, or aircraft, and to the extent vessels are restricted in their ability to maneuver. Restricted maneuverability includes, but is not limited to, situations when vessels are engaged in dredging, submerged operations, launching and recovering aircraft or landing craft, minesweeping operations, replenishment while underway and towing operations that severely restrict a vessel’s ability to deviate course. Vessels will take reasonable steps to alert other vessels in the vicinity of the whale.
- Where feasible and consistent with mission and safety, vessels will avoid closing to within 200-yd of sea turtles and marine mammals other than whales (whales addressed above).
- Floating weeds and kelp, algal mats, clusters of seabirds, and jellyfish are good indicators of sea turtles and marine mammals. Therefore, increased vigilance in watching for sea turtles and marine mammals will be taken where these are present.
- Navy aircraft participating in exercises at sea will conduct and maintain, when operationally feasible and safe, surveillance for marine species of concern as long as it does not violate safety constraints or interfere with the accomplishment of primary operational duties. Marine mammal detections will be immediately reported to assigned Aircraft Control Unit for further dissemination to ships in the vicinity of the marine species as appropriate where it is reasonable to conclude that the course of the ship will likely result in a closing of the distance to the detected marine mammal.
- All vessels will maintain logs and records documenting training operations should they be required for event reconstruction purposes. Logs and records will be kept for a period of 30 days following completion of a major training exercise.

5.8.2 Measures for Specific Training Events

5.8.2.1 Mid-Frequency Active Sonar Operations

5.8.2.1.1 General Maritime Mitigation Measures: Personnel Training

- All lookouts onboard platforms involved in ASW training events will review the NMFS-approved Marine Species Awareness Training material prior to use of mid-frequency active sonar.
- All COs, XOs, and officers standing watch on the bridge will have reviewed the Marine Species Awareness Training material prior to a training event employing the use of mid-frequency active sonar.
- Navy lookouts will undertake extensive training in order to qualify as a watchstander in accordance with the Lookout Training Handbook (Naval Educational Training [NAVEDTRA], 12968-B).
- Lookout training will include on-the-job instruction under the supervision of a qualified, experienced watchstander. Following successful completion of this supervised training period, lookouts will complete the Personal Qualification Standard program, certifying that they have demonstrated the necessary skills (such as detection and reporting of partially submerged objects). This does not forbid personnel being trained as lookouts from being counted as those listed in previous measures so long as supervisors monitor their progress and performance.
- Lookouts will be trained in the most effective means to ensure quick and effective communication within the command structure in order to facilitate implementation of mitigation measures if marine species are spotted.

5.8.2.1.2 General Maritime Mitigation Measures: Lookout and Watchstander Responsibilities

- On the bridge of surface ships, there will always be at least three people on watch whose duties include observing the water surface around the vessel.
- All surface ships participating in ASW training events will, in addition to the three personnel on watch noted previously, have at all times during the exercise at least two additional personnel on watch as marine mammal lookouts.
- Personnel on lookout and officers on watch on the bridge will have at least one set of binoculars available for each person to aid in the detection of marine mammals.
- On surface vessels equipped with mid-frequency active sonar, pedestal mounted “Big Eye” (20x110) binoculars will be present and in good working order to assist in the detection of marine mammals in the vicinity of the vessel.
- Personnel on lookout will employ visual search procedures employing a scanning methodology in accordance with the Lookout Training Handbook (NAVEDTRA 12968-B).
- After sunset and prior to sunrise, lookouts will employ Night Lookouts Techniques in accordance with the Lookout Training Handbook.
- Personnel on lookout will be responsible for reporting all objects or anomalies sighted in the water (regardless of the distance from the vessel) to the Officer of the Deck, since any object or disturbance (e.g., trash, periscope, surface disturbance, discoloration) in the water may be indicative of a threat to the vessel and its crew or indicative of a marine species that may need to be avoided as warranted.

5.8.2.1.3 Operating Procedures

- A Letter of Instruction, Mitigation Measures Message, or Environmental Annex to the Operational Order will be issued prior to the exercise to further disseminate the personnel training requirement and general marine mammal mitigation measures.
- COs will make use of marine species detection cues and information to limit interaction with marine species to the maximum extent possible consistent with safety of the ship.
- All personnel engaged in passive acoustic sonar operation (including aircraft, surface ships, or submarines) will monitor for marine mammal vocalizations and report the detection of any marine mammal to the appropriate watch station for dissemination and appropriate action.
- During mid-frequency active sonar operations, personnel will utilize all available sensor and optical systems (such as night vision goggles) to aid in the detection of marine mammals.
- Navy aircraft participating in exercises at sea will conduct and maintain, when operationally feasible and safe, surveillance for marine species of concern as long as it does not violate safety constraints or interfere with the accomplishment of primary operational duties.
- Aircraft with deployed sonobuoys will use only the passive capability of sonobuoys when marine mammals are detected within 200 yds (183 m) of the sonobuoy.
- Marine mammal detections will be immediately reported to assigned Aircraft Control Unit for further dissemination to ships in the vicinity of the marine species as appropriate where it is reasonable to conclude that the course of the ship will likely result in a closing of the distance to the detected marine mammal.
- Safety Zones—When marine mammals are detected by any means (aircraft, shipboard lookout, or acoustically) within 1,000 yds (914 m) of the sonar dome (the bow), the ship or submarine will limit active transmission levels to at least 6 decibels (dB) below normal operating levels. (A 6 dB reduction equates to a 75 percent power reduction. The reason is that decibel levels are on a logarithmic scale, not a linear scale. Thus, a 6 dB reduction results in a power level only 25 percent of the original power.)
    - Ships and submarines will continue to limit maximum transmission levels by this 6-dB factor until the animal has been seen to leave the area, has not been detected for 30 minutes, or the vessel has transited more than 2,000 yds (1829 m) beyond the location of the last detection.
    - Should a marine mammal be detected within or closing to inside 500 yds (457 m) of the sonar dome, active sonar transmissions will be limited to at least 10 dB below the equipment's normal operating level. (A 10 dB reduction equates to a 90 percent power reduction from normal operating levels.) Ships and submarines will continue to limit maximum ping levels by this 10-dB factor until the animal has been seen to leave the area, has not been detected for 30 minutes, or the vessel has transited more than 2,000 yds (457 m) beyond the location of the last detection.
    - Should the marine mammal be detected within or closing to inside 200 yds (183 m) of the sonar dome, active sonar transmissions will cease. Sonar will not resume until the animal has been seen to leave the area, has not been detected for

30 minutes, or the vessel has transited more than 2,000 yds (457 m) beyond the location of the last detection.

- o Special conditions applicable for dolphins and porpoises only: If, after conducting an initial maneuver to avoid close quarters with dolphins or porpoises, the OOD concludes that dolphins or porpoises are deliberately closing to ride the vessel's bow wave, no further mitigation actions are necessary while the dolphins or porpoises continue to exhibit bow wave riding behavior.
- o If the need for power-down should arise as detailed in "Safety Zones" above, the Navy shall follow the requirements as though they were operating at 235 dB—the normal operating level (i.e., the first power-down will be to 229 dB, regardless of at what level above 235 sonar was being operated).

- Prior to start up or restart of active sonar, operators will check that the Safety Zone radius around the sound source is clear of marine mammals.
- Sonar levels (generally)—Navy will operate sonar at the lowest practicable level, not to exceed 235 dB, except as required to meet tactical training objectives.
- Helicopters shall observe/survey the vicinity of an ASW training event for 10 minutes before the first deployment of active (dipping) sonar in the water.
- Helicopters shall not dip their sonar within 200 yds (183 m) of a marine mammal and shall cease pinging if a marine mammal closes within 200 yds (183 m) after pinging has begun.
- Submarine sonar operators will review detection indicators of close-aboard marine mammals prior to the commencement of ASW training events involving active mid-frequency sonar.
- Increased vigilance during ASW training events with tactical active sonar when critical conditions are present.

  Based on lessons learned from strandings in Bahamas 2000, Madeiras 2000, Canaries 2002 and Spain 2006, beaked whales are of particular concern since they have been associated with mid-frequency active sonar operations. The Navy should avoid planning Major ASW Training Exercises with mid-frequency active sonar in areas where they will encounter conditions which, in their aggregate, may contribute to a marine mammal stranding event.

  The conditions to be considered during exercise planning include:

  - o Areas of at least 1,000-meter depth near a shoreline where there is a rapid change in bathymetry on the order of 1,000-6,000 yds (914-5486 m) occurring across a relatively short horizontal distance (e.g., 5 nautical miles [nm]).
  - o Cases for which multiple ships or submarines (≥ 3) operating mid-frequency active sonar in the same area over extended periods of time (≥ 6 hours) in close proximity (≤ 10 nm apart).
  - o An area surrounded by land masses, separated by less than 35 nm and at least 10 nm in length, or an embayment, wherein operations involving multiple ships/subs (≥ 3) employing mid-frequency active sonar near land may produce sound directed toward the channel or embayment that may cut off the lines of egress for marine mammals.

- Though not as dominant a condition as bathymetric features, the historical presence of a significant surface duct (i.e., a mixed layer of constant water temperature extending from the sea surface to 100 or more feet [ft]).

If the Major Range Event is to occur in an area where the above conditions exist in their aggregate, these conditions must be fully analyzed in environmental planning documentation. The Navy will increase vigilance by undertaking the following additional mitigation measure:

- A dedicated aircraft (Navy asset or contracted aircraft) will undertake reconnaissance of the embayment or channel ahead of the exercise participants to detect marine mammals that may be in the area exposed to active sonar. Where practical, advance survey should occur within about 2 hours prior to mid-frequency active sonar use and periodic surveillance should continue for the duration of the exercise. Any unusual conditions (e.g., presence of sensitive species, groups of species milling out of habitat, and any stranded animals) shall be reported to the Office in Tactical Command, who should give consideration to delaying, suspending, or altering the exercise.
- All safety zone power down requirements described above will apply.
- The post-exercise report must include specific reference to any event conducted in areas where the above conditions exist, with exact location and time/duration of the event, and noting results of surveys conducted.

5.8.2.2 Surface-to-Surface Gunnery (5-inch, 76 mm, 20 mm, 25 mm and 30 mm explosive rounds)

- Lookouts will visually survey for floating weeds and kelp, and algal mats which may be inhabited by immature sea turtles in the target area. Intended impact shall not be within 600 yds (585 m) of known or observed floating weeds and kelp, and algal mats.
- For exercises using targets towed by a vessel or aircraft, target-towing vessels/aircraft shall maintain a trained lookout for marine mammals and sea turtles. If a marine mammal or sea turtle is sighted in the vicinity, the tow aircraft/vessel will immediately notify the firing vessel, which will suspend the exercise until the area is clear.
- A 600 yard radius buffer zone will be established around the intended target.
- From the intended firing position, trained lookouts will survey the buffer zone for marine mammals and sea turtles prior to commencement and during the exercise as long as practicable. Due to the distance between the firing position and the buffer zone, lookouts are only expected to visually detect breaching whales, whale blows, and large pods of dolphins and porpoises.
- The exercise will be conducted only when the buffer zone is visible and marine mammals and sea turtles are not detected within it.

5.8.2.3 Surface-to-Surface Gunnery (non-explosive rounds)

- Lookouts will visually survey for floating weeds and kelp, and algal mats which may be inhabited by immature sea turtles in the target area. Intended impact will not be within 200 yds (183 m) of known or observed floating weeds and kelp, and algal mats.
- A 200 yd (183 m) radius buffer zone will be established around the intended target.
- From the intended firing position, trained lookouts will survey the buffer zone for marine mammals and sea turtles prior to commencement and during the exercise as long as practicable. Due to the distance between the firing position and the buffer zone, lookouts

are only expected to visually detect breaching whales, whale blows, and large pods of dolphins and porpoises.

- If applicable, target towing vessels will maintain a lookout. If a marine mammal or sea turtle is sighted in the vicinity of the exercise, the tow vessel will immediately notify the firing vessel in order to secure gunnery firing until the area is clear.
- The exercise will be conducted only when the buffer zone is visible and marine mammals and sea turtles are not detected within the target area and the buffer zone.

5.8.2.4 Surface-to-Air Gunnery (explosive and non-explosive rounds)

- Vessels will orient the geometry of gunnery exercises in order to prevent debris from falling in the area of sighted marine mammals, sea turtles, algal mats, and floating kelp.
- Vessels will expedite the recovery of any parachute deploying aerial targets to reduce the potential for entanglement of marine mammals and sea turtles.
- Target towing aircraft shall maintain a lookout. If a marine mammal or sea turtle is sighted in the vicinity of the exercise, the tow aircraft will immediately notify the firing vessel in order to secure gunnery firing until the area is clear.

5.8.2.5 Air-to-Surface Gunnery (explosive and non-explosive rounds)

- If surface vessels are involved, lookouts will visually survey for floating kelp, which may be inhabited by immature sea turtles, in the target area. Impact should not occur within 200 yds (183 m) of known or observed floating weeds and kelp or algal mats.
- A 200 yd (183 m) radius buffer zone will be established around the intended target.
- If surface vessels are involved, lookout(s) will visually survey the buffer zone for marine mammals and sea turtles prior to and during the exercise.
- Aerial surveillance of the buffer zone for marine mammals and sea turtles will be conducted prior to commencement of the exercise. Aerial surveillance altitude of 500 feet to 1,500 feet (ft) (152 - 456 m) is optimum. Aircraft crew/pilot will maintain visual watch during exercises. Release of ordnance through cloud cover is prohibited: aircraft must be able to actually see ordnance impact areas.
- The exercise will be conducted only if marine mammals and sea turtles are not visible within the buffer zone.

5.8.2.6 Small Arms Training - (grenades, explosive and non-explosive rounds)

- Lookouts will visually survey for floating weeds or kelp, algal mats, marine mammals, and sea turtles. Weapons will not be fired in the direction of known or observed floating weeds or kelp, algal mats, marine mammals, sea turtles.

5.8.2.7 Air-to-Surface At-Sea Bombing Exercises (explosive bombs and cluster munitions, rockets)

- If surface vessels are involved, trained lookouts will survey for floating kelp, which may be inhabited by immature sea turtles. Ordnance shall not be targeted to impact within 1,000 yds (914 m) of known or observed floating kelp, sea turtles, or marine mammals.
- A buffer zone of 1,000 yd (914 m) radius will be established around the intended target.
- Aircraft will visually survey the target and buffer zone for marine mammals and sea turtles prior to and during the exercise. The survey of the impact area will be made by flying at 1,500 feet or lower, if safe to do so, and at the slowest safe speed. Release of

ordnance through cloud cover is prohibited: aircraft must be able to actually see ordnance impact areas. Survey aircraft should employ most effective search tactics and capabilities.

- The exercises will be conducted only if marine mammals and sea turtles are not visible within the buffer zone.

5.8.2.8 Air-to-Surface At-Sea Bombing Exercises (non-explosive bombs and cluster munitions, rockets)

- If surface vessels are involved, trained lookouts will survey for floating kelp, which may be inhabited by immature sea turtles, and for sea turtles and marine mammals. Ordnance shall not be targeted to impact within 1,000 yds (914 m) of known or observed floating kelp, sea turtles, or marine mammals.
- A 1,000 yd (914 m) radius buffer zone will be established around the intended target.
- Aircraft will visually survey the target and buffer zone for marine mammals and sea turtles prior to and during the exercise. The survey of the impact area will be made by flying at 1,500 ft (152 m) or lower, if safe to do so, and at the slowest safe speed. Release of ordnance through cloud cover is prohibited: aircraft must be able to actually see ordnance impact areas. Survey aircraft should employ most effective search tactics and capabilities.
- The exercise will be conducted only if marine mammals and sea turtles are not visible within the buffer zone.

5.8.2.9 Air-to-Surface Missile Exercises (explosive and non-explosive)

- Ordnance shall not be targeted to impact within 1,800 yds (1646 m) of known or observed floating kelp, which may be inhabited by immature sea turtles, or coral reefs.
- Aircraft will visually survey the target area for marine mammals and sea turtles. Visual inspection of the target area will be made by flying at 1,500 (457 m) feet or lower, if safe to do so, and at slowest safe speed. Firing or range clearance aircraft must be able to actually see ordnance impact areas. Explosive ordnance shall not be targeted to impact within 1,800 yds (1646 m) of sighted marine mammals and sea turtles.

5.8.2.10 Underwater Detonations (up to 20-lb charges)

To ensure protection of marine mammals and sea turtles during underwater detonation training, the operating area must be determined to be clear of marine mammals and sea turtles prior to detonation. Implementation of the following mitigation measures continue to ensure that marine mammals would not be exposed to temporary threshold shift (TTS), permanent threshold shift (PTS), or injury from physical contact with training mine shapes during Major Exercises.

5.8.2.10.1 Exclusion Zones

All Mine Warfare and Mine Countermeasures Operations involving the use of explosive charges must include exclusion zones for marine mammals and sea turtles to prevent physical and/or acoustic effects to those species. These exclusion zones shall extend in a 700-yard arc radius around the detonation site.

5.8.2.10.2 Pre-Exercise Surveys

For Demolition and Ship Mine Countermeasures Operations, pre-exercise survey shall be conducted within 30 minutes prior to the commencement of the scheduled explosive event. The survey may be conducted from the surface, by divers, and/or from the air, and personnel shall be alert to the presence of any marine mammal or sea turtle. Should such an animal be present within the survey area, the exercise shall be paused until the animal voluntarily leaves the area. The Navy will suspend detonation exercises and ensure the area is clear for a full 30 minutes prior to detonation. Personnel will record any protected species marine mammal and sea turtle observations during the exercise as well as measures taken if species are detected within the exclusion zone.

5.8.2.10.3 Post-Exercise Surveys and Reporting

Surveys within the same radius shall also be conducted within 30 minutes after the completion of the explosive event.

If there is evidence that a marine mammal or sea turtle may have been stranded, injured or killed by the action, Navy training activities will be immediately suspended and the situation immediately reported by the participating unit to the Officer in Charge of the Exercise (OCE), who will follow Navy procedures for reporting the incident to to Commander, Pacific Fleet, Commander, Navy Region Southwest, Environmental Director, and the chain-of-command.

5.8.2.11 Mining Operations

Mining Operations involve aerial drops of inert training shapes on target points. Aircrews are scored for their ability to accurately hit the target points. This operation does not involve live ordnance. The probability of a marine species being in the exact spot in the ocean where an inert object is dropped is remote. However, as a conservative measure, initial target points will be briefly surveyed prior to inert ordnance release from an aircraft to ensure the intended drop area is clear of marine mammals and sea turtles. To the extent feasible, the Navy shall retrieve inert mine shapes dropped during Mining Operations.

5.8.2.12 Sink Exercise (SINKEX)

The selection of sites suitable for SINKEX involves a balance of operational suitability, requirements established under the Marine Protection, Research and Sanctuaries Act (MPRSA) permit granted to the Navy (40 Code of Federal Regulations § 229.2), and the identification of areas with a low likelihood of encountering Endangered Species Act (ESA) listed species. To meet operational suitability criteria, locations must be within a reasonable distance of the target vessels' originating location. The locations should also be close to active military bases to allow participating assets access to shore facilities. For safety purposes, these locations should also be in areas that are not generally used by non-military air or watercraft. The MPRSA permit requires vessels to be sunk in waters which are at least 1,000 fathoms (3,000 yds / 2742 m)) deep and at least 50 nm from land.

In general, most listed species prefer areas with strong bathymetric gradients and oceanographic fronts for significant biological activity such as feeding and reproduction. Typical locations include the continental shelf and shelf-edge.

5.8.2.12.1 SINKEX Mitigation Plan

The Navy has developed range clearance procedures to maximize the probability of sighting any ships or protected species in the vicinity of an exercise, which are as follows:

- All weapons firing would be conducted during the period 1 hour after official sunrise to 30 minutes before official sunset.
- Extensive range clearance operations would be conducted in the hours prior to commencement of the exercise, ensuring that no shipping is located within the hazard range of the longest-range weapon being fired for that event.
- Prior to conducting the exercise, remotely sensed sea surface temperature maps would be reviewed. SINKEX would not be conducted within areas where strong temperature

discontinuities are present, thereby indicating the existence of oceanographic fronts. These areas would be avoided because concentrations of some listed species, or their prey, are known to be associated with these oceanographic features.

- An exclusion zone with a radius of 1.0 nm would be established around each target. This exclusion zone is based on calculations using a 990-pound (lb) H6 net explosive weight high explosive source detonated 5 ft below the surface of the water, which yields a distance of 0.85 nm (cold season) and 0.89 nm (warm season) beyond which the received level is below the 182 decibels (dB) re: 1 micropascal squared-seconds (µPa2-s) threshold established for the WINSTON S. CHURCHILL (DDG 81) shock trials (DoN 2001). An additional buffer of 0.5 nm would be added to account for errors, target drift, and animal movements. Additionally, a safety zone, which extends from the exclusion zone at 1.0 nm out an additional 0.5 nm, would be surveyed. Together, the zones extend out 2 nm from the target.
- A series of surveillance over-flights would be conducted within the exclusion and the safety zones, prior to and during the exercise, when feasible. Survey protocol would be as follows:
  - Overflights within the exclusion zone would be conducted in a manner that optimizes the surface area of the water observed. This may be accomplished through the use of the Navy's Search and Rescue Tactical Aid, which provides the best search altitude, ground speed, and track spacing for the discovery of small, possibly dark objects in the water based on the environmental conditions of the day. These environmental conditions include the angle of sun inclination, amount of daylight, cloud cover, visibility, and sea state.
  - All visual surveillance activities would be conducted by Navy personnel trained in visual surveillance. At least one member of the mitigation team would have completed the Navy's marine mammal training program for lookouts.
  - In addition to the overflights, the exclusion zone would be monitored by passive acoustic means, when assets are available. This passive acoustic monitoring would be maintained throughout the exercise. Potential assets include sonobuoys, which can be utilized to detect any vocalizing marine mammals (particularly sperm whales) in the vicinity of the exercise. The sonobuoys would be re-seeded as necessary throughout the exercise. Additionally, passive sonar onboard submarines may be utilized to detect any vocalizing marine mammals in the area. The OCE would be informed of any aural detection of marine mammals and would include this information in the determination of when it is safe to commence the exercise.
  - On each day of the exercise, aerial surveillance of the exclusion and safety zones would commence 2 hours prior to the first firing.
  - The results of all visual, aerial, and acoustic searches would be reported immediately to the OCE. No weapons launches or firing would commence until the OCE declares the safety and exclusion zones free of marine mammals and threatened and endangered species.
  - If a protected species observed within the exclusion zone is diving, firing would be delayed until the animal is re-sighted outside the exclusion zone, or 30 minutes have elapsed. After 30 minutes, if the animal has not been re-sighted it would be assumed to have left the exclusion zone. This is based on a typical dive

time of 30 minutes for traveling listed species of concern. The OCE would determine if the listed species is in danger of being adversely affected by commencement of the exercise.

  - During breaks in the exercise of 30 minutes or more, the exclusion zone would again be surveyed for any protected species. If protected species are sighted within the exclusion zone, the OCE would be notified, and the procedure described above would be followed.
  - Upon sinking of the vessel, a final surveillance of the exclusion zone would be monitored for 2 hours, or until sunset, to verify that no listed species were harmed.

- Aerial surveillance would be conducted using helicopters or other aircraft based on necessity and availability. The Navy has several types of aircraft capable of performing this task; however, not all types are available for every exercise. For each exercise, the available asset best suited for identifying objects on and near the surface of the ocean would be used. These aircraft would be capable of flying at the slow safe speeds necessary to enable viewing of marine vertebrates with unobstructed, or minimally obstructed, downward and outward visibility. The exclusion and safety zone surveys may be cancelled in the event that a mechanical problem, emergency search and rescue, or other similar and unexpected event preempts the use of one of the aircraft onsite for the exercise.
- Every attempt would be made to conduct the exercise in sea states that are ideal for marine mammal sighting, Beaufort Sea State 3 or less. In the event of a 4 or above, survey efforts would be increased within the zones. This would be accomplished through the use of an additional aircraft, if available, and conducting tight search patterns.
- The exercise would not be conducted unless the exclusion zone could be adequately monitored visually.
- In the unlikely event that any listed species are observed to be harmed in the area, a detailed description of the animal would be taken, the location noted, and if possible, photos taken. This information would be provided to NMFS via the Navy's regional environmental coordinator for purposes of identification.
- An after action report detailing the exercise's time line, the time the surveys commenced and terminated, amount, and types of all ordnance expended, and the results of survey efforts for each event would be submitted to NMFS.

5.8.2.13 Mitigation Measures Related to Explosive Source Sonobuoys (AN/SSQ-110A)

- Crews will conduct visual reconnaissance of the drop area prior to laying their intended sonobuoy pattern. This search should be conducted below 457 m (500 yd) at a slow speed, if operationally feasible and weather conditions permit. In dual aircraft operations, crews are allowed to conduct coordinated area clearances.
- Crews shall conduct a minimum of 30 minutes of visual and aural monitoring of the search area prior to commanding the first post detonation. This 30-minute observation period may include pattern deployment time.
- For any part of the briefed pattern where a post (source/receiver sonobuoy pair) will be deployed within 914 m (1,000 yd) of observed marine mammal activity, deploy the receiver ONLY and monitor while conducting a visual search. When marine mammals

are no longer detected within 914 m (1,000 yd) of the intended post position, co-locate the explosive source sonobuoy (AN/SSQ-110A) (source) with the receiver.

- When able, crews will conduct continuous visual and aural monitoring of marine mammal activity. This is to include monitoring of own-aircraft sensors from first sensor placement to checking off station and out of RF range of these sensors.
- Aural Detection:
  - If the presence of marine mammals is detected aurally, then that should cue the aircrew to increase the diligence of their visual surveillance. Subsequently, if no marine mammals are visually detected, then the crew may continue multi-static active search.
- Visual Detection:
  - If marine mammals are visually detected within 914 m (1,000 yd) of the explosive source sonobuoy (AN/SSQ-110A) intended for use, then that payload shall not be detonated. Aircrews may utilize this post once the marine mammals have not been re-sighted for 10 minutes, or are observed to have moved outside the 914 m (1,000 yd) safety buffer.
  - Aircrews may shift their multi-static active search to another post, where marine mammals are outside the 914 m (1,000 yd) safety buffer.
- Aircrews shall make every attempt to manually detonate the unexploded charges at each post in the pattern prior to departing the operations area by using the “Payload 1 Release” command followed by the “Payload 2 Release” command. Aircrews shall refrain from using the “Scuttle” command when two payloads remain at a given post. Aircrews will ensure that a 914 m (1,000 yd) safety buffer, visually clear of marine mammals, is maintained around each post as is done during active search operations.
- Aircrews shall only leave posts with unexploded charges in the event of a sonobuoy malfunction, an aircraft system malfunction, or when an aircraft must immediately depart the area due to issues such as fuel constraints, inclement weather, and in-flight emergencies. In these cases, the sonobuoy will self-scuttle using the secondary or tertiary method.
- Ensure all payloads are accounted for. Explosive source sonobuoys (AN/SSQ-110A) that can not be scuttled shall be reported as unexploded ordnance via voice communications while airborne, then upon landing via naval message.
- Mammal monitoring shall continue until out of own-aircraft sensor range.

5.8.3 Conservation Measures

5.8.3.1 SOCAL Marine Species Monitoring Plan

The Navy is developing developed a Marine Species Monitoring Plan (MSMP) that provides recommendations for site-specific monitoring for MMPA and ESA listed species (primarily marine mammals) within the SOCAL Range Complex, including during training exercises. The primary goals of monitoring are to evaluate trends in marine species distribution and abundance in order to assess potential population effects from Navy training activities and determine the effectiveness of the Navy’s mitigation measures. The information gained from the monitoring will also allow the Navy to evaluate the models used to predict effects to marine mammals.

By using a combination of monitoring techniques or tools appropriate for the species of concern, type of Navy activities conducted, sea state conditions, and the size of the Range Complex, the detection, localization, and observation of marine mammals and sea turtles can be maximized. The following available monitoring techniques and tools are described in this monitoring plan for monitoring for range events (several days or weeks) and monitoring of population effects such as abundance and distribution (months or years):

- Visual Observations – Vessel-, Aerial- and Shore-based Surveys (for marine mammals and sea turtles) will provide data on population trends (abundance, distribution, and presence) and response of marine species to Navy training activities. Navy lookouts will also record observations of detected marine mammals from Navy ships during appropriate training and test events.

- Acoustic Monitoring – Passive Acoustic Monitoring possibly using towed hydrophone arrays, Autonomous Acoustic Recording buoys and U.S. Navy Instrument Acoustic Range (for marine mammals only) may provide presence/absence data on cryptic species that are difficult to detect visually (beaked whales and minke whales) that could address long term population trends and response to Navy training exercises.

- Tagging – Tagging marine mammals with instruments to measure their dive depth and duration, determine location and record the received level of natural and anthropogenic sounds.

- Additional Methods – Oceanographic Observations and Other Environmental Factors will be obtained during ship-based surveys and satellite remote sensing data. Oceanographic data is important factor that influences the abundance and distribution of prey items and therefore the distribution and movements of marine mammals.

The monitoring plan will be reviewed annually by Navy biologists to determine the effectiveness of the monitoring elements and to consider any new monitoring tools or techniques that may have become available.

5.8.3.2 Research

The Navy provides a significant amount of funding and support to marine research. The agency provides nearly 10 million dollars annually to universities, research institutions, federal laboratories, private companies, and independent researchers around the world to study marine mammals. The U.S. Navy sponsors seventy percent of all U.S. research concerning the effects of human-generated sound on marine mammals and 50 percent of such research conducted worldwide. Major topics of Navy-supported research include the following:

- Better understanding of marine species distribution and important habitat areas,
- Developing methods to detect and monitor marine species before and during training,
- Understanding the effects of sound on marine mammals, sea turtles, fish, and birds, and
- Developing tools to model and estimate potential effects of sound.

The Navy's Office of Naval Research currently coordinates six programs that examine the marine environment and are devoted solely to studying the effects of noise and/or the implementation of technology tools that will assist the Navy in studying and tracking marine mammals. The six programs are as follows:

- Environmental Consequences of Underwater Sound,
- Non-Auditory Biological Effects of Sound on Marine Mammals,

- Effects of Sound on the Marine Environment,
- Sensors and Models for Marine Environmental Monitoring,
- Effects of Sound on Hearing of Marine Animals, and
- Passive Acoustic Detection, Classification, and Tracking of Marine Mammals.

The Navy has also developed the technical reports referenced within this document, which include the Marine Resource Assessments and the Navy OPAREA Density Estimates (NODE) reports. Furthermore, research cruises by the National Marine Fisheries Service (NMFS) and by academic institutions have received funding from the U.S. Navy.

The Navy has sponsored several workshops to evaluate the current state of knowledge and potential for future acoustic monitoring of marine mammals. The workshops brought together acoustic experts and marine biologists from the Navy and other research organizations to present data and information on current acoustic monitoring research efforts and to evaluate the potential for incorporating similar technology and methods on instrumented ranges. However, acoustic detection, identification, localization, and tracking of individual animals still requires a significant amount of research effort to be considered a reliable method for marine mammal monitoring. The Navy supports research efforts on acoustic monitoring and will continue to investigate the feasibility of passive acoustics as a potential mitigation and monitoring tool.

Overall, the Navy will continue to fund ongoing marine mammal research, and is planning to coordinate long term monitoring/studies of marine mammals on various established ranges and operating areas. The Navy will continue to research and contribute to university/external research to improve the state of the science regarding marine species biology and acoustic effects. These efforts include mitigation and monitoring programs; data sharing with NMFS and via the literature for research and development efforts; and future research as described previously.

5.8.4 Coordination and Reporting

The Navy will coordinate with the local NMFS Stranding Coordinator for any unusual marine mammal behavior and any stranding, beached live/dead or floating marine mammals that may occur coincident with Navy training activities.

5.8.5 Alternative Mitigation Measures Considered but Eliminated

As described in Chapter 3, Section 3.9 and Appendix F, the vast majority of estimated sound exposures of marine mammals during proposed active sonar activities would not cause injury. Potential acoustic effects on marine mammals would be further reduced by the mitigation measures described above. Therefore, the Navy concludes the proposed action and mitigation measures would achieve the least practical adverse impact on species or stocks of marine mammals.

A determination of “least practicable adverse impacts” includes consideration of personnel safety, practicality of implementation, and impact on the effectiveness of the military readiness activity in consultation with the DoD. Therefore, the following additional mitigation measures were analyzed and eliminated from further consideration:

- Reduction of training. The requirements for training have been developed through many years of iteration to ensure sailors achieve levels of readiness to ensure they are prepared to properly respond to the many contingencies that may occur during an actual mission. These training requirements are designed provide the experience needed to ensure sailors are properly prepared for operational success. There is no extra training built in to the plan, as this would not be an efficient use of the resources needed to support the training (e.g. fuel, time). Therefore, any reduction of training would not allow sailors to achieve satisfactory levels of readiness needed to accomplish their mission.

- Use of ramp-up to attempt to clear the range prior to the conduct of exercises. Ramp-up procedures, (slowly increasing the sound in the water to necessary levels), are not a viable alternative for training exercises because the ramp-up would alert opponents to the participants' presence. This affects the realism of training in that the target submarine would be able to detect the searching unit prior to themselves being detected, enabling them to take evasive measures. This would insert a significant anomaly to the training, affecting its realism and effectiveness. Though ramp-up procedures have been used in testing, the procedure is not effective in training sailors to react to tactical situations, as it provides an unrealistic advantage by alerting the target. Using these procedures would not allow the Navy to conduct realistic training, thus adversely impacting the effectiveness of the military readiness activity.

- Visual monitoring using third-party observers from air or surface platforms, in addition to the existing Navy-trained lookouts.
    - The use of third-party observers would compromise security due to the requirement to provide advance notification of specific times/locations of Navy platforms.
    - Reliance on the availability of third-party personnel would also impact training flexibility, thus adversely affecting training effectiveness.
    - The presence of other aircraft in the vicinity of naval exercises would raise safety concerns for both the commercial observers and naval aircraft.
    - Use of Navy observers is the most effective means to ensure quick and effective implementation of mitigation measures if marine species are spotted. A critical skill set of effective Navy training is communication. Navy lookouts are trained to act swiftly and decisively to ensure that appropriate actions are taken.
    - Use of third-party observers is not necessary because Navy personnel are extensively trained in spotting items on or near the water surface. Navy spotters receive more hours of training, and use their spotting skills more frequently, than many third-party trained personnel.
    - Crew members participating in training activities involving aerial assets have been specifically trained to detect objects in the water. The crew's ability to sight from both surface and aerial platforms provides excellent survey capabilities using the Navy's existing exercise assets.
    - Security clearance issues would have to be overcome to allow non-Navy observers onboard exercise participants.
    - Some training events will span one or more 24-hour periods, with operations underway continuously in that timeframe. It is not feasible to maintain non-Navy surveillance of these operations, given the number of non-Navy observers that would be required onboard.
    - Surface ships having active mid-frequency sonar have limited berthing capacity. As exercise planning includes careful consideration of this limited capacity in the placement of exercise controllers, data collection personnel, and Afloat Training Group personnel on ships involved in the exercise. Inclusion of non-Navy observers onboard these ships would require that in some cases there would be

no additional berthing space for essential Navy personnel required to fully evaluate and efficiently use the training opportunity to accomplish the exercise objectives.

- Contiguous ASW events may cover many hundreds of square miles. The number of civilian ships and/or aircraft required to monitor the area of these events would be considerable. It is, thus, not feasible to survey or monitor the large exercise areas in the time required ensuring these areas are devoid of marine mammals. In addition, marine mammals may move into or out of an area, if surveyed before an event, or an animal could move into an area after an exercise took place. Given that there are no adequate controls to account for these or other possibilities and there are no identified research objectives, there is no utility to performing either a before or an after the event survey of an exercise area.
- Survey during an event raises safety issues with multiple, slow civilian aircraft operating in the same airspace as military aircraft engaged in combat training activities. In addition, most of the training events take place far from land, limiting both the time available for civilian aircraft to be in the exercise area and presenting a concern should aircraft mechanical problems arise.
- Scheduling civilian vessels or aircraft to coincide with training events would impact training effectiveness, since exercise event timetables cannot be precisely fixed and are instead based on the free-flow development of tactical situations. Waiting for civilian aircraft or vessels to complete surveys, refuel, or be on station would slow the unceasing progress of the exercise and impact the effectiveness of the military readiness activity.
- Multiple simultaneous training events continue for extended periods. There are not enough qualified third-party personnel to accomplish the monitoring task.

- Reducing or securing power during the following conditions.
    - Low-visibility / night training: ASW can require a significant amount of time to develop the “tactical picture,” or an understanding of the battle space such as area searched or unsearched, identifying false contacts, understanding the water conditions, etc. Reducing or securing power in low-visibility conditions would affect a commander’s ability to develop this tactical picture and would not provide realistic training.
    - Strong surface duct: The complexity of ASW requires the most realistic training possible for the effectiveness and safety of the sailors. Reducing power in strong surface duct conditions would not provide this training realism because the unit would be operating differently than it would in a combat scenario, reducing training effectiveness and the crew’s ability. Additionally, water conditions may change rapidly, resulting in continually changing mitigation requirements, resulting in a focus on mitigation versus training.

- Vessel speed: Establish and implement a set vessel speed.
  - Navy personnel are required to use caution and operate at a slow, safe speed consistent with mission and safety. Ships and submarines need to be able to react to changing tactical situations in training as they would in actual combat. Placing arbitrary speed restrictions would not allow them to properly react to these situations, resulting in decreased training effectiveness and reduction the crew proficiency.
- Increasing power down and shut down zones:
  - The current power down zones of 457 and 914 m (500 and 1,000 yd), as well as the 183 m (200 yd) shut down zone were developed to minimize exposing marine mammals to sound levels that could cause temporary threshold shift (TTS) or permanent threshold shift (PTS), levels that are supported by the scientific community. Implementation of the safety zones discussed above will prevent exposure to sound levels greater than 195 dB re 1μPa for animals sighted. The safety range the Navy has developed is also within a range sailors can realistically maintain situational awareness and achieve visually during most conditions at sea.
  - Although the three action alternatives were developed using marine mammal density data and areas believed to provide habitat features conducive to marine mammals, not all such areas could be avoided. ASW requires large areas of ocean space to provide realistic and meaningful training to the sailors. These areas were considered to the maximum extent practicable while ensuring Navy's ability to properly train its forces in accordance with federal law. Avoiding any area that has the potential for marine mammal populations is impractical and would impact the effectiveness of the military readiness activity.
- Using active sonar with output levels as low as possible consistent with mission requirements and use of active sonar only when necessary.
  - Operators of sonar equipment are always cognizant of the environmental variables affecting sound propagation. In this regard, the sonar equipment power levels are always set consistent with mission requirements.

    Active sonar is only used when required by the mission since it has the potential to alert opposing forces to the sonar platform's presence. Passive sonar and all other sensors are used in concert with active sonar to the maximum extent practicable when available and when required by the mission.

5.9 SEA BIRDS

Avoidance of seabirds and their nesting and roosting habitats provides the greatest degree of protective measure from potential impacts within the SOCAl Range Complex. Currently, the majority of aircraft operations that might affect seabirds are concentrated at the Naval Auxilary Landing Field (NALF) on SCI, and the potential for bird aircraft strikes exists. Pursuant to Navy instruction, measures to evaluate and reduce of eliminate this hazard to aircraft, aircrews, and birds are implemented. Additionally, guidance involving land or water detonations contains instructions to personnel to observe the surrounding area within 600 yds (585 m) for 30 minutes prior to detonation. If birds (or marine mammals or sea turtles) are seen, the operation must be relocated to an unoccupied area or postponed until animals leave the area. Monitoring of seabird populations and colonies by conservation groups and researchers is conducted intermittently within coastal areas and offshore islands with limited support from various military commands.

5.10 TERRESTRIAL BIOLOGICAL RESOURCES

As noted in section 3.11.1.3, the Navy implements measures to avoid, minimize, or compensate for its effects on biological resources including listed species on SCI. Key management and monitoring activities include completion and implementation of the SCI Wildland Fire Management Plan; continued monitoring and management activities for all endangered species but with particular attention to San Clemente loggerhead shrike, San Clemente sage sparrow, island fox, and six federally-listed plant species; invasive species monitoring and control efforts; continued operation of the on-island nursery and restoration efforts being conducted by nursery staff; vegetation condition and trend assessment; and continued implementation of the SCI Integrated Natural Resources Management Plan (INRMP). The Navy proposes to continue these measures. Further, as noted in section 3.11.4, the Navy proposes to implement additional measures to mitigate the environmental effects of its activities. The following is a comprehensive list of current and proposed mitigation measures intended to reduce effects of military activities on biological resources of SCI:

5.10.1 General Measures

- **G-M-1.** Continue to control invasive exotic plant species on an island-wide scale, with an emphasis on the AVMC, the IOA, TARs, and other operations insertion areas such as West Cove, Wilson Cove and the airfield. A pretreatment survey to identify areas needing treatment, one treatment cycle, and a retreatment cycle (when necessary) will be planned each year to minimize the distribution of invasive species. The focus of the invasive exotic plant control program will continue to be the control of highly invasive exotic plants that have the potential to adversely impact habitat for federally listed species in known locations, and the early detection and eradication of new occurrences of such species. Where feasible, include future construction sites in a treatment and retreatment cycle prior to construction.

- **G-M-2.** Continue feral cat and rat control efforts and monitoring level of feral cat and rat population (would benefit all endangered and threatened wildlife on SCI as well as the island fox). To reduce human-induced increases in the feral cat and rat populations, the Navy will ensure that personnel do not feed cats and that all trash, food waste, and training refuse are disposed of properly in animal proof containers.

- **G-M-3.** Continue implementation of INRMP per funding availability, with review and revision per Navy directives addressing management of natural resources.

- **G-M-4.** Continue to review and coordinate the dissemination of environmental conservation measures to island users. Conservation measures will be distributed to island military and civilian staff in accordance with commander's guidelines, and with Fleet operations.

- **G-M-5.** Conduct any necessary Explosive Ordnance Disposal (EOD) ordnance detonations in or near endangered or threatened species habitat in a manner that minimizes the potential for wildfire without compromising personnel safety.

- **G-M-6.** Coordinate range access to achieve optimal flexibility between training operations and NRO activities, according to range use instructions and with priority given to military training.

- **G-M-7.** Locate SHOBA heavy ordnance targets with regard to proximity to sensitive resources, including San Clemente loggerhead shrike, sensitive plants (e.g., away from Horse Beach Canyon), and coastal salt marsh, to the extent feasible while meeting operational needs.

- **G-M-8.** Conduct monitoring and control activities for non-native predators outside the impact area boundaries. Monitoring and control activities would include China Point Road between Impact Areas I and II. Monitoring and control activities may be intensified as needed to prevent elevated predation on listed species outside the Impact Area boundaries attributable to predator populations within the Impact Area boundaries. Access to conduct control efforts would not be limited within SHOBA outside the Impact Area I and II boundaries. (See also related measure **G-M-2)**.
- **G-M-9.** Conduct monitoring and control activities for invasive non-native plant species outside of the impact area boundaries. Monitoring and control activities would include the China Point Road between Impact Areas I and II. Monitoring and control activities may be intensified as needed to prevent spread of invasive species and effects on listed species outside the Impact Area boundaries attributable to invasive species populations within the Impact Area boundaries. Access to conduct control efforts would not be limited within SHOBA outside the Impact Area I and II boundaries. (See also related measure G-M-1).

5.10.2 AVMC, AVMR, AVMA, AFPs, AMPs, IOA, and Amphibious Landing Sites

- **AVMC-M-1.** Complete survey for federally listed and sensitive plant species within the AVMC (including AVMAs, AFP-1, AFP-6, AMPs) and IOA. This survey was initiated in 2005 and was completed in 2007.
- **AVMC-M-2.** Conduct periodic monitoring of the AVMC (AVMAs, AMPs, AFPs, AVMR) and IOA as part of vegetation/habitat and sensitive species survey updates for the INRMP.
- **AVMC-M-3.** Develop an erosion control plan. Finalize AVMA, AMP, and AFP areas based on field review with soil erosion experts and military personnel, such that operational areas minimize inclusion of steep slopes and drainage heads. Develop, apply and maintain BMPs for erosion/sedimentation where appropriate, and provide for regular monitoring and control of invasive species.
- **AVMC-M-4.** Military units will be briefed on maneuver area boundaries prior to conducting operations in these areas.
- **AVMC-M-5.** Tracked vehicle travel or maneuvering will not be conducted outside the boundaries of the AVMC (including AFPs, AMPs, AVMAs, AVMR).
- **AVMC-M-6.** Develop and implement a project to monitor for erosion, dust generation, and deposition of dust in adjacent habitats.
- **AVMC-M-7.** Prior to coming to SCI, military and non-military personnel will be asked to conduct a brief check for visible plant material, dirt, or mud on equipment and shoes. Any visible plant material, dirt or mud should be removed before leaving for SCI. Wash tactical ground vehicles for invasive species prior to embarkation for SCI. Additional washing is not required for amphibious vehicles after 15 minutes of self-propelled travel through salt water prior to coming ashore on SCI.
- **AVMC-M-8.** Continue to enforce the existing 35 mph speed limit on Ridge Road for shore installation and administrative traffic. Post signs, continue public awareness programs; mow roadside vegetation; and monitor roadways for kills of protected or conservation agreement species including San Clemente loggerhead shrike, San Clemente sage sparrow, and island fox.

- **AVMC-M-9.** Tracked and wheeled vehicles will continue to use the existing route for ingress and egress to/from the beach at West Cove.
- **AVMC-M-10.** For Horse Beach Cove Amphibious Landing and Embarkation Area at TAR 21, vehicles will use an ingress/egress route that avoids impact on wetlands and minimizes impacts on coastal dune scrub. This involves driving amphibious vehicles westward on the unvegetated beach and egressing from beach west of the mouth of Horse Beach Canyon.

5.10.3 Training Areas and Ranges (TARs)

- **TAR-M-1.** Develop and implement a five-year monitoring plan with annual surveys for Threatened and Endangered plant species when they are known to occur within or adjacent to TARs outside of Impact Areas I and II.

5.10.4 Additional Species-Specific Measures

San Clemente sage sparrow

- **SCSS-M-1.** Continue surveys and population analysis for the San Clemente sage sparrow including the populations within TARs 4, 10, and 17. This survey effort includes monitoring transects and breeding plots along the west shore and marine terraces between February through June of each year.
- **SCSS-M-2.** Develop a sage sparrow management plan that includes objectives and management actions for the conservation of the sage sparrow on San Clemente Island. The goal of the management plan would be to provide for the long-term survival of the species on SCI in a manner that supports delisting from protection under the ESA while enabling military training requirements on San Clemente Island to be met.

San Clemente Loggerhead Shrike

- **SCLS-M-1.** ontinue the currently successful program of habitat restoration, predator management, monitoring, captive breeding, and re-introduction to benefit the San Clemente loggerhead shrike until such time that recovery objectives are identified and achieved.
- **SCLS-M-2.** Evaluate nest success data for SCLS in sites nearest AFP-6, including those in Eagle and Cave Canyons, and compare it to other sites in and out of SHOBA with the objective of determining whether or not success rates are typical for the species**.**

Island Night Lizard

- **INL-M-1.** Continue population monitoring at 3-year intervals and annual habitat evaluations while the delisting petition is being evaluated by USFWS.

California brown pelican

- **CBP-M-1.** Ensure that California brown pelicans are not in proximity to over-blast pressure prior to underwater demolition activities.

Western Snowy Plover

- **WSP-M-1.** Continue annual breeding and non-breeding season surveys for the western snowy plover at West Cove and Northwest Harbor.

Island Fox

- **IF-M-1.** Continue educational work with on-Island civilian and military personnel to prevent feeding, handling of foxes.
- **IF-M-2.** Continue feral cat control and education and enforcement of prohibitions concerning on-Island civilian and military personnel feeding, keeping, or otherwise encouraging the persistence of cats on SCI.
- **IF-M-3.** Continue posting signs, mowing road verges, and education to help minimize the potential for vehicular collisions with foxes.

Santa Cruz Island Rock-Cress

- **RC-M-1**. Investigate feasibility of establishing additional colonies in suitable habitat farther away from the IOA and AFP--1 using the on-island nursery to propagate from local seed.

5.11 CULTURAL RESOURCES

Section 3.12.1 details protective measures implemented with regard to cultural resources on SCI. (submerged cultural resources in ocean areas are unaffected by Navy activities.) As noted, the Navy has developed a draft Programmatic Agreement (PA) pursuant to 36 (C.F.R.) § 800.14 (the regulation implementing the National Historic Preservation Act). NHPA Section 106 compliance on SCI will be governed by a PA. The Draft PA stipulates qualifications of personnel, development of an Integrated Cultural Resources Management Plan (ICRMP), determination of an Area of Potential Effects, evaluation of resources to ensure that authorizations for ground-disturbing activities include appropriate measures to protect archaeological resources, emergency procedures, and annual reporting.

The PA identifies Impact Areas I and II in the southern portion of SCI as areas exempt from compliance with Section 106 due to their degree of disturbance and the safety risk to personnel that would be required to survey these areas. The PA defines dispersed pedestrian troop movements as having no potential for affecting cultural resources.

To ensure that cultural resources are managed in a planned and coordinated manner, the Navy is preparing an ICRMP for SCI. There are 18 elements of the ICRMP, as noted in Section 3.12.1.2. Several of these elements already have been addressed in the current Cultural Resources Management Plan for SCI, and some are being addressed in this EIS/ OEIS. All required elements will be addressed in the ICRMP, which will provide for overall management of cultural resources.

Avoidance of adverse effect is the preferred treatment for cultural resources. There are several existing cultural resource measures for site avoidance in place as standard operating procedures at SCI. These measures include:

- All proposed actions except those on existing ranges are reviewed by the NRO for potential effects on cultural resources;
- Ongoing mitigation focuses on treating adverse effects;
- Vehicles are required to stay on established roads or within the AVMC;

- Unauthorized collection of archaeological material is not allowed;
- No digging is permitted;
- Archaeological sites in areas of high use are posted with archaeological site protection signs; and

The Navy uses environmental planning, and project design and redesign to avoid or minimize impacts on resources. When avoidance is not feasible, however, eligible resources must receive appropriate mitigation. For archaeological sites considered important for their potential to provide information, this usually involves data recovery. Mitigating impacts on built resources typically involves Historic American Building Survey/Historic American Engineering Record documentation. The character of treatment is determined through consultation with the California State Historic Preservation Office (SHPO) and Advisory Council on Historic Preservation on adverse effect under 36 C.F.R. § 800.

5.12 TRAFFIC

The Navy strives to ensure that it retains access to ocean training areas and special use airspace (SUA) as necessary to accomplish its mission, while facilitating joint military-civilian use of such areas to the extent practicable and consistent with safety. These goals of military access, joint use, and safety are promoted through various coordination and outreach measures, including:

- Publication of NOTAM advising of the status and nature of activities being conducted in W-291 and other components of SUA in the EIS Study Area.
- Return of SUA to civilian Federal Aviation Administration (FAA) control when not in use for military activities. To accommodate the joint use of SUA, a Letter of Agreement is in place between Los Angeles Air Traffic Control Center (ARTCC) and Fleet Area Control and Surveillance Facility (FACSFAC) San Diego (Navy). The LOA defines the conditions and procedures to ensure safe and efficient joint use of waning areas.
- Publication of NOTMAR and other outreach. The Navy provides information about potentially hazardous activities planned for the SOCAL OPAREA, for publication by the U.S. Coast Guard in NOTMAR. Most such activities occur in the vicinity of SCI. To ensure the broadest dissemination of information about hazards to commercial and recreational vessels, the Navy provides detailed schedules of its activities planned near SCI on a dedicated website.

5.13 SOCIOECONOMICS

Given the nature and location of Navy activities addressed in this EIS/OEIS, mitigation and protective measures are unnecessary with respect to socioeconomic considerations.

5.14 ENVIRONMENTAL JUSTICE AND PROTECTION OF CHILDREN

Given the nature and location of Navy activities addressed in this EIS/OEIS, mitigation and protective measures are unnecessary with respect to socioeconomic considerations.

5.15 PUBLIC SAFETY

Navy activities in the SOCAL Range Complex comply with numerous established safety procedures to ensure the safety of participants and the public. FACSFAC and Navy range managers have published safety procedures for activities on the offshore and nearshore areas. These guidelines are directive for range users. They provide, among other measures, that:

- Commanders are responsible for ensuring that impact areas and targets are clear prior to commencing activities that are hazardous.

- Aircraft or vessels expending ordnance shall not commence firing without permission of the scheduling authority for their specific range area.
- Firing units and targets must remain in their assigned areas, and units must fire in accordance with current safety instructions.
- Except for SCI, ships are authorized to fire their weapons only in offshore areas and at specific distances from land, depending on the caliber and range of the weapons fired. The larger the caliber, the farther offshore that the firing must take place.
- The use of pyrotechnic or illumination devices and marine markers such as smoke or dye markers will be allowed only in the assigned areas, to avoid the launch of Search and Rescue forces when not required. Aircraft carrying ordnance to or from ranges shall avoid populated areas to the maximum extent possible.
- Aircrews operating in W-291 are aware that non-participating aircraft are not precluded from entering the area and may not comply with a NOTAM or radio warning that hazardous activities are scheduled or occurring. Aircrews are required to maintain a continuous lookout for non-participating aircraft while operating under visual flight rules in W-291.

In addition to the FACSFAC and SCORE procedures, the Navy has instituted the following SOPs for use of the SOCAL Range Complex:

5.15.1.1 Aviation Safety

Aircraft in W-291 fly under visual flight rules (VFR) and under visual meteorological conditions. This means that the commanders of military aircraft are responsible for the safe conduct of their flight. Prior to releasing any weapons or ordnance, the impact area must be clear of non-participating vessels, people, or aircraft. The OCE is ultimately responsible for the safe conduct of range training. A qualified Safety Officer is assigned to each training event or exercises and can terminate activities if unsafe conditions exist. Aircraft entering the SCI Air Traffic Area are required to be in radio contact with military air traffic control.

5.15.1.2 Submarine Safety

Vertical separation of at least 100 ft (30.5 m) is required between the top of a submarine's sail and the depth of a surface ship's keel. If a submarine (or submarine simulated target, the MK-30) is at periscope depth, at least a 1,500-yard (yd) (1,372-m) horizontal separation from other vessels must be maintained.

5.15.1.3 Surface Ship Safety

During training events, surface ships maintain radio contact with range control. Prior to launching a weapon, ships are required to obtain a "Green Range," which indicates that all safety criteria have been satisfied, and that the weapons and target recovery conditions and recovery helicopters and boats are ready to be employed.

5.15.1.4 Missile Exercise Safety

Safety is the top priority and paramount concern during missile exercises. These exercises can be surface-to-surface, subsurface-to-surface, surface-to-air, or air-to-air. A Missile Exercise (MISSILEX) Letter of Instruction is prepared prior to any missile firing exercise. This instruction establishes precise ground rules for the safe and successful execution of the exercise. Any MISSILEX participant who observes an unsafe situation can communicate a "Red Range" order over any voice communication systems. Range control is in radio contact with participants at all times during a MISSILEX.

6 Other Considerations Required by NEPA

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6 OTHER CONSIDERATIONS REQUIRED BY NEPA

6.1 CONSISTENCY WITH OTHER FEDERAL, STATE, AND LOCAL PLANS, POLICIES, AND REGULATIONS

Based on an evaluation with respect to consistency with statutory obligations, the Department of the Navy's (DoN) alternatives including the Proposed Action for the Southern California Range Complex Draft Environmental Impact Statement (EIS) / Overseas Environmental Impact Statement (OEIS) (hereafter referred to as "EIS/OEIS") does not conflict with the objectives or requirements of Federal, State, regional, or local plans, policies, or legal requirements. Table 6-1 provides a summary of environmental compliance requirements that may apply.

Table 6-1: Summary of Environmental Compliance for the Proposed Action

Plans, Policies, and Controls	Responsible Agency	Status of Compliance
National Environmental Policy Act (NEPA) of 1969 (42 U.S.C §§ 4321 *et seq.*) Council on Environmental Quality (CEQ) Regulations for Implementing the Procedural Provisions of NEPA (40 C.F.R. §§ 1500-1508) DoN Procedures for Implementing NEPA (32 C.F.R. § 775)	DoN	This EIS has been prepared in accordance with NEPA, CEQ regulations and Navy NEPA procedures. Public participation and review is being conducted in compliance with the NEPA.
Executive Order 12114, 32 CFR 187, Environmental Effects Abroad of Major Federal Actions	DoN	This OEIS has been prepared in accordance with EO 12114 as implemented by 32 CFR 187, which requires environmental consideration for actions that may affect the environment outside of U.S. Territorial Waters on the high seas.
Clean Air Act (CAA) (42 USC §§ 7401 *et seq.*) CAA General Conformity Rule (40 C.F.R. § 93[B]) State Implementation Plan (SIP)	U.S. Environmental Protection Agency (USEPA) South Coast Air Quality Management District San Diego Air Pollution Control District	The Proposed Action would not conflict with attainment and maintenance goals established in SIPs. A CAA conformity determination will not be required because emissions attributable to the alternatives including the Proposed Action would be below *de minimis* thresholds.
Federal Water Pollution Control Act (Clean Water Act [CWA)]) (33 U.S.C. §§ 1344 *et seq.*)	USEPA	No permits are required under the CWA Sections 401, 402, or 404 (b) (1).
Rivers and Harbors Act (33 U.S.C.§§ 401 et seq.)	U.S. Army Corps of Engineers	No permit is required under the Rivers and Harbors Act.

Plans, Policies, and Controls	Responsible Agency	Status of Compliance
Coastal Zone Management Act (CZMA) (16 C.F.R. §§ 1451 *et seq.*)	California Coastal Commission	See Section 6.1.1, below, for discussion of Navy activities and compliance with the CZMA.
Magnuson-Stevens Fishery Conservation and Management Act (16 U.S.C. §§ 1801-1802)	National Marine Fisheries Service (NMFS)	The Proposed Action would not adversely affect Essential Fish Habitat (EFH) and would not decrease the available area or quality of EFH.
Endangered Species Act (ESA) (16 U.S.C. §§ 1531 et seq.)	DoN U.S. Fish and Wildlife Service (USFWS) NMFS	The EIS/OEIS analyzes potential effects to species listed under the ESA. In accordance with ESA requirements, the Navy will complete consultation under Section 7 of the ESA with NMFS and USFWS on the potential that implementation of the Proposed Action may affect listed species. With regard to NMFS jurisdiction, upon concluding Section 7 consultation, the Navy will adhere to any Biological Opinion (BO). In addition, the Navy will apply for a Letter of Authorization (see discussion below re: Marine Mammal Protection Act), which is expected to impose terms and conditions that, when implemented, would make ESA Section 9 prohibitions inapplicable to covered Navy activities. With regard to USFWS jurisdiction over species present in SCI, the Navy will initiate Section 7 consultation and conduct its activities in accordance with any applicable BOs.
Marine Mammal Protection Act (MMPA) (16 U.S.C. §§ 1431 *et seq.*)	NMFS	The MMPA governs activities with the potential to harm, disturb, or otherwise "harass" marine mammals. As a result of acoustic effects associated with mid-frequency active sonar use and underwater detonations of explosives, implementation of the alternatives including the Proposed Action may result in potential Level A (harm) or Level B (disturbance) harassment to marine mammals. Therefore, the Navy will engage NMFS in the regulatory process to determine whether incidental "takes" of marine mammals are likely, and seek a Letter of Authorization (LOA) from NMFS to permit takes as appropriate.

Plans, Policies, and Controls	Responsible Agency	Status of Compliance
The National Marine Sanctuaries Act (16 U.S.C. §§ 1431 et. seq.)	National Oceanic and Atmospheric Administration	Channel Islands National Marine Sanctuary (CINMS) lies within the study area addressed in this EIS/OEIS. Per CINMS regulations (15 CFR §922.71(a)), national defense activities in existence at the time of designation are not subject to CINMS regulatory prohibitions, provided they are "consistent with the [CINMS] regulations to the maximum extent practicable." CINMS regulations also require that the exemption of additional activities having significant impact shall be determined after consultation with the Director of the National Marine Sanctuary Program (NMSP). The Navy does not propose new activities in the CINMS, nor activities that are different from those currently conducted in the CINMS. Therefore, proposed activities are consistent with those activities currently conducted in the CINMS, are consistent with those described in the designation document, and are not being changed or modified in a way that would require consultation. Implementation of the alternatives including the Proposed Action would have no effect on sanctuary resources in the off-shore environment of southern California. Review of agency actions under Section 304 of the National Marine Sanctuaries Act is not required.
The Sikes Act of 1960 (16 U.S.C. §§ 670a-670o, as amended by the Sikes Act Improvement Act of 1997, Pub. L. No. 105-85)	DoD	The alternatives including the Proposed Action would be implemented in accordance with the management and conservation criteria developed in the Sikes Act Integrated Natural Resources Management Plans (INRMP) for SCI.
National Historic Preservation Act (NHPA) (16 U.S.C. §§ 470 *et seq.*)	DoN	The alternatives including the Proposed Action would be implemented in consultation with and under programmatic agreement with the State Historic Preservation Office, and pursuant to the criteria developed in the Integrated Cultural Resources Management Plans (ICRMP) for SCI.
EO 12898, Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations	DoN	The Proposed Action would not result in any disproportionately high adverse human health or environmental effects on minority or low-income populations.
EO 13045, Protection of Children from Environmental Health Risks and Safety Risks	DoN	The Proposed Action would not result in environmental health and safety risks to children.

Plans, Policies, and Controls	Responsible Agency	Status of Compliance
EO 13112, Invasive Species	DoN	EO 13112 requires agencies to identify actions that may affect the status of invasive species and take measures to avoid introduction and spread of these species. To the extent invasive species management relates to ESA compliance on SCI, the BO is expected to ensure compliance with EO 13112. This EIS/OEIS also otherwise satisfies the requirement of EO 13112.
EO 13089, Coral Reef Protection	DoN	EO 13089 preserves and protects the biodiversity, health, heritage, social and economic value of U.S. coral reef ecosystems and the marine environments. All Navy actions that may affect U.S. coral reef ecosystems shall: (a) identify their actions that may affect U.S. coral reef ecosystems; (b) utilize their programs and authorities to protect and enhance the conditions of such ecosystems; and (c) to the extent permitted by law, ensure that any actions they authorize, fund, or carry out will not degrade the conditions of such ecosystems. Navy SOPs ensure all precautions are made to comply with required statutes. No resources that are governed by this EO exist within the SOCAL Range Complex, therefore, mitigation of effects will not be necessary for the protection of resources under EO 13089.
EO 11990, Protection of Wetlands	DoN	Implementation of the alternatives including the Proposed Action would not have a significant impact on wetlands.
EO 12962, Recreational Fisheries	DoN	EO 12962 requires federal agencies to fulfill certain duties with regard to promoting the health and access of the public to recreational fishing areas. The alternatives including the Proposed Action comply with EO 12962.
California Coastal National Monument Designation (Presidential Proclamation, January 11, 2000)	Bureau of Land Management (BLM) and California Department of Fish and Game (CDFG)	The proclamation designates all non-major U.S. owned lands (rocks, islands, etc.) along the coast of California from mean high tide out to a distance of 12 nautical miles (22 kilometers) as national monuments. The SOCAL Range Complex includes resources designated as part of the California Coastal National Monument area. The Navy has agreed with BLM on the terms of a memorandum of understanding (MOU) dated Nov. 5, 2007 regarding Navy activities in the vicinity of monument resources. Implementation of the alternatives including the Proposed Action would be consistent with the MOU and would not affect monument resources.

Plans, Policies, and Controls	Responsible Agency	Status of Compliance
California Marine Life Protection Act (MLPA) and Marine Managed Areas Improvement Act (California Fish and Game Code §§ 2850-2863)	CDFG	MLPA requires CDFG to confer with the Navy regarding issues related to Navy activities as such may engage Marine Managed Areas.
Migratory Bird Treaty Act (16 U.S.C. §§ 703-712)	USFWS	Implementation of the alternatives including the Proposed Action would not have a significant impact on any population of migratory birds; would comply with the MBTA; and would not require a permit under the MBTA.

6.1.1 Coastal Zone Management Act Compliance

The CZMA of 1972 (16 United States Code [U.S.C.] Section [§] 1451) encourages coastal states to be proactive in managing coastal zone uses and resources. CZMA established a voluntary coastal planning program; participating states submit a Coastal Management Plan (CMP) to National Oceanographic and Atmospheric Administration (NOAA) for approval. Under CZMA, federal actions are required to be consistent, to the maximum extent practicable, with the enforceable policies of approved CMPs.

CZMA defines the coastal zone (16 U.S.C. § 1453) as extending, "to the outer limit of State title and ownership under the Submerged Lands Act" (i.e., 3 nautical miles [nm] from the shoreline). The coastal zone extends inland only to the extent necessary to control the shoreline. Excluded from the coastal zone are lands the use of which is by law subject solely to the discretion of, or which is held in trust by, the federal government (16 U.S.C. § 1453). Accordingly, federal military lands such as SCI are not within the coastal zone.

The State of California has an approved CMP. The *California Coastal Act* (CCA) of 1976 (California Public Resources Code, Division 20) implements California's CZMA program. The CCA includes policies to protect and expand public access to shorelines, and to protect, enhance, and restore environmentally sensitive habitats, including intertidal and nearshore waters, wetlands, bays and estuaries, riparian habitat, certain woods and grasslands, streams, lakes, and habitat for rare and endangered plants and animals. The California Coastal Commission (CCC) administers the State's CMP.

The CZMA federal consistency determination process includes a review of the Proposed Action to determine whether it has reasonably foreseeable effects on coastal zone resources or uses, an in-depth examination of any such effects, and a determination on whether those effects are consistent to the maximum extent practicable with the State's enforceable policies. Under the CZMA, the CCC must provide an opportunity for public comment and involvement in the federal coastal consistency determination process.

In conjunction with the EIS process, and before issuing a Record of Decision (ROD), the Navy will complete the federal consistency review process, which will be initiated through submission of its Consistency Determination to the CCC. Its preliminary determination, based in large part on the environmental impact analyses presented in this EIS/OEIS, is that the Navy is consistent to the maximum extent practicable with the State's enforceable CZMA policies. In particular, the Navy has determined that its Proposed Action is consistent with: CCA Article 2 (Public Access), Section 30210 (Access, recreational opportunities, posting); Article 3 (Recreation), Section 30220 (Protection of water-oriented activities); Article 4 (Maritime Environment), Sections 30230 (Marine resources, maintenance), 30231 (Biological productivity, wastewater), and 30234.5 (Fishing; economic, commercial, and recreational importance); and Article 5 (Land Resources), Section 30240 (Environmentally sensitive habitat areas). The Navy has determined that other policies embodied in the articles and sections of the CCA are not applicable to the Proposed Action.

The EIS/OEIS addresses those coastal resources and uses which would be affected by the Proposed Action, although the impact analyses do not specifically distinguish effects within the coastal zone from those effects outside of it. Public access and recreation are discussed in Sections 3.4 (Water Resources) and 3.16 (Public Health and Safety). Marine resources and biological productivity are discussed in Sections 3.6 (Marine Plants and Invertebrates), 3.7 (Fish), 3.8 (Sea Turtles), 3.9 (Marine Mammals), and 3.10 (Sea Birds). Fishing and commercial and recreational economics is discussed in Sections 3.7 (Fish) and 3.14 (Socioeconomics). Cultural resources are discussed in Section 3.12, Cultural Resources.

6.2 RELATIONSHIP BETWEEN SHORT-TERM USE OF MAN'S ENVIRONMENT AND MAINTENANCE AND ENHANCEMENT OF LONG-TERM PRODUCTIVITY

NEPA requires an analysis of the relationship between a project's short-term impacts on the environment and the effects that these impacts may have on the maintenance and enhancement of the long-term productivity of the affected environment. Impacts that narrow the range of beneficial uses of the environment are of particular concern. This means that choosing one option may reduce future flexibility in pursuing other options, or that committing a resource to a certain use may often eliminate the possibility for other uses of that resource.

The Proposed Action would result in both short- and long-term environmental effects. However, the Proposed Action would not be expected to result in any impacts that would reduce environmental productivity, permanently narrow the range of beneficial uses of the environment, or pose long-term risks to health, safety or the general welfare of the public. The Navy is committed to sustainable range management, including co-use of the SOCAL Range Complex with the general public and commercial interests to the extent practicable consistent with accomplishment of the Navy mission and in compliance with applicable law. This commitment to co-use will enhance the long-term productivity of the range areas surrounding SOCAL Range Complex.

6.3 IRREVERSIBLE OR IRRETRIEVABLE COMMITMENT OF RESOURCES

NEPA requires that environmental analysis include identification of "any irreversible and irretrievable commitments of resources which would be involved in the Proposed Action should it be implemented." [NEPA Sec. 102 (2)(C)(v), 42 USC § 4332**].** Irreversible and irretrievable resource commitments are related to the use of non-renewable resources and the effects that the uses of these resources have on future generations. Irreversible effects primarily result from the use or destruction of a specific resource (*e.g.*, energy or minerals) that cannot be replaced within a reasonable time frame. Irretrievable resource commitments involve the loss in value of an affected resource that cannot be restored as a result of the action (*e.g.*, the disturbance of a cultural site). Construction of the SWTR and the shallow water minefield would cause short-term and temporary impacts during construction. Once SWTR is put in place, anchoring points will be carefully chosen by the Navy in order to mitigate any possible effects the laying of SWTR cable might have on marine resources.

For the alternatives including the Proposed Action, most resource commitments are neither irreversible nor irretrievable. Most impacts are short-term and temporary, or, if long lasting are negligible. Culturally significant resources known to occur in the area proposed for training activities are carefully managed under a comprehensive cultural resources program which the Navy is currently advancing through a programmatic agreement. This will insure the future management of these resources. No habitat associated with threatened or endangered species would be lost as result of implementation of the Proposed Action. Since there would be no building or facility construction, the consumption of materials typically associated with such construction (*e.g.*, concrete, metal, sand, fuel) would not occur. Energy typically associated with construction activities would not be expended and irreversibly lost.

Implementation of the Proposed Action would require fuels used by aircraft, ships, and ground-based vehicles. Since fixed- and rotary-wing flight and ship activities could increase relative, total fuel use would increase. Fuel use by ground-based vehicles involved in training activities would also increase. Therefore, total fuel consumption would increase and this nonrenewable resource would be considered irreversibly lost.

6.4 ENERGY REQUIREMENTS AND CONSERVATION POTENTIAL OF ALTERNATIVES AND MITIGATION MEASURES

Increased training and testing operations on the SOCAL Range Complex would result in an increase in energy demand over the No Action Alternative. This would result in an increase in fossil fuel consumption, mainly from aircraft, vessels, ground equipment, and power supply. Although the required electricity demands of increased intensity of land-use would be met by the existing electrical generation infrastructure at the SOCAL Range Complex, the alternatives would result in a net cumulative negative impact on the energy supply.

Energy requirements would be subject to any established energy conservation practices at each facility. No additional power generation capacity other than the potential use of generators would be required for any of the operations. The use of energy sources has been minimized wherever possible without compromising safety, training, or testing operations. No additional conservation measures related to direct energy consumption by the proposed operations are identified.

6.5 NATURAL OR DEPLETABLE RESOURCE REQUIREMENTS AND CONSERVATION POTENTIAL OF VARIOUS ALTERNATIVES AND MITIGATION MEASURES.

Resources that will be permanently and continually consumed by project implementation include water, electricity, natural gas, and fossil fuels; however, the amount and rate of consumption of these resources would not result in significant environmental impacts or the unnecessary, inefficient, or wasteful use of resources. Nuclear powered vessels would be a benefit as it decreases use of fossil fuels.

In addition, construction activities related to increased training and testing operations on the SOCAL Range Complex would result in the irretrievable commitment of nonrenewable energy resources, primarily in the form of fossil fuels (including fuel oil), natural gas, and gasoline construction equipment. With respect to operational activities, compliance with all applicable building codes, as well as project mitigation measures, would ensure that all natural resources are conserved or recycled to the maximum extent feasible. It is also possible that new technologies or systems will emerge, or will become more cost effective or user-friendly, that will further reduce the site's reliance upon nonrenewable natural resources; however, even with implementation of conservation measures, consumption of natural resources would generally increase with implementation of the alternatives.

Pollution prevention is an important component of mitigation of the alternative's adverse impacts. To the extent practicable, pollution prevention considerations are included.

By virtue of inclusion of proposed increases in SOCAL Range Complex operations in the SIP, air emissions inventory, the emissions of NO_x and ROG associated with the Proposed Action and alternatives are in conformity with the SIP and have demonstrated that they will not cause or contribute to a violation of the ozone standard [SOCAL, 2007 (Chapter 3.2 Air Quality)]. Therefore, because the Proposed Action will not adversely affect the ability of the South Coast

Air Basin to attain and maintain the NAAQS, the proposed project is presumed to conform with the SIP.

Aircraft operations at NALF SCI are the single largest airborne noise source. Noise levels in excess of 90-dBA can occur at the BUD/S Camp [(SOCAL, 2007 (Chapter 3.5 Acoustic Environment)]. Mitigations (structural attenuation features) are in place.

Sustainable range management practices are in place that protect and conserve natural and cultural resources; and preservation of access to training areas for current and future training requirements, while addressing potential encroachments that threaten to impact range capabilities.

7 List of Preparers

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7 LIST OF PREPARERS

GOVERNMENT PREPARERS

Alexander Stone (U.S. Navy Fleet Environmental Division)
EIS Project Manager
B.S. Environmental Studies, George Washington University

Chip Johnson (U.S. Navy Pacific Fleet)
Marine Species Advisor and Staff Marine Biologist
B.S. Biology, University of North Carolina at Wilmington
M.A. Marine Science, Virginia Institute of Marine Science, College of William and Mary

Dean Leach, CDR, JAGC (U.S. Navy Pacific Fleet)
U.S. Navy Judge Advocate, U.S. Pacific Fleet
J.D., 1988
LLM (Environmental), 2001

Arthur Popper, PhD
Interim Associate Dean, College of Chemical and Life Sciences, Department of Biology
University of Maryland, College Park, MD

CONTRACTOR PREPARERS

Matthew Bartlett (Parsons Infrastructure and Technology), Cultural Resources, Public Health/Safety
B.S. Environmental Policy & Planning, Virginia Polytechnic Institute and State University
Years of Experience: 3.5

Blair Brownyard (Man Tech SRS Technologies, Inc.), Environmental Analyst
B.A. History, California State University, San Marcos
J.D. Touro Law Center
Years of Experience: 6

Bruce Campbell (Parsons Infrastructure and Technology), Lead Analyst, Geology/Soils, Noise
B.S. Environmental Biology, University of California, Santa Barbara
M.S. Environmental Management, University of San Francisco
Years of Experience: 26

Brian Fenlon (ManTech SRS Technologies), Military Operations Specialist
B.A. Mathematics, Providence College
Years of experience: 20

Lawrence Honma (Merkel & Associates, Inc.), Marine Biology and Fish
B.S. Wildlife and Fisheries Biology, University of California, Davis M.S. Marine Sciences, Moss Landng Marine Laboratory, California State University, San Francisco
Years of Experience: 18

Krystal Kermott (ManTech SRS), Deputy Project Manager
B.S. Biological Sciences, University of California at Santa Barbara
Years of Experience: 7

Derek Lerma (Tierra Data Inc.), Senior Marine Biologist, USCG 100 Ton Captain, Dive Master
B.S. Biological Oceanography, Humboldt State University
Years of Experience: 20

Thomas W. Mulroy (SAIC), Terrestrial Biological Assessment Leader
Ph.D. Ecology and Evolutionary Biology, University of California at Irvine,
M. A. Biology, University of Arizona; B.A. Zoology, Pomona College.
Years of Experience: 30

Paul Nyenhuis (ManTech SRS), Senior Systems Analyst
B.S. Computer Science, National University
Years of Experience: 17

Karyn Palma (ManTech SRS), Resource Analyst
B.A. Environmental Studies, University of California, Santa Barbara
Years of Experience: 15

Antonio Perez (ManTech SRS), Lead Geospatial Analyst
Geospatial Intelligence Diploma, National Geospatial Intelligence College
Years of Experience: 15

Angela Schnapp (Parsons Infrastructure and Technology), Hazardous Materials / Wastes, Water Quality
B.S., Nuclear Engineering, University of Illinois at Urbana-Champaign, Urbana, Illinois
M.S., Environmental Engineering, University of Illinois at Urbana-Champaign, Urbana, Illinois
Years of Experience: 13

Valorie L. Thompson (Scientific Resources Associated), Air Quality
B.S. Chemistry, Eastern Michigan University
M.S. Chemical Engineering, Purdue University
Ph.D. Chemical Engineering, Purdue University
Years of Experience: 21

Philip Thorson (ManTech SRS), Senior Research Biologist/Marine Mammal Biologist
Ph.D. Biology, University of California at Santa Cruz
Years of Experience: 27

Brian Tucker (ManTech SRS), Project Manager
B.A. University of Notre Dame
J.D. Loyola Law School, Los Angeles
Years of Experience: 21

Karen Waller (ManTech SRS), Vice President/Quality Assurance
B.S. Public and Environmental Affairs, Indiana University
Years of Experience: 20

Brian D. Wauer (ManTech SRS), Director, Range and Environmental Services
B.S. 1983, Administrative Management, University of Arkansas
B.S. 1984, Industrial Management, University of Arkansas
Years of Experience: 22

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CHAPTER 4

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Washington, DC

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Los Angeles District
David Castanon
Ventura, CA

Army Corps of Engineers
San Diego Project Office
Mark Tucker
San Diego, CA

Army Corps of Engineers,
Los Angeles District
Thomas H. Magness, IV
Los Angeles, CA

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Jim Cason
Washington, DC

Bureau of Indian Affairs,
Southern California Agency
Virgil Townsend
Riverside, CA

Bureau of Land Management
Maitland Sharpe
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Bureau of Land Management,
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Gail Acheson
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Washington, DC

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Chris Mobley
Santa Barbara, CA
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Mary Josie Blanchard
Washington, DC

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Patricia S. Port
Oakland, CA

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Augustin Moses
Renton, WA

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Air Traffic Division, Western Pacific Region (AWP-532),
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Region IX
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Christina Fahy
Long Beach, CA

NOAA Marine Protected Areas Center
Joseph Uravitch
Silver Spring, MD

NOAA Southwest Fisheries Science Center
Meghan Donahue
La Jolla, CA

NOAA Southwest Fisheries Science Center
William Perrin
La Jolla, CA

NOAA
Office of Protected Resources, National Marine Fisheries Service
Ken Hollingshead
Silver Spring, MD

NOAA
Office of Protected Resources, National Marine Fisheries Service
Jaclyn Daly
Silver Spring, MD

NOAA
Office of Protected Resources, National Marine Fisheries Service
Craig Johnson
Silver Spring, MD

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John Coon
Portland, OR

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U.S. Coast Guard
T.J. Granito
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Mr. Daniels
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Port Operations
Kathleen Garza
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U.S. Coast Guard,
Eleventh Coast Guard District
Marine Safety Division
Long Beach, CA

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Portland, OR

U.S. Department of Transportation
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Washington, DC

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Kim DePaul
Washington, DC

U.S. Environmental Protection Agency
Region IX
Karen Vitulano
San Francisco, CA

U.S. Environmental Protection Agency
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California - Nevada Operations
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Arcata, CA

Eberly, Chris
The Plains, VA

Eckenroth, Dean
Coronado, CA

Elliott, Ted
Bakersfield, CA

English, T. Malcolm
PE9 1XQ, U.K.

Evans, Carol
Oceanside, CA

Everett, William
La Jolla, CA

Farmer, Dave
Los Angeles, CA

Fisher, George
Laguna Hills, CA

Fisher, Robert
San Diego, CA

Fletcher, Bob
San Diego, CA

Ford, Bill
Laguna Beach, CA

Freed, Lynn
Canoga Park, CA

Freireich, Richard
San Diego, CA

Fuentes, Gidget
Carlsbad, CA

Fusaro, Craig
Santa Barbara, CA

Gagosian, Bob
Washington, DC

Gaines, Bill
La Jolla, CA

Galway, Megan
Costa Mesa, CA

Gamble, Lynn
San Diego, CA

Geary, Patty
San Pedro, CA

Glantz, Dale
San Diego, CA

Glassow, Michael
Santa Barbara, CA

Goehring, Vern
Sacramento, CA

Gorss, Marlin
La Jolla, CA

Grader, W.F.
Sausalito, CA

Green, Marsha
Reading, PA

Greenberg, Joel
Los Angeles, CA

Guinther, Eric
Kailua, HI

Guth, John
Vista, CA

Guth, John
Vista, CA

Hall, Albert
Irvine, CA

Halmay, Peter
Lakeside, CA

Hansen, Mike
Dana Point, CA

Hanson, Brian
San Pedro, CA

Hark, Bob
Ventura, CA

Harlowe, Anna
Los Angeles, CA

Harper, Rick
Santa Barbara, CA

Harris, Martha
Los Angeles, CA

Hasbrouck, Bruce G.
Tampa, FL

Heath, Shane
Arcata, CA

Heck, Ronald G
Santa Barbara, CA

Heikkila, Wayne
Redding, CA

Helgren, Richard
Oceanside, CA

Helling, Harry
Dana Point, CA

Hine, Gail
Tustin, CA

Hinman, Ken
Leesburg, VA

Hinton, Mel
San Diego, CA

Hoinkes, Mary Elizabeth
Washington, DC
Holcberg, David
Irvine, CA

Holtel, M.
Vista, CA

Hoogendam, Heather
Solana Beach, CA

Hoover, Carole
Coronado, CA

Hoskins, Gary
Cypress, CA

Howorth, Peter
Santa Barbara, CA

Hunter, Laura
National City, CA

Huntting-Coronel, Charmaine
Escondido, CA

Ininns, Morgan
Dana Point, CA

Jahnkow, Carol
San Diego, CA

James, Kitty
Irvine, CA

Jeffredo, John
Fallbrook, CA

Jeffredo-Warden, Louise
Moss Beach, CA

Jeffrey, Walt
Huntington Beach, CA

Johnson, Tim
Oceanside, CA

Jones, Terry
San Luis Obispo, CA

Jurji, Judith
Seattle, WA

Kanig, Ed
San Diego, CA
Kedis, Angelo
Avalon, CA

Kelly, Fred
Imperial Beach, CA

Kie, John
Fresno, CA

Kingsmill, Jim
San Clemente, CA

Knaster, Alana
Woodland Hills, CA

Knight, Cathy
Santa Monica, CA

Kramer, Rob
Dania Beach, FL

Lang, Valerie
Los Angeles, CA

Lavars, George
Alhambra, CA

Lee, Mike
San Diego, CA

LePore, Paul
Huntington Beach, CA

Lindsay, John
Newport Beach, CA

Lindsey, John
Newport Beach, CA

Lingerfelder, Terry
Solana Beach, CA

Little, Isabelle
Encino, CA

Lowenthal, Alan
Long Beach, CA

Lucasey, Ray
Point Mugu, CA

MacMillan, Adrian
Santa Monica, CA

Mader, Tracey
Petaluma, CA

Marineros, Catalina
Marina Del Rey, CA

Martindell, Chris
San Diego, CA

Martindell, Rich
San Diego, CA

Martus, Carolyn
San Diego, CA

Martz, Patricia
Los Angeles, CA
Mason, Jeff
Santa Barbara, CA

Matson, Lawrence
Cypress, CA

Mautz, William
Hilo, HI

Mazlamian, Bob
Hollywood, CA

McBain, Jim
San Diego, CA

McCall, James L.
Paso Robles, CA

McCorkle, Mike
Summerland, CA

Mcfarland, Chuck
Newport Beach, CA

McGrail, J.
Marina Del Ray, CA

McIntosh, Heather
Patuxent River, MD

McIsaac, Donald O.
Portland, OR

McKeown, John C,
Laguna Beach, CA

McLauren, Jon
San Francisco, CA

Medford, Roberta
Los Angeles, CA

Medina, Nichelle
San Diego, CA

Mello, John
Avalon, CA

Merriam, Clark
Hampton, VA

Millan, Edward J.
Camarillo, CA

Murphy, Richard
Santa Barbara, CA

Murray, Pat
Houston, TX

Myers, Larry
Sacramento, CA
Nowicke, Susan
San Diego CA

Nussman, Mike
Alexandria, VA

Nydegger, David L.
Oceanside, CA

O'Day, Terry
Santa Monica, CA

Olson, Kevin
Montrose, CA

Opdycke, Jeff
San Diego, CA

Owen, Michael
Manhattan Beach, CA

Parenude, Dave
San Diego, CA

Parr, Michael J.
Washington, DC

Pashley, David
The Plains, VA

Patton, Gary A.
Sacramento, CA

Perez, Edgar
San Gabriel, CA

Perleberg, Brian
Longview, WA

Peters, Dennis
Shalimar, FL

Peterson, Jim
San Pedro, CA

Pitcher, Ben
Long Beach, CA

Pivovaroff, Mary
Irvine, CA

Pleschner-Steele, Diane
Buellton, CA

Potorti, Grace
Reno, NV

Raftican, Tom
Irvine, CA

Rassam, Ghassan
Bethesda, MD
Ratican, Tom
Huntington Beach, CA

Rausa, Rosario
Alexandria, VA

Reamer, Jerry
San Diego, CA

Redfern, Chris
San Diego, CA

Reynolds, Joel
Los Angeles, CA

Reznik, Bruce
San Diego, CA

Risser, Art
San Diego, CA

Rocha, Vera
Baldwin Hills, CA

Rodgers, Terry
San Diego, CA

Rogers, Lou
Point Mugu, CA

Rose, Naomi
Washington, D.C.

Roy, Kristina
Washington, D.C.

Royal, Jim
San Diego, CA

Salamunovich, Peter
Avalon, CA

Sanchez, Gerald
Newbury Park, CA

Sandhu, M.S.
Newport Beach, CA

Schillo, Frank
Thousand Oaks, CA

Schroeder, James
Seattle, WA

Schuck, Tony
Rio Vista, CA

Schumann, Kai
San Diego, CA

Scoble, John
San Pedro, CA
Scott, Tom
Riverside, CA

Serden, Bertram
Beverly Hills, CA

Shea, Robert
Campo, CA

Shirey, Jim
Coronado, CA

Simmen, Jeffrey A.
Seattle, WA

Smith, Dennis
San Diego, CA

Smullen, Steve
El Paso, TX

Sobel, Jan
Carlsbad, CA

Sparling, Steven C.
Alexandria, VA

Squibb, Jim
Oceanside, CA

Storsteen, Erik
Redondo Beach, CA

Sullivan, James J.
La Jolla, CA

Sweeting, Richard
Long Beach, CA

Swisher, Ken
Northridge, CA

Talbert, Joe
Coronado, CA

Terrebone, Pamela
Coronado, CA

Thomas, Scott
Irvine, CA

Thompson, Mark
Imperial Beach, CA

Thompson, Michael R.
San Juan Capistrano, CA

Towler, Blake
Washington, DC

Urone, William V
Laguna Niguel, CA

Valdez, Val
Torrence, CA

Vega, Felix
San Pedro, CA

Vincent, Delores
Orange, CA

Vissman, Sandy
Carlsbad, CA

Walker, Greg
Coronado, CA

Walker, Cheryl
San Diego, CA

Walsh, Dan
Encinitas, CA

Walter, Debbie
Solana Beach, CA

Ward, Jack
Long Beach, CA

Warnock, Nils
Stinson Beach, CA

Wauben, Scott
Avalon, CA

Wilson, Darrel
Carpenteria, CA

Wilson, Rick
San Diego, CA

Winegrad, Gerald
Washington, DC

Winter, Jay
Los Angelos, CA

Wise, Chuck
San Francisco, CA

Woodard, Bill
Huntington Beach, CA

Woodard, Robert
San Diego, CA

Woodfield, Helen
Oceanside, CA

Woodfield, Jeff
Oceanside, CA

Woodruff, David S.
La Jolla, CA

Young, Bruce
Coronado, CA

Zechman, Joe
San Diego, CA

Zoggas, Nikos
Escondido, CA

Appendices

Appendix A

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Training and RDT&E Descriptions

This Appendix provides detailed information about Training and Research, Development, Test, and Evaluation (RDT&E) activities that are addressed in this Draft Environmental Impact Statement (EIS) / Overseas Environmental Impact Statement (OEIS) (hereafter referred to as "EIS/OEIS").

Organization of this Appendix

The Appendix contains:

- An overview of each of the Navy's Primary Mission Areas (PMARS),
- A Table listing and briefly describing the 53 types of training and RDT&E events analyzed in the EIS/OEIS, categorized by PMAR, and
- A detailed description of each of the 53 types of training and RDT&E events.

Primary Mission Areas

Anti-Air Warfare (AAW) Training

AAW is the PMAR that addresses combat operations by air and surface forces against hostile aircraft. Navy ships contain an array of modern anti-aircraft weapon systems, including naval guns linked to radar-directed fire-control systems, surface-to-air missile systems, and radar-controlled cannon for close-in point defense. Strike/fighter aircraft carry anti-aircraft weapons, including air-to-air missiles and aircraft cannon. AAW training encompasses events and exercises to train ship and aircraft crews in employment of these weapons systems against simulated threat aircraft or targets. AAW training includes surface-to-air gunnery surface-to-air and air-to-air missile exercises and aircraft force-on-force combat maneuvers

Anti-Submarine Warfare (ASW) Training

ASW involves helicopter and sea control aircraft, ships, and submarines, operating alone or in combination, in operations to locate, track, and neutralize submarines. Controlling the undersea battlespace is a unique naval capability and a vital aspect of sea control. Undersea battlespace dominance requires proficiency in ASW. Every deploying strike group and individual surface combatant must possess this capability.

Various types of active and passive sonars are used by the Navy to determine water depth, locate mines, and identify, track, and target submarines. Passive sonar "listens" for sound waves by using underwater microphones, called hydrophones, which receive, amplify and process underwater sounds. No sound is introduced into the water when using passive sonar. Passive sonar can indicate the presence, character and movement of submarines. However, passive sonar provides only a bearing (direction) to a sound-emitting source; it does not provide an accurate range (distance) to the source. Active sonar is needed to locate objects because active sonar provides both bearing and range to the detected contact (such as an enemy submarine).

Active sonar transmits pulses of sound that travel through the water, reflect off objects and return to a receiver. By knowing the speed of sound in water and the time taken for the sound wave to travel to the object and back, active sonar systems can quickly calculate direction and distance from the sonar platform to the underwater object. There are three types of active sonar.

- High-frequency active sonar, which operates at frequencies greater than 10 kilohertz (kHz). At higher acoustic frequencies, sound rapidly dissipates in the ocean environment, resulting in short detection ranges, typically less than five nm. High-frequency sonar is used primarily for determining water depth, hunting mines and guiding torpedoes.

- Mid-frequency active sonar operates between 1 and 10 kHz, providing an optimal balance of detection range and resolution. Typical mid-frequency sonar detection ranges are up to 10 nautical miles making it the primary tool for conducting anti-submarine warfare.
- Low-frequency sonar operates below 1 kHz and is designed to detect extremely quiet diesel-electric submarines at ranges far beyond the capabilities of mid-frequency active sonars. There are only two ships in use by the U.S. Navy that are equipped with low frequency sonar; both are ocean surveillance vessels operated by Military Sealift Command.

The Navy's ASW training plan, including the use of active sonar in at-sea training scenarios, includes multiple levels of training. Individual-level ASW training addresses basic skills such as detection and classification of contacts, distinguishing discrete acoustic signatures including those of ships, submarines, and marine life, and identifying the characteristics, functions, and effects of controlled jamming and evasion devices.

More advanced, integrated ASW training exercises involving active sonar is conducted in coordinated, at-sea operations during multi-dimensional training events involving submarines, ships, aircraft, and helicopters. This training integrates the full anti-submarine warfare continuum from detecting and tracking a submarine to attacking a target using either exercise torpedoes or simulated weapons. Training events include detection and tracking exercises (TRACKEX) against "enemy" submarine contacts; torpedo employment exercises (TORPEX) against the target; and exercising command and control tasks in a multi-dimensional battlespace.

Anti-Surface Warfare (ASUW) Training

ASUW is a type of naval warfare in which aircraft, surface ships, and submarines employ weapons, sensors, and operations directed against enemy surface ships or boats. Aircraft-to-surface ASUW is conducted by long-range attacks using air-launched cruise missiles or other precision guided munitions, or using aircraft cannon. ASUW also is conducted by warships employing torpedoes, naval guns, and surface-to-surface missiles. Submarines attack surface ships using torpedoes or submarine-launched, anti-ship cruise missiles. Training in ASUW includes surface-to-surface gunnery and missile exercises, air-to-surface gunnery and missile exercises, and submarine missile or torpedo launch events. Training generally involves expenditure of ordnance against a towed target. A sinking exercise (SINKEX) is a specialized training event that provides an opportunity for ship, submarine, and aircraft crews to deliver live ordnance on a deactivated vessel, which is deliberately sunk using multiple weapons systems.

ASUW also encompasses maritime interdiction, that is, the interception of a suspect surface ship by a Navy ship for the purpose of boarding-party inspection or the seizure of the suspect ship. Training in these tasks is conducted in Visit, Board, Search and Seizure exercises.

Amphibious Warfare (AMW) Training

AMW is a type of naval warfare involving the utilization of naval firepower and logistics, and Marine Corps landing forces to project military power ashore. AMW encompasses a broad spectrum of operations involving maneuver from the sea to objectives ashore, ranging from reconnaissance or raid missions involving a small unit, to large-scale amphibious operations involving over one thousand Marines and Sailors, and multiple ships and aircraft embarked in a Strike Group.

AMW training includes tasks at increasing levels of complexity, from individual, crew, and small unit events to large task force exercises. Individual and crew training include the operation of amphibious vehicles and naval gunfire support training. Small-unit training operations include events leading to the certification of a Marine Expeditionary Unit (MEU) as “Special Operations Capable” (SOC). Such training includes shore assaults, boat raids, airfield or port seizures, and reconnaissance. Larger-scale amphibious exercises involve ship-to-shore maneuver, shore bombardment and other naval fire support, and air strike and close air support training.

Electronic Combat (EC) Training

EC is the mission area of naval warfare that aims to control use of the electromagnetic spectrum and to deny its use by an adversary. Typical EC activities include threat avoidance training, signals analysis for intelligence purposes, and use of airborne and surface electronic jamming devices to defeat tracking systems.

Mine Warfare (MIW) Training

MIW is the naval warfare area involving the detection, avoidance, and neutralization of mines to protect Navy ships and submarines, and offensive mine laying in naval operations. A naval mine is a self-contained explosive device placed in water to destroy ships or submarines. Naval mines are deposited and left in place until triggered by the approach of or a contact with an enemy ship, or are destroyed or removed. Naval mines can be laid by purpose-built minelayers, other ships, submarines, or airplanes. MIW training includes Mine Countermeasures (MCM) Exercises and Mine Laying Exercises (MINEX).

Naval Special Warfare (NSW) Training

NSW forces (SEALs and Special Boat Units [SBUs]) train to conduct military operations in five Special Operations mission areas: unconventional warfare, direct action, special reconnaissance, foreign internal defense, and counterterrorism. NSW training involves specialized tactics, techniques, and procedures, employed in training events that include: insertion/extraction operations using parachutes rubber boats, or helicopters; boat-to-shore and boat-to-boat gunnery; demolition training on land or underwater; reconnaissance; and small arms training.

Strike Warfare (STW) Training

STW operations include training of fixed-wing fighter/attack aircraft in delivery of precision guided munitions, non-guided munitions, rockets, and other ordnance against land targets in all weather and light conditions. Training events typically involve a simulated strike mission with a flight of four or more aircraft. The strike mission may simulate attacks on “deep targets” (i.e., those geographically distant from friendly ground forces), or may simulate close air support of targets within close range of friendly ground forces. Laser designators from aircraft or ground personnel may be employed for delivery of precision guided munitions. Some strike missions involve no-drop events in which prosecution of targets is simulated, but video footage is often obtained by onboard sensors.

Combat Search and Rescue (CSAR) is a strike warfare operation with the purpose of training aircrews to locate, protect, and evacuate downed aviation crew members from hostile territory. The operation can include reconnaissance aircraft to find the downed aircrew, helicopters to conduct the rescue, and fighter aircraft to perform close air support to protect both the downed aircrews and the rescue helicopters.

Explosive Ordnance Disposal (EOD) Activities

The EOD mission area involves employment of skills, tactics, and equipment designed to safely render unexploded ordnance (UXO). EOD personnel are highly trained and operate in both tactical and administrative capacities. Tactical missions include safe disposal of improvised explosive devices. Administrative missions include range clearance and ordnance safety in support of operational forces.

U.S. Coast Guard Training

Coast Guard Sector San Diego, a shore command within the Coast Guard 11th District, carries out its mission to serve, protect and defend the American public, maritime infrastructure and the environment. The Sector San Diego Area of Responsibility (AOR) extends southward from the Dana Point harbor to the border with Mexico. Equipment utilized by the Coast Guard includes 25-ft response boats, 41-ft utility boats and 87-ft patrol boats, as well as HH-60 helicopters. Training events include: search and rescue, maritime patrol training, boat handling, and helicopter and surface vessel live-fire training with small arms.

Naval Auxiliary Landing Field (NALF) SCI Airfield Activities

NALF SCI provides opportunities for aviation training and aircraft access to the island. The airfield is restricted to military aircraft and authorized contract flights. There are no permanently assigned aircraft, and aviation support is limited essentially to refueling. NALF SCI has the primary mission of training Naval Air Force Pacific aircrews in Field Carrier Landing Practice (FCLP). FCLP involves landing on a simulated aircraft carrier deck painted on the surface of the runway near its eastern end. Other military activities include visual and instrument approaches and departures, aircraft equipment calibration, survey and photo missions, range support, exercise training, RDT&E test support, medical evacuation, and supply and personnel flights.

RDT&E Events

Space and Naval Warfare Systems Center (SPAWARSYSCEN) conducts RDT&E, engineering, and fleet support for command, control, and communications systems and ocean surveillance. Space and Naval Warfare System's (SPAWAR's) tests on SCI include a wide variety of ocean engineering, missile firings, torpedo testing, manned and unmanned submersibles, Unmanned aerial vehicles (UAVs), EC, and other Navy weapons systems. Specific events include:

- Ship Tracking and Torpedo Tests;
- Unmanned Underwater Vehicle (UUV) Tests;
- Sonobuoy Quality Assurance (QA)/Quality Control (QC) Tests;
- Ocean Engineering Tests;
- Marine Mammal Mine Shape Location and Research; and
- Missile Flight Tests;

The San Diego Division of the Naval Undersea Warfare Center is a Naval Sea Systems Command (NAVSEA) organization supporting the Pacific Fleet. NUWC operates and maintains the SCI Underwater Range (SCIUR). NUWC conducts tests, analysis, and evaluation of submarine USW exercises and test programs. NUWC also provides engineering and technical support for Undersea Warfare (USW) programs and exercises, design cognizance of underwater weapons acoustic and tracking ranges and associated range equipment, and provides proof testing and evaluation for underwater weapons, weapons systems, and components.

Table A-1: Training and RDT&E Activities on the SOCAL Range Complex

Navy Warfare Area	No.	Operation Type	Summary
Anti-Air Warfare	**1**	Aircraft Combat Maneuvers	Trains fighter crews in basic flight maneuvers and advanced air combat tactics. Participants are from two or four aircraft. No weapons are fired.
	2	Air Defense Exercise	Coordinated operations involving surface ships and aircraft, training in radar detection, and simulated airborne and surface firing. No weapons are fired.
	3	Surface-to-Air Missile Exercise	Live-firing event from a surface ship to an aerial target. Weapons employed are Rolling Airframe Missile (RAM) and STANDARD missile. Aerial targets are drones recovered via parachute and small boat.
	4	Surface-to-Air Gunnery Exercise	Surface-to-air live-fire gunnery at aerial target that simulates a threat aircraft or missile. Weapons include the 5-inch naval gun, 76 mm and 20 mm cannon, and 7.62 machine guns.
	5	Air-to-Air Missile Exercise	Fighter/attack aircraft firing against an aerial target that simulates an enemy aircraft. Missiles include AIM-7 SPARROW, AIM-9 SIDEWINDER, and AIM-120 AMRAAM.
Anti-Submarine Warfare	**6**	Antisubmarine Warfare Tracking Exercise - Helicopter	Trains helicopter crews in anti-submarine search, detection, localization, classification and track. Two primary targets: recoverable MK 30 and expendable MK 39. The target simulates a submarine at varying depths and speeds. SH-60 crews drop sonobuoys to detect and localize the target.

Navy Warfare Area	No.	Operation Type	Summary
	7	Antisubmarine Warfare Torpedo Exercise - Helicopter	Trains SH-60 crews in employment of air-launched torpedoes. Aircrew drops an inert, running exercise torpedo or a non-running practice torpedo against ASW targets.
	8	Antisubmarine Warfare Tracking Exercise - Maritime Patrol Aircraft	Trains patrol aircraft crews in anti-submarine search, detection, localization, classification and track. Employs multiple sensor systems against a submarine simulating a threat.
	9	Antisubmarine Warfare Torpedo Exercise - Maritime Patrol Aircraft	Trains patrol aircraft crews in employment of air-launched torpedoes. Aircrew drops an inert, running exercise torpedo or a non-running practice torpedo against ASW targets.
	10	Antisubmarine Warfare EER / IEER sonobuoy employment	Trains patrol aircraft crews in deployment and use of Extended Echo Ranging (EER) and Improved EER (IEER) sonobuoy systems.
	11	Antisubmarine Warfare Tracking Exercise - Surface	Trains ship crews in anti-submarine search, detection, localization, classification, track and attack. ASW targets simulate a submarine at varying depths and speeds. Ships crews and SH-60 helicopter crews employ sensors to detect and localize the target.
	12	Antisubmarine Warfare Torpedo Exercise - Surface	Trains ship crews in anti-submarine search, detection, localization, classification, track and attack. One or more torpedoes are dropped/fired in this exercise. Includes Integrated ASW Phase 2 (IAC II).
	13	Antisubmarine Warfare Tracking Exercise - Submarine	Trains submarine crews in ASW using passive sonar (active sonar use is tactically proscribed), No ordnance expended in this exercise.

Navy Warfare Area	No.	Operation Type	Summary
	14	Antisubmarine Warfare Torpedo Exercise - Submarine	Submarine exercise training Tactical Weapons Proficiency, lasting 1-2 days and multiple firings or exercise torpedoes. Attacking submarines use only passive sonar.
Anti-Surface Warfare	**15**	Visit Board Search and Seizure	Training in interception of a suspect surface craft by a naval ship for the purpose of inspection for illegal activities. Helicopters, surface ships and small boats participate. Small arms may be fired.
	16	Air-Surface Missile Exercise	Ships, helicopters and fighter/attack aircraft expend precision-guided munitions against maneuverable, high-speed, surface targets. The missiles used in this operation are the AGM-114 (Hellfire) and the Harpoon. Small arms are also fired from helicopters.
	17	Air-to-Surface Bombing Exercise	Trains fighter or patrol aircraft crews in delivery of bombs against surface vessels. Involves in-flight arming and releasing of bombs in accordance with appropriate tactics and drop restrictions. These include; Laser-Guided Training Round (LGTR) and Glide Bomb Units (GBUs) 12, 16 and 32i.
	18	Air-to-Surface Gunnery Exercise	Trains helicopter crews in daytime aerial gunnery operations with the GAU-16 (.50 cal) or M-60 (7.62 mm) machine gun.
	19	Surface-to-Surface Gunnery Exercise	Trains surface ship crews in high-speed engagement procedures against mobile seaborne targets, using 5-inch guns, 25 mm cannon, or .50 cal machine guns.
	20	Sink Exercise	Trains ship and aircraft crews in delivering live ordnance on a real, seaborne target, namely a large deactivated vessel, which is deliberately sunk using multiple weapon systems. The ship is cleaned,

Navy Warfare Area	No.	Operation Type	Summary
			environmentally remediated and empty. It is towed to sea and set adrift at the exercise location. The precise duration of a SINKEX is variable, ending when the target sinks, whether after the first weapon impacts or and after multiple impacts.
Amphibious Warfare	**21**	Naval Surface Fire Support	Trains ship crews in naval gunnery against shore targets. Training Naval Gunfire Spotters located ashore to direct the fires of naval guns.
	22	Expeditionary Fires Exercise	USMC field training in integration of close air support, naval gunfire, artillery, and mortars.
	23	Expeditionary Assault - Battalion Landing	Proposed training event for a Marine Corps battalion-sized unit (1,500 personnel). This live-fire exercise would last up to 4 days, employ the full combined arms team of a MEU, and occur up to two times per year. The amphibious forces would land by helicopter (primarily CH-46s) and across the beach. Amphibious landings would use rubber boats, and amphibious crafts and vehicles.
	24	Stinger Firing Exercise	Trains Marine Corps personnel in employment of man-portable air defense systems with the Stinger missile. This is a ground-launched missile firing exercise against a small aerial target.
	25	Amphibious Landings and Raids (on SCI)	Trains Marine Corps forces in small unit live-fire and non-live-fire amphibious operations from the sea onto land areas of SCI.
	26	Amphibious Operations - CPAAA	Trains Marine Corps small units including assault amphibian vehicle units and small boat units in amphibious operations.

Navy Warfare Area	No.	Operation Type	Summary
Electronic Combat	**27**	Electronic Combat Operations	Signal generators on SCI and commercial air services provide air, surface and subsurface units with operating experience in electronic combat, using emitters and electronic and communications jammers to simulate threats.
Mine Warfare	**28**	Mine Countermeasures Exercise	Surface ship uses all organic mine countermeasures, including sonar, to locate and avoid mines. No weapons are fired. Future operations would also use unmanned side-scan sonar systems and be conducted in SWTR Offshore near the Tanner/Cortez Banks.
	29	Mine Neutralization	Training of crews of ships, patrol aircraft, and helicopters crews in mine neutralization
	30	Mine Laying	Training of fighter/attack and patrol aircraft crews in aerial mine laying.
Naval Special Warfare	**31**	NSW Land Demolition	Training of NSW personnel in construction, emplacement and safe detonation of explosives for land breaching and demolition of buildings and other facilities.
	32	Underwater Demolition-Single Point Source Charge	Training of NSW personnel to construct, emplace and safety detonate single charge explosives for underwater obstacle clearance.
	33	Underwater Demolition Multiple Charge - Mat Weave and Obstacle Loading	Training of NSW personnel to construct, emplace and safety detonate multiple charges laid in a pattern for underwater obstacle clearance.
	34	Small Arms Training and GUNEX	Training of NSW personnel in employment of small arms up to 7.62 mm.
	35	Land Navigation	Training of NSW personnel in land navigation techniques.
	36	NSW UAV / UAS Operations	Training of NSW personnel in employment of unmanned aerial vehicles.
	37	Insertion/Extraction	Training of NSW personnel in covert insertion and extraction

Navy Warfare Area	No.	Operation Type	Summary
			into target areas, using boats, aircraft, and parachutes.
	38	NSW Boat Operations	Training of NSW Special Boat Teams in open-ocean operations, and firing from boats, including into land impact areas of SCI.
	39	SEAL Platoon Operations	SEAL Platoon live-fire training in special operations tactics, techniques and procedures
	40	NSW Direct Action	Training of NSW personnel in live-fire events involving insertion, movement to and actions on the objective, and extraction. May engage close air support and NSFS.
Strike	**41**	Bombing Exercise (Land)	Training of fighter/attack crews in bombing of land targets on SCI, using precision guided munitions and unguided munitions. Typical event involves 2-4 aircraft.
	42	Combat Search & Rescue	Training of aircrews, submarine, an NSW forces in rescue of military personnel in a simulated hostile area.
Explosive Ordnance Disposal	**43**	Explosive Ordnance Disposal SCI	Training of EOD teams to locate and neutralize or destroy unexploded ordnance.
U.S. Coast Guard	**44**	Coast Guard Training	Training in SOCAL OPAREA.
Air Operations-Other	**45**	NALF Airfield Activities	Flight training (e.g., landing and takeoff practice) of aircrews utilizing NALF airfield.
RDT&E	**46**	Ship Torpedo Tests	Test event for reliability, maintainability, and performance of torpedoes used in training (REXTORPS and EXTORPS) and operational torpedoes.
	47	Unmanned Underwater Vehicles	Development and operational testing of UUVs.
	48	Sonobuoy QA/QC Testing	Test event for reliability, maintainability, and performance of lots of sonobuoys.
	49	Ocean Engineering	Test event for reliability, maintainability, and performance of marine

Navy Warfare Area	No.	Operation Type	Summary
			designs.
	50	Marine Mammal Mine Shape Location/Research	Events in which marine mammals (primarily porpoises) are trained to locate and mark inert mineshapes.
	51	Missile Flight Tests	Missile testing in which land attack missiles are launched from within SOCAL Range Complex, to impact at SCI or at another range complex outside SOCAL.
	52	NUWC Underwater Acoustics Testing	Test events to evaluate acoustic and non-acoustic ship sensors.
	53	Other Tests	Diverse RDT&E activities.
Major Range Events	NA	Major exercises	Comprised of multiple range events, identified above*

Detailed Operations Descriptions

1. Air Combat Maneuvers (ACM)

ACM is the general term used to describe an air-to-air (A-A) event involving two or more strike / fighter aircraft. Aircraft perform intricate flight maneuvers to achieve a gun or missile firing position from which an attack can be made on a threat aircraft with the goal of destroying the adversary aircraft. No ordnance is expended during ACM operations.

ACM training consists of:

- Basic fighter maneuvering, in which two aircraft will engage in offensive and defensive maneuvering practice against each other.
- Intermediate and advanced offensive and defensive counter air training, in which three or more aircraft will engage in offensive and defensive maneuvering. Participating aircraft will be separated at the start by distances up to 50 nm. These exercises which may also occur in the context of major range events, involve high airspeeds (from high subsonic to supersonic) and rapidly changing aircraft altitudes and attitudes.

The preferred ACM training location is on an range located within a Warning Area or Restricted Airspace, instrumented with systems having the capability to precisely track and record the location of aircraft conducting maneuvers on the range.

2. Air Defense Exercise (ADEX)

ADEXs consist of air-to-air and surface-to-air missile training events. These operations are coordinated between surface ships and aircraft. Tasks include radar detection, positioning, maneuver to a simulated airborne of surface firing position, and recovery of aircraft aboard an aircraft carrier. Air-to-air refueling may be included. These operations vary widely in the numbers of ships and aircraft involved and consist of a full array of tactics and procedures that are practiced between air and surface units for defense of the force. No ordnance is expended during ADEX operations.

3. Surface to Air Missile Exercise (MISSILEX (S-A))

The MISSILEX (S-A) is a basic event to train surface ships' crews to engage threat missiles and aircraft with missiles with the goal of disabling or destroying the threat. The threat is simulated by a target towed behind a commercial air services Lear jet, or by a specialized BQM-74 target (a remote controlled target drone, with a parachute to enable recovery at sea). An exercise typically lasts 2 to 3 hours.

Aircraft carrier crews typically will expend one live or telemetered-inert-missile in the course of the MISSILEX (SA). Other ships and their crews typically will not expend ordnance, but will conduct a "detect to engage exercise," simulating firing of a missile.

4. Surface-to-Air Gunnery Exercise (GUNEX (S-A)

The GUNEX (S-A) is a basic event to train surface ships' crews to engage threat missiles and aircraft with gun systems with the goal of disabling or destroying the threat. A target simulating a threat aircraft or missile is deployed on a heading toward the ship. The target tow by a commercial air services Lear jet. Weapons crews practice tracking the target, and also engage the target using main battery guns (5-inch or 76 mm naval guns), or the Close-In Weapon System (CIWS). The exercise lasts about two hours, and typically includes several non-firing tracking runs followed by one or more (up to five) firing runs. The target must maintain an altitude above 500 ft for safety reasons and is not destroyed during the exercise.

Typically six rounds of 5-inch Variable Timed, Non-Fragmentation (VTNF) ammunition and 12 rounds of 76 mm ordnance per gun mount are expended by each main battery gun mount involved in the exercise. CIWS-equipped ships can expend between 900 to 1400 rounds per mount per firing run for each firing run. The CIWS fires a 20 mm inert, projectile made of tungsten. The number of CIWS rounds expended during this exercise varies depending on the ship class, the CIWS model installed, and the available ammunition allowance.

5. Air-to-Air Missile Exercise (MISSILEX (A-A))

The MISSLEX (A-A) is a basic event to strike fighter aircraft crews to attack a simulated threat target aircraft with air-to-air missiles. The target is an unmanned aerial target drone (BQM-34 or BQM-74) or Tactical Air-Launched Decoy (TALD). BQM targets deploy parachutes, float on the surface of the water, and are recovered by boat. TALDs are expended. The exercise lasts about one hour, is conducted in a Warning Area at sea outside of 12 nm at typical altitudes of 15,000 to 25,000 ft. In the exercise, a flight of two aircraft operating at high speeds approach a target from several miles away and, when within missile range, launch live or inert-telemetry missiles against the target. Missiles fired are not recovered.

6. Antisubmarine Warfare Tracking Exercise–Helicopter (ASW TRACKEX-Helo)

ASW TRACKEX-Helo involves helicopters using sonobuoys and dipping sonar to search for, detect, classify, localize, and track a simulated threat submarine with the goal of determining a firing solution that could be used to launch a torpedo and destroy the submarine.

Sonobuoys are typically employed by a helicopter operating at altitudes below 3,000 ft. Sonobuoys are deployed in specific patterns based on the expected threat submarine and specific water conditions. These patterns will cover many different size areas, depending on these two factors. Both passive and active sonobuoys are employed. For certain sonobuoys, tactical parameters of use may be classified.

The dipping sonar is employed from an altitude of about 50 ft after the search area has been narrowed based on the an sonobuoy search. Both passive and active sonar are employed. As the location of the submarine is further narrowed, a Magnetic Anomaly Device (MAD) is used by the SH-60B to further confirm and localize the target's location.

The target for this exercise is either an Expendable Mobile ASW Training Target (EMATT) or live submarine and may be either non-evading and assigned to a specified track, or fully evasive depending on the state of training of the helicopter. The ASW TRACKEX-Helo usually takes one to two hours. No ordnance is expended. This exercise may involve a single aircraft, or be undertaken in the context of a coordinated larger exercise involving multiple aircraft and/ or ships, including a major range event.

7. Antisubmarine Warfare Torpedo Exercise–Helicopter (ASW TORPEX-Helo)

The ASW TORPEX-Helo involves helicopters using sonobuoys and dipping sonar to search for, detect, classify, localize, and track a simulated threat submarine, as in the ASW TRACKEX-Helo. The TORPEX proceeds to the release of an exercise torpedo against the target, which is typically an EMATT or MK-30 target system.

8. Antisubmarine Warfare Tracking Exercise–Maritime Patrol Aircraft (ASW TRACKEX-MPA)

The ASW TRACKEX-MPA involves fixed-wing maritime patrol aircraft (MPA) employing sonobuoys to search for, detect, classify, localize, and track a simulated threat submarine with the goal of determining a firing solution that could be used to launch a torpedo and destroy the submarine.

Sonobuoys are typically employed by an MPA operating at altitudes below 3,000 ft. Sonobuoys are deployed in specific patterns based on the expected threat submarine and specific water conditions. These patterns will cover many different size areas, depending on these two factors. Both passive and active sonobuoys are employed. For certain sonobuoys, tactical parameters of use may be classified. A sonobuoy field pattern delivered by an MPA will typically be much larger than a helicopter pattern, as the MPA can carry and deploy more buoys than a helicopter, and can monitor more buoys at one time. The MPA operates at higher altitudes, allowing monitoring the buoys over a larger search pattern area.

The target for this exercise is either an EMATT or live submarine and may be either non-evading and assigned to a specified track, or fully evasive depending on the state of training of the helicopter. The ASW TRACKEX-MPA usually takes two to four hours. No ordnance is expended. This exercise may involve a single aircraft, or be undertaken in the context of a coordinated larger exercise involving multiple aircraft and/ or ships, including a major range event.

9. Antisubmarine Warfare Torpedo Exercise–Maritime Patrol Aircraft (ASW TORPEX-MPA)

The ASW TORPEX-MPA involves patrol aircraft using sonobuoys to search for, detect, classify, localize, and track a simulated threat submarine, as in the ASW TRACKEX-Helo. Additionally, the TORPEX proceeds to the release of an exercise torpedo against the target, which is typically an EMATT or MK-30 target system.

10. Antisubmarine Warfare-Extended Echo Ranging (EER) / Improved EER (IEER) Training

This training event is an at-sea flying exercise designed to train MPA crews in the deployment and use of the Extended Echo Ranging (EER) and Improved EER (IEER) sonobuoy systems. These systems both use the SSQ-110 source. An EER event and an IEER event differ in the number and type of sonobuoys used. The EER event uses the SSQ-77 as the receiver buoy, while the SSQ-101 is the receiver buoy during IEER events. Both use the SSQ-110A sonobuoy as the signal source.

11. Antisubmarine Warfare Tracking Exercise–Surface (ASW TRACKEX-Surface)

The ASW TRACKEX-Surface involves a surface ship employing hull mounted and/or towed array sonar against a target which may be an EMATT or live submarine. The target may be either non-evading and assigned to a specified track or fully evasive depending on the state of training of the ship and crew. Passive and active sonar may be employed depending on the type of threat submarine, the tactical situation, and water conditions that may affect sonar effectiveness. Active sonar transmits at varying power levels, pulse types, and intervals, while passive sonar listens for noise emitted by the threat submarine. Passive sonar is typically employed first for tactical reasons, followed by active sonar to determine an exact target location; however, active sonar may be employed during the initial search phase against an extremely quiet submarine or in situations where the water conditions do not support acceptable passive reception. There is no ordnance expended in this exercise. An ASW TRACKEX-Surface usually lasts two to four hours. This exercise may involve a single ship, or be undertaken in the context of a coordinated larger exercise involving multiple aircraft and/ or ships, including a major range event.

12. Antisubmarine Warfare Torpedo Exercise–Surface (ASW TORPEX-Surface)

The ASW TORPEX-Surface involves a surface ship using hull-mounted and towed sonar arrays to search for, detect, classify, localize, and track a simulated threat submarine, as in the ASW TRACKEX-Surface. Additionally, the TORPEX proceeds to the release of an exercise torpedo against the target, which is typically an EMATT or MK-30 target system.

13. Antisubmarine Warfare Tracking Exercise–Submarine (ASW TRACKEX-Sub)

The ASW TRACKEX-Sub involves a submarine employing hull mounted and/or towed array sonar against a target which may be an EMATT or live submarine. During this event, passive sonar is used almost exclusively; active sonar use is tactically proscribed because it would reveal the tracking submarine’s presence to the target submarine. The preferred range for this exercise is an instrumented underwater training range with the capability to track the locations of submarines and targets, to enhance the after-action learning component of the training. There is no ordnance expended in this exercise. An ASW TRACKEX-Surface usually lasts two to four hours. This exercise may involve a single submarine, or be undertaken in the context of a coordinated larger exercise involving multiple aircraft, ships, and submarines, including a major range event.

14. Antisubmarine Warfare Torpedo Exercise–Submarine (ASW TORPEX-Sub)

The ASW TORPEX-Sub involves a submarine employing hull mounted and/or towed array sonar against a target which may be an EMATT or MK-30 Mobile ASW Target, followed by launch of a MK-48 exercise torpedo. The exercise torpedo is recovered by helicopter or small craft. The preferred range for this exercise is an instrumented underwater range, but it may be conducted in other operating areas depending on training requirements and available assets.

15. Visit, Board, Search, and Seizure (VBSS)

The VBSS involves training of boarding parties delivered by helicopters and surface ships to surface vessels for the purpose of simulating vessel search and seizure operations. Various training scenarios are employed. Small arms with inert blanks may be used. The entire exercise may last two to three hours.

16. Missile Exercise: Air-to-Surface (MISSILEX (A-S))

The MISSILEX (A-S) trains fixed winged aircraft and helicopter crews to launch missiles at surface maritime targets, day and night, with the goal of destroying or disabling enemy ships or boats.

In the typical helicopter event, one or two helicopters approach and acquire an at-sea surface target, which is then designated with a laser to guide the missile to the target. Specially prepared targets with an expendable target area on a stationary floating or remote controlled platform are employed. The missile passes through the expendable target without damaging the platform and explodes near the surface of the water. Live Hellfire missiles are expended.

In the typical fixed-wing event, a flight of two aircraft approach an at-sea surface target from an altitude dictated by the missile parameters. The majority of fixed-wing exercises involve the use of captive carry (inert, no release) training missiles; the aircraft perform all detection, tracking, and targeting requirements without actually releasing a missile. A MISSLEX (A-S) not involving live ordnance may involve a single aircraft, or be undertaken in the context of a coordinated larger exercise involving multiple aircraft, including a major range event. Live ordnance, if employed by a strike fighter aircraft would be either a SLAM-ER or Maverick missile. A patrol aircraft may launch SLAM-ER, Maverick, or Harpoon missiles. A MISSLEX (A-S) involving fixed-wing delivery of live ordnance typically will be carried out in conjunction with a SINKEX (see Event No. 20).

17. Bombing Exercise: Air-to-Surface (BOMBEX (A-S))

BOMBEX (A-S) involve training of strike fighter and MPA in delivery of bombs against surface maritime targets in day or night conditions.

Exercises for strike fighters typically involve a flight of two aircraft delivering unguided or guided munitions that may be either live or inert. Exercises at night will normally be done with captive carry (no drop) simulated guided weapons because of safety considerations. The very large safety footprints of precision guided munitions limit their employment to events at-sea, typically in conjunction with a SINKEX. The following munitions may be employed by strike fighter in the course of the BOMBEX: Unguided munitions: MK-76 and BDU-45 (inert training bombs); MK-80 series (inert or live); MK-20 Cluster Bomb (inert or live). Precision-guided munitions: Laser-guided bombs (LGB) (inert or live); Laser-guided Training Rounds (LGTR) (inert); Joint Direct Attack Munition (JDAM) (inert or live).

MPA use bombs to attack surfaced submarines and surface craft that would not present a major threat to the MPA itself. The MPA is larger and slower than an F/A-18, so its bombing tactics differ markedly. A single MPA approaches the target at a low altitude. MPA have the capability to deliver the following unguided munitions, which may be used in the BOMBEX: BDU-45 inert bomb; MK-82 (500 Lb bomb) (inert or live); MK-20 (Rockeye cluster bomb) (inert or live); CBU-99 (cluster bomb) (inert or live). In most training exercises, it drops inert training munitions, such as the BDU-45 on a MK-58 smoke float used as the target. This exercise may involve a single aircraft (MPA), a flight of two strike fighters, or be undertaken in the context of a coordinated larger exercise involving multiple aircraft and/ or ships, including a major range event or SINKEX.

18. Gunnery Exercise: Air-to-Surface (GUNEX (A-S))

GUNEX (A-S) involves training strike fighter aircraft or helicopters to employ guns to attack surface maritime targets in day or night. Sea targets simulate enemy ships, boats, or floating or near-surface mines. Land targets simulate enemy formations, vehicles or facilities. Exercises involving strike fighter aircraft typically involve a flight of two aircraft firing approximately 250 rounds of inert ammunition against either land (most often) or water targets. Helicopter exercises typically involve a single helicopter flying at an altitude between 50 ft to 100 ft in a racetrack pattern around an at-sea target. Several gunners will each expend about 200 rounds of .50 cal and 800 rounds of 7.62 mm ordnance in each exercise. 40mm grenades fired from hand-held weapons also may be expended. The target is normally a non-instrumented floating object such as an expendable smoke float, steel drum, or cardboard box, but may be a remote controlled speed boat or jet ski type target. Gunners will shoot special target areas or at towed targets when using a remote controlled target to avoid damaging them. The exercise lasts about 1 hour.

19. Gunnery Exercise: Surface-to-Surface, Boat (GUNEX (S-S Boat)

This exercises involves training of crews manning small boats to use a machine guns to attack and disable or destroy a surface target that simulates another ship, boat, floating mine or near shore land targets. A number of different types of boats are used depending on the unit using the boat and their mission. Boats are most used by Naval Special Warfare (NSW) teams and Navy Expeditionary Combat Command (NECC) units with a mission to protect ships in harbors and high value units, such as: aircraft carriers, nuclear submarines, liquid natural gas tankers, etc., while entering and leaving ports, as well as to conduct riverine operations, insertion and extractions, and various naval special warfare operations. The boats used by these units include: Small Unit River Craft (SURC), Combat Rubber Raiding Craft (CRRC), Rigid Hull Inflatable Boats (RHIB), Patrol Craft, and many other versions of these types of boats. These boats use inboard or outboard, diesel or gasoline engines with either propeller or water jet propulsion.

This exercise is usually a live fire exercise, but at times blanks may be used so that the boat crews can practice their ship handling skills for the employment of the weapons without being concerned with the safety requirements involved with live weapons. Boat crews may use high or low speeds to approach and engage targets simulating other boats, swimmers, floating mines, or near shore land targets with .50 cal, 7.62 mm, or 40 mm machine guns (about 200, 800, and 10 rounds respectively). The most common exercise target is a 50 gallon steel drum that is expended during the exercise and not recovered.

20. Gunnery Exercise: Surface-to-Surface, Ship (GUNEX (S-S Ship)

This exercise involves ships’ gun crews engaging surface targets at sea with their main battery 5-inch and 76 mm naval guns as well as small arms (25 mm, .50 cal, or 7.62 mm machine guns). There are three types of main battery shipboard guns currently in use: 5-inch/54, 5-inch/62, and 76 mm. Both 5-inch guns use the same types of 5-inch projectiles for training exercises. The difference between the 5-inch guns is the longer range of the 5-inch/62 because of the larger powder propulsion charge. Targets employed include the QST-35 Seaborne Powered Target (SEPTAR), High Speed Maneuverable Surface Target (HSMST), or a specially configured remote controlled water craft.

The exercise proceeds with the target boat approaching from about 10 nm distance. The target is tracked by radar, and when it is within five to nine nm, it is engaged by approximately 60 rounds of 5-inch or 76 mm, (fired with an offset so as not to actually hit the targets) over a period of about 3 hours. After impacting the water, the live rounds are expected to detonate within 3 ft of the surface. Inert rounds and fragments from the live rounds will sink to the bottom of the ocean.

This exercise may involve a single firing ship, or be undertaken in the context of a coordinated larger exercise involving multiple ships, including a major range event.

Ships use machine guns to practice defensive marksmanship, typically against stationary floating targets. The target is typically a 10-foot diameter red balloon tethered by a sea anchor, or a 50 gallon steel drum, or other available target, such as a cardboard box. Targets are expended during the exercise and are not recovered.

bombardment of a target within an impact area on SCI's Shore Bombardment Area (SHOBA), by one or more ships. The ship is often supported by Navy or Marine spotters ashore, or by spotters embarked in fixed-wing aircraft or helicopters in the air, to call for the fire support from the ship, and to adjust the fall of shot onto the target. Target shapes simulate vehicles, aircraft or personnel on the ground.

The ship positions itself in the NSFS area offshore of SCI about four to six nm from the target area to receive information concerning the target and the type and exact location of the target from the assigned spotter. One or more rounds are fired at the target. The fall of the round is observed by the spotter, who then tells the ship if the target was hit or if the ship needs to adjust where the next round should fall. More shots are fired, and once the rounds are falling on the target, then the spotter will request a larger number of rounds to be fired to effectively destroy the target. Typically five rounds are fired in rapid succession (about one round every five to seven seconds). Ten or more minutes will pass, and then similar missions will be conducted until the allocated number of rounds for the exercise has been expended.

About 70 rounds of 5-inch inert or high explosive ordnance (typically 53% live and 47% inert), in addition to about 5 rounds of illumination are expended during a NSFS FIREX. Portions of the exercise are conducted during both the day and the night to achieve full qualification. A ship will normally conduct three FIREXs at different levels of complexity over several months to become fully qualified.

A Shore Fire Control Party (SFCP) may consist of about 10 personnel who supply target information to the ship. From positions on the ground, the Navy, Marine, or NSW personnel who make up the SFCP provide the target coordinates at which the ship's crew directs its fire. As the rounds fall, the SFCP records where the rounds falls and provide adjustments to the fall of shot, as necessary, to ensure the target is "destroyed."

This exercise may involve a single ship, or be undertaken in the context of a coordinated larger exercise involving multiple ships, aircraft conducting BOMBEX or CAS missions in support of troops on the ground, and / or artillery located ashore on SCI including a major range event.

The locations and opportunities for live-fire from a ship at sea to targets ashore are very limited, and often the training range area is not adequate to establish and maintain surface fire support proficiency. A technology solution has been developed to precisely determine the impact of rounds fired at a simulated or virtual land area containing virtual targets located in the ocean, which enables ships to complete NSFS training in the absence of a land target or impact area. The current training system is called the VAST, which is supported by the Integrated Maritime Portable Acoustic Scoring and Simulation System (IMPASS). VAST is an onboard computer system that provides a realistic presentation, such as a land mass with topography, to the ship's systems. The scoring system is deployed by the firing ship and consists of five sonobuoys set in a pentagon-shaped arrangement at 1.3 km intervals. Within the ship's combat system, VAST creates a virtual land mass that overlays the array and simulates land targets. The ship fires its ordnance into this target area; the sonobuoys detect the bearing to the acoustic noise resulting from the impact of a high explosive or inert round landing in the water then transmit their GPS position and their bearing information to the ship. From the impact location data collected, the VAST computer triangulates the exact point of impact of the round, and, from that data, the exercise may be conducted as if the ship were firing at an actual land target. When the training is complete, the IMPASS buoy system is recovered by the ship.

The FIREX (VAST) exercise is conducted very similarity to the FIREX (Land) exercise from the ship perspective, even though the exercise is conducted completely at sea. Approximately 5 to 70 rounds of 5-inch inert or high explosive ordnance and five rounds of illumination are expended per exercise over several hours. All exercises are conducted in daylight and outside of 12 nm from land in order to have sufficient sea space to maneuver the ship and lay out the IMPASS sonobuoy pattern.

22. Expeditionary Fires Exercise (EFEX)/Supporting Arms Coordination Exercise (SACEX)

The EFEX/SACEX is a major training exercise oriented around NSFS and Marine artillery fires in support of ground amphibious operations. The mission of the exercises is to achieve effective integration of Naval gunfire, close air support, and artillery fire support. EFEX/SACEX is typically eight days long, during which the ESG commander runs a schedule-of-operations driven exercise. NSFS ships must have completed NSFS certification (see NSFS FIREX [#21] above) prior to commencement of the exercise.

An EFEX/SACEX is the final evaluation of amphibious warfare, conventional warfare, and special operations capability and serves as the formal pre-deployment coordination exercise of the supporting arms capabilities of Expeditionary Strike Group (ESG). This exercise involves employment of live ordnance by an artillery battery (six howitzers), 81 mm mortars (eight mortars), four AH-1Ws attack helicopters, six fixed wing strike fighter or attack aircraft, two NSFS ships, and associated spotting teams, controllers, and liaison personnel. Additional support elements can include an additional artillery battery for simulated naval gunfire and additional aircraft from a carrier air wing.

23. Infantry Battalion-Sized Amphibious Landing

Battalion landing operations are proposed for SCI because the island's challenging terrain, high plateaus, and shallow beaches provide the a superior littoral training environment, and the only range area in the U.S. inventory at which live NSFS may be coordinated with amphibious landing operations. Proposed operations would employ a Marine Air Ground Task Force of approximately 1,500 personnel including infantry, armored vehicle, logistics, command and control, and aviation personnel and their aircraft, vehicles, and other weapons systems. This exercise would last up to 4 days and occur up to two times per year. The amphibious forces would land by helicopter and across the beach by amphibious landing craft and amphibious vehicles This exercise may involve a single ship, or be undertaken in the context of a coordinated larger exercise involving multiple aircraft and/ or ships, including a major range event.

The concept of operations around which the Battalion Landing is being analyzed includes the following:

Day 1. An opposition force of one infantry company would land by helicopter at VC-3 and take up positions to defend the airfield. The company of about 140 would bivouac in the field, remaining within the Infantry Operations Area. A small reconnaissance unit (12 Marines) would land by rubber boat at Eel Cove and proceed on foot in tactical formation, across open country, not using established roadways.

Day 2. Multiple company-sized units embarked in boats, landing craft, or vehicles would land at Northwest Harbor, West Cove, Wilson Cove, and Horse Beach. These units would execute a coordinated attack on a designated objective such as VC-3, using the Infantry Operations Area as the boundary of their operation. Tanks, EFVs and other amphibious assault vehicles would remain in the AVMC. The size (width) of the AVMC is a critical factor in providing a realistic training venue for armored vehicles.

Day 3. Operations would continue across SCI in accordance with exercise objectives.

Day 4. Forces would redeploy off the island.

Aircraft would support all phases of the operation. Live-fire training operations would take place in day and night.

24. Stinger Missile Firing

The Stinger missile is a portable, shoulder fired weapon that also may be mounted on and fired from a vehicle. Stinger firing has occurred in the past; however not for several years. Proposed stinger training would be conducted from positions on-shore in SHOBA, toward the ocean, not over land, at target drones, either Ballistic Aerial Targets (BATs) or Remotely Piloted Vehicles (RPVs). The BAT is a solid-rocket, ground-launched glider target that is destroyed upon impact with the water and is not recovered. The RPV is a small, gasoline-powered aircraft and is remote controlled. The RPV can be used repeatedly, if not damaged by the missile. RPVs would land in SHOBA after the firing exercise. Training would occur predominantly in the daytime.

25. Amphibious Landings and Raids by Small Units

SCI supports training of small units of Marines or NSW personnel in the conduct of amphibious operations using small boats, amphibious craft or assault amphibian vehicles. Training includes both live-fire and non-live-fire events, including reconnaissance missions, raids, tactical recovery of aircraft and personnel (TRAP) exercises, assault amphibian vehicle landing events. These events typically involve units of from 12 to 40 personnel, and may be conducted across beaches at Wilson Cove, Horse Beach Cove, Northwest Harbor, and Eel Point, and in any of various training areas designated on SCI.

Amphibious Operations-Camp Pendleton Amphibious Assault Area (CPAAA)

The ocean area adjacent to Camp Pendleton is designated as the CPAAA. This area is utilized extensively for amphibious training by units of the 1st Marine Expeditionary Force, 1st Marine Division, and 1st Marine Logistics Group. Training events conducted by these operating forces in this area include: reconnaissance unit training, small boat unit training, assault amphibian vehicle crew and unit training, and Marine Expeditionary Unit (Special Operations Capable) events, and ESG training. Initial training to qualify marines to operate amphibian vehicles is conducted by the Assault Amphibian School Battalion in the CPAAA. Naval Beach Groups, which operate Landing Craft, Air Cushioned (LCAC) vehicles utilize the CPAAA for training. The Amphibian Vehicle Test Branch conducts RDT&E of vehicles including EFVs in the CPAAA. Events conducted in the CPAAA include:

- amphibious demonstrations
- amphibious raids
- amphibious assaults
- amphibious withdrawals
- basic amphibious training
- amphibious support training
- parachute operations
- submarine operations (wet deck/dry deck)
- diving operations
- scout swimmer training
- Tactical Recovery of Aircraft and Personnel (TRAP)

27. Electronic Combat (EC) Operations

These events train aircraft, surface ship, and submarine crews to control critical portions of the electromagnetic spectrum used by threat radars, communications equipment, and electronic detection equipment. EC operations can be active or passive, offensive or defensive.

Active EC uses radio frequency (RF) transmissions in the 2-12 gigahertz frequency spectrum to conduct jamming of threat equipment and deception through generation of false targets.

Passive EC uses the enemy's electromagnetic transmissions to obtain intelligence about their operations and to recognize and categorize enemy threats.

Offensive EC uses active or passive installed EC systems against enemy search, EC, and weapons systems.

Defensive EC uses active or passive installed EC systems in reaction to enemy threat systems. Missile, gun or search radar signals are common threat signals that can initiate an automatic response, including dispersion of chaff (very thin metal strips) and flares as decoys.

Navy units can conduct EC training in stand-alone events, involving few aircraft, or single ships or submarines, however EC operations typically are conducted in the context of a coordinated larger exercise involving multiple aircraft, ships, and submarines, including a major range event.

28 / 29. Mine Countermeasures (MCM) Training

MCM consists of mine avoidance training (#28) and mine neutralization training (#29). These events trains surface ships and aircraft to detect and either avoid or neutralize mines. Training utilizes simulated minefields constructed of moored or bottom mines, or instrumented mines that can record effectiveness of mine detection efforts. Mine or small object avoidance training for surface ships involves use of mid-frequency active sonar systems to detect mines. Submarines also have the capability to detect mines utilizing organic sonar; however, use of active sonar is tactically proscribed for submarines as it allows detection. Therefore, MCM training is primarily conducted by surface ships. Ship or submarine-mounted MFAS systems employed are:

- AN/SQS-53
- AN/SQS-56
- AN/SQQ-32
- AN/BQQ-5 or 10

Helicopters engage in airborne MCM training, utilizing specialized equipment including:

- AN/AQS-20 Mine Hunting System (employing side-looking sonar)
- AN/AES-1 Airborne Laser Mine Detection System
- AN/ALQ-220 Organic Airborne Surface Influence Sweep

MCM exercises typically last one or two hours for surface ships and helicopters, and may last up to 15 hours for specially configured MCM ships. Navy units typically conduct MCM training in stand-alone events, involving few aircraft, or single ships or submarines, however MCM training may occur in the context of a coordinated larger exercise involving multiple aircraft, ships, and submarines, including a major range event.

30. Mine Laying

Fixed-winged aircraft and submarines lay offensive or defensive mines to create a tactical advantage for friendly forces. Offensive mines prevent enemy shipping from leaving an enemy port or area, or supplies from entering an enemy port or area. Defensive mines protect friendly forces and facilities by preventing enemy forces from entering the friendly port or area.

At the basic level of training, fixed winged aircraft use precise navigation to lay a minefield pattern for a specific tactical situation. A flight of two strike fighter aircraft or a single MPA attempt to fly undetected to the area where the mines will be laid and use either a low or high altitude tactic to lay the mines. The aircrew typically drops a series of four inert training shapes (MK-76, BDU-45, or BDU-48), making multiple passes in the same flight pattern, and dropping one or more shapes each time. The shapes are scored for accuracy as they enter the water, and the aircrew is later debriefed on their performance. Advanced training scenarios involve multiple aircraft to evaluate the ability of an entire squadron to plan, load, and execute a mine-laying mission. The aircraft drop their shapes in a pre-determined pattern and return to the carrier or base. Since the final location of each mine shape is of tactical importance, the drops are scored and the shapes are recovered.

Submarine mine laying operations are typically "virtual" with no expenditure of any mine shape or any range requirements.

31. Land Demolitions

NSW or EOD personnel train in use of explosive charges to destroy land mines, explosives such as improvised explosive devices, unexploded ordnance, structures, or other items as required. The size of an explosive charge is defined in terms of net explosive weight (NEW). Charge sizes typically employed range from 1 to 20 pounds NEW.

32 / 33. Underwater Demolitions

NSW or EOD personnel use small explosive charges to destroy obstacles or other structures in an underwater area that could cause interference with friendly or neutral forces and planned operations. Underwater demolitions training involves either a single charge (#32) or multiple charges laid in a pattern. In atypical training scenario, NSW or EOD personnel locate barriers or obstacles designed to block amphibious vehicle access to beach areas, then use small explosive charges to destroy them. These training events typically use less than five pounds NEW of explosives which are detonated near the shoreline in water less than 21 ft deep.

34. Small Arms Training

Navy personnel training in the use small arms and small unit tactics to defend unit positions or attack simulated enemy positions. Small arms training exercises may include use of 9 mm pistols, 12-gauge shotguns, 5.56 mm automatic rifles, .50 caliber, 7.62 mm, 5.56 mm machine guns, and 40 mm grenades. Training involving live-fire of small arms may be conducted on marksmanship training ranges with fixed firing points and fixed targets, or may occur in free-play training events with firing positions dictated by the training scenario and use of mobile or pop-up targets. While small arms training events typically occur on designated ranges ashore on SCI, training of personnel also is conducted aboard surface ships at sea firing into the sea.

35. Land Navigation

Training in land navigation is conducted on SCI by individuals and small units on foot utilizing maps, compasses, and other navigation aids on established courses.

36. Unmanned Aerial Vehicle (UAV) Operations

Unmanned Aerial Vehicles (UAV) obtain information about the activities of an enemy or potential enemy or tactical area of operations by use of various onboard surveillance systems including: visual, aural, electronic, photographic, or other means. There are currently numerous types of UAVs employed to obtain intelligence data on threats. UAVs are typically flown at altitudes well above 3,000 ft in patterns to best collect the required data, yet remain beyond the reach threat weapon systems. The UAVs may be controlled by a pilot at a remote location, just as if the pilot were onboard, or may fly a preplanned, preprogrammed route from start to finish. Missions will typically last four to six hours, but will vary depending on the scheduled mission training. Training occurs in restricted airspace on and above SCI.

37. NSW Insertion / Extraction

NSW and other personnel train to approach or depart an objective area using various transportation methods and tactics. These operations train forces to insert and extract personnel and equipment day or night. Tactics and techniques employed include insertion from aircraft by parachute, by rope, or from low, slow-flying helicopters from which personnel jump into the water. Parachute training is required to be conducted on surveyed drop zones to enhance safety. Insertion and extraction methods also employ submarine deliver of personnel into the water, and small inflatable boats.

Insertion and extraction training typically is conducted in the context of additional related exercises, and such as direct action training of NSW personnel, live-fire small arms training, and NSFS spotter training.

38. NSW Boat Operations

NSW personnel assigned to Special Boat Units conduct training in open ocean and littoral operations, including in the vicinity of SCI. Training events include firing of crew-served machine guns and hand held weapons into land impact areas of SHOBA.

39. NSW SEAL Platoon Operations

NSW SEAL platoons perform special operations using tactics that are applicable to the specific tactical situations where the NSW personnel are employed. They are specially trained, equipped, and organized to conduct special operations in maritime, littoral, and riverine environments. SCI is a principal training venue for SEAL platoons and other NSW personnel. NSW training is continually evolving to meet the tactical requirements and special weapons required to complete the mission assigned. NSW personnel train to move covertly or overtly, by sea, air, or land, to an area of operation as the tactical situation demands and perform those tasks required to capture a site, destroy a target, rescue personnel, or perform a multitude of operations against hostile forces, using weapons required by the tactical situation. Opposing forces and targets within training range areas are utilized for realism. Typically, NSW personnel employ a variety of live fire or blank small arms and explosive ordnance in the course of training. SEAL platoon training may be conducted in isolation, or may occur in the context of larger-scale events and exercises, including major range events.

40. Direct Action

Direct action training is a specialized NSW event involving a squad or platoon size force of personnel inserted into and later extracted from a hostile area by helicopter, small boat or other means to conduct live-fire offensive actions against simulated hostile forces or targets. These offensive actions can include: raids, ambushes, standoff attacks, designating or illuminating targets for precision-guided munitions, providing support for cover and deception operations, and sabotage. Small arms such as 7.62 mm, 5.56 mm, 9 mm, 12-gauge, 40 mm grenades, laser illuminators, and other squad or platoon weapons are typically employed.

41. Bombing Exercise (Air-to-Ground) (BOMBEX (A-G))

BOMBEX (A-G) involves training of strike fighter aircraft or helicopter delivery of ordnance against land targets in day or night conditions. The BOMBEX may involve Close Air Support

(CAS) training in direct support of and in close proximity to forces on the ground, such as NSW or marine forces engaged in training exercises on SCI.

For strike fighter aircraft, in a typical exercise at the basic level, a flight of two aircraft will approach the target from an altitude of between 15,000 ft to less than 3,000 ft and, when on an established range, will usually establish a racetrack pattern around the target. The pattern is established in a predetermined horizontal and vertical position relative to the target to ensure that all participating aircraft follow the same flight path during their target ingress, ordnance delivery, target egress, and “downwind” profiles. This type of pattern is designed to ensure that only one aircraft will be releasing ordnance at any given time. The typical bomb release altitude is below 3,000 ft and within a range of 1,000 yards for unguided munitions; above 15,000 ft and may be in excess of 10 nm for precision-guided munitions. Exercises at night will normally be done with captive carry (no drop) weapons because of safety considerations. Laser designators from the aircraft dropping the bomb, a support aircraft, or ground support personnel are used to illuminate certified targets for use with lasers when using laser guided weapons.

Advanced-level training events for strike fighters typically involve a flight of four or more aircraft, with or without a designated opposition force. Participating aircraft attack the target using tactics which may require that several aircraft approach the target and deliver their ordnance simultaneously from different altitudes and/or directions. An E-2 aircraft is typically involved in this exercise from a command and control perspective, and an EA-18G aircraft may provide electronic combat support in major range events.

The following munitions may be employed by strike fighters in the course of the BOMBEX: Unguided munitions: MK-76 and BDU-45 (inert training bombs); MK-80 series (inert or live); MK-20 Cluster Bomb (inert or live). Precision-guided munitions: Laser-guided bombs (LGB) (inert or live); Laser-guided Training Rounds (LGTR) (inert); Joint Direct Attack Munition (JDAM) (inert or live). Rockets: 5-inch Zuni rockets.

Helicopter training involves one or two helicopters approaching an assigned target. The target is attacked with guns, Zuni rockets, or a Hellfire missile. A laser is used to guide a Hellfire missile to the target. The laser designator is either the one of the attacking aircraft or a designator team (typically NSW or Marine forces) on the ground. The helicopter launches one live missile per exercise from an altitude of about 300 ft while in forward flight or in a hover, against a specially prepared target. The target can be a stationary target or a remote controlled vehicle whose infrared signature has been augmented with a heat source to better represent a typical threat vehicle.

42. Combat Search and Rescue (CSAR)

CSAR training involves fixed-winged aircraft, helicopters and / or submarines using tactical procedures to rescue military personnel within a hostile area of operation. In a helicopter training scenario, helicopters fly below 3,000 ft the target area. Machine guns (7.62 mm or 5.56 mm) are mounted in the side door, and blank ammunition is normally used in this exercise. Chaff and flares may be expended if a surface-to-air or air-to-air threat or opposing force is employed to provide additional complexity. NSW personnel may be embarked during this exercise to act as the rescue party. This NSW squad would debark from the helicopter, "rescue" the personnel to be recovered, and return to the helicopter to be removed from the area. This basic exercise would last about one and a half hours. More advanced training would involve command and control aircraft and strike fighter aircraft in a role as a combat air patrol. In a submarine training scenario, the submarine proceeds to a specified location near land, locates the persons to be rescued, and surfaces to embark them. This exercise may involve a single helicopter or submarine, or be undertaken in the context of a coordinated larger exercise involving multiple aircraft and/ or ships, including a major range event.

43. Explosive Ordnance Disposal (EOD)

EOD personnel train to gain and maintain qualification and proficiency in locating, neutralizing or destroying unexploded ordnance (UXO) and conducting other hazardous range clearance activities. Removal of UXO is important for personnel safety and environmental sustainability of ranges. Operations are conducted in impact areas on SCI. These EOD activities are similar in nature to the activities described under the heading Land Demolition (# 31), the difference being that EOD range clearance actions are not undertaken in a tactical training environment, but are administrative in nature.

44. Coast Guard Training

Coast Guard Sector San Diego is a command within the Coast Guard 11th District. The Sector San Diego Area Of Responsibility (AOR) extends from the border with Mexico north to Dana Point. Coast Guard personnel regularly train in maritime rescue and patrol activities in the SOCAL Range Complex, using a variety of boats, small ships, and helicopters.

45. Naval Auxiliary Landing Field (NALF)

The NALF on SCI supports aviation events, including training and logistics activities. The primary training activity conducted at the NALF is Field Carrier Landing Practice (FCLP), which are characterized by touch-and-go practice in day and night conditions on a simulated aircraft carrier outline marked on the landing field. NALF also supports regular resupply and personnel transport aircraft runs between SCI and mainland bases.

46. Ship Torpedo Tests

This is a test event for reliability, maintainability, and performance of EXTORPS and REXTORPS. Events include torpedo firing.

47. Unmanned Underwater Vehicle Tests

These are in-water events for the development and operational testing of advanced designs of underwater vehicles, conducted in the vicinity of NOTS Pier.

48. Sonobuoy Quality Assurance and Quality Control Tests

This testing event evaluates random lots of sonobuoys and determine the quality of the set. The sonobuoys are dropped from an aircraft into the SCIUR area east of SCI. Defective buoys are recovered. All non-defective buoys are scuttled.

49. Ocean Engineering

Ocean engineering tests determine the characteristics, reliability, maintainability and endurance of various pieces of marine design. The items to be tested are left in the water off NOTS Pier for an extended period, and are monitored by Navy personnel.

50. Marine Mammal Mine Shape Location / Research

In this series of events, trained marine mammals are taught to locate and mark inert mine shapes. The marine mammals, most of which are porpoises, are penned and cared for at Naval Base Point Loma, and transported to SCI for mine location and applied research.

51. Missile Flight Tests

Missile flight test events confirm performance, reliability, maintainability and suitability for operational use of various missiles in the Navy inventory. Tests involve launches from operational ships and aircraft from within either the Point Mugu Sea Range or the SOCAL Range Complex against airborne targets in W-291, or land targets in the Missile Impact Range on SCI

52. Underwater Acoustic Sensor Tests

These tests are conducted to evaluate the accuracy of several acoustic and nonacoustic ship sensors. Tests occur at SCIUR.

53. Other Tests

The SOCAL Range Complex supports diverse tests including surface warfare tests against fast-moving, small boats, mine countermeasures, naval gunfire, electronic combat and combat systems verification. Testing is conducted primarily in the waters west of SCI.

1-42. Integrated Training and Major Range Events

A major range event is comprised of several "unit level" range operations conducted by several units operating together while commanded and controlled by a single commander. These exercises typically employ an exercise scenario developed to train and evaluate the Strike Group / Force in required naval tactical tasks. In a major range event, most of the operations and activities being directed and coordinated by the Strike Group commander are identical in nature to the operations conducted in the course in individual, crew, and smaller-unit training events. In a major range event, however, these disparate training tasks are conducted in concert, rather than in isolation.

Major range events include:

- Composite Training Unit Exercise (COMPTUEX). The COMPTUEX is an Integration Phase, at-sea, major range event. For the CSG, this exercise integrates the aircraft carrier and carrier air wing with surface and submarine units in a challenging operational environment. For the ESG, this exercise integrates amphibious ships with their associated air wing, surface ships, submarines, and MEU. Live-fire operations that may take place during COMPTUEX include long-range air strikes, Naval Surface Fire Support (NSFS), and surface-to-air, surface-to-surface, and air-to-surface missile exercises. The MEU also conducts realistic training based on anticipated operational requirements and to further develop the required coordination between Navy and Marine Corps forces. Special Operations training may also be integrated with the exercise scenario. The COMPTUEX is typically 21 days in length. The exercise is conducted in accordance with a schedule of events, which may include two 1-day, scenario-driven, “mini” battle problems, culminating with a scenario-driven 3-day Final Battle Problem. COMPTUEX occurs three to four times per year.
- JTFEX. The JTFEX is a dynamic and complex major range event that is the culminating exercise in the Sustainment Phase training for the CSGs and ESGs. For an ESG, the exercise incorporates an Amphibious Ready Group (ARG) Certification Exercise (ARG CERT) for the amphibious ships and a Special Operations Capable Certification (SOCCERT) for the MEU. When schedules align, the JTFEX may be conducted concurrently for an ESG and CSG. JTFEX emphasizes mission planning and effective execution by all primary and support warfare commanders, including command and control, surveillance, intelligence, logistics support, and the integration of tactical fires. JTFEXs are complex scenario-driven exercises that evaluate a strike group in all warfare areas. JTFEX is normally 10 days long, not including a 3-day in-port Force Protection Exercise, and is the final at-sea exercise for the CSG or ESG prior to deployment. JTFEX occurs three to four times per year.

Integrated unit-level training events, which pursue tailored training objectives for components of a Strike Group, are complex exercises of lesser scope than Major Range Events. This type of training includes:

- Ship ASW Readiness and Evaluation Measuring (SHAREM). SHAREM is a Chief of Naval Operations (CNO) chartered program with the overall objective to collect and analyze high-quality data to quantitatively "assess" surface ship ASW readiness and effectiveness. The SHAREM will typically involve multiple ships, submarines, and aircraft in several coordinated events over a period of a week or less. A SHAREM may take place once per year in SOCAL.

- Sustainment Exercise. Included in the FRTP is a requirement to conduct post-deployment training, and maintenance. This ensures that the components of a Strike Group maintain an acceptable level of readiness after returning from deployment. A sustainment exercise is an exercise designed to challenge the strike group in all warfare areas. This exercise is similar to a COMPTUEX but of shorter duration. One to two sustainment exercises may occur each year in SOCAL.
- Integrated ASW Course (IAC) Phase II. IAC exercises are combined aircraft and surface ship events. The IAC Phase II consists of two 12-hour events conducted primarily on SOAR over a 2-day period. The typical participants include four helicopters, two P-3 aircraft, two adversary submarines, and two Mk 30 or Mk 39 targets. Frequently, IACs include the introduction of an off-range Mk 30 target. Four IAC Phase II exercises may occur per year.

Appendix B

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DEPARTMENT OF COMMERCE

National Oceanic and Atmospheric Administration

[I.D. 121506A]

Endangered and Threatened Species; Initiation of a Status Review under the Endangered Species Act for the Atlantic White Marlin

AGENCY: National Marine Fisheries Service (NMFS), National Oceanic and Atmospheric Administration (NOAA), Commerce.

ACTION: Notice of initiation of a status review under the Endangered Species Act (ESA); request for information.

SUMMARY: We, NMFS, announce the initiation of a status review for the Atlantic white marlin (*Tetrapturus albidus*), and we solicit information on the status of and threats to the species.

DATES: Information regarding the status of and threats to the Atlantic white marlin must be received by February 20, 2007.

ADDRESSES: You may submit information on the Atlantic white marlin by any one of the following methods:

- Fax: 727–824–5309, Attention: Dr. Stephania Bolden
- Mail: Information on paper, disk or CD-ROM should be addressed to the Assistant Regional Administrator for Protected Resources, NMFS Southeast Regional Office, 263 13th Avenue South, St. Petersburg, FL 33701
- E-mail: *whitemarlin.info@noaa.gov*. Include in the subject line the following identifier: white marlin review

FOR FURTHER INFORMATION CONTACT: Dr. Stephania Bolden, NMFS, Southeast Regional Office (727) 824–5312, or Ms. Marta Nammack, NMFS, Office of Protected Resources (301) 713–1401.

SUPPLEMENTARY INFORMATION:

Background

We conducted a status review of the Atlantic white marlin under the ESA and published a 12-month determination that listing was not warranted (67 FR 57204; September 9, 2002). As a result of subsequent litigation and a settlement agreement with the Center for Biological Diversity, we agreed to initiate a status review following the 2006 stock assessment by the International Commission for the Conservation of Atlantic Tunas (ICCAT); the 2006 ICCAT white marlin stock assessment can be found at *www.iccat.int*. Atlantic white marlin are billfish (Family: Istiophoridae) found throughout tropical and temperate waters of the Atlantic Ocean and adjacent seas. White marlin, along with other billfish and tunas, are managed internationally by the member nations of the ICCAT. At this time we announce commencement of a new status review for the Atlantic white marlin, and request information regarding the status of and threats to the species, pursuant to the terms of the aforementioned settlement agreement.

Request for Information

To support this status review, we are soliciting information relevant to the status of and threats to the species, including, but not limited to, information on the following topics: (1) historical and current abundance and distribution of the species and congeners throughout the species range; (2) potential factors for the species' decline throughout the species range; (3) rates of capture and release of the species from both recreational and commercial fisheries; (4) post-release mortality; (5) life history information (size/age at maturity, growth rates, fecundity, reproductive rate/success, etc.); (6) morphological and molecular information to assist in determining taxonomy of this species and congeners; (7) threats to the species, particularly: (a) present or threatened destruction, modification, or curtailment of habitat or range; (b) over-utilization for commercial, recreational, scientific, or educational purposes; (c) disease or predation, (d) inadequacy of existing regulatory mechanisms, or (e) other natural or manmade factors affecting its continued existence; and (8) any ongoing conservation efforts for the species. See **DATES** and **ADDRESSES** for guidance on and deadlines for submitting information.

Authority: 16 U.S.C. 1531 *et seq.*

Dated: December 18, 2006.

Donna Wieting,

Deputy Director, Office of Protected Resources, National Marine Fisheries Service.

[FR Doc. 06–9812 Filed 12–18–06; 2:45 pm]

BILLING CODE 3510–22–S

DEPARTMENT OF DEFENSE

Department of the Navy

Notice of Intent To Prepare an Environmental Impact Statement/Overseas Environmental Impact Statement for the Southern California Range Complex (including the San Clemente Island Range Complex) and To Announce Public Scoping Meetings

AGENCY: Department of the Navy, DoD.

ACTION: Notice.

SUMMARY: Pursuant to Section 102(2)(c) of the National Environmental Policy Act (NEPA) of 1969, as implemented by the Council on Environmental Quality regulations (40 CFR parts 1500–1508), and Presidential Executive Order 12114 (Environmental Effects Abroad of Major Federal Actions), the Department of the Navy (DON) announces its intent to prepare an Environmental Impact Statement (EIS)/Overseas Environmental Impact Statement (OEIS) to evaluate the potential environmental effects associated with conducting naval readiness activities in the Southern California (SOCAL) Range Complex (to include the San Clemente Island (SCI) Range Complex). DON proposes to support current, emerging, and future military activities in the SOCAL and SCI Range Complexes as necessary to achieve and sustain Fleet readiness, including military training; research, development, testing, and evaluation (RDT&E) of systems, weapons, and platforms; and investment in range resources and range infrastructure, all in furtherance of our statutory obligations under Title 10 of the United States Code governing the roles and responsibilities of the DON.

On August 17, 1999, DON initiated the NEPA process for an EIS/OEIS evaluating the impacts of DON activities at the SCI Range Complex by publishing a Notice of Intent in the **Federal Register** (64 FR 44716–44717). DON has determined that it is appropriate to include within the scope of the SOCAL Range Complex EIS/OEIS the previously announced environmental analysis of military activities on the SCI Range. Therefore, this Notice of Intent supersedes and withdraws the August 17, 1999, notice of the DON's intent to prepare an EIS/OEIS for the SCI Range Complex.

Dates and Addresses: Three public scoping meetings will be held to receive oral and written comments on environmental concerns that should be addressed in the EIS/OEIS. Public scoping meetings will be held on the following dates, at the times and locations specified:

1. Wednesday, January 29, 2007, 6 p.m.–8 p.m., Cabrillo Marine Aquarium Library, 3720 Stephen M. White Drive, San Pedro, CA.
2. Tuesday, January 30, 2007, 6 p.m.–8 p.m., Oceanside Civic Center Library, 330 North Coast Highway, Oceanside, CA.
3. Wednesday, January 31, 2007, 6 p.m.–8 p.m., Coronado Public Library, 640 Orange Avenue, Coronado, CA.

Each meeting will consist of an information session staffed by DON representatives, to be followed by a presentation describing the proposed action and alternatives. Written comments from interested parties are encouraged to ensure that the full range of relevant issues is identified. Members of the public can contribute oral or written comments at the scoping meetings, or written comments by mail or fax, subsequent to the meetings. Additional information concerning the scoping meetings is available at: *http://www.SocalRangeComplexEIS.com.*

FOR FURTHER INFORMATION CONTACT: Ms. Diori Kreske, Naval Facilities Engineering Command Southwest, 2585 Callaghan Hwy., San Diego, CA 92136–5198; telephone 619–556–8706.

SUPPLEMENTARY INFORMATION: The SOCAL Range Complex is a suite of land ranges and training areas, surface and subsurface ocean ranges and operating areas, and military airspace that is centrally managed and controlled by DON agencies. The complex geographically encompasses near-shore and offshore surface ocean operating areas and extensive military Special Use Airspace generally located between Marine Corp Base Camp Pendleton to the north and San Diego to the south. It extends more than 600 miles to the southwest in the Pacific Ocean covering approximately 120,000 square nautical miles of ocean area. The SCI Range Complex is geographically encompassed by the SOCAL Range Complex. The SCI Range Complex consists of land ranges and training areas on San Clemente Island and certain near-island ocean operating areas and ranges.

Collectively, the components of the SOCAL Range Complex provide the space and resources needed to execute training events across the training continuum, from individual skills training to complex joint exercises. The mission of the SOCAL Range Complex is to support DON, Marine Corps, and joint (multi-service) training by maintaining and operating range facilities and by providing range services and support to the Pacific Fleet, U.S. Marine Corps Forces Pacific, and other forces and military activities. The Commander, Fleet Forces Command and Commander, U.S. Pacific Fleet are responsible for operations, maintenance, training, and support of this national training asset.

Naval transformation initiatives determine current, emerging, and future requirements for training access to the SOCAL Range Complex. Moreover, recent world events have placed the U.S. military on heightened alert in the defense of the U.S., and in defense of allied nations. At this time, the U.S. military, and specifically the U.S. Navy, is actively engaged in anti-terrorism efforts around the globe. Title 10 U.S. Code Section 5062 directs the Chief of Naval Operations to maintain, train, and equip all naval forces for combat so that they are capable of winning wars, deterring aggression, and maintaining freedom of the seas. To achieve this level of readiness, naval forces must have access to ranges, operating areas (OPAREAs), and airspace where they can develop and maintain skills for wartime missions and conduct RDT&E of naval weapons systems. As such, DON ranges, OPAREAs, and airspace must be maintained and/or enhanced to accommodate necessary training and testing activities in support of national security objectives.

The proposed action, therefore, responds to DON's need to: (1) Maintain baseline operations at current levels; (2) accommodate future increases in operational training tempo in the SOCAL and SCI Range Complexes as necessary to support the deployment of naval forces; (3) achieve and sustain readiness in ships and squadrons so that the DON can quickly surge significant combat power in the event of a national crisis or contingency operation and consistent with Fleet Readiness Training Plan; (4) support the acquisition, testing, training, and introduction into the Fleet of advanced platforms and weapons systems; and, (5) implement investments to optimize range capabilities required to adequately support required training. DON will meet these needs and maintain the long-term viability of the SOCAL Range Complex, while protecting human health and the environment.

Three alternatives will be evaluated in the EIS/OEIS, including: (1) The No Action Alternative, comprised of baseline operations and support of existing range capabilities; (2) Alternative 1 comprised of the No Action Alternative plus additional operations on upgraded/-modernized existing ranges; and (3) Alternative 1 plus new ranges, new dedicated capabilities, additional increased tempo (beyond Alternative 1) to optimize training in support of future contingencies. The analysis will address potentially significant direct, indirect, and cumulative impacts on biological resources, land use, air quality, water quality, water resources, and socioeconomics, as well as other environmental issues that could occur with the implementation of the DON's proposed actions and alternatives.

The DON is initiating the scoping process to identify community concerns and local issues to be addressed in the EIS/OEIS. Federal, State, and local agencies, and interested parties are encouraged to provide oral and/or written comments to the DON that identify specific issues or topics of environmental concern that should be addressed in the EIS/OEIS. Written comments must be postmarked by February 8, 2007, and should be mailed to: Naval Facilities Engineering Command Southwest, 2585 Callaghan Hwy., San Diego, CA 92136–5198; Attention: Ms. Diori Kreske, telephone 619–556–8706.

Dated: December 13, 2006.

M.A. Harvison,

Lieutenant Commander, Judge Advocate General's Corps, Federal Legislative Liaison Officer.

[FR Doc. E6–21802 Filed 12–20–06; 8:45 am]

BILLING CODE 3810–FF–P

DEPARTMENT OF EDUCATION

Notice of Proposed Information Collection Requests

AGENCY: Department of Education.

ACTION: Notice of proposed information collection requests.

SUMMARY: The IC Clearance Official, Regulatory Information Management Services, Office of Management, invites comments on the proposed information collection requests as required by the Paperwork Reduction Act of 1995.

DATES: An emergency review has been requested in accordance with the Act (44 U.S.C. Chapter 3507 (j)), since public harm is reasonably likely to result if normal clearance procedures are followed. Approval by the Office of Management and Budget (OMB) has been requested by January 22, 2007. A regular clearance process is also beginning. Interested persons are invited to submit comments on or before February 20, 2007.

ADDRESSES: Written comments regarding the emergency review should be addressed to the Office of Information and Regulatory Affairs, Attention: Rachael Potter, Desk Officer, Department of Education, Office of Management and Budget; 725 17th Street, NW., Room 10222, New Executive Office Building, Washington, DC 20503 or faxed to (202) 395–6974.

SUPPLEMENTARY INFORMATION: Section 3506 of the Paperwork Reduction Act of 1995 (44 U.S.C. Chapter 35) requires that the Director of OMB provide interested Federal agencies and the

Appendix C

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AIR QUALITY ANALYSIS
SUPPORTING DATA

This Appendix provides supporting data for the analysis contained in Section 3.2 (Air Quality).

Table C-1 Surface Ship Air Emissions – No Action Alternative
Table C-2 Surface Ship Air Emissions – Alternative 1
Table C-3 Surface Ship Air Emissions – Alternative 2

Tables provide estimates of emissions from combustion of fuel by marine vessels during SOCAL Range operations. Each table includes a listing of individual training operations from the SOCAL Operations Data Book, number of each type of marine vessel participating in the operations for the No Action Alternative and Alternatives 1 and 2, and hours on range for each training operation. Percentage of time within 0 to 3 nm of shore, 3 to 12 nm from shore, and > 12 nm from shore for both SCI and the SDAB are based on the SOCAL Operations Data Book. Emission factors are provided by JJMA in terms of lbs/hour. Emissions are then calculated for each area as follows:

Lbs/year per operation = No. of marine vessels in each category x hours per operation x percentage of time at the specified distance from shore x emission factor (lbs/hour).

Table C-4 Aircraft Air Emissions – No Action Alternative
Table C-5 Aircraft Air Emissions – Alternative 1
Table C-6 Aircraft Air Emissions – Alternative 2

Tables provide estimates of emissions from combustion of fuel by aircraft during SOCAL Range operations. Each table includes a listing of individual training operations from the SOCAL Operations Data Book, number of each type of aircraft participating in the operations for each alternative, and hours on range for each operation. Emissions below 3,000 ft above ground level are not counted in the emission calculations as they are not assumed to affect ambient air quality. Percentage of time below 3,000 feet, and within 0 to 3 nm of shore, 3 to 12 nm from shore, and > 12 nm from shore for both SCI and the SDAB are based on the SOCAL Operations Data Book. Fuel flow in lbs/hour and emission factors in terms of lbs/1000 lbs/ fuel are provided by AESO for each type of aircraft and each type of operation. Aircraft is generally assumed to operate in cruise mode unless otherwise specified. Emissions are then calculated for each area as follows:

Lbs/year per operation = No. of aircraft in each category x hours per operation x percentage of time below 3,000 feet AGL x percentage of time at the specified distance from shore x fuel flow (lbs/hour) emission factor (lbs/1,000 lbs fuel).

Table C-7 Takeoffs/Landings from NALF – No Action Alternative
Table C-8 Takeoffs/Landings from NALF – Alternative 1
Table C-9 Takeoffs/Landings from NALF – Alternative 2

Tables provide estimates of emissions from combustion of fuel during takeoffs/landings at the NALF. Numbers of takeoffs/landings per aircraft type were provided by the Navy. Different types of operations (i.e., takeoff, arrival, touch and go, etc.) were identified for each aircraft type. Emissions were estimated based on data from AESO for each operation. AESO provided emission factors in lbs/operation. Emissions are then calculated for each area as follows:

Lbs/year per operation = No. of aircraft in each category x number of operations x lbs/operation.

Table C-10 SOCAL Ordnance Expenditures – No Action Alternative
Table C-11 SOCAL Ordnance Expenditures – Alternative 1
Table C-12 SOCAL Ordnance Expenditures – Alternative 2

Tables provide estimates of emissions from ordnance used in SOCAL Range operations. Estimates of total ordnance use by category were obtained from the SOCAL Operations Data Book. Total ordnance use for each alternative was summed by ordnance type. Emissions by ordnance type were estimated based on emission factors from the EPA's AP-42 document. Emissions were calculated as follows:

Lbs/year per ordnance type = Amount of ordnance by type x emission factor (lbs/ordnance used or weight of explosives).

Table C-13 Ground Vehicle Operations – No Action Alternative
Table C-14 Ground Vehicles Operations – Alternative 1
Table C-15 Ground Vehicles Operations – Alternative 2

Tables provide estimates of emissions from ground vehicles used in SOCAL Range operations. Each table includes a listing of individual training operations from the SOCAL Operations Data Book, number of each type of ground vehicle participating in the operations for each alternative, and hours on range for each operation. Emission factors were obtained either from the Navy or from the ARB's EMFAC2007 model, which provides emission estimates in grams/VMT; vehicle speeds were estimated to be 5 mph during training exercises to estimate emissions in lbs/hour. Emissions are then calculated for each area as follows:

Lbs/year per operation = No. of ground vehicles in each category x hours per operation x emission factor (lbs/hour).

Table C-16 Total Emissions with 3 nm – SOCAL Conformity

Table presents a summary of emissions within 3 nm of shore and onshore for the purpose of demonstrating conformity with

Table C-1. Surface Ship Air Emissions—No Action Alternative

Scenario	Type Training	Number of Ships	Program Totals	Nomenclature	Ship/Boat Type	Vessel Mode	Ship Time on Range (hrs)	Percent at Each Power Level	Total Time on Range (hrs)	Percentage 0-3 nm from shore	Percentage 3-12 nm from Shore	Percentage >12 nm from Shore	Total Time 0-3 nm from shore	Total Time 3-12 nm from shore	Total Time >12 nm from shore	Emissions Factors (lb/hr) CO	NOx	HC	SOx	PM10	Emissions 0-3 nm Offshore (lbs) CO	Nox	HC	Sox	PM	Emissions 3-12 nm Offshore - US Territory (lbs) CO	Nox	HC	Sox	PM	Emissions >12 nm Offshore - Outside US Territory: Offshore San Diego CO	Nox	HC	Sox	PM	Offshore Mexico CO	Nox	HC	Sox	PM
							Hours	%	Hours	Percent			Hours																											
Training Exercises																																								
1	Air Combat Maneuvers	0																																						
2	Air Defense Exercise	107		CG	Cruiser	CG-2	1.0	100%	107.0	0%	0%	100%	0.0	0.0	107.0	107.78	47.1	8.8	21.0	2.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	11532.5	5041.8	943.7	2249.1	281.4					
		214		DDG	Guided Missile Destroyer	DDG-2	1.0	100%	214.0	0%	0%	100%	0.0	0.0	214.0	103.99	48.9	8.0	17.9	2.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	22253.9	10464.6	1718.4	3839.2	526.4					
		22		CVN	Nuclear Carrier (No emissions)					0%	0%	100%																												
		4		FFG	Guided Missile Frigate	FFG-2	3.7	100%	14.8	0%	0%	100%	0.0	0.0	14.8	66.82	67.7	7.8	11.6	3.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	988.9	1002.3	115.6	171.2	48.1					
3	S-A Missiles	1		CVN	Nuclear Carrier (No emissions)					0%	0%	100%																												
		1		TRB	Torpedo Retrieval Boats	TRB-3	4.0	100%	4.0	1%	2%	97%	0.0	0.1	3.9	6.47	56.2	1.6	7.4	1.2	0.3	2.2	0.1	0.3	0.0	0.5	4.5	0.1	0.6	0.1	25.1	218.1	6.0	28.7	4.6					
4	S-A Gunnery Exercise	17		CVN						0%	0%	100%																												
		33		CG	Cruiser	CG-2	1.5	100%	49.5	0%	0%	100%	0.0	0.0	49.5	107.78	47.1	8.8	21.0	2.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0						5335.1	2332.4	436.6	1040.5	130.2
		68		DDG	Guided Missile Destroyer	DDG-2	1.5	100%	102.0	0%	0%	100%	0.0	0.0	102.0	103.99	48.9	8.0	17.9	2.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0						10607.0	4987.8	819.1	1829.9	250.9
		41		FFG	Guided Missile Frigate	FFG-2	1.5	100%	61.5	0%	0%	100%	0.0	0.0	61.5	66.82	67.7	7.8	11.6	3.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0						4109.4	4164.8	480.3	711.6	199.9
		10		LHA	Amphib. Assault Ship - Tarawa	LHA-1	1.5	100%	15.0	0%	0%	100%	0.0	0.0	15.0	7.38	43.5	5.5	131.0	26.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0						110.7	653.0	83.0	1964.6	394.4
		11		LDH	Large Helicopter-dock Ships	LHD-1	1.5	100%	16.5	0%	0%	100%	0.0	0.0	16.5	5.89	34.8	4.4	104.6	21.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0						97.2	573.7	72.9	1725.9	346.3
		16		LPD	Amphibious Transport Dock - Wasp	LPD-1	1.5	100%	24.0	0%	0%	100%	0.0	0.0	24.0	1.845393	10.9	1.4	32.8	6.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0						44.3	261.3	33.2	786.1	157.8
		18		LSD	Landing Ship Dock	LPD-1	1.5	100%	27.0	0%	0%	100%	0.0	0.0	27.0	1.845393	10.9	1.4	32.8	6.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0						49.8	294.0	37.4	884.4	177.5
		28		USCGS	US Coast Guard	USCG	1.5	100%	42.0	0%	0%	100%	0.0	0.0	42.0	5.74	57.9	0.9	11.6	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0						241.1	2432.2	37.0	485.1	8.8
		20		Other Ship	Coastal Patrol-Independent Low Speed (	PC-1	1.5	100%	30.0	0%	0%	100%	0.0	0.0	30.0	6.5	12.5	1.1	2.5	0.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0						195.0	373.8	31.5	75.3	10.5
5	A-A Missiles	1		TRB	Torpedo Retrieval Boats	TRB-3	4.0	100%	4.0	1%	2%	97%	0.0	0.1	3.9	6.47	56.2	1.6	7.4	1.2	0.3	2.2	0.1	0.3	0.0	0.5	4.5	0.1	0.6	0.1						25.1	218.1	6.0	28.7	4.6
6	Helicopter ASW TRACKEX	9		CG	Cruiser	CG-3	3.6	100%	32.4	1%	10%	89%	0.3	3.2	28.8	114.75	65.2	7.7	33.6	3.4	37.2	21.1	2.5	10.9	1.1	371.8	211.3	24.9	108.7	11.1	3308.9	1880.7	221.2	967.4	99.2					
		23		DDG	Guided Missile Destroyer	DDG-3	3.6	100%	82.8	1%	10%	89%	0.8	8.3	73.7	106.67	53.8	7.8	21.2	2.8	88.3	44.6	6.5	17.6	2.3	883.2	445.8	64.9	175.7	23.2	7860.7	3967.6	577.7	1563.7	206.3					
		14		TRB	Torpedo Retrieval Boats	TRB-3	3.6	100%	50.4	1%	10%	89%	0.5	5.0	44.9	6.47	56.2	1.6	7.4	1.2	3.3	28.3	0.8	3.7	0.6	32.6	283.3	7.8	37.3	5.9	290.2	2521.8	69.5	331.9	52.9					
7	Helicopter ASW TORPEX	21		CG	Cruiser	CG-3	3.6	100%	75.6	1%	10%	89%	0.8	7.6	67.3	114.75	65.2	7.7	33.6	3.4	86.8	49.3	5.8	25.4	2.6	867.5	493.1	58.0	253.6	26.0	7720.8	4388.3	516.1	2257.4	231.5					
		57		DDG	Guided Missile Destroyer	DDG-3	3.6	100%	205.2	1%	10%	89%	2.1	20.5	182.6	106.67	53.8	7.8	21.2	2.8	218.9	110.5	16.1	43.5	5.7	2188.9	1104.8	160.9	435.4	57.5	19480.9	9832.7	1431.8	3875.4	511.4					
		55		TRB	Torpedo Retrieval Boats	TRB-3	3.6	100%	198.0	1%	10%	89%	2.0	19.8	176.2	6.47	56.2	1.6	7.4	1.2	12.8	111.3	3.1	14.7	2.3	128.1	1113.2	30.7	146.5	23.4	1140.1	9907.1	273.1	1304.0	207.9					
8	MPA ASW TRACKEX																																							
9	MPA ASW TORPEX	2		CG	Cruiser	CG-3	2.0	100%	4.0	5%	10%	85%	0.2	0.4	3.4	114.75	65.2	7.7	33.6	3.4	23.0	13.0	1.5	6.7	0.7	45.9	26.1	3.1	13.4	1.4	390.2	221.7	26.1	114.1	11.7					
		4		DDG	Guided Missile Destroyer	DDG-3	2.0	100%	8.0	5%	10%	85%	0.4	0.8	6.8	106.67	53.8	7.8	21.2	2.8	42.7	21.5	3.1	8.5	1.1	85.3	43.1	6.3	17.0	2.2	725.4	366.1	53.3	144.3	19.0					
		3		FFG	Guided Missile Frigate	FFG-3	2.0	100%	6.0	5%	10%	85%	0.3	0.6	5.1	120.04	78.1	11.6	16.1	4.3	36.0	23.4	3.5	4.8	1.3	72.0	46.9	7.0	9.6	2.6	612.2	398.4	59.4	82.0	21.9					
		13		TRB	Torpedo Retrieval Boats	TRB-3	2.0	100%	26.0	5%	10%	85%	1.3	2.6	22.1	6.47	56.2	1.6	7.4	1.2	8.4	73.1	2.0	9.6	1.5	16.8	146.2	4.0	19.2	3.1	143.0	1242.5	34.3	163.5	26.1					
10	EER/IEER ASW																																							
11	Surface Ship ASW TRACKEX	228		CG	Cruiser	CG-3	2.0	100%	456.0	1%	10%	89%	4.6	45.6	405.8	114.75	65.2	7.7	33.6	3.4	523.3	297.4	35.0	153.0	15.7	5232.6	2974.0	349.8	1529.9	156.9	46570.1	26468.9	3112.8	13615.9	1396.1					
		450		DDG	Guided Missile Destroyer	DDG-3	2.0	100%	900.0	1%	10%	89%	9.0	90.0	801.0	106.67	53.8	7.8	21.2	2.8	960.0	484.6	70.6	191.0	25.2	9600.3	4845.6	705.6	1909.8	252.0	85442.7	43125.8	6279.8	16997.2	2242.8					
		169		FFG	Guided Missile Frigate	FFG-3	2.0	100%	338.0	1%	10%	89%	3.4	33.8	300.8	120.04	78.1	11.6	16.1	4.3	405.7	264.0	39.3	54.4	14.5	4057.4	2640.1	393.4	543.5	145.3	36110.4	23497.1	3501.5	4837.2	1293.5					
		0		Support	Torpedo Retrieval Boats	TRB-3	2.0	100%	0.0	1%	10%	89%	0.0	0.0	0.0	6.47	56.2	1.6	7.4	1.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0					
12	Surface Ship ASW TORPEX	6		CG	Cruiser	CG-3	3.7	100%	22.2	1%	10%	89%	0.2	2.2	19.8	114.75	65.2	7.7	33.6	3.4	25.5	14.5	1.7	7.4	0.8	254.7	144.8	17.0	74.5	7.6	2267.2	1288.6	151.5	662.9	68.0					
		10		DDG	Guided Missile Destroyer	DDG-3	3.7	100%	37.0	1%	10%	89%	0.4	3.7	32.9	106.67	53.8	7.8	21.2	2.8	39.5	19.9	2.9	7.9	1.0	394.7	199.2	29.0	78.5	10.4	3512.6	1773.0	258.2	698.8	92.2					
		5		FFG	Guided Missile Frigate	FFG-3	3.7	100%	18.5	1%	10%	89%	0.2	1.9	16.5	120.04	78.1	11.6	16.1	4.3	22.2	14.5	2.2	3.0	0.8	222.1	144.5	21.5	29.7	8.0	1976.5	1286.1	191.7	264.8	70.8					
		10		TRB	Torpedo Retrieval Boats	TRB-3	3.7	100%	37.0	1%	10%	89%	0.4	3.7	32.9	6.47	56.2	1.6	7.4	1.2	2.4	20.8	0.6	2.7	0.4	23.9	208.0	5.7	27.4	4.4	213.1	1851.3	51.0	243.7	38.9					
13	Sub ASW Trackex	45		SSN	Submarines (No emissions)																																			
		14		TRB	Torpedo Retrieval Boats	TRB-3	12.8	100%	179.2	1%	2%	97%	1.8	3.6	173.8	6.47	56.2	1.6	7.4	1.2	11.6	100.7	2.8	13.3	2.1	23.2	201.5	5.6	26.5	4.2	1124.6	9772.4	269.4	1286.3	205.1					
14	Sub ASW TORPEX	18		SSN	Submarines (No emissions)																																			
		18		TRB	Torpedo Retrieval Boats	TRB-3	11.7	100%	210.6	1%	2%	97%	2.1	4.2	204.3	6.47	56.2	1.6	7.4	1.2	13.6	118.4	3.3	15.6	2.5	27.3	236.8	6.5	31.2	5.0	1321.7	11484.7	316.6	1511.7	241.1					
15	VBSS	13		CG	Cruiser	CG-2	4.0	100%	52.0	0%	0%	100%	0.0	0.0	52.0	107.78	47.1	8.8	21.0	2.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	5604.6	2450.2	458.6	1093.0	136.8					
		26		DDG	Guided Missile Destroyer	DDG-2	4.0	100%	104.0	0%	0%	100%	0.0	0.0	104.0	103.99	48.9	8.0	17.9	2.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	10815.0	5085.6	835.1	1865.8	255.8					
		5		FFG	Guided Missile Frigate	FFG-2	4.0	100%	20.0	0%	0%	100%	0.0	0.0	20.0	66.82	67.7	7.8	11.6	3.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1336.4	1354.4	156.2	231.4	65.0					
		2		LPD	Amphibious Transport Dock - Wasp	LPD-1	4.0	100%	8.0	0%	0%	100%	0.0	0.0	8.0	1.845393	10.9	1.4	32.8	6.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	14.8	87.1	11.1	262.0	52.6					
		5		LSD		LPD-1	4.0	100%	20.0	0%	0%	100%	0.0	0.0	20.0	1.845393	10.9	1.4	32.8	6.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	36.9	217.8	27.7	655.1	131.5					
16	ASUW MISSILEX	30		TRB	Torpedo Retrieval Boats	TRB-2	7.0	100%	210.0	5%	28%	67%	10.5	58.8	140.7	7.64	33.1	0.6	3.4	1.2	80.2	347.4	6.2	35.6	12.2	449.2	1945.7	34.7	199.3	68.2	1074.9	4655.8	83.0	477.0	163.2					
		2		CG	Cruiser	CG-2	4.0	100%	8.0	0%	0%	100%	0.0	0.0	8.0	107.78	47.1	8.8	21.0	2.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	862.2	377.0	70.6	168.2	21.0					
		2		DDG	Guided Missile Destroyer	DDG-2	4.0	100%	8.0	0%	0%	100%	0.0	0.0	8.0	103.99	48.9	8.0	17.9	2.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	831.9	391.2	64.2	143.5	19.7					
17	A-S BOMBEX	0																																						
18	A-S GUNEX	0																																						
19	S-S GUNEX	1		CVN	Nuclear Carrier (No emissions)																																			
		64		CG	Cruiser	CG-1	2.5	100%	160.0	0%	28%	72%	0.0	44.8	115.2	102.58	40.6	9.2	17.7	2.1	0.0	0.0	0.0	0.0	0.0	4595.6	1819.3	413.1	793.4	95.0						11817.2	4678.3	1062.1	2040.2	244.2
		132		DDG	Guided Missile Destroyer	DDG-1	2.5	100%	330.0	0%	28%	72%	0.0	92.4	237.6	102.98	47.3	8.1	17.0	2.4	0.0	0.0	0.0	0.0	0.0	9515.4	4374.2	748.4	1574.5	217.1						24468.0	11248.0	1924.6	4048.7	558.4
		44		FFG	Guided Missile Frigate	FFG-1	2.5	100%	110.0	0%	28%	72%	0.0	30.8	79.2	65.75	66.4	7.9	10.9	3.1	0.0	0.0	0.0	0.0	0.0	2025.1	2043.6	243.0	335.4	96.7						5207.4	5254.9	624.9	862.5	248.7
		2		LPD	Amphibious Transport Dock - Wasp	LPD-1	2.5	100%	5.0	0%	28%	72%	0.0	1.4	3.6	1.845393	10.9	1.4	32.8	6.6	0.0	0.0	0.0	0.0	0.0	2.6	15.2	1.9	45.9	9.2						6.6	39.2	5.0	117.9	23.7
		1		LSD	Landing Ship Dock	LPD-1	2.5	100%	2.5	0%	28%	72%	0.0	0.7	1.8	1.845393	10.9	1.4	32.8	6.6	0.0	0.0	0.0	0.0	0.0	1.3	7.6	1.0	22.9	4.6						3.3	19.6	2.5	59.0	11.8
		1		LHD	Large Helicopter-dock Ships	LHD-2	2.5	100%	2.5	0%	28%	72%	0.0	0.7	1.8	6.8	40.1	5.1	120.7	24.2	0.0	0.0	0.0	0.0	0.0	4.8	28.1	3.6	84.5	17.0						12.2	72.2	9.2	217.3	43.6
		16		Unknown	Other	PC-2	2.5	100%	40.0	0%	28%	72%	0.0	11.2	28.8	17.21	38.1	2.9	8.2	0.9	0.0	0.0	0.0	0.0	0.0	192.8	427.2	32.9	92.2	10.3						495.6	1098.4	84.7	237.0	26.5
		36		USCG	US Coast Guard	USCG	2.5	100%	90.0	0%	28%	72%	0.0	25.2	64.8	5.74	57.9	0.9	11.6	0.2	0.0	0.0	0.0	0.0	0.0	144.6	1459.3	22.2	291.1	5.3						372.0	3752.6	57.0	748.4	13.6
20	SINKEX	4		CG	Cruiser	CG-2	16.0	100%	64.0	0%	0%	100%	0.0	0.0	64.0	107.78	47.1	8.8	21.0	2.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0						6897.9	3015.7	564.5	1345.3	168.3
		4		DDG	Guided Missile Destroyer	DDG-2	16.0	100%	64.0	0%	0%	100%	0.0	0.0	64.0	103.99	48.9	8.0	17.9	2.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0						6655.4	3129.6	513.9	1148.2	157.4
		4		DD	Destroyer	DDG-2	16.0	100%	64.0	0%	0%	100%	0.0	0.0	64.0	103.99	48.9	8.0	17.9	2.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0						6655.4	3129.6	513.9	1148.2	157.4
		4		FFG	Guided Missile Frigate	FFG-2	16.0	100%	64.0	0%	0%	100%	0.0	0.0	64.0	66.82	67.7	7.8	11.6	3.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0						4276.5	4334.1	499.8	740.5	208.0
		2		SSN	Submarines (No emissions)																																			
21	NSFS	15		CG	Cruiser	CG-2	9.0	100%	135.0	0%	30%	70%	0.0	40.5	94.5	107.78	47.1	8.8	21.0	2.6	0.0	0.0	0.0	0.0	0.0	4365.1	1908.4	357.2	851.3	106.5	10185.2	4452.8	833.5	1986.4	248.5					
		32		DDG	Guided Missile Destroyer	DDG-2	9.0	100%	288.0	0%	30%	70%	0.0	86.4	201.6	103.99	48.9	8.0	17.9	2.5	0.0	0.0	0.0	0.0	0.0	8984.7	4225.0	693.8	1550.0	212.5	20964.4	9858.2	1618.8	3616.7	495.9					
		4		FFG	Guided Missile Frigate	FFG-2	9.0	100%	36.0	0%	30%	70%	0.0	10.8	25.2	66.82	67.7	7.8	11.6	3.3	0.0	0.0	0.0	0.0	0.0	721.7	731.4	84.3	125.0	35.1	1683.9	1706.5	196.8	291.6	81.9					
22	EFEX	2		CG	Cruiser	CG-2	72.0	100%	144.0	0%	100%	0%	0.0	144.0	0.0	107.78	47.1	8.8	21.0	2.6	0.0	0.0	0.0	0.0	0.0	15520.3	6785.3	1270.1	3026.9	378.7	0.0	0.0	0.0	0.0	0.0					
		2		DDG	Guided Missile Destroyer	DDG-2	72.0	100%	144.0	0%	100%	0%	0.0	144.0	0.0	103.99	48.9	8.0	17.9	2.5	0.0	0.0	0.0	0.0	0.0	14974.6	7041.6	1156.3	2583.4	354.2	0.0	0.0	0.0	0.0	0.0					
23	Battalion Landing	0		LHA	Amphib. Assault Ship - Tarawa	LHA-1	6.0	100%	0.0	10%	30%	60%	0.0	0.0	0.0	7.38	131.0	26.3	7.4	43.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0					
		0		LCU	Landing Craft Utility	LCU	3.0	100%	0.0	10%	30%	60%	0.0	0.0	0.0	36.21	3.1	1.6	36.2	45.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0					
		0		AAV/EFV	Amphibious Assault Vehicle	AAV-2	6.0	100%	0.0	10%	30%	60%	0.0	0.0	0.0	0.633674	3.8	0.2	0.1	0.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0					
		0		LCAC	Landing Craft Air Cushioned	LCAC	3.0	100%	0.0	10%	30%	60%	0.0	0.0	0.0	25.41	43.3	3.9	25.4	55.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0					
		0		CRRC	Combat Raiding Rubber Craft	CRRC-4	6.0	100%	0.0	10%	30%	60%	0.0	0.0	0.0	0	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0					
24	USMC Stinger	0																																						
25	Amphibious Landings & Raids																																							
25A	Recon Mission	0																																						
25B	Helicopter Assault	0		LHD	Large Helicopter-dock Ships	LHD-2	6.0	100%	0.0	0%	0%	100%	0.0	0.0	0.0	6.8	40.1	5.1	120.7	24.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0					
		0		LHA	Amphib. Assault Ship - Tarawa	LHA-1	6.0	100%	0.0	0%	0%	100%	0.0	0.0	0.0	7.38	131.0	26.3	7.4	43.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0					
25C	Armored Operations	0		LHD	Large Helicopter-dock Ships	LHD-2	12.0	100%	0.0	33%	33%	33%	0.0	0.0	0.0	6.8	40.1	5.1	120.7	24.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0					
		0		LHA	Amphib. Assault Ship - Tarawa	LHA-1	12.0	100%	0.0	33%	33%	33%	0.0	0.0	0.0	7.38	131.0	26.3	7.4	43.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0					
		0		LCAC	Landing Craft Air Cushioned	LCAC	12.0	100%	0.0	33%	33%	33%	0.0	0.0	0.0	25.41	43.3	3.9	25.4	55.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0					
		0		LCU	Landing Craft Utility	LCU	12.0	100%	0.0	33%	33%	33%	0.0	0.0	0.0	36.21	3.1	1.6	36.2	45.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0					
25D	Artillery Operations	2		LHD	Large Helicopter-dock Ships	LHD-2	24.0	100%	48.0	100%	0%	0%	48.0	0.0	0.0	6.8	40.1	5.1	120.7	24.2	326.4	1925.8	244.8	5793.6	1163.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0					
		1		LHA	Amphib. Assault Ship - Tarawa	LHA-1	24.0	100%	24.0	20%	40%	40%	4.8	9.6	9.6	7.38	43.5	5.5	131.0	26.3	35.4	208.9	26.5	628.7	126.2	70.8	417.9	53.1	1257.3	252.4	70.8	417.9	53.1	1257.3	252.4					
		4		LCAC	Landing Craft Air Cushion	LCAC	24.0	100%	96.0	100%	0%	0%	96.0	0.0	0.0	25.41	55.3	0.7	43.3	3.9	2439.4	5310.7	69.1	4156.8	373.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0					
		4		LCU	Landing Craft Utility	LCU	24.0	100%	96.0	100%	0%	0%	96.0	0.0	0.0	36.21	45.0	0.5	3.1	1.6	3476.2	4315.2	49.9	298.6	150.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0					
25E	Amphibious Assault	0		LHD	Large Helicopter-dock Ships	LHD-2	8.0	100%	0.0	38%	38%	25%	0.0	0.0	0.0	6.8	40.1	5.1	120.7	24.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0					

Table C-1. Surface Ship Air Emissions—No Action Alternative

Scenario	Type Training	Number of Ships	Program Totals	Nomenclature	Ship/Boat Type	Vessel Mode	Ship Time on Range (hrs)	Percent at Each Power Level	Total Time on Range (hrs)	Percentage 0-3 nm from shore	Percentage 3-12 nm from Shore	Percentage >12 nm from Shore	Total Time 0-3 nm from shore	Total Time 3-12 nm from shore	Total Time >12 nm from shore	Emissions Factors (lb/hr)					Emissions: Emissions 0-3 nm Offshore (lbs)					Emissions 3-12 nm Offshore - US Territory (lbs)					Emissions >12 nm Offshore - Outside US Territory									
							Hours	%	Hours	Percent			Hours			CO	NOx	HC	SOx	PM10	CO	Nox	HC	Sox	PM	CO	Nox	HC	Sox	PM	CO	Nox	HC	Sox	PM	CO	Nox	HC	Sox	PM
		0		LHA	Amphib. Assault Ship - Tarawa	LHA-1	8.0	100%	0.0	38%	38%	25%	0.0	0.0	0.0	7.38	43.5	5.5	131.0	26.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0					
		0		LPD	Amphibious Transport Dock - Wasp	LPD-1	8.0	100%	0.0	38%	38%	25%	0.0	0.0	0.0	1.845393	10.9	1.4	32.8	6.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0					
		0		LCAC	Landing Craft Air Cushioned	LCAC	8.0	100%	0.0	38%	38%	25%	0.0	0.0	0.0	25.41	43.3	3.9	25.4	55.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0					
		0		LCU	Landing Craft Utility	LCU	8.0	100%	0.0	38%	38%	25%	0.0	0.0	0.0	36.21	3.1	1.6	36.2	45.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0					
25F	Combat Engineer Ops	0		LHA	Amphib. Assault Ship - Tarawa	LHA-1	6.0	100%	0.0	33%	33%	33%	0.0	0.0	0.0	7.38	131.0	26.3	7.4	43.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0					
		0		LCU	Landing Craft Utility	LCU	6.0	100%	0.0	33%	33%	33%	0.0	0.0	0.0	36.21	3.1	1.6	36.2	45.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0					
25G	Amphibious Assault Vehicle Ops	0		LHA	Amphib. Assault Ship - Tarawa	LHA-1	8.0	100%	0.0	25%	25%	50%	0.0	0.0	0.0	7.38	131.0	26.3	7.4	43.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0					
		0		EFV	Expeditionary Fighting Vessel	EFV-1	8.0	100%	0.0	25%	25%	50%	0.0	0.0	0.0	2.0611	4.17	0.72	0.06	0.3211	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0					
25H	EFV	0		LPD	Amphibious Transport Dock - Wasp	LPD-1	8.0	100%	0.0	25%	25%	50%	0.0	0.0	0.0	1.845393	10.9	1.4	32.8	6.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0					
		0		LCAC	Landing Craft Air Cushioned	LCAC	8.0	100%	0.0	25%	25%	50%	0.0	0.0	0.0	25.41	43.3	3.9	25.4	55.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0					
		0		EFV	Expeditionary Fighting Vessel	EFV-1	8.0	100%	0.0	25%	25%	50%	0.0	0.0	0.0	2.0611	4.17	0.72	0.06	0.3211	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0					
25I	Assault Amphibian School	0		LCAC	Landing Craft Air Cushioned	LCAC	8.0	100%	0.0	0%	0%	100%	0.0	0.0	0.0	25.41	43.3	3.9	25.4	55.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0					
		0		LCU	Landing Craft Utility	LCU	8.0	100%	0.0	0%	0%	100%	0.0	0.0	0.0	36.21	3.1	1.6	36.2	45.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0					
		0		EFV	Amphibious Assault Vehicle	EFV-1	8.0	100%	0.0	0%	0%	100%	0.0	0.0	0.0	2.0611	4.17	0.72	0.06	0.3211	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0					
26	Ambphibious Operations CPAAA																																							
26A	Amphibious Operations	1530		AAV/EFV	Amphibious Assault Vehicle	AAV-1	16.8	20%	25704.0	100%	0%	0%	25704.0	0.0	0.0	0.444918	1.0	0.2	0.1	0.2	11436.2	26631.2	4474.8	1323.2	4604.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0					
				AAV/EFV	Amphibious Assault Vehicle	AAV-2	16.8	80%	0.0	100%	0%	0%	0.0	0.0	0.0	0.633674	3.8	0.2	0.1	0.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0					
		6		LCAC	Landing Craft Air Cushion	LCAC	16.8	100%	100.8	100%	0%	0%	100.8	0.0	0.0	25.41	55.3	0.7	43.3	3.9	2561.3	5576.3	72.6	4364.6	392.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0					
26B	Amphibious Ops	4		LHD	Large Helicopter-dock Ships	LHD-1	4.2	90%	15.2	0%	0%	100%	0.0	0.0	15.2	5.89	34.8	4.4	104.6	21.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	89.3	527.0	67.0	1585.3	318.1					
				LHD	Large Helicopter-dock Ships	LHD-2	4.2	10%	1.7	0%	0%	100%	0.0	0.0	1.7	6.8	40.1	5.1	120.7	24.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	11.5	67.6	8.6	203.3	40.8					
		4		LCAC	Landing Craft Air Cushion	LCAC	4.2	100%	16.8	0%	0%	100%	0.0	0.0	16.8	25.41	55.3	0.7	43.3	3.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	427.9	931.6	12.1	729.2	65.5					
		60		CRRC	Combat Raiding Rubber Craft	CRRC-1	4.2	22%	55.6	28%	36%	36%	15.6	20.0	20.0	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.3	0.0	0.0	0.0	0.0	0.4	0.0	0.0	0.0	0.0	0.4					
				CRRC	Combat Raiding Rubber Craft	CRRC-4	4.2	27%	55.6	28%	36%	36%	15.6	20.0	20.0	0	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0	2.1	0.0	0.0	0.0	0.0	2.6	0.0	0.0	0.0	0.0	2.6					
				CRRC	Combat Raiding Rubber Craft	CRRC-5	4.2	51%	128.8	28%	36%	36%	36.1	46.4	46.4	0	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0	5.4	0.0	0.0	0.0	0.0	6.9	0.0	0.0	0.0	0.0	6.9					
		4		LCU	Landing Craft Utility	LCU	4.2	100%	16.8	32%	0%	68%	5.4	0.0	11.5	36.21	45.0	0.5	3.1	1.6	195.1	242.2	2.8	16.8	8.5	0.0	0.0	0.0	0.0	0.0	414.6	514.7	6.0	35.6	18.0					
26C	Amphibious Ops	130		AAV/EFV	Amphibious Assault Vehicle	AAV-1	15.0	10%	195.0	100%	0%	0%	195.0	0.0	0.0	0.444918	1.0	0.2	0.1	0.2	86.8	202.0	33.9	10.0	34.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0					
						AAV-2	15.0	90%	1755.0	100%	0%	0%	1755.0	0.0	0.0	0.633674	3.8	0.2	0.1	0.3	1112.1	6596.0	300.9	184.8	516.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0					
26D	Amphibious Ops	5		AAV	Amphibious Assault Vehicle	AAV-1	2.4	20%	2.4	100%	0%	0%	2.4	0.0	0.0	0.444918	1.0	0.2	0.1	0.2	1.0	2.4	0.4	0.1	0.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0					
						AAV-2	2.4	80%	9.4	100%	0%	0%	9.4	0.0	0.0	0.633674	3.8	0.2	0.1	0.3	6.0	35.3	1.6	1.0	2.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0					
		1502		EFV	Amphibious Assault Vehicle	EFV-1	2.4	33%	1176.4	28%	70%	2%	329.4	823.5	23.5	2.0611	4.17	0.72	0.06	0.3211	678.9	1372.6	237.5	20.8	105.8	1697.3	3431.6	593.8	52.0	264.4	48.5	98.0	17.0	1.5	7.6					
						EFV-2	2.4	67%	2353.3	28%	70%	2%	658.9	1647.3	47.1	2.0611	4.17	0.72	0.06	0.3211	1358.1	2745.7	475.1	41.6	211.6	3395.2	6864.2	1187.9	104.1	528.9	97.0	196.1	33.9	3.0	15.1					
		2268		RIB	Rigid Inflatable	RIB-1	2.4	7%	355.5	28%	70%	2%	99.5	248.8	7.1	0.04	1.6	0.0	0.2	0.0	4.0	158.3	1.0	16.9	2.0	10.0	395.7	2.5	42.3	5.0	0.3	11.3	0.1	1.2	0.1					
						RIB-3		13%	708.9	28%	70%	2%	198.5	496.2	14.2	0.08	3.0	0.0	0.4	0.0	15.9	595.4	2.0	71.5	7.9	39.7	1488.6	5.0	178.6	19.8	1.1	42.5	0.1	5.1	0.6					
						RIB-4		80%	4263.8	28%	70%	2%	1193.9	2984.7	85.3	0.34	9.1	0.1	1.4	0.2	405.9	10912.0	71.6	1719.2	179.1	1014.8	27280.0	179.1	4298.0	447.7	29.0	779.4	5.1	122.8	12.8					
		756		Support	Coastal Patrol-Independent Low Speed (	PC-1	2.4	20%	355.3	28%	70%	2%	99.5	248.7	7.1	6.5	12.5	1.1	2.5	0.4	646.7	1239.6	104.5	249.7	34.8	1616.7	3099.1	261.2	624.3	87.1	46.2	88.5	7.5	17.8	2.5					
					Dynamic Maneuvering	PC-3		80%	1421.3	28%	70%	2%	398.0	994.9	28.4	59.93	187.6	9.3	47.1	4.8	23849.6	74661.0	3709.0	18751.8	1898.3	59624.1	186652.4	9272.4	46879.5	4745.7	1703.5	5332.9	264.9	1339.4	135.6					
26E	Amphibious Ops	348		AAV	Amphibious Assault Vehicle	AAV-1	13.2	20%	918.7	100%	0%	0%	918.7	0.0	0.0	0.444918	1.0	0.2	0.1	0.2	408.8	951.9	159.9	47.3	164.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0					
						AAV-2	13.2	80%	3674.9	100%	0%	0%	3674.9	0.0	0.0	0.633674	3.8	0.2	0.1	0.3	2328.7	13811.7	630.1	387.0	1081.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0					
		156		CRRC	Combat Raiding Rubber Craft	CRRC-1	13.2	28%	566.3	70%	30%	0%	396.4	169.9	0.0	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	7.9	0.0	0.0	0.0	0.0	3.4	0.0	0.0	0.0	0.0	0.0					
				CRRC	Combat Raiding Rubber Craft	CRRC-4	13.2	18%	360.4	70%	30%	0%	252.3	108.1	0.0	0	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0	33.3	0.0	0.0	0.0	0.0	14.3	0.0	0.0	0.0	0.0	0.0					
				CRRC	Combat Raiding Rubber Craft	CRRC-5	13.2	55%	1132.6	70%	30%	0%	792.8	339.8	0.0	0	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0	117.8	0.0	0.0	0.0	0.0	50.5	0.0	0.0	0.0	0.0	0.0					
26F	Amphibious Warfare	964		LCAC	Landing Craft Air Cushion	LCAC	8.5	100%	8194.0	16%	55%	29%	1311.0	4506.7	2376.3	25.41	55.3	0.7	43.3	3.9	33313.5	72526.7	943.9	56768.0	5099.9	114515.2	249310.6	3244.8	195140.1	17531.1	60380.8	131454.7	1710.9	102892.1	9243.7					
		221		LCU	Landing Craft Utility	LCU	8.5	100%	1878.5	75%	5%	20%	1408.9	93.9	375.7	36.21	45.0	0.5	3.1	1.6	51015.4	63328.9	732.6	4381.6	2211.9	3401.0	4221.9	48.8	292.1	147.5	13604.1	16887.7	195.4	1168.4	589.8					
		72		Support	Coastal Patrol-Independent Low Speed (	PC-2	8.5	100%	612.0	100%	0%	0%	612.0	0.0	0.0	17.21	38.1	2.9	8.2	0.9	10532.5	23341.7	1799.3	5036.8	563.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0					
		72		LCM-8		LCU	8.5	100%	612.0	100%	0%	0%	612.0	0.0	0.0	36.21	45.0	0.5	3.1	1.6	22160.5	27509.4	318.2	1903.3	960.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0					
		30		LARC		LCU	8.5	100%	255.0	100%	0%	0%	255.0	0.0	0.0	36.21	45.0	0.5	3.1	1.6	9233.6	11462.3	132.6	793.1	400.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0					
		36		SLWT	SLWT (assume LPD)	LPD-2	8.5	20%	61.2	95%	5%	0%	58.1	3.1	0.0	2.935967	17.3	2.2	52.1	10.5	170.7	1007.1	128.0	3029.9	608.1	9.0	53.0	6.7	159.5	32.0	0.0	0.0	0.0	0.0	0.0					
						LPD-3	8.5	80%	244.8	95%	5%	0%	232.6	12.2	0.0	6.549492	38.6	4.9	116.3	23.3	1523.1	8986.6	1142.4	27035.9	5426.2	80.2	473.0	60.1	1422.9	285.6	0.0	0.0	0.0	0.0	0.0					
		36		SLWT	SLWT (assume LPD)	LPD-2	8.5	20%	61.2	95%	5%	0%	58.1	3.1	0.0	2.935967	17.3	2.2	52.1	10.5	170.7	1007.1	128.0	3029.9	608.1	9.0	53.0	6.7	159.5	32.0	0.0	0.0	0.0	0.0	0.0					
						LPD-3	8.5	80%	244.8	95%	5%	0%	232.6	12.2	0.0	6.549492	38.6	4.9	116.3	23.3	1523.1	8986.6	1142.4	27035.9	5426.2	80.2	473.0	60.1	1422.9	285.6	0.0	0.0	0.0	0.0	0.0					
		18		BW	Boston Whaler	BW-2	8.5	20%	30.6	95%	5%	0%	29.1	1.5	0.0	0	0.1	9.0	0.0	0.0	0.0	2.6	262.1	0.0	0.0	0.0	0.1	13.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0					
						BW-3	8.5	80%	122.4	95%	5%	0%	116.3	6.1	0.0	0	0.3	26.3	0.0	0.0	0.0	30.7	3058.2	0.0	0.0	0.0	1.6	161.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0					
26G	Amphibious Ops	614		CRRC	Combat Raiding Rubber Craft	CRRC-1	6.2	28%	1038.4	80%	20%	0%	830.7	207.7	0.0	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	16.5	0.0	0.0	0.0	0.0	4.1	0.0	0.0	0.0	0.0	0.0					
				CRRC	Combat Raiding Rubber Craft	CRRC-4	6.2	18%	660.8	80%	20%	0%	528.7	132.2	0.0	0	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0	69.8	0.0	0.0	0.0	0.0	17.5	0.0	0.0	0.0	0.0	0.0					
				CRRC	Combat Raiding Rubber Craft	CRRC-5	6.2	55%	2076.9	80%	20%	0%	1661.5	415.4	0.0	0	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0	246.8	0.0	0.0	0.0	0.0	61.7	0.0	0.0	0.0	0.0	0.0					
27	Elec Combat	314		CVN	Nuclear Carrier (No emissions)																																			
		741		CG	Cruiser	CG-2	4.9	100%	3630.9	0%	3%	97%	0.0	108.9	3522.0	107.78	47.1	8.8	21.0	2.6	0.0	0.0	0.0	0.0	0.0	11740.2	5132.6	960.7	2289.6	286.5	379598.2	165955.4	31063.8	74031.9	9262.8					
		635		DDG	Guided Missile Destroyer	DDG-2	4.9	100%	3111.5	0%	3%	97%	0.0	93.3	3018.2	103.99	48.9	8.0	17.9	2.5	0.0	0.0	0.0	0.0	0.0	9706.9	4564.6	749.6	1674.6	229.6	313857.9	147587.8	24235.8	54145.7	7424.7					
		23		DD	Destroyer	DDG-2	4.9	100%	112.7	0%	3%	97%	0.0	3.4	109.3	103.99	48.9	8.0	17.9	2.5	0.0	0.0	0.0	0.0	0.0	351.6	165.3	27.1	60.7	8.3	11368.1	5345.7	877.8	1961.2	268.9					
		18		FFG	Guided Missile Frigate	FFG-2	4.9	100%	88.2	0%	3%	97%	0.0	2.6	85.6	66.82	67.7	7.8	11.6	3.3	0.0	0.0	0.0	0.0	0.0	176.8	179.2	20.7	30.6	8.6	5716.7	5793.7	668.2	989.9	278.1					
		5		FFH	Canadian Frigate	FFG-2	4.9	100%	24.5	0%	3%	97%	0.0	0.7	23.8	66.82	67.7	7.8	11.6	3.3	0.0	0.0	0.0	0.0	0.0	49.1	49.8	5.7	8.5	2.4	1588.0	1609.4	185.6	275.0	77.2					
		5		AOE	Logistics/Support	AOE-1	4.9	100%	24.5	0%	3%	97%	0.0	0.7	23.8	3.73	22.0	2.8	66.1	13.3	0.0	0.0	0.0	0.0	0.0	2.7	16.2	2.1	48.6	9.8	88.6	522.6	66.3	1571.8	315.6					
		2		MHC		PC-1	4.9	100%	9.8	0%	3%	97%	0.0	0.3	9.5	6.5	12.5	1.1	2.5	0.4	0.0	0.0	0.0	0.0	0.0	1.9	3.7	0.3	0.7	0.1	61.8	118.4	10.0	23.9	3.3					
		16		LPD	Amphibious Transport Dock - Wasp	LPD-1	4.9	100%	78.4	0%	3%	97%	0.0	2.4	76.0	1.845393	10.9	1.4	32.8	6.6	0.0	0.0	0.0	0.0	0.0	4.3	25.6	3.3	77.0	15.5	140.3	828.0	105.3	2491.0	500.0					
		230		LHD	Large Helicopter-dock Ships	LHD-1	4.9	100%	1127.0	0%	3%	97%	0.0	33.8	1093.2	5.89	34.8	4.4	104.6	21.0	0.0	0.0	0.0	0.0	0.0	199.1	1175.6	149.4	3536.5	709.7	6438.9	38010.2	4831.9	114347.7	22946.1					
		15		LSD	Landing Ship Dock	LPD-1	4.9	100%	73.5	0%	3%	97%	0.0	2.2	71.3	1.845393	10.9	1.4	32.8	6.6	0.0	0.0	0.0	0.0	0.0	4.1	24.0	3.1	72.2	14.5	131.6	776.2	98.7	2335.3	468.7					
		175		LHA	Amphib. Assault Ship - Tarawa	LHA-1	4.9	100%	857.5	0%	3%	97%	0.0	25.7	831.8	7.38	43.5	5.5	131.0	26.3	0.0	0.0	0.0	0.0	0.0	189.9	1119.8	142.3	3369.2	676.3	6138.5	36207.2	4599.7	108937.6	21867.4					
		1		AGF		LPD-1	4.9	100%	4.9	0%	3%	97%	0.0	0.1	4.8	1.845393	10.9	1.4	32.8	6.6	0.0	0.0	0.0	0.0	0.0	0.3	1.6	0.2	4.8	1.0	8.8	51.7	6.6	155.7	31.2					
		4		WHEC	US Coast Guard	USCG	4.9	100%	19.6	0%	3%	97%	0.0	0.6	19.0	5.74	57.9	0.9	11.6	0.2	0.0	0.0	0.0	0.0	0.0	3.4	34.1	0.5	6.8	0.1	109.1	1101.0	16.7	219.6	4.0					
		144		Unknown		PC-1	4.9	100%	705.6	0%	3%	97%	0.0	21.2	684.4	6.5	12.5	1.1	2.5	0.4	0.0	0.0	0.0	0.0	0.0	137.6	263.8	22.2	53.1	7.4	4448.8	8528.0	718.7	1717.9	239.6					
		10		SSN	Submarines (No emissions)																																			
		2		SSBN	Submarines (No emissions)																																			
28A	Sm Obj Avoidance	8		CG	Cruiser	CG-2	1.8	100%	14.0	100%	0%	0%	14.0	0.0	0.0	107.78	47.1	8.8	21.0	2.6	1508.9	659.7	123.5	294.3	36.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0					
		13		DDG	Guided Missile Destroyer	DDG-2	1.8	100%	22.8	100%	0%	0%	22.8	0.0	0.0	103.99	48.9	8.0	17.9	2.5	2365.8	1112.5	182.7	408.1	56.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0					
		10		FFG	Guided Missile Frigate	FFG-2	1.8	100%	17.5	100%	0%	0%	17.5	0.0	0.0	66.82	67.7	7.8	11.6	3.3	1169.4	1185.1	136.7	202.5	56.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0					
		15		MCM		USCG	1.8	100%	26.3	100%	0%	0%	26.3	0.0	0.0	5.74	57.9	0.9	11.6	0.2	150.7	1520.1	23.1	303.2	5.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0					
		21		MHC		USCG	1.8	100%	36.8	100%	0%	0%	36.8	0.0	0.0	5.74	57.9	0.9	11.6	0.2	210.9	2128.2	32.3	424.5	7.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0					
29	Mine Neutralization	0																																						
30	Mining Exercise	2		MHC		USCG	0.5	100%	1.0	50%	40%	10%	0.5	0.4	0.1	5.74	57.9	0.9	11.6	0.2	2.9	29.0	0.4	5.8	0.1	2.3	23.2	0.4	4.6	0.1	0.6	5.8	0.1	1.2	0.0					
31	NSWC Land Demolition	3		CRRC		CRRC-2	4.0	90%	10.8	100%	0%	0%	10.8	0.0	0.0	0	0.0	2.3	0.0	0.0	0.0	0.3	24.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0					
						CRRC-3		10%	1.2	100%	0%	0%	1.2	0.0	0.0	0	0.1	6.3	0.0	0.0	0.0	0.1	7.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0					
32	NSWC UW Demo	72		CRRC		CRRC-2	6.0	90%	388.8	100%	0%	0%	388.8	0.0	0.0	0	0.0	2.3	0.0	0.0	0.0	10.3	891.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0					
						CRRC-3		10%	43.2	100%	0%	0%	43.2	0.0	0.0	0	0.1	6.3	0.0	0.0	0.0	3.1	272.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0					
33	Mat Weave	28		CRRC		CRRC-2	4.0	90%	100.8	100%	0%	0%	100.8	0.0	0.0	0	0.0	2.3	0.0	0.0	0.0	2.7	231.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0					
						CRRC-3		10%	11.2	100%	0%	0%	11.2	0.0	0.0	0	0.1	6.3	0.0	0.0	0.0	0.8	70.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0					
34	NSWC Small Arms	20		CRRC		CRRC-2	6.0	90%	108.0	100%	0%	0%	108.0	0.0	0.0	0	0.0	2.3	0.0	0.0	0.0	2.9	247.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0					
						CRRC-3		10%	12.0	100%	0%	0%	12.0	0.0	0.0	0	0.1	6.3	0.0	0.0	0.0	0.9	75.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0					
35	NSWC Land Nav	0																																						
36	NSW UAV Operationa	0																																						
37	Insertion/Extraction	0																																						
38	NSW Boat Operations	220		MK V	MK V	MK-1	10.0	50%	1100.0	5%	42%	53%	55.0	462.0	583.0	1.94	14.8	0.5	2.4	0.2	106.7	815.7	27.5	131.5	11.0	896.3	6851.5	231.0	1104.2	92.4	1131.0	8645.9	291.5	1393.4	116.6					
						MK-3		50%	1100.0	5%	42%	53%	55.0	462.0	583.0	13.22	71.5	1.1	15.7	1.2	727.1	3931.4	57.8	860.8	63.3	6107.6	33023.8	485.1	7230.3	531.3	7707.3	41672.8	612.2	9124.0	670.5					
		67		RIB	Rigid Inflatable	RIB-3	10.0	50%	335.0	5%	42%	53%	16.8	140.7	177.6	0.08	3.0	0.0	0.4	0.0	1.3	50.3	0.2	6.0	0.7	11.3	422.1	1.4	50.7	5.6	14.2	532.7	1.8	63.9	7.1					
						RIB-4		50%	335.0	5%	42%	53%	16.8	140.7	177.6	0.34	9.1	0.1	1.4	0.2	5.7	153.1	1.0	24.1	2.5	47.8	1286.0	8.4	202.6	21.1	60.4	1622.8	10.7	255.7	26.6					

Table C-1. Surface Ship Air Emissions—No Action Alternative

Scenario	Type Training	Number of Ships	Program Totals	Nomenclature	Ship/Boat Type	Vessel Mode	Ship Time on Range (hrs) (Hours)	Percent at Each Power Level (%)	Total Time on Range (hrs) (Hours)	Percentage 0-3 nm from shore (Percent)	Percentage 3-12 nm from Shore (Percent)	Percentage >12 nm from Shore (Percent)	Total Time 0-3 nm from shore (Hours)	Total Time 3-12 nm from shore (Hours)	Total Time >12 nm from shore (Hours)	Emissions Factors (lb/hr) CO	NOx	HC	SOx	PM10
39	NSWG-1 Platoon Ops	2		PC	Coastal Patrol-Independent Low Speed (	PC-3	4.0	100%	8.0	20%	30%	50%	1.6	2.4	4.0	59.93	187.6	9.3	47.1	4.8
		25		CRRC		CRRC-5	0.5	100%	12.5	100%	0%	0%	12.5	0.0	0.0	0	0.1	12.9	0.0	0.0
		42		SOW	MK V	MK-3	0.5	100%	21.0	100%	0%	0%	21.0	0.0	0.0	13.22	71.5	1.1	15.7	1.2
40	Direct Action	2		PC	Coastal Patrol-Independent Low Speed (	PC-2	8.0	80%	12.8	30%	20%	50%	3.8	2.6	6.4	17.21	38.1	2.9	8.2	0.9
					Dynamic Maneuvering	PC-3		20%	3.2	30%	20%	50%	1.0	0.6	1.6	59.93	187.6	9.3	47.1	4.8
		3		SOW	MK V	MK-1	4.0	80%	9.6	30%	25%	45%	2.9	2.4	4.3	1.94	14.8	0.5	2.4	0.2
						MK-3		20%	2.4	30%	25%	45%	0.7	0.6	1.1	13.22	71.5	1.1	15.7	1.2
		1		LCAC	Landing Craft Air Cushion	LCAC	1.0	100%	1.0	100%	0%	0%	1.0	0.0	0.0	25.41	55.3	0.7	43.3	3.9
		10		CRRC	Combat Rubber Raiding Craft	CRRC-3	1.0	100%	10.0	100%	0%	0%	10.0	0.0	0.0	0	0.1	6.3	0.0	0.0
		10		SDV	Combat Rubber Raiding Craft	CRRC-3	1.0	100%	10.0	100%	0%	0%	10.0	0.0	0.0	0	0.1	6.3	0.0	0.0
41	Bombing Exercise - Land	0																		
42	CSAR	0																		
43	EOD Outside SHOBA	0																		
44	USCG Ops	149		Response	Coastal Patrol-Independent Low Speed (	PC-1	3.2	2%	9.5	80%	20%	0%	7.6	1.9	0.0	6.5	12.5	1.1	2.5	0.4
						PC-2		2%	9.5	80%	20%	0%	7.6	1.9	0.0	17.21	38.1	2.9	8.2	0.9
				Utility	Dynamic Maneuvering	PC-3		96%	457.7	80%	20%	0%	366.2	91.5	0.0	59.93	187.6	9.3	47.1	4.8
		149		Utility	Coastal Patrol-Independent Low Speed (	PC-1	3.2	15%	71.5	80%	20%	0%	57.2	14.3	0.0	6.5	12.5	1.1	2.5	0.4
						PC-2		60%	286.1	80%	20%	0%	228.9	57.2	0.0	17.21	38.1	2.9	8.2	0.9
					Dynamic Maneuvering	PC-3		25%	119.2	80%	20%	0%	95.4	23.8	0.0	59.93	187.6	9.3	47.1	4.8
		100		Cutter	US Coast Guard	USCG	3.2	100%	320.0	20%	20%	60%	64.0	64.0	192.0	5.74	57.9	0.9	11.6	0.2
		49		Cutter	US Coast Guard	USCG	3.2	100%	156.8	5%	5%	90%	7.8	7.8	141.1	5.74	57.9	0.9	11.6	0.2
45	NALF Airfield	0																		
46	Ship Torpedo Test	2		DDG	Guided Missile Destroyer	DDG-3	6.5	100%	13.0	0%	23%	77%	0.0	3.0	10.0	106.67	53.8	7.8	21.2	2.8
		2		DDH	Japanese Destroye Helo Deck (FMS)	CG-3	6.5	100%	13.0	0%	23%	77%	0.0	3.0	10.0	114.75	65.2	7.7	33.6	3.4
		2		DD	Japanese Destroyer (FMS)	CG-3	6.5	100%	13.0	0%	23%	77%	0.0	3.0	10.0	114.75	65.2	7.7	33.6	3.4
		7		FFH	Helicopter Frigate (Canadian)	FFG-3	6.5	100%	45.5	0%	23%	77%	0.0	10.6	34.9	120.04	78.1	11.6	16.1	4.3
47	UUV	10		BW	Boston Whalers	BW-1	10.0	100%	100.0	100%	0%	0%	100.0	0.0	0.0	0	0.1	7.5	0.0	0.0
		10		HS	Harbor Security	RIB-2	10.0	100%	100.0	100%	0%	0%	100.0	0.0	0.0	0.04	1.6	0.0	0.2	0.0
		20			Phanton DS4 (no emissions)					100%	0%	0%								
48	Sonobuoy QA/QC	60		AE	Acoustic Explorer	AE-2	4.0	100%	240.0	50%	30%	20%	120.0	72.0	48.0	20.17	20.9	1.0	6.0	1.6
49	Ocean Engineering	65		BW	Boston Whaler	BW-2	3.0	100%	195.0	100%	0%	0%	195.0	0.0	0.0	0	0.1	9.0	0.0	0.0
50	MM Mine Location	1		AE	Acoustic Explorer	AE-1	12.0	100%	12.0	100%	0%	0%	12.0	0.0	0.0	7.31	8.5	0.4	2.1	0.6
		5		BW	Boston Whaler	BW-2	12.0	100%	60.0	100%	0%	0%	60.0	0.0	0.0	0	0.1	9.0	0.0	0.0
51	Missile Flight Test	3		CG		CG-2	4.0	100%	12.0	0%	0%	100%	0.0	0.0	12.0	107.78	47.1	8.8	21.0	2.6
		6		DDG	Guided Missile Destroyer	DDG-2	4.0	100%	24.0	0%	0%	100%	0.0	0.0	24.0	103.99	48.9	8.0	17.9	2.5
52	NUWC UW Acoustic	44		FFG	Guided Missile Frigate	FFG-2	4.0	100%	176.0	0%	0%	100%	0.0	0.0	176.0	66.82	67.7	7.8	11.6	3.3
		12		AE	Acoustic Explorer	AE-1	4.0	100%	48.0	0%	0%	100%	0.0	0.0	48.0	7.31	8.5	0.4	2.1	0.6
		44		BW	Boston Whaler	BW-2	4.0	100%	176.0	0%	0%	100%	0.0	0.0	176.0	0	0.1	9.0	0.0	0.0
53	Other Tests	6		CG	Cruiser	CG-2	4.0	100%	24.0	0%	0%	100%	0.0	0.0	24.0	107.78	47.1	8.8	21.0	2.6
	(MCM, ASUW, FIREX)	18		DDG	Guided Missile Destroyer	DDG-2	4.0	100%	72.0	0%	0%	100%	0.0	0.0	72.0	103.99	48.9	8.0	17.9	2.5
		19		FFH	Helicopter Frigate (Canadian)	FFG-2	4.0	100%	76.0	0%	0%	100%	0.0	0.0	76.0	66.82	67.7	7.8	11.6	3.3
		1		DD	Japanese Destroyer (FMS)	CG-2	4.0	100%	4.0	0%	0%	100%	0.0	0.0	4.0	107.78	47.1	8.8	21.02	2.6
		4		AOR	Canadian	AOE-1	4.0	100%	16.0	0%	0%	100%	0.0	0.0	16.0	3.73	22.0	2.8	66.1	13.3
	Total	####																		

Emissions

Scenario	Nomenclature	Vessel Mode	Emissions 0-3 nm Offshore (lbs) CO	Nox	HC	Sox	PM	Emissions 3-12 nm Offshore - US Territory (lbs) CO	Nox	HC	Sox	PM	Emissions >12 nm Offshore - Outside US Territory CO	Nox	HC	Sox	PM	CO	Nox	HC	Sox	PM
39	PC	PC-3	95.9	300.2	14.9	75.4	7.6	143.8	450.3	22.4	113.1	11.4	239.7	750.4	37.3	188.5	19.1					
	CRRC	CRRC-5	0.0	1.9	161.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0					
	SOW	MK-3	277.6	1501.1	22.1	328.7	24.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0					
40	PC	PC-2	66.1	146.5	11.3	31.6	3.5	44.1	97.6	7.5	21.1	2.4	110.1	244.1	18.8	52.7	5.9					
		PC-3	57.5	180.1	8.9	45.2	4.6	38.4	120.1	6.0	30.2	3.1	95.9	300.2	14.9	75.4	7.6					
	SOW	MK-1	5.6	42.7	1.4	6.9	0.6	4.7	35.6	1.2	5.7	0.5	8.4	64.1	2.2	10.3	0.9					
		MK-3	9.5	51.5	0.8	11.3	0.8	7.9	42.9	0.6	9.4	0.7	14.3	77.2	1.1	16.9	1.2					
	LCAC	LCAC	25.4	55.3	0.7	43.3	3.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0					
	CRRC	CRRC-3	0.0	0.7	63.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0					
	SDV	CRRC-3	0.0	0.7	63.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0					
44	Response	PC-1	49.6	95.1	8.0	19.1	2.7	12.4	23.8	2.0	4.8	0.7	0.0	0.0	0.0	0.0	0.0					
		PC-2	131.3	291.0	22.4	62.8	7.0	32.8	72.7	5.6	15.7	1.8	0.0	0.0	0.0	0.0	0.0					
	Utility	PC-3	21945.3	68699.5	3412.8	17254.5	1746.7	5486.3	17174.9	853.2	4313.6	436.7	0.0	0.0	0.0	0.0	0.0					
	Utility	PC-1	371.9	712.9	60.1	143.6	20.0	93.0	178.2	15.0	35.9	5.0	0.0	0.0	0.0	0.0	0.0					
		PC-2	3938.7	8728.9	672.9	1883.6	210.6	984.7	2182.2	168.2	470.9	52.6	0.0	0.0	0.0	0.0	0.0					
		PC-3	5714.9	17890.5	888.8	4493.4	454.9	1428.7	4472.6	222.2	1123.3	113.7	0.0	0.0	0.0	0.0	0.0					
	Cutter	USCG	367.4	3706.2	56.3	739.2	13.4	367.4	3706.2	56.3	739.2	13.4	1102.1	11118.7	169.0	2217.6	40.3					
	Cutter	USCG	45.0	454.0	6.9	90.6	1.6	45.0	454.0	6.9	90.6	1.6	810.0	8172.3	124.2	1629.9	29.6					
46	DDG	DDG-3	0.0	0.0	0.0	0.0	0.0	321.7	162.4	23.6	64.0	8.4	1065.0	537.5	78.3	211.9	28.0					
	DDH	CG-3	0.0	0.0	0.0	0.0	0.0	346.1	196.7	23.1	101.2	10.4	1145.7	651.2	76.6	335.0	34.3					
	DD	CG-3	0.0	0.0	0.0	0.0	0.0	346.1	196.7	23.1	101.2	10.4	1145.7	651.2	76.6	335.0	34.3					
	FFH	FFG-3	0.0	0.0	0.0	0.0	0.0	1267.1	824.5	122.9	169.7	45.4	4194.7	2729.5	406.7	561.9	150.3					
47	BW	BW-1	0.0	7.6	751.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0					
	HS	RIB-2	4.0	159.0	1.0	17.0	2.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0					
48	AE	AE-2	2420.4	2511.6	118.8	716.4	188.4	1452.2	1507.0	71.3	429.8	113.0	968.2	1004.6	47.5	286.6	75.4					
49	BW	BW-2	0.0	17.7	1758.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0					
50	AE	AE-1	87.7	101.5	4.6	25.4	6.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0					
	BW	BW-2	0.0	5.4	541.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0					
51	CG	CG-2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1293.4	565.4	105.8	252.2	31.6					
	DDG	DDG-2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2495.8	1173.6	192.7	430.6	59.0					
52	FFG	FFG-2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	11760.3	11918.7	1374.6	2036.3	572.0					
	AE	AE-1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	350.9	406.1	18.2	101.8	26.4					
	BW	BW-2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	16.0	1587.1	0.0	0.0					
53	CG	CG-2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2586.7	1130.9	211.7	504.5	63.1					
	DDG	DDG-2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	7487.3	3520.8	578.2	1291.7	177.1					
	FFH	FFG-2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	5078.3	5146.7	593.6	879.3	247.0					
	DD	CG-2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	431.1	188.5	35.3	84.1	10.5					
	AOR	AOE-1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	59.7	351.8	44.6	1058.2	212.5					
Total Emissions (SCI) tons			**8.69**	**12.84**	**3.22**	**7.22**	**1.16**	**56.32**	**32.58**	**4.70**	**15.29**	**2.39**	**583.20**	**437.81**	**50.56**	**281.98**	**43.31**	**43.84**	**28.03**	**3.95**	**11.12**	**1.77**
Total Emissions (SD) tons			**104.07**	**234.73**	**12.64**	**90.96**	**16.79**	**100.50**	**276.82**	**8.58**	**133.08**	**12.92**										
Total Emissions within US Territory (SCI)			**65.01**	**45.42**	**7.92**	**22.52**	**3.55**															
Total Emissions within US Territory (SD)			**204.57**	**511.55**	**21.22**	**224.04**	**29.72**															
						56768.0																

Date: 13-May-2007

Notes: 1 - Ship nomenclature highlighted in yellow signifies no specific AQ Emissions data for that vessel.
For vessels without AQ emissions data, the following data was used:

Support (for USW)	TRB	AGF	LPD
Support (for Surf Firing)	PC	WHEC	USCG
MCM	USCG	Unknown (for Elec Combat)	PC
MHC	USCG	SOW	MKV
LSD	LPD	EFV	AAV
Unknown (for VBSS)	PC	DDH	CG
DD	CG	HS	RIB
FFH	FFG	AOR	AOE

Table C-2. Surface Ship Air Emissions—Alternative 1

Scenario	Type Training	Number of Ships	Program Totals	Nomenclature	Ship/Boat Type	Vessel Mode	Ship Time on Range (hrs)	Percent at Each Power Level	Total Time on Range (hrs)	Percentage 0-3 nm from shore	Percentage 3-12 nm from Shore	Percentage >12 nm from Shore	Total Time 0-3 nm from shore	Total Time 3-12 nm from shore	Total Time >12 nm from shore	Emissions Factors (lb/hr) CO	NOx	HC	SOx	PM10
							Hours	%	Hours	Percent			Hours			CO	NOx	HC	SOx	PM10
Training Exercises																				
1	Air Combat Maneuvers	0																		
2	Air Defense Exercise	111		CG	Cruiser	CG-2	1.0	100%	111.0	0%	0%	100%	0.0	0.0	111.0	107.78	47.1	8.8	21.0	2.6
		221		DDG	Guided Missile Destroyer	DDG-2	1.0	100%	221.0	0%	0%	100%	0.0	0.0	221.0	103.99	48.9	8.0	17.9	2.5
		23		CVN	Nuclear Carrier (No emissions)					0%	0%	100%								
		4		FFG	Guided Missile Frigate	FFG-2	3.7	100%	14.8	0%	0%	100%	0.0	0.0	14.8	66.82	67.7	7.8	11.6	3.3
3	S-A Missiles	4		CVN	Nuclear Carrier (No emissions)					0%	0%	100%								
		4		TRB	Torpedo Retrieval Boats	TRB-3	4.0	100%	16.0	1%	2%	97%	0.2	0.3	15.5	6.47	56.2	1.6	7.4	1.2
4	S-A Gunnery Exercise	23		CVN						0%	0%	100%								
		44		CG	Cruiser	CG-2	1.5	100%	66.0	0%	0%	100%	0.0	0.0	66.0	107.78	47.1	8.8	21.0	2.6
		91		DDG	Guided Missile Destroyer	DDG-2	1.5	100%	136.5	0%	0%	100%	0.0	0.0	136.5	103.99	48.9	8.0	17.9	2.5
		55		FFG	Guided Missile Frigate	FFG-2	1.5	100%	82.5	0%	0%	100%	0.0	0.0	82.5	66.82	67.7	7.8	11.6	3.3
		13		LHA	Amphib. Assault Ship - Tarawa	LHA-1	1.5	100%	19.5	0%	0%	100%	0.0	0.0	19.5	7.38	43.5	5.5	131.0	26.3
		15		LDH	Large Helicopter-dock Ships	LHD-1	1.5	100%	22.5	0%	0%	100%	0.0	0.0	22.5	5.89	34.8	4.4	104.6	21.0
		21		LPD	Amphibious Transport Dock - Wasp	LPD-1	1.5	100%	31.5	0%	0%	100%	0.0	0.0	31.5	1.845393	10.9	1.4	32.8	6.6
		24		LSD	Landing Ship Dock	LPD-1	1.5	100%	36.0	0%	0%	100%	0.0	0.0	36.0	1.845393	10.9	1.4	32.8	6.6
		37		USCGS	US Coast Guard	USCG	1.5	100%	55.5	0%	0%	100%	0.0	0.0	55.5	5.74	57.9	0.9	11.6	0.2
		27		Other Ship	Coastal Patrol-Independent Low Speed (	PC-1	1.5	100%	40.5	0%	0%	100%	0.0	0.0	40.5	6.5	12.5	1.1	2.5	0.4
5	A-A Missiles	1		TRB	Torpedo Retrieval Boats	TRB-3	4.0	100%	4.0	1%	2%	97%	0.0	0.1	3.9	6.47	56.2	1.6	7.4	1.2
6	Helicopter ASW TRACKEX	28		CG	Cruiser	CG-3	3.6	100%	100.8	1%	10%	89%	1.0	10.1	89.7	114.75	65.2	7.7	33.6	3.4
		71		DDG	Guided Missile Destroyer	DDG-3	3.6	100%	255.6	1%	10%	89%	2.6	25.6	227.5	106.67	53.8	7.8	21.2	2.8
		43		TRB	Torpedo Retrieval Boats	TRB-3	3.6	100%	154.8	1%	10%	89%	1.5	15.5	137.8	6.47	56.2	1.6	7.4	1.2
7	Helicopter ASW TORPEX	28		CG	Cruiser	CG-3	3.6	100%	100.8	1%	10%	89%	1.0	10.1	89.7	114.75	65.2	7.7	33.6	3.4
		75		DDG	Guided Missile Destroyer	DDG-3	3.6	100%	270.0	1%	10%	89%	2.7	27.0	240.3	106.67	53.8	7.8	21.2	2.8
		72		TRB	Torpedo Retrieval Boats	TRB-3	3.6	100%	259.2	1%	10%	89%	2.6	25.9	230.7	6.47	56.2	1.6	7.4	1.2
8	MPA ASW TRACKEX																			
9	MPA ASW TORPEX	2		CG	Cruiser	CG-3	2.0	100%	4.0	5%	10%	85%	0.2	0.4	3.4	114.75	65.2	7.7	33.6	3.4
		4		DDG	Guided Missile Destroyer	DDG-3	2.0	100%	8.0	5%	10%	85%	0.4	0.8	6.8	106.67	53.8	7.8	21.2	2.8
		3		FFG	Guided Missile Frigate	FFG-3	2.0	100%	6.0	5%	10%	85%	0.3	0.6	5.1	120.04	78.1	11.6	16.1	4.3
		14		TRB	Torpedo Retrieval Boats	TRB-3	2.0	100%	28.0	5%	10%	85%	1.4	2.8	23.8	6.47	56.2	1.6	7.4	1.2
10	EER/IEER ASW																			
11	Surface Ship ASW TRACKEX	225		CG	Cruiser	CG-3	2.0	100%	450.0	1%	10%	89%	4.5	45.0	400.5	114.75	65.2	7.7	33.6	3.4
		450		DDG	Guided Missile Destroyer	DDG-3	2.0	100%	900.0	1%	10%	89%	9.0	90.0	801.0	106.67	53.8	7.8	21.2	2.8
		225		FFG	Guided Missile Frigate	FFG-3	2.0	100%	450.0	1%	10%	89%	4.5	45.0	400.5	120.04	78.1	11.6	16.1	4.3
		0		Support	Torpedo Retrieval Boats	TRB-3	2.0	100%	0.0	1%	10%	89%	0.0	0.0	0.0	6.47	56.2	1.6	7.4	1.2
12	Surface Ship ASW TORPEX	8		CG	Cruiser	CG-3	3.7	100%	29.6	1%	10%	89%	0.3	3.0	26.3	114.75	65.2	7.7	33.6	3.4
		12		DDG	Guided Missile Destroyer	DDG-3	3.7	100%	44.4	1%	10%	89%	0.4	4.4	39.5	106.67	53.8	7.8	21.2	2.8
		6		FFG	Guided Missile Frigate	FFG-3	3.7	100%	22.2	1%	10%	89%	0.2	2.2	19.8	120.04	78.1	11.6	16.1	4.3
		12		TRB	Torpedo Retrieval Boats	TRB-3	3.7	100%	44.4	1%	10%	89%	0.4	4.4	39.5	6.47	56.2	1.6	7.4	1.2
13	Sub ASW Trackex	53		SSN	Submarines (No emissions)															
		16		TRB	Torpedo Retrieval Boats	TRB-3	12.8	100%	204.8	1%	2%	97%	2.0	4.1	198.7	6.47	56.2	1.6	7.4	1.2
14	Sub ASW TORPEX	22		SSN	Submarines (No emissions)															
		22		TRB	Torpedo Retrieval Boats	TRB-3	11.7	100%	257.4	1%	2%	97%	2.6	5.1	249.7	6.47	56.2	1.6	7.4	1.2
15	VBSS	18		CG	Cruiser	CG-2	4.0	100%	72.0	0%	0%	100%	0.0	0.0	72.0	107.78	47.1	8.8	21.0	2.6
		36		DDG	Guided Missile Destroyer	DDG-2	4.0	100%	144.0	0%	0%	100%	0.0	0.0	144.0	103.99	48.9	8.0	17.9	2.5
		7		FFG	Guided Missile Frigate	FFG-2	4.0	100%	28.0	0%	0%	100%	0.0	0.0	28.0	66.82	67.7	7.8	11.6	3.3
		3		LPD	Amphibious Transport Dock - Wasp	LPD-1	4.0	100%	12.0	0%	0%	100%	0.0	0.0	12.0	1.845393	10.9	1.4	32.8	6.6
		7		LSD		LPD-1	4.0	100%	28.0	0%	0%	100%	0.0	0.0	28.0	1.845393	10.9	1.4	32.8	6.6
16	ASUW MISSILEX	32		TRB	Torpedo Retrieval Boats	TRB-2	7.0	100%	224.0	5%	28%	67%	11.2	62.7	150.1	7.64	33.1	0.6	3.4	1.2
		2		CG	Cruiser	CG-2	4.0	100%	8.0	0%	0%	100%	0.0	0.0	8.0	107.78	47.1	8.8	21.0	2.6
		2		DDG	Guided Missile Destroyer	DDG-2	4.0	100%	8.0	0%	0%	100%	0.0	0.0	8.0	103.99	48.9	8.0	17.9	2.5
17	A-S BOMBEX	0																		
18	A-S GUNEX	0																		
19	S-S GUNEX	1		CVN	Nuclear Carrier (No emissions)															
		71		CG	Cruiser	CG-1	2.5	100%	177.5	0%	28%	72%	0.0	49.7	127.8	102.58	40.6	9.2	17.7	2.1
		147		DDG	Guided Missile Destroyer	DDG-1	2.5	100%	367.5	0%	28%	72%	0.0	102.9	264.6	102.98	47.3	8.1	17.0	2.4
		49		FFG	Guided Missile Frigate	FFG-1	2.5	100%	122.5	0%	28%	72%	0.0	34.3	88.2	65.75	66.4	7.9	10.9	3.1
		2		LPD	Amphibious Transport Dock - Wasp	LPD-1	2.5	100%	5.0	0%	28%	72%	0.0	1.4	3.6	1.845393	10.9	1.4	32.8	6.6
		1		LSD	Landing Ship Dock	LPD-1	2.5	100%	2.5	0%	28%	72%	0.0	0.7	1.8	1.845393	10.9	1.4	32.8	6.6
		1		LHD	Large Helicopter-dock Ships	LHD-2	2.5	100%	2.5	0%	28%	72%	0.0	0.7	1.8	6.8	40.1	5.1	120.7	24.2
		18		Unknown	Other	PC-2	2.5	100%	45.0	0%	28%	72%	0.0	12.6	32.4	17.21	38.1	2.9	8.2	0.9
		40		USCG	US Coast Guard	USCG	2.5	100%	100.0	0%	28%	72%	0.0	28.0	72.0	5.74	57.9	0.9	11.6	0.2
20	SINKEX	4		CG	Cruiser	CG-2	16.0	100%	64.0	0%	0%	100%	0.0	0.0	64.0	107.78	47.1	8.8	21.0	2.6
		8		DDG	Guided Missile Destroyer	DDG-2	16.0	100%	128.0	0%	0%	100%	0.0	0.0	128.0	103.99	48.9	8.0	17.9	2.5
		0		DD	Destroyer	DDG-2	16.0	100%	0.0	0%	0%	100%	0.0	0.0	0.0	103.99	48.9	8.0	17.9	2.5
		4		FFG	Guided Missile Frigate	FFG-2	16.0	100%	64.0	0%	0%	100%	0.0	0.0	64.0	66.82	67.7	7.8	11.6	3.3
		2		SSN	Submarines (No emissions)															
21	NSFS	16		CG	Cruiser	CG-2	9.0	100%	144.0	0%	30%	70%	0.0	43.2	100.8	107.78	47.1	8.8	21.0	2.6
		34		DDG	Guided Missile Destroyer	DDG-2	9.0	100%	306.0	0%	30%	70%	0.0	91.8	214.2	103.99	48.9	8.0	17.9	2.5
		4		FFG	Guided Missile Frigate	FFG-2	9.0	100%	36.0	0%	30%	70%	0.0	10.8	25.2	66.82	67.7	7.8	11.6	3.3
22	EFEX	2		CG	Cruiser	CG-2	72.0	100%	144.0	0%	100%	0%	0.0	144.0	0.0	107.78	47.1	8.8	21.0	2.6
		2		DDG	Guided Missile Destroyer	DDG-2	72.0	100%	144.0	0%	100%	0%	0.0	144.0	0.0	103.99	48.9	8.0	17.9	2.5
23	Battalion Landing	1		LHA	Amphib. Assault Ship - Tarawa	LHA-1	6.0	100%	6.0	10%	30%	60%	0.6	1.8	3.6	7.38	131.0	26.3	7.4	43.5
		1		LHD	Large Helicopter-dock Ships	LHD-2	2.5	100%	2.5	10%	30%	60%	0.3	0.8	1.5	6.8	40.1	5.1	120.7	24.2
		1		LPD	Amphibious Transport Dock - Wasp	LPD-1	2.5	100%	2.5	10%	30%	60%	0.3	0.8	1.5	1.845393	10.9	1.4	32.8	6.6
		6		LCU	Landing Craft Utility	LCU	3.0	100%	18.0	10%	30%	60%	1.8	5.4	10.8	36.21	3.1	1.6	36.2	45.0
		14		AAV/EFV	Amphibious Assault Vehicle	EFV-2	6.0	100%	84.0	10%	30%	60%	8.4	25.2	50.4	2.0611	4.17	0.72	0.06	0.3211
		5		LCAC	Landing Craft Air Cushioned	LCAC	3.0	100%	15.0	10%	30%	60%	1.5	4.5	9.0	25.41	43.3	3.9	25.4	55.3
		0		CRRC	Combat Raiding Rubber Craft	CRRC-4	6.0	100%	0.0	10%	30%	60%	0.0	0.0	0.0	0	0.0	0.0	0.0	0.1
24	USMC Stinger	0																		
25	Amphibious Landings & Raids																			
25A	Recon Mission	8		LPD	Amphibious Transport Dock - Wasp	LPD-1	4.0	100%	32.0	0%	0%	100%	0.0	0.0	32.0	1.845393	10.9	1.4	32.8	6.6
25B	Helicopter Assault	4		LHD	Large Helicopter-dock Ships	LHD-2	6.0	100%	24.0	0%	0%	100%	0.0	0.0	24.0	6.8	40.1	5.1	120.7	24.2
		4		LHA	Amphib. Assault Ship - Tarawa	LHA-1	6.0	100%	24.0	0%	0%	100%	0.0	0.0	24.0	7.38	131.0	26.3	7.4	43.5
25C	Armored Operations	3		LHD	Large Helicopter-dock Ships	LHD-2	12.0	100%	36.0	33%	33%	33%	12.0	12.0	12.0	6.8	40.1	5.1	120.7	24.2
		3		LHA	Amphib. Assault Ship - Tarawa	LHA-1	12.0	100%	36.0	33%	33%	33%	12.0	12.0	12.0	7.38	131.0	26.3	7.4	43.5
		6		LCAC	Landing Craft Air Cushioned	LCAC	12.0	100%	72.0	33%	33%	33%	24.0	24.0	24.0	25.41	43.3	3.9	25.4	55.3
		6		LCU	Landing Craft Utility	LCU	12.0	100%	72.0	33%	33%	33%	24.0	24.0	24.0	36.21	3.1	1.6	36.2	45.0
25D	Artillery Operations	2		LHD	Large Helicopter-dock Ships	LHD-2	24.0	100%	48.0	100%	0%	0%	48.0	0.0	0.0	6.8	40.1	5.1	120.7	24.2
		1		LHA	Amphib. Assault Ship - Tarawa	LHA-1	24.0	100%	24.0	20%	40%	40%	4.8	9.6	9.6	7.38	43.5	5.5	131.0	26.3
		4		LCAC	Landing Craft Air Cushion	LCAC	24.0	100%	96.0	100%	0%	0%	96.0	0.0	0.0	25.41	55.3	0.7	43.3	3.9
		4		LCU	Landing Craft Utility	LCU	24.0	100%	96.0	100%	0%	0%	96.0	0.0	0.0	36.21	45.0	0.5	3.1	1.6

Emissions

Scenario	Nomenclature	Emissions 0-3 nm Offshore (lbs) CO	Nox	HC	Sox	PM	Emissions 3-12 nm Offshore - US Territory (lbs) CO	Nox	HC	Sox	PM	Emissions >12 nm Offshore - Outside US Territory: Offshore San Diego CO	Nox	HC	Sox	PM	Offshore Mexico CO	Nox	HC	Sox	PM
2	CG	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	11963.6	5230.3	979.0	2333.2	291.9					
	DDG	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	22981.8	10806.9	1774.6	3964.7	543.7					
	FFG	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	988.9	1002.3	115.6	171.2	48.1					
3	TRB	1.0	9.0	0.2	1.2	0.2	2.1	18.0	0.5	2.4	0.4	100.4	872.5	24.1	114.8	18.3					
4	CG	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0						7113.5	3109.9	582.1	1387.3	173.6
	DDG	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0						14194.6	6674.9	1096.1	2448.8	335.8
	FFG	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0						5512.7	5586.9	644.3	954.5	268.1
	LHA	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0						143.9	848.8	107.8	2553.9	512.7
	LDH	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0						132.5	782.3	99.5	2353.5	472.3
	LPD	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0						58.1	343.0	43.6	1031.8	207.1
	LSD	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0						66.4	392.0	49.8	1179.2	236.7
	USCGS	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0						318.6	3214.0	48.8	641.0	11.7
	Other Ship	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0						263.3	504.6	42.5	101.7	14.2
5	TRB	0.3	2.2	0.1	0.3	0.0	0.5	4.5	0.1	0.6	0.1						25.1	218.1	6.0	28.7	4.6
6	CG	115.7	65.7	7.7	33.8	3.5	1156.7	657.4	77.3	338.2	34.7	10294.5	5851.0	688.1	3009.8	308.6					
	DDG	272.6	137.6	20.0	54.2	7.2	2726.5	1376.2	200.4	542.4	71.6	24265.7	12247.7	1783.5	4827.2	637.0					
	TRB	10.0	87.0	2.4	11.5	1.8	100.2	870.3	24.0	114.6	18.3	891.4	7745.5	213.5	1019.5	162.6					
7	CG	115.7	65.7	7.7	33.8	3.5	1156.7	657.4	77.3	338.2	34.7	10294.5	5851.0	688.1	3009.8	308.6					
	DDG	288.0	145.4	21.2	57.3	7.6	2880.1	1453.7	211.7	572.9	75.6	25632.8	12937.8	1884.0	5099.2	672.8					
	TRB	16.8	145.7	4.0	19.2	3.1	167.7	1457.2	40.2	191.8	30.6	1492.6	12969.3	357.6	1707.1	272.2					
9	CG	23.0	13.0	1.5	6.7	0.7	45.9	26.1	3.1	13.4	1.4	390.2	221.7	26.1	114.1	11.7					
	DDG	42.7	21.5	3.1	8.5	1.1	85.3	43.1	6.3	17.0	2.2	725.4	366.1	53.3	144.3	19.0					
	FFG	36.0	23.4	3.5	4.8	1.3	72.0	46.9	7.0	9.6	2.6	612.2	398.4	59.4	82.0	21.9					
	TRB	9.1	78.7	2.2	10.4	1.7	18.1	157.4	4.3	20.7	3.3	154.0	1338.0	36.9	176.1	28.1					
																0.0					
11	CG	516.4	293.5	34.5	151.0	15.5	5163.8	2934.9	345.2	1509.8	154.8	45957.4	26120.6	3071.8	13436.8	1377.7					
	DDG	960.0	484.6	70.6	191.0	25.2	9600.3	4845.6	705.6	1909.8	252.0	85442.7	43125.8	6279.8	16997.2	2242.8					
	FFG	540.2	351.5	52.4	72.4	19.4	5401.8	3515.0	523.8	723.6	193.5	48076.0	31283.1	4661.8	6440.0	1722.2					
	Support	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0					
12	CG	34.0	19.3	2.3	9.9	1.0	339.7	193.1	22.7	99.3	10.2	3023.0	1718.2	202.1	883.8	90.6					
	DDG	47.4	23.9	3.5	9.4	1.2	473.6	239.0	34.8	94.2	12.4	4215.2	2127.5	309.8	838.5	110.6					
	FFG	26.6	17.3	2.6	3.6	1.0	266.5	173.4	25.8	35.7	9.5	2371.8	1543.3	230.0	317.7	85.0					
	TRB	2.9	25.0	0.7	3.3	0.5	28.7	249.6	6.9	32.9	5.2	255.7	2221.6	61.2	292.4	46.6					
13	TRB	13.3	115.1	3.2	15.2	2.4	26.5	230.3	6.3	30.3	4.8	1285.3	11168.4	307.9	1470.1	234.4					
14	TRB	16.7	144.7	4.0	19.0	3.0	33.3	289.4	8.0	38.1	6.1	1615.4	14036.9	387.0	1847.6	294.6					
15	CG	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	7760.2	3392.6	635.0	1513.4	189.4					
	DDG	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	14974.6	7041.6	1156.3	2583.4	354.2					
	FFG	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1871.0	1896.2	218.7	324.0	91.0					
	LPD	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	22.1	130.7	16.6	393.1	78.9					
	LSD	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	51.7	304.9	38.8	917.2	184.1					
																0.0					
16	TRB	85.6	370.6	6.6	38.0	13.0	479.2	2075.4	37.0	212.6	72.8	1146.6	4966.1	88.5	508.8	174.1					
	CG	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	862.2	377.0	70.6	168.2	21.0					
	DDG	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	831.9	391.2	64.2	143.5	19.7					
19	CG	0.0	0.0	0.0	0.0	0.0	5098.2	2018.3	458.2	880.2	105.4						13109.7	5190.0	1178.3	2263.3	270.9
	DDG	0.0	0.0	0.0	0.0	0.0	10596.6	4871.3	833.5	1753.4	241.8						27248.5	12526.2	2143.3	4508.8	621.8
	FFG	0.0	0.0	0.0	0.0	0.0	2255.2	2275.8	270.6	373.5	107.7						5799.2	5852.1	695.9	960.5	276.9
	LPD	0.0	0.0	0.0	0.0	0.0	2.6	15.2	1.9	45.9	9.2						6.6	39.2	5.0	117.9	23.7
	LSD	0.0	0.0	0.0	0.0	0.0	1.3	7.6	1.0	22.9	4.6						3.3	19.6	2.5	59.0	11.8
	LHD	0.0	0.0	0.0	0.0	0.0	4.8	28.1	3.6	84.5	17.0						12.2	72.2	9.2	217.3	43.6
	Unknown	0.0	0.0	0.0	0.0	0.0	216.8	480.6	37.0	103.7	11.6						557.6	1235.7	95.3	266.7	29.8
	USCG	0.0	0.0	0.0	0.0	0.0	160.7	1621.5	24.6	323.4	5.9						413.3	4169.5	63.4	831.6	15.1
20	CG	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0						6897.9	3015.7	564.5	1345.3	168.3
	DDG	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0						13310.7	6259.2	1027.8	2296.3	314.9
	DD	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0						0.0	0.0	0.0	0.0	0.0
	FFG	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0						4276.5	4334.1	499.8	740.5	208.0
21	CG	0.0	0.0	0.0	0.0	0.0	4656.1	2035.6	381.0	908.1	113.6	10864.2	4749.7	889.1	2118.8	265.1					
	DDG	0.0	0.0	0.0	0.0	0.0	9546.3	4489.0	737.2	1646.9	225.8	22274.7	10474.4	1720.0	3842.7	526.9					
	FFG	0.0	0.0	0.0	0.0	0.0	721.7	731.4	84.3	125.0	35.1	1683.9	1706.5	196.8	291.6	81.9					
22	CG	0.0	0.0	0.0	0.0	0.0	15520.3	6785.3	1270.1	3026.9	378.7	0.0	0.0	0.0	0.0	0.0					
	DDG	0.0	0.0	0.0	0.0	0.0	14974.6	7041.6	1156.3	2583.4	354.2	0.0	0.0	0.0	0.0	0.0					
23	LHA	4.4	78.6	15.8	4.4	26.1	13.3	235.7	47.3	13.3	78.4	26.6	471.5	94.6	26.6	156.7					
	LHD	1.7	10.0	1.3	30.2	6.1	5.1	30.1	3.8	90.5	18.2	10.2	60.2	7.7	181.1	36.3					
	LPD	0.5	2.7	0.3	8.2	1.6	1.4	8.2	1.0	24.6	4.9	2.8	16.3	2.1	49.1	9.9					
	LCU	65.2	5.6	2.8	65.2	80.9	195.5	16.8	8.5	195.5	242.7	391.1	33.6	17.0	391.1	485.5					
	AAV/EFV	17.3	35.0	6.1	0.5	2.7	51.9	105.0	18.2	1.6	8.1	103.9	210.0	36.3	3.2	16.2					
	LCAC	38.1	65.0	5.8	38.1	83.0	114.3	194.9	17.5	114.3	248.9	228.7	389.7	35.0	228.7	497.9					
	CRRC	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0					
25A	LPD	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	59.1	348.4	44.3	1048.2	210.4					
25B	LHD	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	163.2	962.9	122.4	2896.8	581.5					
	LHA	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	177.1	3143.3	631.0	177.1	1044.7					
25C	LHD	81.5	481.0	61.1	1447.0	290.5	81.5	481.0	61.1	1447.0	290.5	81.5	481.0	61.1	1447.0	290.5					
	LHA	88.5	1570.1	315.2	88.5	521.8	88.5	1570.1	315.2	88.5	521.8	88.5	1570.1	315.2	88.5	521.8					
	LCAC	609.2	1038.2	93.3	609.2	1326.4	609.2	1038.2	93.3	609.2	1326.4	609.2	1038.2	93.3	609.2	1326.4					
	LCU	868.2	74.6	37.6	868.2	1077.7	868.2	74.6	37.6	868.2	1077.7	868.2	74.6	37.6	868.2	1077.7					
25D	LHD	326.4	1925.8	244.8	5793.6	1163.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0					
	LHA	35.4	208.9	26.5	628.7	126.2	70.8	417.9	53.1	1257.3	252.4	70.8	417.9	53.1	1257.3	252.4					
	LCAC	2439.4	5310.7	69.1	4156.8	373.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0					
	LCU	3476.2	4315.2	49.9	298.6	150.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0					

Table C-2. Surface Ship Air Emissions—Alternative 1

Scenario	Type Training	Number of Ships	Program Totals	Nomenclature	Ship/Boat Type	Vessel Mode	Ship Time on Range (hrs)	Percent at Each Power Level	Total Time on Range (hrs)	Percentage 0-3 nm from shore	Percentage 3-12 nm from Shore	Percentage >12 nm from Shore	Total Time 0-3 nm from shore	Total Time 3-12 nm from shore	Total Time >12 nm from shore	Emissions Factors (lb/hr) CO	NOx	HC	SOx	PM10	Emissions 0-3 nm Offshore (lbs) CO	Nox	HC	Sox	PM	Emissions 3-12 nm Offshore - US Territory (lbs) CO	Nox	HC	Sox	PM	Emissions >12 nm Offshore - Outside US Territory CO	Nox	HC	Sox	PM	CO	Nox	HC	Sox	PM
							Hours	%	Hours	Percent			Hours			CO	NOx	HC	SOx	PM10	CO	Nox	HC	Sox	PM	CO	Nox	HC	Sox	PM	CO	Nox	HC	Sox	PM	CO	Nox	HC	Sox	PM
25E	Amphibious Assault	2		LHD	Large Helicopter-dock Ships	LHD-2	8.0	100%	16.0	38%	38%	25%	6.0	6.0	4.0	6.8	40.1	5.1	120.7	24.2	40.8	240.7	30.6	724.2	145.4	40.8	240.7	30.6	724.2	145.4	27.2	160.5	20.4	482.8	96.9					
		1		LHA	Amphib. Assault Ship - Tarawa	LHA-1	8.0	100%	8.0	38%	38%	25%	3.0	3.0	2.0	7.38	43.5	5.5	131.0	26.3	22.1	130.6	16.6	392.9	78.9	22.1	130.6	16.6	392.9	78.9	14.8	87.1	11.1	261.9	52.6					
		3		LPD	Amphibious Transport Dock - Wasp	LPD-1	8.0	100%	24.0	38%	38%	25%	9.0	9.0	6.0	1.845393	10.9	1.4	32.8	6.6	16.6	98.0	12.5	294.8	59.2	16.6	98.0	12.5	294.8	59.2	11.1	65.3	8.3	196.5	39.4					
		4		LCAC	Landing Craft Air Cushioned	LCAC	8.0	100%	32.0	38%	38%	25%	12.0	12.0	8.0	25.41	43.3	3.9	25.4	55.3	304.9	519.6	46.7	304.9	663.8	304.9	519.6	46.7	304.9	663.8	203.3	346.4	31.1	203.3	442.6					
		4		LCU	Landing Craft Utility	LCU	8.0	100%	32.0	38%	38%	25%	12.0	12.0	8.0	36.21	3.1	1.6	36.2	45.0	434.5	37.3	18.8	434.5	539.4	434.5	37.3	18.8	434.5	539.4	289.7	24.9	12.6	289.7	359.6					
25F	Combat Engineer Ops	1		LHA	Amphib. Assault Ship - Tarawa	LHA-1	6.0	100%	6.0	33%	33%	33%	2.0	2.0	2.0	7.38	131.0	26.3	7.4	43.5	14.7	261.7	52.5	14.7	87.0	14.7	261.7	52.5	14.7	87.0	14.7	261.7	52.5	14.7	87.0					
		2		LCU	Landing Craft Utility	LCU	6.0	100%	12.0	33%	33%	33%	4.0	4.0	4.0	36.21	3.1	1.6	36.2	45.0	144.7	12.4	6.3	144.7	179.6	144.7	12.4	6.3	144.7	179.6	144.7	12.4	6.3	144.7	179.6					
25G	Amphibious Assault Vehicle Ops	6		LHA	Amphib. Assault Ship - Tarawa	LHA-1	8.0	100%	48.0	25%	25%	50%	12.0	12.0	24.0	7.38	131.0	26.3	7.4	43.5	88.6	1571.6	315.5	88.6	522.4	88.6	1571.6	315.5	88.6	522.4	177.1	3143.3	631.0	177.1	1044.7					
		36		EFV	Expeditionary Fighting Vessel	EFV-1	8.0	100%	288.0	25%	25%	50%	72.0	72.0	144.0	2.0611	4.17	0.72	0.06	0.3211	148.4	300.0	51.9	4.6	23.1	148.4	300.0	51.9	4.6	23.1	296.8	600.0	103.8	9.1	46.2					
25H	EFV	2		LPD	Amphibious Transport Dock - Wasp	LPD-1	8.0	100%	16.0	25%	25%	50%	4.0	4.0	8.0	1.845393	10.9	1.4	32.8	6.6	7.4	43.6	5.5	131.0	26.3	7.4	43.6	5.5	131.0	26.3	14.8	87.1	11.1	262.0	52.6					
		1		LCAC	Landing Craft Air Cushioned	LCAC	8.0	100%	8.0	25%	25%	50%	2.0	2.0	4.0	25.41	43.3	3.9	25.4	55.3	50.8	86.6	7.8	50.8	110.6	50.8	86.6	7.8	50.8	110.6	101.6	173.2	15.6	101.6	221.3					
		46		EFV	Expeditionary Fighting Vessel	EFV-1	8.0	100%	368.0	25%	25%	50%	92.0	92.0	184.0	2.0611	4.17	0.72	0.06	0.3211	189.6	383.4	66.3	5.8	29.5	189.6	383.4	66.3	5.8	29.5	379.2	766.7	132.7	11.6	59.1					
25I	Assault Amphibian School	80		LCAC	Landing Craft Air Cushioned	LCAC	8.0	100%	640.0	0%	0%	100%	0.0	0.0	640.0	25.41	43.3	3.9	25.4	55.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	16262.4	27712.0	2489.6	16262.4	35404.8					
		40		LCU	Landing Craft Utility	LCU	8.0	100%	320.0	0%	0%	100%	0.0	0.0	320.0	36.21	3.1	1.6	36.2	45.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	11587.2	995.2	502.4	11587.2	14384.0					
		60		EFV	Amphibious Assault Vehicle	EFV-1	8.0	100%	480.0	0%	0%	100%	0.0	0.0	480.0	2.0611	4.17	0.72	0.06	0.3211	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	989.3	2000.2	346.1	30.3	154.1					
26	Ambphibious Operations CPAAA																																							
26A	Amphibious Operations	1688		AAV/EFV	Amphibious Assault Vehicle	EFV-1	16.8	20%	5671.7	28%	70%	2%	1588.1	3970.2	113.4	2.0611	4.17	0.72	0.06	0.3211	3273.2	6617.5	1145.2	100.4	509.9	8182.9	16543.7	2862.9	250.9	1274.8	233.8	472.7	81.8	7.2	36.4					
				AAV/EFV	Amphibious Assault Vehicle	EFV-2	16.8	80%	22686.7	28%	70%	2%	6352.3	15880.7	453.7	2.0611	4.17	0.72	0.06	0.3211	13092.7	26470.0	4580.6	401.5	2039.7	32731.7	66174.9	11451.6	1003.7	5099.3	935.2	1890.7	327.2	28.7	145.7					
		6		LCAC	Landing Craft Air Cushion	LCAC	16.8	100%	100.8	100%	0%	0%	100.8	0.0	0.0	25.41	55.3	0.7	43.3	3.9	2561.3	5576.3	72.6	4364.6	392.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0					
26B	Amphibious Ops	5		LHD	Large Helicopter-dock Ships	LHD-1	4.2	90%	18.9	0%	0%	100%	0.0	0.0	18.9	5.89	34.8	4.4	104.6	21.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	111.6	658.7	83.7	1981.6	397.7					
				LHD	Large Helicopter-dock Ships	LHD-2	4.2	10%	2.1	0%	0%	100%	0.0	0.0	2.1	6.8	40.1	5.1	120.7	24.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	14.3	84.5	10.7	254.1	51.0					
		5		LCAC	Landing Craft Air Cushion	LCAC	4.2	100%	21.1	0%	0%	100%	0.0	0.0	21.1	25.41	55.3	0.7	43.3	3.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	534.9	1164.5	15.2	911.5	81.9					
		69		CRRC	Combat Raiding Rubber Craft	CRRC-1	4.2	22%	63.9	28%	36%	36%	17.9	23.0	23.0	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.4	0.0	0.0	0.0	0.0	0.5	0.0	0.0	0.0	0.0	0.5					
				CRRC	Combat Raiding Rubber Craft	CRRC-4	4.2	27%	78.4	28%	36%	36%	22.0	28.2	28.2	0	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0	2.9	0.0	0.0	0.0	0.0	3.7	0.0	0.0	0.0	0.0	3.7					
				CRRC	Combat Raiding Rubber Craft	CRRC-5	4.2	51%	148.1	28%	36%	36%	41.5	53.3	53.3	0	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0	6.2	0.0	0.0	0.0	0.0	7.9	0.0	0.0	0.0	0.0	7.9					
		5		LCU	Landing Craft Utility	LCU	4.2	100%	21.1	32%	0%	68%	6.7	0.0	14.3	36.21	45.0	0.5	3.1	1.6	243.9	302.8	3.5	20.9	10.6	0.0	0.0	0.0	0.0	0.0	518.3	643.4	7.4	44.5	22.5					
26C	Amphibious Ops	143		AAV/EFV	Amphibious Assault Vehicle	EFV-1	2.4	33%	112.0	28%	70%	2%	31.4	78.4	2.2	2.0611	4.17	0.72	0.06	0.3211	64.6	130.7	22.6	2.0	10.1	161.6	326.7	56.5	5.0	25.2	4.6	9.3	1.6	0.1	0.7					
						EFV-2	2.4	67%	224.0	28%	70%	2%	62.7	156.8	4.5	2.0611	4.17	0.72	0.06	0.3211	129.3	261.4	45.2	4.0	20.1	323.2	653.5	113.1	9.9	50.4	9.2	18.7	3.2	0.3	1.4					
26D	Amphibious Ops	5		AAV	Amphibious Assault Vehicle	AAV-1	2.4	20%	2.4	100%	0%	0%	2.4	0.0	0.0	0.444918	1.0	0.2	0.1	0.2	1.0	2.4	0.4	0.1	0.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0					
						AAV-2	2.4	80%	9.4	100%	0%	0%	9.4	0.0	0.0	0.633674	3.8	0.2	0.1	0.3	6.0	35.3	1.6	1.0	2.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0					
		2258		EFV	Amphibious Assault Vehicle	EFV-1	2.4	33%	1768.6	28%	70%	2%	495.2	1238.0	35.4	2.0611	4.17	0.72	0.06	0.3211	1020.7	2063.5	357.1	31.3	159.0	2551.7	5158.8	892.7	78.2	397.5	72.9	147.4	25.5	2.2	11.4					
						EFV-2	2.4	67%	3537.7	28%	70%	2%	990.6	2476.4	70.8	2.0611	4.17	0.72	0.06	0.3211	2041.6	4127.7	714.3	62.6	318.1	5104.1	10319.1	1785.7	156.5	795.2	145.8	294.8	51.0	4.5	22.7					
		2268		RIB	Rigid Inflatable	RIB-1	2.4	7%	355.5	28%	70%	2%	99.5	248.8	7.1	0.04	1.6	0.0	0.2	0.0	4.0	158.3	1.0	16.9	2.0	10.0	395.7	2.5	42.3	5.0	0.3	11.3	0.1	1.2	0.1					
						RIB-3		13%	708.9	28%	70%	2%	198.5	496.2	14.2	0.08	3.0	0.0	0.4	0.0	15.9	595.4	2.0	71.5	7.9	39.7	1488.6	5.0	178.6	19.8	1.1	42.5	0.1	5.1	0.6					
						RIB-4		80%	4263.8	28%	70%	2%	1193.9	2984.7	85.3	0.34	9.1	0.1	1.4	0.2	405.9	10912.0	71.6	1719.2	179.1	1014.8	27280.0	179.1	4298.0	447.7	29.0	779.4	5.1	122.8	12.8					
		756		Support	Coastal Patrol-Independent Low Speed (	PC-1	2.4	20%	355.3	28%	70%	2%	99.5	248.7	7.1	6.5	12.5	1.1	2.5	0.4	646.7	1239.6	104.5	249.7	34.8	1616.7	3099.1	261.2	624.3	87.1	46.2	88.5	7.5	17.8	2.5					
					Dynamic Maneuvering	PC-3		80%	1421.3	28%	70%	2%	398.0	994.9	28.4	59.93	187.6	9.3	47.1	4.8	23849.6	74661.0	3709.0	18751.8	1898.3	59624.1	186652.4	9272.4	46879.5	4745.7	1703.5	5332.9	264.9	1339.4	135.6					
26E	Amphibious Ops	386		AAV	Amphibious Assault Vehicle	AAV-1	13.2	20%	1019.0	100%	0%	0%	1019.0	0.0	0.0	0.444918	1.0	0.2	0.1	0.2	453.4	1055.8	177.4	52.5	182.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0					
						AAV-2	13.2	80%	4076.2	100%	0%	0%	4076.2	0.0	0.0	0.633674	3.8	0.2	0.1	0.3	2583.0	15319.8	698.9	429.2	1199.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0					
		173		CRRC	Combat Raiding Rubber Craft	CRRC-1	13.2	28%	628.0	70%	30%	0%	439.6	188.4	0.0	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	8.7	0.0	0.0	0.0	0.0	3.7	0.0	0.0	0.0	0.0	0.0					
				CRRC	Combat Raiding Rubber Craft	CRRC-4	13.2	18%	399.6	70%	30%	0%	279.7	119.9	0.0	0	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0	36.9	0.0	0.0	0.0	0.0	15.8	0.0	0.0	0.0	0.0	0.0					
				CRRC	Combat Raiding Rubber Craft	CRRC-5	13.2	55%	1256.0	70%	30%	0%	879.2	376.8	0.0	0	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0	130.6	0.0	0.0	0.0	0.0	56.0	0.0	0.0	0.0	0.0	0.0					
26F	Amphibious Warfare	964		LCAC	Landing Craft Air Cushion	LCAC	8.5	100%	8194.0	16%	55%	29%	1311.0	4506.7	2376.3	25.41	55.3	0.7	43.3	3.9	33313.5	72526.7	943.9	56768.0	5099.9	114515.2	249310.6	3244.8	195140.1	17531.1	60380.8	131454.7	1710.9	102892.1	9243.7					
		221		LCU	Landing Craft Utility	LCU	8.5	100%	1878.5	75%	5%	20%	1408.9	93.9	375.7	36.21	45.0	0.5	3.1	1.6	51015.4	63328.9	732.6	4381.6	2211.9	3401.0	4221.9	48.8	292.1	147.5	13604.1	16887.7	195.4	1168.4	589.8					
		72		Support	Coastal Patrol-Independent Low Speed (	PC-2	8.5	100%	612.0	100%	0%	0%	612.0	0.0	0.0	17.21	38.1	2.9	8.2	0.9	10532.5	23341.7	1799.3	5036.8	563.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0					
		72		LCM-8		LCU	8.5	100%	612.0	100%	0%	0%	612.0	0.0	0.0	36.21	45.0	0.5	3.1	1.6	22160.5	27509.4	318.2	1903.3	960.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0					
		30		LARC		LCU	8.5	100%	255.0	100%	0%	0%	255.0	0.0	0.0	36.21	45.0	0.5	3.1	1.6	9233.6	11462.3	132.6	793.1	400.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0					
		36		SLWT	SLWT (assume LPD)	LPD-2	8.5	20%	61.2	95%	5%	0%	58.1	3.1	0.0	2.935967	17.3	2.2	52.1	10.5	170.7	1007.1	128.0	3029.9	608.1	9.0	53.0	6.7	159.5	32.0	0.0	0.0	0.0	0.0	0.0					
						LPD-3	8.5	80%	244.8	95%	5%	0%	232.6	12.2	0.0	6.549492	38.6	4.9	116.3	23.3	1523.1	8986.6	1142.4	27035.9	5426.2	80.2	473.0	60.1	1422.9	285.6	0.0	0.0	0.0	0.0	0.0					
		36		SLWT	SLWT (assume LPD)	LPD-2	8.5	20%	61.2	95%	5%	0%	58.1	3.1	0.0	2.935967	17.3	2.2	52.1	10.5	170.7	1007.1	128.0	3029.9	608.1	9.0	53.0	6.7	159.5	32.0	0.0	0.0	0.0	0.0	0.0					
						LPD-3	8.5	80%	244.8	95%	5%	0%	232.6	12.2	0.0	6.549492	38.6	4.9	116.3	23.3	1523.1	8986.6	1142.4	27035.9	5426.2	80.2	473.0	60.1	1422.9	285.6	0.0	0.0	0.0	0.0	0.0					
		18		BW	Boston Whaler	BW-2	8.5	20%	30.6	95%	5%	0%	29.1	1.5	0.0	0	0.1	9.0	0.0	0.0	0.0	2.6	262.1	0.0	0.0	0.0	0.1	13.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0					
						BW-3	8.5	80%	122.4	95%	5%	0%	116.3	6.1	0.0	0	0.3	26.3	0.0	0.0	0.0	30.7	3058.2	0.0	0.0	0.0	1.6	161.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0					
26G	Amphibious Ops	675		CRRC	Combat Raiding Rubber Craft	CRRC-1	6.2	28%	1141.6	80%	20%	0%	913.3	228.3	0.0	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	18.1	0.0	0.0	0.0	0.0	4.5	0.0	0.0	0.0	0.0	0.0					
				CRRC	Combat Raiding Rubber Craft	CRRC-4	6.2	18%	726.5	80%	20%	0%	581.2	145.3	0.0	0	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0	76.7	0.0	0.0	0.0	0.0	19.2	0.0	0.0	0.0	0.0	0.0					
				CRRC	Combat Raiding Rubber Craft	CRRC-5	6.2	55%	2283.2	80%	20%	0%	1826.6	456.6	0.0	0	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0	271.3	0.0	0.0	0.0	0.0	67.8	0.0	0.0	0.0	0.0	0.0					
27	Elec Combat	317		CVN	Nuclear Carrier (No emissions)																																			
		748		CG	Cruiser	CG-2	4.9	100%	3665.2	0%	3%	97%	0.0	110.0	3555.2	107.78	47.1	8.8	21.0	2.6	0.0	0.0	0.0	0.0	0.0	11851.1	5181.1	969.8	2311.3	289.2	383184.2	167523.1	31357.3	74731.2	9350.3					
		641		DDG	Guided Missile Destroyer	DDG-2	4.9	100%	3140.9	0%	3%	97%	0.0	94.2	3046.7	103.99	48.9	8.0	17.9	2.5	0.0	0.0	0.0	0.0	0.0	9798.7	4607.7	756.6	1690.4	231.8	316823.5	148982.3	24464.8	54657.3	7494.8					
		23		DD	Destroyer	DDG-2	4.9	100%	112.7	0%	3%	97%	0.0	3.4	109.3	103.99	48.9	8.0	17.9	2.5	0.0	0.0	0.0	0.0	0.0	351.6	165.3	27.1	60.7	8.3	11368.1	5345.7	877.8	1961.2	268.9					
		18		FFG	Guided Missile Frigate	FFG-2	4.9	100%	88.2	0%	3%	97%	0.0	2.6	85.6	66.82	67.7	7.8	11.6	3.3	0.0	0.0	0.0	0.0	0.0	176.8	179.2	20.7	30.6	8.6	5716.7	5793.7	668.2	989.9	278.1					
		5		FFH	Canadian Frigate	FFG-2	4.9	100%	24.5	0%	3%	97%	0.0	0.7	23.8	66.82	67.7	7.8	11.6	3.3	0.0	0.0	0.0	0.0	0.0	49.1	49.8	5.7	8.5	2.4	1588.0	1609.4	185.6	275.0	77.2					
		5		AOE	Logistics/Support	AOE-1	4.9	100%	24.5	0%	3%	97%	0.0	0.7	23.8	3.73	22.0	2.8	66.1	13.3	0.0	0.0	0.0	0.0	0.0	2.7	16.2	2.1	48.6	9.8	88.6	522.6	66.3	1571.8	315.6					
		2		MHC		PC-1	4.9	100%	9.8	0%	3%	97%	0.0	0.3	9.5	6.5	12.5	1.1	2.5	0.4	0.0	0.0	0.0	0.0	0.0	1.9	3.7	0.3	0.7	0.1	61.8	118.4	10.0	23.9	3.3					
		16		LPD	Amphibious Transport Dock - Wasp	LPD-1	4.9	100%	78.4	0%	3%	97%	0.0	2.4	76.0	1.845393	10.9	1.4	32.8	6.6	0.0	0.0	0.0	0.0	0.0	4.3	25.6	3.3	77.0	15.5	140.3	828.0	105.3	2491.0	500.0					
		232		LHD	Large Helicopter-dock Ships	LHD-1	4.9	100%	1136.8	0%	3%	97%	0.0	34.1	1102.7	5.89	34.8	4.4	104.6	21.0	0.0	0.0	0.0	0.0	0.0	200.9	1185.8	150.7	3567.3	715.8	6494.9	38340.7	4873.9	115342.0	23145.6					
		15		LSD	Landing Ship Dock	LPD-1	4.9	100%	73.5	0%	3%	97%	0.0	2.2	71.3	1.845393	10.9	1.4	32.8	6.6	0.0	0.0	0.0	0.0	0.0	4.1	24.0	3.1	72.2	14.5	131.6	776.2	98.7	2335.3	468.7					
		177		LHA	Amphib. Assault Ship - Tarawa	LHA-1	4.9	100%	867.3	0%	3%	97%	0.0	26.0	841.3	7.38	43.5	5.5	131.0	26.3	0.0	0.0	0.0	0.0	0.0	192.0	1132.6	143.9	3407.7	684.0	6208.7	36621.0	4652.3	110182.6	22117.3					
		1		AGF		LPD-1	4.9	100%	4.9	0%	3%	97%	0.0	0.1	4.8	1.845393	10.9	1.4	32.8	6.6	0.0	0.0	0.0	0.0	0.0	0.3	1.6	0.2	4.8	1.0	8.8	51.7	6.6	155.7	31.2					
		4		WHEC	US Coast Guard	USCG	4.9	100%	19.6	0%	3%	97%	0.0	0.6	19.0	5.74	57.9	0.9	11.6	0.2	0.0	0.0	0.0	0.0	0.0	3.4	34.1	0.5	6.8	0.1	109.1	1101.0	16.7	219.6	4.0					
		145		Unknown		PC-1	4.9	100%	710.5	0%	3%	97%	0.0	21.3	689.2	6.5	12.5	1.1	2.5	0.4	0.0	0.0	0.0	0.0	0.0	138.5	265.6	22.4	53.5	7.5	4479.7	8587.2	723.6	1729.9	241.2					
		204		SSN	Submarines (No emissions)																																			
		41		SSBN	Submarines (No emissions)																																			
28A	Sm Obj Avoidance	8		CG	Cruiser	CG-2	1.8	100%	14.0	100%	0%	0%	14.0	0.0	0.0	107.78	47.1	8.8	21.0	2.6	1508.9	659.7	123.5	294.3	36.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0					
		14		DDG	Guided Missile Destroyer	DDG-2	1.8	100%	24.5	100%	0%	0%	24.5	0.0	0.0	103.99	48.9	8.0	17.9	2.5	2547.8	1198.1	196.7	439.5	60.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0					
		10		FFG	Guided Missile Frigate	FFG-2	1.8	100%	17.5	100%	0%	0%	17.5	0.0	0.0	66.82	67.7	7.8	11.6	3.3	1169.4	1185.1	136.7	202.5	56.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0					
		16		MCM		USCG	1.8	100%	28.0	100%	0%	0%	28.0	0.0	0.0	5.74	57.9	0.9	11.6	0.2	160.7	1621.5	24.6	323.4	5.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0					
		22		MHC		USCG	1.8	100%	38.5	100%	0%	0%	38.5	0.0	0.0	5.74	57.9	0.9	11.6	0.2	221.0	2229.5	33.9	444.7	8.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0					
29	Mine Neutralization	0																																						
30	Mining Exercise	2		MHC		USCG	0.5	100%	1.0	50%	40%	10%	0.5	0.4	0.1	5.74	57.9	0.9	11.6	0.2	2.9	29.0	0.4	5.8	0.1	2.3	23.2	0.4	4.6	0.1	0.6	5.8	0.1	1.2	0.0					
31	NSWC Land Demolition	6		CRRC		CRRC-2	4.0	90%	21.6	100%	0%	0%	21.6	0.0	0.0	0	0.0	2.3	0.0	0.0	0.0	0.6	49.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0					
						CRRC-3		10%	2.4	100%	0%	0%	2.4	0.0	0.0	0	0.1	6.3	0.0	0.0	0.0	0.2	15.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0					
32	NSWC UW Demo	85		CRRC		CRRC-2	6.0	90%	459.0	100%	0%	0%	459.0	0.0	0.0	0	0.0	2.3	0.0	0.0	0.0	12.1	1052.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0					
						CRRC-3		10%	51.0	100%	0%	0%	51.0	0.0	0.0	0	0.1	6.3	0.0	0.0	0.0	3.7	321.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0					
33	Mat Weave	32		CRRC		CRRC-2	4.0	90%	115.2	100%	0%	0%	115.2	0.0	0.0	0	0.0	2.3	0.0	0.0	0.0	3.0	264.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0					
						CRRC-3		10%	12.8	100%	0%	0%	12.8	0.0	0.0	0	0.1	6.3	0.0	0.0	0.0	0.9	80.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0					
34	NSWC Small Arms	24		CRRC		CRRC-2	6.0	90%	129.6	100%	0%	0%	129.6	0.0	0.0	0	0.0	2.3	0.0	0.0	0.0	3.4	297.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0					
						CRRC-3		10%	14.4	100%	0%	0%	14.4	0.0	0.0	0	0.1	6.3	0.0	0.0	0.0	1.0	90.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0					
35	NSWC Land Nav	0																																						
36	NSW UAV Operationa	0																																						
37	Insertion/Extraction	0																																						
38	NSW Boat Operations	245		MK V	MK V	MK-1	10.0	50%	1225.0	5%	42%	53%	61.3	514.5	649.3	1.94	14.8	0.5	2.4	0.2	118.8	908.3	30.6	146.4	12.3	998.1	7630.0	257.3	1229.7	102.9	1259.5	9628.4	324.6	1551.7	129.9					
						MK-3		50%	1225.0	5%	42%	53%	61.3	514.5	649.3	13.22	71.5	1.1	15.7	1.2	809.7	4378.2	64.3	958.6	70.4	6801.7	36776.5	540.2	8051.9	591.7	8583.1	46408.4	681.7	10160.8	746.6					

Table C-2. Surface Ship Air Emissions—Alternative 1

Scenario	Type Training	Number of Ships	Program Totals	Nomenclature	Ship/Boat Type	Vessel Mode	Ship Time on Range (hrs)	Percent at Each Power Level	Total Time on Range (hrs)	Percentage 0-3 nm from shore	Percentage 3-12 nm from Shore	Percentage >12 nm from Shore	Total Time 0-3 nm from shore	Total Time 3-12 nm from shore	Total Time >12 nm from shore	Emissions Factors (lb/hr)					Emissions — Emissions 0-3 nm Offshore (lbs)					Emissions 3-12 nm Offshore - US Territory (lbs)					Emissions >12 nm Offshore - Outside US Territory									
							Hours	%	Hours	Percent			Hours			CO	NOx	HC	SOx	PM10	CO	Nox	HC	Sox	PM	CO	Nox	HC	Sox	PM	CO	Nox	HC	Sox	PM	CO	Nox	HC	Sox	PM
		75		RIB	Rigid Inflatable	RIB-3	10.0	50%	375.0	5%	42%	53%	18.8	157.5	198.8	0.08	3.0	0.0	0.4	0.0	1.5	56.3	0.2	6.8	0.8	12.6	472.5	1.6	56.7	6.3	15.9	596.3	2.0	71.6	8.0					
						RIB-4		50%	375.0	5%	42%	53%	18.8	157.5	198.8	0.34	9.1	0.1	1.4	0.2	6.4	171.4	1.1	27.0	2.8	53.6	1439.6	9.5	226.8	23.6	67.6	1816.6	11.9	286.2	29.8					
39	NSWG-1 Platoon Ops	3		PC	Coastal Patrol-Independent Low Speed (	PC-3	4.0	100%	12.0	20%	30%	50%	2.4	3.6	6.0	59.93	187.6	9.3	47.1	4.8	143.8	450.3	22.4	113.1	11.4	215.7	675.4	33.6	169.6	17.2	359.6	1125.7	55.9	282.7	28.6					
		38		CRRC		CRRC-5	0.5	100%	19.0	100%	0%	0%	19.0	0.0	0.0	0	0.1	12.9	0.0	0.0	0.0	2.8	245.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0					
		63		SOW	MK V	MK-3	0.5	100%	31.5	100%	0%	0%	31.5	0.0	0.0	13.22	71.5	1.1	15.7	1.2	416.4	2251.6	33.1	493.0	36.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0					
40	Direct Action	2		PC	Coastal Patrol-Independent Low Speed (	PC-2	8.0	80%	12.8	30%	20%	50%	3.8	2.6	6.4	17.21	38.1	2.9	8.2	0.9	66.1	146.5	11.3	31.6	3.5	44.1	97.6	7.5	21.1	2.4	110.1	244.1	18.8	52.7	5.9					
					Dynamic Maneuvering	PC-3		20%	3.2	30%	20%	50%	1.0	0.6	1.6	59.93	187.6	9.3	47.1	4.8	57.5	180.1	8.9	45.2	4.6	38.4	120.1	6.0	30.2	3.1	95.9	300.2	14.9	75.4	7.6					
		3		SOW	MK V	MK-1	4.0	80%	9.6	30%	25%	45%	2.9	2.4	4.3	1.94	14.8	0.5	2.4	0.2	5.6	42.7	1.4	6.9	0.6	4.7	35.6	1.2	5.7	0.5	8.4	64.1	2.2	10.3	0.9					
						MK-3		20%	2.4	30%	25%	45%	0.7	0.6	1.1	13.22	71.5	1.1	15.7	1.2	9.5	51.5	0.8	11.3	0.8	7.9	42.9	0.6	9.4	0.7	14.3	77.2	1.1	16.9	1.2					
		1		LCAC	Landing Craft Air Cushion	LCAC	1.0	100%	1.0	100%	0%	0%	1.0	0.0	0.0	25.41	55.3	0.7	43.3	3.9	25.4	55.3	0.7	43.3	3.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0					
		10		CRRC	Combat Rubber Raiding Craft	CRRC-3	1.0	100%	10.0	100%	0%	0%	10.0	0.0	0.0	0	0.1	6.3	0.0	0.0	0.0	0.7	63.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0					
		10		SDV	Combat Rubber Raiding Craft	CRRC-3	1.0	100%	10.0	100%	0%	0%	10.0	0.0	0.0	0	0.1	6.3	0.0	0.0	0.0	0.7	63.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0					
41	Bombing Exercise - Land	0																																						
42	CSAR	0																																						
43	EOD Outside SHOBA	0																																						
44	USCG Ops	149		Response	Coastal Patrol-Independent Low Speed (	PC-1	3.2	2%	9.5	80%	20%	0%	7.6	1.9	0.0	6.5	12.5	1.1	2.5	0.4	49.6	95.1	8.0	19.1	2.7	12.4	23.8	2.0	4.8	0.7	0.0	0.0	0.0	0.0	0.0					
						PC-2		2%	9.5	80%	20%	0%	7.6	1.9	0.0	17.21	38.1	2.9	8.2	0.9	131.3	291.0	22.4	62.8	7.0	32.8	72.7	5.6	15.7	1.8	0.0	0.0	0.0	0.0	0.0					
				Utility	Dynamic Maneuvering	PC-3		96%	457.7	80%	20%	0%	366.2	91.5	0.0	59.93	187.6	9.3	47.1	4.8	21945.3	68699.5	3412.8	17254.5	1746.7	5486.3	17174.9	853.2	4313.6	436.7	0.0	0.0	0.0	0.0	0.0					
		149		Utility	Coastal Patrol-Independent Low Speed (	PC-1	3.2	15%	71.5	80%	20%	0%	57.2	14.3	0.0	6.5	12.5	1.1	2.5	0.4	371.9	712.9	60.1	143.6	20.0	93.0	178.2	15.0	35.9	5.0	0.0	0.0	0.0	0.0	0.0					
						PC-2		60%	286.1	80%	20%	0%	228.9	57.2	0.0	17.21	38.1	2.9	8.2	0.9	3938.7	8728.9	672.9	1883.6	210.6	984.7	2182.2	168.2	470.9	52.6	0.0	0.0	0.0	0.0	0.0					
					Dynamic Maneuvering	PC-3		25%	119.2	80%	20%	0%	95.4	23.8	0.0	59.93	187.6	9.3	47.1	4.8	5714.9	17890.5	888.8	4493.4	454.9	1428.7	4472.6	222.2	1123.3	113.7	0.0	0.0	0.0	0.0	0.0					
		100		Cutter	US Coast Guard	USCG	3.2	100%	320.0	20%	20%	60%	64.0	64.0	192.0	5.74	57.9	0.9	11.6	0.2	367.4	3706.2	56.3	739.2	13.4	367.4	3706.2	56.3	739.2	13.4	1102.1	11118.7	169.0	2217.6	40.3					
		49		Cutter	US Coast Guard	USCG	3.2	100%	156.8	5%	5%	90%	7.8	7.8	141.1	5.74	57.9	0.9	11.6	0.2	45.0	454.0	6.9	90.6	1.6	45.0	454.0	6.9	90.6	1.6	810.0	8172.3	124.2	1629.9	29.6					
45	NALF Airfield	0																																						
46	Ship Torpedo Test	1		DDG	Guided Missile Destroyer	DDG-3	6.5	100%	6.5	0%	23%	77%	0.0	1.5	5.0	106.67	53.8	7.8	21.2	2.8	0.0	0.0	0.0	0.0	0.0	160.9	81.2	11.8	32.0	4.2	532.5	268.8	39.1	105.9	14.0					
		1		DDH	Japanese Destroye Helo Deck (FMS)	CG-3	6.5	100%	6.5	0%	23%	77%	0.0	1.5	5.0	114.75	65.2	7.7	33.6	3.4	0.0	0.0	0.0	0.0	0.0	173.0	98.4	11.6	50.6	5.2	572.8	325.6	38.3	167.5	17.2					
		1		DD	Japanese Destroyer (FMS)	CG-3	6.5	100%	6.5	0%	23%	77%	0.0	1.5	5.0	114.75	65.2	7.7	33.6	3.4	0.0	0.0	0.0	0.0	0.0	173.0	98.4	11.6	50.6	5.2	572.8	325.6	38.3	167.5	17.2					
		5		FFH	Helicopter Frigate (Canadian)	FFG-3	6.5	100%	32.5	0%	23%	77%	0.0	7.5	25.0	120.04	78.1	11.6	16.1	4.3	0.0	0.0	0.0	0.0	0.0	905.1	588.9	87.8	121.2	32.4	2996.2	1949.6	290.5	401.4	107.3					
47	UUV	10		BW	Boston Whalers	BW-1	10.0	100%	100.0	100%	0%	0%	100.0	0.0	0.0	0	0.1	7.5	0.0	0.0	0.0	7.6	751.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0					
		10		HS	Harbor Security	RIB-2	10.0	100%	100.0	100%	0%	0%	100.0	0.0	0.0	0.04	1.6	0.0	0.2	0.0	4.0	159.0	1.0	17.0	2.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0					
		20			Phanton DS4 (no emissions)					100%	0%	0%																												
48	Sonobuoy QA/QC	60		AE	Acoustic Explorer	AE-2	4.0	100%	240.0	50%	30%	20%	120.0	72.0	48.0	20.17	20.9	1.0	6.0	1.6	2420.4	2511.6	118.8	716.4	188.4	1452.2	1507.0	71.3	429.8	113.0	968.2	1004.6	47.5	286.6	75.4					
49	Ocean Engineering	65		BW	Boston Whaler	BW-2	3.0	100%	195.0	100%	0%	0%	195.0	0.0	0.0	0	0.1	9.0	0.0	0.0	0.0	17.7	1758.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0					
50	MM Mine Location	4		AE	Acoustic Explorer	AE-1	12.0	100%	48.0	100%	0%	0%	48.0	0.0	0.0	7.31	8.5	0.4	2.1	0.6	350.9	406.1	18.2	101.8	26.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0					
		20		BW	Boston Whaler	BW-2	12.0	100%	240.0	100%	0%	0%	240.0	0.0	0.0	0	0.1	9.0	0.0	0.0	0.0	21.8	2164.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0					
51	Missile Flight Test	9		CG		CG-2	4.0	100%	36.0	0%	0%	100%	0.0	0.0	36.0	107.78	47.1	8.8	21.0	2.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3880.1	1696.3	317.5	756.7	94.7					
		18		DDG	Guided Missile Destroyer	DDG-2	4.0	100%	72.0	0%	0%	100%	0.0	0.0	72.0	103.99	48.9	8.0	17.9	2.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	7487.3	3520.8	578.2	1291.7	177.1					
52	NUWC UW Acoustic	83		FFG	Guided Missile Frigate	FFG-2	4.0	100%	332.0	0%	0%	100%	0.0	0.0	332.0	66.82	67.7	7.8	11.6	3.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	22184.2	22483.0	2592.9	3841.2	1079.0					
		23		AE	Acoustic Explorer	AE-1	4.0	100%	92.0	0%	0%	100%	0.0	0.0	92.0	7.31	8.5	0.4	2.1	0.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	672.5	778.3	35.0	195.0	50.6					
		83		BW	Boston Whaler	BW-2	4.0	100%	332.0	0%	0%	100%	0.0	0.0	332.0	0	0.1	9.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	30.1	2993.8	0.0	0.0					
53	Other Tests	3		CG	Cruiser	CG-2	4.0	100%	12.0	0%	0%	100%	0.0	0.0	12.0	107.78	47.1	8.8	21.0	2.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1293.4	565.4	105.8	252.2	31.6					
	(MCM, ASUW, FIREX)	8		DDG	Guided Missile Destroyer	DDG-2	4.0	100%	32.0	0%	0%	100%	0.0	0.0	32.0	103.99	48.9	8.0	17.9	2.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3327.7	1564.8	257.0	574.1	78.7					
		0		FFH	Helicopter Frigate (Canadian)	FFG-2	4.0	100%	0.0	0%	0%	100%	0.0	0.0	0.0	66.82	67.7	7.8	11.6	3.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0					
		8		DD	Japanese Destroyer (FMS)	CG-2	4.0	100%	32.0	0%	0%	100%	0.0	0.0	32.0	107.78	47.1	8.8	21.02	2.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3449.0	1507.8	282.2	672.6	84.2					
		2		AOR	Canadian	AOE-1	4.0	100%	8.0	0%	0%	100%	0.0	0.0	8.0	3.73	22.0	2.8	66.1	13.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	29.8	175.9	22.3	529.1	106.2					
	Total	####														**Total Emissions (SCI) tons**					**10.90**	**17.35**	**4.88**	**10.34**	**4.13**	**61.75**	**39.01**	**5.63**	**19.15**	**5.66**	**636.96**	**492.10**	**57.58**	**310.73**	**74.35**	**49.73**	**32.19**	**4.50**	**13.14**	**2.11**
																Total Emissions (SD) tons					**106.77**	**236.91**	**13.36**	**90.56**	**15.68**	**122.89**	**323.63**	**16.31**	**134.24**	**16.40**										
																Total Emissions within US Territory (SCI)					**72.65**	**56.36**	**10.51**	**29.48**	**9.78**															
																Total Emissions within US Territory (SD)					**229.65**	**560.54**	**29.67**	**224.80**	**32.08**															
																								56768.0																

Date: 13-May-2007

Notes: 1 - Ship nomenclature highlighted in yellow signifies no specific AQ Emissions data for that vessel.
For vessels without AQ emissions data, the following data was used:

Support (for USW)	TRB	AGF	LPD
Support (for Surf Firing)	PC	WHEC	USCG
MCM	USCG	Unknown (for Elec Combat)	PC
MHC	USCG	SOW	MKV
LSD	LPD	EFV	AAV
Unknown (for VBSS)	PC	DDH	CG
DD	CG	HS	RIB
FFH	FFG	AOR	AOE

Table C-3. Surface Ship Air Emissions—Alternative 2

Scenario	Type Training	Number of Ships	Program Totals	Nomenclature	Ship/Boat Type	Vessel Mode	Ship Time on Range (hrs)	Percent at Each Power Level	Total Time on Range (hrs)	Percentage 0-3 nm from shore	Percentage 3-12 nm from Shore	Percentage >12 nm from Shore	Total Time 0-3 nm from shore	Total Time 3-12 nm from shore	Total Time >12 nm from shore	Emissions Factors (lb/hr)					Emissions: Emissions 0-3 nm Offshore (lbs)					Emissions 3-12 nm Offshore - US Territory (lbs)					Emissions >12 nm Offshore - Outside US Territory									
							Hours	%	Hours	Percent				Hours		CO	NOx	HC	SOx	PM10	CO	Nox	HC	Sox	PM	CO	Nox	HC	Sox	PM	CO	Nox	HC	Sox	PM	CO	Nox	HC	Sox	PM
Training Exercises																															Offshore San Diego					Offshore Mexico				
1	Air Combat Maneuvers	0																																						
2	Air Defense Exercise	117		CG	Cruiser	CG-2	1.0	100%	117.0	0%	0%	100%	0.0	0.0	117.0	107.78	47.1	8.8	21.0	2.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	12610.3	5513.0	1031.9	2459.3	307.7					
		234		DDG	Guided Missile Destroyer	DDG-2	1.0	100%	234.0	0%	0%	100%	0.0	0.0	234.0	103.99	48.9	8.0	17.9	2.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	24333.7	11442.6	1879.0	4198.0	575.6					
		24		CVN	Nuclear Carrier (No emissions)					0%	0%	100%																												
		4		FFG	Guided Missile Frigate	FFG-2	3.7	100%	14.8	0%	0%	100%	0.0	0.0	14.8	66.82	67.7	7.8	11.6	3.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	988.9	1002.3	115.6	171.2	48.1					
3	S-A Missiles	6		CVN	Nuclear Carrier (No emissions)					0%	0%	100%																												
		6		TRB	Torpedo Retrieval Boats	TRB-3	4.0	100%	24.0	1%	2%	97%	0.2	0.5	23.3	6.47	56.2	1.6	7.4	1.2	1.6	13.5	0.4	1.8	0.3	3.1	27.0	0.7	3.6	0.6	150.6	1308.8	36.1	172.3	27.5					
4	S-A Gunnery Exercise	23		CVN						0%	0%	100%																												
		44		CG	Cruiser	CG-2	1.5	100%	66.0	0%	0%	100%	0.0	0.0	66.0	107.78	47.1	8.8	21.0	2.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0						7113.5	3109.9	582.1	1387.3	173.6
		91		DDG	Guided Missile Destroyer	DDG-2	1.5	100%	136.5	0%	0%	100%	0.0	0.0	136.5	103.99	48.9	8.0	17.9	2.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0						14194.6	6674.9	1096.1	2448.8	335.8
		55		FFG	Guided Missile Frigate	FFG-2	1.5	100%	82.5	0%	0%	100%	0.0	0.0	82.5	66.82	67.7	7.8	11.6	3.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0						5512.7	5586.9	644.3	954.5	268.1
		13		LHA	Amphib. Assault Ship - Tarawa	LHA-1	1.5	100%	19.5	0%	0%	100%	0.0	0.0	19.5	7.38	43.5	5.5	131.0	26.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0						143.9	848.8	107.8	2553.9	512.7
		15		LDH	Large Helicopter-dock Ships	LHD-1	1.5	100%	22.5	0%	0%	100%	0.0	0.0	22.5	5.89	34.8	4.4	104.6	21.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0						132.5	782.3	99.5	2353.5	472.3
		21		LPD	Amphibious Transport Dock - Wasp	LPD-1	1.5	100%	31.5	0%	0%	100%	0.0	0.0	31.5	1.845393	10.9	1.4	32.8	6.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0						58.1	343.0	43.6	1031.8	207.1
		24		LSD	Landing Ship Dock	LPD-1	1.5	100%	36.0	0%	0%	100%	0.0	0.0	36.0	1.845393	10.9	1.4	32.8	6.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0						66.4	392.0	49.8	1179.2	236.7
		37		USCGS	US Coast Guard	USCG	1.5	100%	55.5	0%	0%	100%	0.0	0.0	55.5	5.74	57.9	0.9	11.6	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0						318.6	3214.0	48.8	641.0	11.7
		27		Other Ship	Coastal Patrol-Independent Low Speed (	PC-1	1.5	100%	40.5	0%	0%	100%	0.0	0.0	40.5	6.5	12.5	1.1	2.5	0.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0						263.3	504.6	42.5	101.7	14.2
5	A-A Missiles	1		TRB	Torpedo Retrieval Boats	TRB-3	4.0	100%	4.0	1%	2%	97%	0.0	0.1	3.9	6.47	56.2	1.6	7.4	1.2	0.3	2.2	0.1	0.3	0.0	0.5	4.5	0.1	0.6	0.1						25.1	218.1	6.0	28.7	4.6
6	Helicopter ASW TRACKEX	28		CG	Cruiser	CG-3	3.6	100%	100.8	1%	10%	89%	1.0	10.1	89.7	114.75	65.2	7.7	33.6	3.4	115.7	65.7	7.7	33.8	3.5	1156.7	657.4	77.3	338.2	34.7	10294.5	5851.0	688.1	3009.8	308.6					
		71		DDG	Guided Missile Destroyer	DDG-3	3.6	100%	255.6	1%	10%	89%	2.6	25.6	227.5	106.67	53.8	7.8	21.2	2.8	272.6	137.6	20.0	54.2	7.2	2726.5	1376.2	200.4	542.4	71.6	24265.7	12247.7	1783.5	4827.2	637.0					
		43		TRB	Torpedo Retrieval Boats	TRB-3	3.6	100%	154.8	1%	10%	89%	1.5	15.5	137.8	6.47	56.2	1.6	7.4	1.2	10.0	87.0	2.4	11.5	1.8	100.2	870.3	24.0	114.6	18.3	891.4	7745.5	213.5	1019.5	162.6					
7	Helicopter ASW TORPEX	28		CG	Cruiser	CG-3	3.6	100%	100.8	1%	10%	89%	1.0	10.1	89.7	114.75	65.2	7.7	33.6	3.4	115.7	65.7	7.7	33.8	3.5	1156.7	657.4	77.3	338.2	34.7	10294.5	5851.0	688.1	3009.8	308.6					
		75		DDG	Guided Missile Destroyer	DDG-3	3.6	100%	270.0	1%	10%	89%	2.7	27.0	240.3	106.67	53.8	7.8	21.2	2.8	288.0	145.4	21.2	57.3	7.6	2880.1	1453.7	211.7	572.9	75.6	25632.8	12937.8	1884.0	5099.2	672.8					
		72		TRB	Torpedo Retrieval Boats	TRB-3	3.6	100%	259.2	1%	10%	89%	2.6	25.9	230.7	6.47	56.2	1.6	7.4	1.2	16.8	145.7	4.0	19.2	3.1	167.7	1457.2	40.2	191.8	30.6	1492.6	12969.3	357.6	1707.1	272.2					
8	MPA ASW TRACKEX																																							
9	MPA ASW TORPEX	2		CG	Cruiser	CG-3	2.0	100%	4.0	5%	10%	85%	0.2	0.4	3.4	114.75	65.2	7.7	33.6	3.4	23.0	13.0	1.5	6.7	0.7	45.9	26.1	3.1	13.4	1.4	390.2	221.7	26.1	114.1	11.7					
		5		DDG	Guided Missile Destroyer	DDG-3	2.0	100%	10.0	5%	10%	85%	0.5	1.0	8.5	106.67	53.8	7.8	21.2	2.8	53.3	26.9	3.9	10.6	1.4	106.7	53.8	7.8	21.2	2.8	906.7	457.6	66.6	180.4	23.8					
		3		FFG	Guided Missile Frigate	FFG-3	2.0	100%	6.0	5%	10%	85%	0.3	0.6	5.1	120.04	78.1	11.6	16.1	4.3	36.0	23.4	3.5	4.8	1.3	72.0	46.9	7.0	9.6	2.6	612.2	398.4	59.4	82.0	21.9					
		10		TRB	Torpedo Retrieval Boats	TRB-3	2.0	100%	20.0	5%	10%	85%	1.0	2.0	17.0	6.47	56.2	1.6	7.4	1.2	6.5	56.2	1.6	7.4	1.2	12.9	112.4	3.1	14.8	2.4	110.0	955.7	26.4	125.8	20.1					
10	EER/IEER ASW																																							
11	Surface Ship ASW TRACKEX	225		CG	Cruiser	CG-3	2.0	100%	450.0	1%	10%	89%	4.5	45.0	400.5	114.75	65.2	7.7	33.6	3.4	516.4	293.5	34.5	151.0	15.5	5163.8	2934.9	345.2	1509.8	154.8	45957.4	26120.6	3071.8	13436.8	1377.7					
		450		DDG	Guided Missile Destroyer	DDG-3	2.0	100%	900.0	1%	10%	89%	9.0	90.0	801.0	106.67	53.8	7.8	21.2	2.8	960.0	484.6	70.6	191.0	25.2	9600.3	4845.6	705.6	1909.8	252.0	85442.7	43125.8	6279.8	16997.2	2242.8					
		225		FFG	Guided Missile Frigate	FFG-3	2.0	100%	450.0	1%	10%	89%	4.5	45.0	400.5	120.04	78.1	11.6	16.1	4.3	540.2	351.5	52.4	72.4	19.4	5401.8	3515.0	523.8	723.6	193.5	48076.0	31283.1	4661.8	6440.0	1722.2					
		0		Support	Torpedo Retrieval Boats	TRB-3	2.0	100%	0.0	1%	10%	89%	0.0	0.0	0.0	6.47	56.2	1.6	7.4	1.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0					
12	Surface Ship ASW TORPEX	8		CG	Cruiser	CG-3	3.7	100%	29.6	1%	10%	89%	0.3	3.0	26.3	114.75	65.2	7.7	33.6	3.4	34.0	19.3	2.3	9.9	1.0	339.7	193.1	22.7	99.3	10.2	3023.0	1718.2	202.1	883.8	90.6					
		12		DDG	Guided Missile Destroyer	DDG-3	3.7	100%	44.4	1%	10%	89%	0.4	4.4	39.5	106.67	53.8	7.8	21.2	2.8	47.4	23.9	3.5	9.4	1.2	473.6	239.0	34.8	94.2	12.4	4215.2	2127.5	309.8	838.5	110.6					
		6		FFG	Guided Missile Frigate	FFG-3	3.7	100%	22.2	1%	10%	89%	0.2	2.2	19.8	120.04	78.1	11.6	16.1	4.3	26.6	17.3	2.6	3.6	1.0	266.5	173.4	25.8	35.7	9.5	2371.8	1543.3	230.0	317.7	85.0					
		12		TRB	Torpedo Retrieval Boats	TRB-3	3.7	100%	44.4	1%	10%	89%	0.4	4.4	39.5	6.47	56.2	1.6	7.4	1.2	2.9	25.0	0.7	3.3	0.5	28.7	249.6	6.9	32.9	5.2	255.7	2221.6	61.2	292.4	46.6					
13	Sub ASW Trackex	53		SSN	Submarines (No emissions)																																			
		16		TRB	Torpedo Retrieval Boats	TRB-3	12.8	100%	204.8	1%	2%	97%	2.0	4.1	198.7	6.47	56.2	1.6	7.4	1.2	13.3	115.1	3.2	15.2	2.4	26.5	230.3	6.3	30.3	4.8	1285.3	11168.4	307.9	1470.1	234.4					
14	Sub ASW TORPEX	22		SSN	Submarines (No emissions)																																			
		22		TRB	Torpedo Retrieval Boats	TRB-3	11.7	100%	257.4	1%	2%	97%	2.6	5.1	249.7	6.47	56.2	1.6	7.4	1.2	16.7	144.7	4.0	19.0	3.0	33.3	289.4	8.0	38.1	6.1	1615.4	14036.9	387.0	1847.6	294.6					
15	VBSS	21		CG	Cruiser	CG-2	4.0	100%	84.0	0%	0%	100%	0.0	0.0	84.0	107.78	47.1	8.8	21.0	2.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	9053.5	3958.1	740.9	1765.7	220.9					
		42		DDG	Guided Missile Destroyer	DDG-2	4.0	100%	168.0	0%	0%	100%	0.0	0.0	168.0	103.99	48.9	8.0	17.9	2.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	17470.3	8215.2	1349.0	3013.9	413.3					
		8		FFG	Guided Missile Frigate	FFG-2	4.0	100%	32.0	0%	0%	100%	0.0	0.0	32.0	66.82	67.7	7.8	11.6	3.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2138.2	2167.0	249.9	370.2	104.0					
		3		LPD	Amphibious Transport Dock - Wasp	LPD-1	4.0	100%	12.0	0%	0%	100%	0.0	0.0	12.0	1.845393	10.9	1.4	32.8	6.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	22.1	130.7	16.6	393.1	78.9					
		8		LSD		LPD-1	4.0	100%	32.0	0%	0%	100%	0.0	0.0	32.0	1.845393	10.9	1.4	32.8	6.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	59.1	348.4	44.3	1048.2	210.4					
16	ASUW MISSILEX	32		TRB	Torpedo Retrieval Boats	TRB-2	7.0	100%	224.0	5%	28%	67%	11.2	62.7	150.1	7.64	33.1	0.6	3.4	1.2	85.6	370.6	6.6	38.0	13.0	479.2	2075.4	37.0	212.6	72.8	1146.6	4966.1	88.5	508.8	174.1					
17	A-S BOMBEX	0																																						
18	A-S GUNEX	0																																						
19	S-S GUNEX	1		CVN	Nuclear Carrier (No emissions)																																			
		71		CG	Cruiser	CG-1	2.5	100%	177.5	0%	28%	72%	0.0	49.7	127.8	102.58	40.6	9.2	17.7	2.1	0.0	0.0	0.0	0.0	0.0	5098.2	2018.3	458.2	880.2	105.4						13109.7	5190.0	1178.3	2263.3	270.9
		147		DDG	Guided Missile Destroyer	DDG-1	2.5	100%	367.5	0%	28%	72%	0.0	102.9	264.6	102.98	47.3	8.1	17.0	2.4	0.0	0.0	0.0	0.0	0.0	10596.6	4871.3	833.5	1753.4	241.8						27248.5	12526.2	2143.3	4508.8	621.8
		49		FFG	Guided Missile Frigate	FFG-1	2.5	100%	122.5	0%	28%	72%	0.0	34.3	88.2	65.75	66.4	7.9	10.9	3.1	0.0	0.0	0.0	0.0	0.0	2255.2	2275.8	270.6	373.5	107.7						5799.2	5852.1	695.9	960.5	276.9
		2		LPD	Amphibious Transport Dock - Wasp	LPD-1	2.5	100%	5.0	0%	28%	72%	0.0	1.4	3.6	1.845393	10.9	1.4	32.8	6.6	0.0	0.0	0.0	0.0	0.0	2.6	15.2	1.9	45.9	9.2						6.6	39.2	5.0	117.9	23.7
		1		LSD	Landing Ship Dock	LPD-1	2.5	100%	2.5	0%	28%	72%	0.0	0.7	1.8	1.845393	10.9	1.4	32.8	6.6	0.0	0.0	0.0	0.0	0.0	1.3	7.6	1.0	22.9	4.6						3.3	19.6	2.5	59.0	11.8
		1		LHD	Large Helicopter-dock Ships	LHD-2	2.5	100%	2.5	0%	28%	72%	0.0	0.7	1.8	6.8	40.1	5.1	120.7	24.2	0.0	0.0	0.0	0.0	0.0	4.8	28.1	3.6	84.5	17.0						12.2	72.2	9.2	217.3	43.6
		18		Unknown	Other	PC-2	2.5	100%	45.0	0%	28%	72%	0.0	12.6	32.4	17.21	38.1	2.9	8.2	0.9	0.0	0.0	0.0	0.0	0.0	216.8	480.6	37.0	103.7	11.6						557.6	1235.7	95.3	266.7	29.8
		40		USCG	US Coast Guard	USCG	2.5	100%	100.0	0%	28%	72%	0.0	28.0	72.0	5.74	57.9	0.9	11.6	0.2	0.0	0.0	0.0	0.0	0.0	160.7	1621.5	24.6	323.4	5.9						413.3	4169.5	63.4	831.6	15.1
20	SINKEX	6		CG	Cruiser	CG-2	16.0	100%	96.0	0%	0%	100%	0.0	0.0	96.0	107.78	47.1	8.8	21.0	2.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0						10346.9	4523.5	846.7	2017.9	252.5
		12		DDG	Guided Missile Destroyer	DDG-2	16.0	100%	192.0	0%	0%	100%	0.0	0.0	192.0	103.99	48.9	8.0	17.9	2.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0						19966.1	9388.8	1541.8	3444.5	472.3
		0		DD	Destroyer	DDG-2	16.0	100%	0.0	0%	0%	100%	0.0	0.0	0.0	103.99	48.9	8.0	17.9	2.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0						0.0	0.0	0.0	0.0	0.0
		6		FFG	Guided Missile Frigate	FFG-2	16.0	100%	96.0	0%	0%	100%	0.0	0.0	96.0	66.82	67.7	7.8	11.6	3.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0						6414.7	6501.1	749.8	1110.7	312.0
		3		SSN	Submarines (No emissions)																																			
21	NSFS	17		CG	Cruiser	CG-2	9.0	100%	153.0	0%	30%	70%	0.0	45.9	107.1	107.78	47.1	8.8	21.0	2.6	0.0	0.0	0.0	0.0	0.0	4947.1	2162.8	404.8	964.8	120.7	11543.2	5046.6	944.6	2251.2	281.7					
		35		DDG	Guided Missile Destroyer	DDG-2	9.0	100%	315.0	0%	30%	70%	0.0	94.5	220.5	103.99	48.9	8.0	17.9	2.5	0.0	0.0	0.0	0.0	0.0	9827.1	4621.1	758.8	1695.3	232.5	22929.8	10782.5	1770.6	3955.8	542.4					
		4		FFG	Guided Missile Frigate	FFG-2	9.0	100%	36.0	0%	30%	70%	0.0	10.8	25.2	66.82	67.7	7.8	11.6	3.3	0.0	0.0	0.0	0.0	0.0	721.7	731.4	84.3	125.0	35.1	1683.9	1706.5	196.8	291.6	81.9					
22	EFEX	3		CG	Cruiser	CG-2	72.0	100%	216.0	0%	100%	0%	0.0	216.0	0.0	107.78	47.1	8.8	21.0	2.6	0.0	0.0	0.0	0.0	0.0	23280.5	10177.9	1905.1	4540.3	568.1	0.0	0.0	0.0	0.0	0.0					
		3		DDG	Guided Missile Destroyer	DDG-2	72.0	100%	216.0	0%	100%	0%	0.0	216.0	0.0	103.99	48.9	8.0	17.9	2.5	0.0	0.0	0.0	0.0	0.0	22461.8	10562.4	1734.5	3875.0	531.4	0.0	0.0	0.0	0.0	0.0					
23	Battalion Landing	2		LHA	Amphib. Assault Ship - Tarawa	LHA-1	6.0	100%	12.0	10%	30%	60%	1.2	3.6	7.2	7.38	131.0	26.3	7.4	43.5	8.9	157.2	31.5	8.9	52.2	26.6	471.5	94.6	26.6	156.7	53.1	943.0	189.3	53.1	313.4					
		2		LHD	Large Helicopter-dock Ships	LHD-2	2.5	100%	5.0	10%	30%	60%	0.5	1.5	3.0	6.8	40.1	5.1	120.7	24.2	3.4	20.1	2.6	60.4	12.1	10.2	60.2	7.7	181.1	36.3	20.4	120.4	15.3	362.1	72.7					
		2		LPD	Amphibious Transport Dock - Wasp	LPD-1	2.5	100%	5.0	10%	30%	60%	0.5	1.5	3.0	1.845393	10.9	1.4	32.8	6.6	0.9	5.4	0.7	16.4	3.3	2.8	16.3	2.1	49.1	9.9	5.5	32.7	4.2	98.3	19.7					
		12		LCU	Landing Craft Utility	LCU	3.0	100%	36.0	10%	30%	60%	3.6	10.8	21.6	36.21	3.1	1.6	36.2	45.0	130.4	11.2	5.7	130.4	161.8	391.1	33.6	17.0	391.1	485.5	782.1	67.2	33.9	782.1	970.9					
		48		AAV/EFV	Amphibious Assault Vehicle	EFV-2	6.0	100%	288.0	10%	30%	60%	28.8	86.4	172.8	2.0611	4.17	0.72	0.06	0.3211	59.4	120.0	20.8	1.8	9.2	178.1	360.0	62.3	5.5	27.7	356.2	720.1	124.6	10.9	55.5					
		10		LCAC	Landing Craft Air Cushioned	LCAC	3.0	100%	30.0	10%	30%	60%	3.0	9.0	18.0	25.41	43.3	3.9	25.4	55.3	76.2	129.9	11.7	76.2	166.0	228.7	389.7	35.0	228.7	497.9	457.4	779.4	70.0	457.4	995.8					
		0		CRRC	Combat Raiding Rubber Craft	CRRC-4	6.0	100%	0.0	10%	30%	60%	0.0	0.0	0.0	0	0.0	0.0	0.06	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0					
24	USMC Stinger	0																																						
25	Amphibious Landings & Raids																																							
25A	Recon Mission	12		LPD	Amphibious Transport Dock - Wasp	LPD-1	4.0	100%	48.0	0%	0%	100%	0.0	0.0	48.0	1.845393	10.9	1.4	32.8	6.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	88.6	522.6	66.4	1572.3	315.6					
25B	Helicopter Assault	6		LHD	Large Helicopter-dock Ships	LHD-2	6.0	100%	36.0	0%	0%	100%	0.0	0.0	36.0	6.8	40.1	5.1	120.7	24.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	244.8	1444.3	183.6	4345.2	872.3					
		6		LHA	Amphib. Assault Ship - Tarawa	LHA-1	6.0	100%	36.0	0%	0%	100%	0.0	0.0	36.0	7.38	131.0	26.3	7.4	43.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	265.7	4714.9	946.4	265.7	1567.1					
25C	Armored Operations	4		LHD	Large Helicopter-dock Ships	LHD-2	12.0	100%	48.0	33%	33%	33%	16.0	16.0	16.0	6.8	40.1	5.1	120.7	24.2	108.7	641.3	81.5	1929.3	387.3	108.7	641.3	81.5	1929.3	387.3	108.7	641.3	81.5	1929.3	387.3					
		4		LHA	Amphib. Assault Ship - Tarawa	LHA-1	12.0	100%	48.0	33%	33%	33%	16.0	16.0	16.0	7.38	131.0	26.3	7.4	43.5	118.0	2093.4	420.2	118.0	695.8	118.0	2093.4	420.2	118.0	695.8	118.0	2093.4	420.2	118.0	695.8					
		8		LCAC	Landing Craft Air Cushioned	LCAC	12.0	100%	96.0	33%	33%	33%	32.0	32.0	32.0	25.41	43.3	3.9	25.4	55.3	812.3	1384.2	124.4	812.3	1768.5	812.3	1384.2	124.4	812.3	1768.5	812.3	1384.2	124.4	812.3	1768.5					
		8		LCU	Landing Craft Utility	LCU	12.0	100%	96.0	33%	33%	33%	32.0	32.0	32.0	36.21	3.1	1.6	36.2	45.0	1157.6	99.4	50.2	1157.6	1437.0	1157.6	99.4	50.2	1157.6	1437.0	1157.6	99.4	50.2	1157.6	1437.0					
25D	Artillery Operations	2		LHD	Large Helicopter-dock Ships	LHD-2	24.0	100%	48.0	100%	0%	0%	48.0	0.0	0.0	6.8	40.1	5.1	120.7	24.2	326.4	1925.8	244.8	5793.6	1163.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0					
		2		LHA	Amphib. Assault Ship - Tarawa	LHA-1	24.0	100%	48.0	20%	40%	40%	9.6	19.2	19.2	7.38	43.5	5.5	131.0	26.3	70.8	417.9	53.1	1257.3	252.4	141.7	835.8	106.2	2514.6	504.8	141.7	835.8	106.2	2514.6	504.8					

Table C-3. Surface Ship Air Emissions—Alternative 2

Scenario	Type Training	Number of Ships	Program Totals	Nomenclature	Ship/Boat Type	Vessel Mode	Ship Time on Range (hrs)	Percent at Each Power Level	Total Time on Range (hrs)	Percentage 0-3 nm from shore	Percentage 3-12 nm from Shore	Percentage >12 nm from Shore	Total Time 0-3 nm from shore	Total Time 3-12 nm from shore	Total Time >12 nm from shore	Emissions Factors (lb/hr) CO	Emissions Factors (lb/hr) NOx	Emissions Factors (lb/hr) HC	Emissions Factors (lb/hr) SOx	Emissions Factors (lb/hr) PM10	Emissions 0-3 nm Offshore (lbs) CO	Emissions 0-3 nm Offshore (lbs) Nox	Emissions 0-3 nm Offshore (lbs) HC	Emissions 0-3 nm Offshore (lbs) Sox	Emissions 0-3 nm Offshore (lbs) PM	Emissions 3-12 nm Offshore - US Territory (lbs) CO	Emissions 3-12 nm Offshore - US Territory (lbs) Nox	Emissions 3-12 nm Offshore - US Territory (lbs) HC	Emissions 3-12 nm Offshore - US Territory (lbs) Sox	Emissions 3-12 nm Offshore - US Territory (lbs) PM	Emissions >12 nm Offshore - Outside US Territory CO	Emissions >12 nm Offshore - Outside US Territory Nox	Emissions >12 nm Offshore - Outside US Territory HC	Emissions >12 nm Offshore - Outside US Territory Sox	Emissions >12 nm Offshore - Outside US Territory PM	CO	Nox	HC	Sox	PM
							Hours	%	Hours	Percent				Hours																										
		4		LCAC	Landing Craft Air Cushion	LCAC	24.0	100%	96.0	100%	0%	0%	96.0	0.0	0.0	25.41	55.3	0.7	43.3	3.9	2439.4	5310.7	69.1	4156.8	373.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0					
		4		LCU	Landing Craft Utility	LCU	24.0	100%	96.0	100%	0%	0%	96.0	0.0	0.0	36.21	45.0	0.5	3.1	1.6	3476.2	4315.2	49.9	298.6	150.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0					
25E	Amphibious Assault	2		LHD	Large Helicopter-dock Ships	LHD-2	8.0	100%	16.0	38%	38%	25%	6.0	6.0	4.0	6.8	40.1	5.1	120.7	24.2	40.8	240.7	30.6	724.2	145.4	40.8	240.7	30.6	724.2	145.4	27.2	160.5	20.4	482.8	96.9					
		2		LHA	Amphib. Assault Ship - Tarawa	LHA-1	8.0	100%	16.0	38%	38%	25%	6.0	6.0	4.0	7.38	43.5	5.5	131.0	26.3	44.3	261.2	33.2	785.8	157.7	44.3	261.2	33.2	785.8	157.7	29.5	174.1	22.1	523.9	105.2					
		4		LPD	Amphibious Transport Dock - Wasp	LPD-1	8.0	100%	32.0	38%	38%	25%	12.0	12.0	8.0	1.845393	10.9	1.4	32.8	6.6	22.1	130.7	16.6	393.1	78.9	22.1	130.7	16.6	393.1	78.9	14.8	87.1	11.1	262.0	52.6					
		6		LCAC	Landing Craft Air Cushioned	LCAC	8.0	100%	48.0	38%	38%	25%	18.0	18.0	12.0	25.41	43.3	3.9	25.4	55.3	457.4	779.4	70.0	457.4	995.8	457.4	779.4	70.0	457.4	995.8	304.9	519.6	46.7	304.9	663.8					
		6		LCU	Landing Craft Utility	LCU	8.0	100%	48.0	38%	38%	25%	18.0	18.0	12.0	36.21	3.1	1.6	36.2	45.0	651.8	56.0	28.3	651.8	809.1	651.8	56.0	28.3	651.8	809.1	434.5	37.3	18.8	434.5	539.4					
25F	Combat Engineer Ops	2		LHA	Amphib. Assault Ship - Tarawa	LHA-1	6.0	100%	12.0	33%	33%	33%	4.0	4.0	4.0	7.38	131.0	26.3	7.4	43.5	29.5	523.4	105.1	29.5	173.9	29.5	523.4	105.1	29.5	173.9	29.5	523.4	105.1	29.5	173.9					
		4		LCU	Landing Craft Utility	LCU	6.0	100%	24.0	33%	33%	33%	8.0	8.0	8.0	36.21	3.1	1.6	36.2	45.0	289.4	24.9	12.5	289.4	359.2	289.4	24.9	12.5	289.4	359.2	289.4	24.9	12.5	289.4	359.2					
25G	Amphibious Assault Vehicle Ops	8		LHA	Amphib. Assault Ship - Tarawa	LHA-1	8.0	100%	64.0	25%	25%	50%	16.0	16.0	32.0	7.38	131.0	26.3	7.4	43.5	118.1	2095.5	420.6	118.1	696.5	118.1	2095.5	420.6	118.1	696.5	236.2	4191.0	841.3	236.2	1393.0					
		48		EFV	Expeditionary Fighting Vessel	EFV-1	8.0	100%	384.0	25%	25%	50%	96.0	96.0	192.0	2.0611	4.17	0.72	0.06	0.3211	197.9	400.0	69.2	6.1	30.8	197.9	400.0	69.2	6.1	30.8	395.7	800.1	138.5	12.1	61.7					
25H	EFV	4		LPD	Amphibious Transport Dock - Wasp	LPD-1	8.0	100%	32.0	25%	25%	50%	8.0	8.0	16.0	1.845393	10.9	1.4	32.8	6.6	14.8	87.1	11.1	262.0	52.6	14.8	87.1	11.1	262.0	52.6	29.5	174.2	22.1	524.1	105.2					
		2		LCAC	Landing Craft Air Cushioned	LCAC	8.0	100%	16.0	25%	25%	50%	4.0	4.0	8.0	25.41	43.3	3.9	25.4	55.3	101.6	173.2	15.6	101.6	221.3	101.6	173.2	15.6	101.6	221.3	203.3	346.4	31.1	203.3	442.6					
		92		EFV	Expeditionary Fighting Vessel	EFV-1	8.0	100%	736.0	25%	25%	50%	184.0	184.0	368.0	2.0611	4.17	0.72	0.06	0.3211	379.2	766.7	132.7	11.6	59.1	379.2	766.7	132.7	11.6	59.1	758.5	1533.5	265.4	23.3	118.2					
25I	Assault Amphibian School	120		LCAC	Landing Craft Air Cushioned	LCAC	8.0	100%	960.0	0%	0%	100%	0.0	0.0	960.0	25.41	43.3	3.9	25.4	55.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	24393.6	41568.0	3734.4	24393.6	53107.2					
		60		LCU	Landing Craft Utility	LCU	8.0	100%	480.0	0%	0%	100%	0.0	0.0	480.0	36.21	3.1	1.6	36.2	45.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	17380.8	1492.8	753.6	17380.8	21576.0					
		90		EFV	Amphibious Assault Vehicle	EFV-1	8.0	100%	720.0	0%	0%	100%	0.0	0.0	720.0	2.0611	4.17	0.72	0.06	0.3211	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1484.0	3000.2	519.2	45.5	231.2					
26	Ambphibious Operations CPAAA																																							
26A	Amphibious Operations	1688		AAV/EFV	Amphibious Assault Vehicle	EFV-1	16.8	20%	5671.7	28%	70%	2%	1588.1	3970.2	113.4	2.0611	4.17	0.72	0.06	0.3211	3273.2	6617.5	1145.2	100.4	509.9	8182.9	16543.7	2862.9	250.9	1274.8	233.8	472.7	81.8	7.2	36.4					
				AAV/EFV	Amphibious Assault Vehicle	EFV-2	16.8	80%	22686.7	28%	70%	2%	6352.3	15880.7	453.7	2.0611	4.17	0.72	0.06	0.3211	13092.7	26470.0	4580.6	401.5	2039.7	32731.7	66174.9	11451.6	1003.7	5099.3	935.2	1890.7	327.2	28.7	145.7					
		6		LCAC	Landing Craft Air Cushion	LCAC	16.8	100%	100.8	100%	0%	0%	100.8	0.0	0.0	25.41	55.3	0.7	43.3	3.9	2561.3	5576.3	72.6	4364.6	392.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0					
26B	Amphibious Ops	5		LHD	Large Helicopter-dock Ships	LHD-1	4.2	90%	18.9	0%	0%	100%	0.0	0.0	18.9	5.89	34.8	4.4	104.6	21.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	111.6	658.7	83.7	1981.6	397.7					
				LHD	Large Helicopter-dock Ships	LHD-2	4.2	10%	2.1	0%	0%	100%	0.0	0.0	2.1	6.8	40.1	5.1	120.7	24.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	14.3	84.5	10.7	254.1	51.0					
		5		LCAC	Landing Craft Air Cushion	LCAC	4.2	100%	21.1	0%	0%	100%	0.0	0.0	21.1	25.41	55.3	0.7	43.3	3.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	534.9	1164.5	15.2	911.5	81.9					
		74		CRRC	Combat Raiding Rubber Craft	CRRC-1	4.2	22%	68.5	28%	36%	36%	19.2	24.7	24.7	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.4	0.0	0.0	0.0	0.0	0.5	0.0	0.0	0.0	0.0	0.5					
				CRRC	Combat Raiding Rubber Craft	CRRC-4	4.2	27%	84.1	28%	36%	36%	23.6	30.3	30.3	0	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0	3.1	0.0	0.0	0.0	0.0	4.0	0.0	0.0	0.0	0.0	4.0					
				CRRC	Combat Raiding Rubber Craft	CRRC-5	4.2	51%	158.9	28%	36%	36%	44.5	57.2	57.2	0	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0	6.6	0.0	0.0	0.0	0.0	8.5	0.0	0.0	0.0	0.0	8.5					
		5		LCU	Landing Craft Utility	LCU	4.2	100%	21.1	32%	0%	68%	6.7	0.0	14.3	36.21	45.0	0.5	3.1	1.6	243.9	302.8	3.5	20.9	10.6	0.0	0.0	0.0	0.0	0.0	518.3	643.4	7.4	44.5	22.5					
26C	Amphibious Ops	143		AAV/EFV	Amphibious Assault Vehicle	EFV-1	2.4	33%	112.0	28%	70%	2%	31.4	78.4	2.2	2.0611	4.17	0.72	0.06	0.3211	64.6	130.7	22.6	2.0	10.1	161.6	326.7	56.5	5.0	25.2	4.6	9.3	1.6	0.1	0.7					
						EFV-2	2.4	67%	224.0	28%	70%	2%	62.7	156.8	4.5	2.0611	4.17	0.72	0.06	0.3211	129.3	261.4	45.2	4.0	20.1	323.2	653.5	113.1	9.9	50.4	9.2	18.7	3.2	0.3	1.4					
26D	Amphibious Ops	5		AAV	Amphibious Assault Vehicle	AAV-1	2.4	20%	2.4	100%	0%	0%	2.4	0.0	0.0	0.444918	1.0	0.2	0.1	0.2	1.0	2.4	0.4	0.1	0.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0					
						AAV-2	2.4	80%	9.4	100%	0%	0%	9.4	0.0	0.0	0.633674	3.8	0.2	0.1	0.3	6.0	35.3	1.6	1.0	2.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0					
		3004		EFV	Amphibious Assault Vehicle	EFV-1	2.4	33%	2352.9	28%	70%	2%	658.8	1647.0	47.1	2.0611	4.17	0.72	0.06	0.3211	1357.9	2745.3	475.1	41.6	211.5	3394.7	6863.2	1187.7	104.1	528.9	97.0	196.1	33.9	3.0	15.1					
						EFV-2	2.4	67%	4706.5	28%	70%	2%	1317.8	3294.6	94.1	2.0611	4.17	0.72	0.06	0.3211	2716.2	5491.4	950.3	83.3	423.2	6790.4	13728.4	2375.7	208.2	1057.9	194.0	392.2	67.9	5.9	30.2					
		2268		RIB	Rigid Inflatable	RIB-1	2.4	7%	355.5	28%	70%	2%	99.5	248.8	7.1	0.04	1.6	0.0	0.2	0.0	4.0	158.3	1.0	16.9	2.0	10.0	395.7	2.5	42.3	5.0	0.3	11.3	0.1	1.2	0.1					
						RIB-3		13%	708.9	28%	70%	2%	198.5	496.2	14.2	0.08	3.0	0.0	0.4	0.0	15.9	595.4	2.0	71.5	7.9	39.7	1488.6	5.0	178.6	19.8	1.1	42.5	0.1	5.1	0.6					
						RIB-4		80%	4263.8	28%	70%	2%	1193.9	2984.7	85.3	0.34	9.1	0.1	1.4	0.2	405.9	10912.0	71.6	1719.2	179.1	1014.8	27280.0	179.1	4298.0	447.7	29.0	779.4	5.1	122.8	12.8					
		756		Support	Coastal Patrol-Independent Low Speed (	PC-1	2.4	20%	355.3	28%	70%	2%	99.5	248.7	7.1	6.5	12.5	1.1	2.5	0.4	646.7	1239.6	104.5	249.7	34.8	1616.7	3099.1	261.2	624.3	87.1	46.2	88.5	7.5	17.8	2.5					
					Dynamic Maneuvering	PC-3		80%	1421.3	28%	70%	2%	398.0	994.9	28.4	59.93	187.6	9.3	47.1	4.8	23849.6	74661.0	3709.0	18751.8	1898.3	59624.1	186652.4	9272.4	46879.5	4745.7	1703.5	5332.9	264.9	1339.4	135.6					
26E	Amphibious Ops	386		AAV	Amphibious Assault Vehicle	AAV-1	13.2	20%	1019.0	100%	0%	0%	1019.0	0.0	0.0	0.444918	1.0	0.2	0.1	0.2	453.4	1055.8	177.4	52.5	182.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0					
						AAV-2	13.2	80%	4076.2	100%	0%	0%	4076.2	0.0	0.0	0.633674	3.8	0.2	0.1	0.3	2583.0	15319.8	698.9	429.2	1199.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0					
		173		CRRC	Combat Raiding Rubber Craft	CRRC-1	13.2	28%	628.0	70%	30%	0%	439.6	188.4	0.0	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	8.7	0.0	0.0	0.0	0.0	3.7	0.0	0.0	0.0	0.0	0.0					
				CRRC	Combat Raiding Rubber Craft	CRRC-4	13.2	18%	399.6	70%	30%	0%	279.7	119.9	0.0	0	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0	36.9	0.0	0.0	0.0	0.0	15.8	0.0	0.0	0.0	0.0	0.0					
				CRRC	Combat Raiding Rubber Craft	CRRC-5	13.2	55%	1256.0	70%	30%	0%	879.2	376.8	0.0	0	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0	130.6	0.0	0.0	0.0	0.0	56.0	0.0	0.0	0.0	0.0	0.0					
26F	Amphibious Warfare	964		LCAC	Landing Craft Air Cushion	LCAC	8.5	100%	8194.0	16%	55%	29%	1311.0	4506.7	2376.3	25.41	55.3	0.7	43.3	3.9	33313.5	72526.7	943.9	56768.0	5099.9	114515.2	249310.6	3244.8	195140.1	17531.1	60380.8	131454.7	1710.9	102892.1	9243.7					
		221		LCU	Landing Craft Utility	LCU	8.5	100%	1878.5	75%	5%	20%	1408.9	93.9	375.7	36.21	45.0	0.5	3.1	1.6	51015.4	63328.9	732.6	4381.6	2211.9	3401.0	4221.9	48.8	292.1	147.5	13604.1	16887.7	195.4	1168.4	589.8					
		72		Support	Coastal Patrol-Independent Low Speed (	PC-2	8.5	100%	612.0	100%	0%	0%	612.0	0.0	0.0	17.21	38.1	2.9	8.2	0.9	10532.5	23341.7	1799.3	5036.8	563.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0					
		72		LCM-8		LCU	8.5	100%	612.0	100%	0%	0%	612.0	0.0	0.0	36.21	45.0	0.5	3.1	1.6	22160.5	27509.4	318.2	1903.3	960.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0					
		30		LARC		LCU	8.5	100%	255.0	100%	0%	0%	255.0	0.0	0.0	36.21	45.0	0.5	3.1	1.6	9233.6	11462.3	132.6	793.1	400.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0					
		36		SLWT	SLWT (assume LPD)	LPD-2	8.5	20%	61.2	95%	5%	0%	58.1	3.1	0.0	2.935967	17.3	2.2	52.1	10.5	170.7	1007.1	128.0	3029.9	608.1	9.0	53.0	6.7	159.5	32.0	0.0	0.0	0.0	0.0	0.0					
						LPD-3	8.5	80%	244.8	95%	5%	0%	232.6	12.2	0.0	6.549492	38.6	4.9	116.3	23.3	1523.1	8986.6	1142.4	27035.9	5426.2	80.2	473.0	60.1	1422.9	285.6	0.0	0.0	0.0	0.0	0.0					
		36		SLWT	SLWT (assume LPD)	LPD-2	8.5	20%	61.2	95%	5%	0%	58.1	3.1	0.0	2.935967	17.3	2.2	52.1	10.5	170.7	1007.1	128.0	3029.9	608.1	9.0	53.0	6.7	159.5	32.0	0.0	0.0	0.0	0.0	0.0					
						LPD-3	8.5	80%	244.8	95%	5%	0%	232.6	12.2	0.0	6.549492	38.6	4.9	116.3	23.3	1523.1	8986.6	1142.4	27035.9	5426.2	80.2	473.0	60.1	1422.9	285.6	0.0	0.0	0.0	0.0	0.0					
		18		BW	Boston Whaler	BW-2	8.5	20%	30.6	95%	5%	0%	29.1	1.5	0.0	0	0.1	9.0	0.0	0.0	0.0	2.6	262.1	0.0	0.0	0.0	0.1	13.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0					
						BW-3	8.5	80%	122.4	95%	5%	0%	116.3	6.1	0.0	0	0.3	26.3	0.0	0.0	0.0	30.7	3058.2	0.0	0.0	0.0	1.6	161.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0					
26G	Amphibious Ops	675		CRRC	Combat Raiding Rubber Craft	CRRC-1	6.2	28%	1141.6	80%	20%	0%	913.3	228.3	0.0	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	18.1	0.0	0.0	0.0	0.0	4.5	0.0	0.0	0.0	0.0	0.0					
				CRRC	Combat Raiding Rubber Craft	CRRC-4	6.2	18%	726.5	80%	20%	0%	581.2	145.3	0.0	0	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0	76.7	0.0	0.0	0.0	0.0	19.2	0.0	0.0	0.0	0.0	0.0					
				CRRC	Combat Raiding Rubber Craft	CRRC-5	6.2	55%	2283.2	80%	20%	0%	1826.6	456.6	0.0	0	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0	271.3	0.0	0.0	0.0	0.0	67.8	0.0	0.0	0.0	0.0	0.0					
27	Elec Combat	325		CVN	Nuclear Carrier (No emissions)																																			
		768		CG	Cruiser	CG-2	4.9	100%	3763.2	0%	3%	97%	0.0	112.9	3650.3	107.78	47.1	8.8	21.0	2.6	0.0	0.0	0.0	0.0	0.0	12167.9	5319.7	995.7	2373.1	296.9	393429.8	172002.3	32195.7	76729.4	9600.3					
		658		DDG	Guided Missile Destroyer	DDG-2	4.9	100%	3224.2	0%	3%	97%	0.0	96.7	3127.5	103.99	48.9	8.0	17.9	2.5	0.0	0.0	0.0	0.0	0.0	10058.5	4729.9	776.7	1735.3	237.9	325226.0	152933.5	25113.6	56106.9	7693.6					
		24		DD	Destroyer	DDG-2	4.9	100%	117.6	0%	3%	97%	0.0	3.5	114.1	103.99	48.9	8.0	17.9	2.5	0.0	0.0	0.0	0.0	0.0	366.9	172.5	28.3	63.3	8.7	11862.3	5578.1	916.0	2046.5	280.6					
		19		FFG	Guided Missile Frigate	FFG-2	4.9	100%	93.1	0%	3%	97%	0.0	2.8	90.3	66.82	67.7	7.8	11.6	3.3	0.0	0.0	0.0	0.0	0.0	186.6	189.1	21.8	32.3	9.1	6034.3	6115.6	705.3	1044.9	293.5					
		5		FFH	Canadian Frigate	FFG-2	4.9	100%	24.5	0%	3%	97%	0.0	0.7	23.8	66.82	67.7	7.8	11.6	3.3	0.0	0.0	0.0	0.0	0.0	49.1	49.8	5.7	8.5	2.4	1588.0	1609.4	185.6	275.0	77.2					
		5		AOE	Logistics/Support	AOE-1	4.9	100%	24.5	0%	3%	97%	0.0	0.7	23.8	3.73	22.0	2.8	66.1	13.3	0.0	0.0	0.0	0.0	0.0	2.7	16.2	2.1	48.6	9.8	88.6	522.6	66.3	1571.8	315.6					
		2		MHC		PC-1	4.9	100%	9.8	0%	3%	97%	0.0	0.3	9.5	6.5	12.5	1.1	2.5	0.4	0.0	0.0	0.0	0.0	0.0	1.9	3.7	0.3	0.7	0.1	61.8	118.4	10.0	23.9	3.3					
		17		LPD	Amphibious Transport Dock - Wasp	LPD-1	4.9	100%	83.3	0%	3%	97%	0.0	2.5	80.8	1.845393	10.9	1.4	32.8	6.6	0.0	0.0	0.0	0.0	0.0	4.6	27.2	3.5	81.9	16.4	149.1	879.7	111.8	2646.7	531.2					
		238		LHD	Large Helicopter-dock Ships	LHD-1	4.9	100%	1166.2	0%	3%	97%	0.0	35.0	1131.2	5.89	34.8	4.4	104.6	21.0	0.0	0.0	0.0	0.0	0.0	206.1	1216.5	154.6	3659.5	734.4	6662.9	39332.3	5000.0	118325.0	23744.2					
		16		LSD	Landing Ship Dock	LPD-1	4.9	100%	78.4	0%	3%	97%	0.0	2.4	76.0	1.845393	10.9	1.4	32.8	6.6	0.0	0.0	0.0	0.0	0.0	4.3	25.6	3.3	77.0	15.5	140.3	828.0	105.3	2491.0	500.0					
		181		LHA	Amphib. Assault Ship - Tarawa	LHA-1	4.9	100%	886.9	0%	3%	97%	0.0	26.6	860.3	7.38	43.5	5.5	131.0	26.3	0.0	0.0	0.0	0.0	0.0	196.4	1158.2	147.1	3484.7	699.5	6349.0	37448.6	4757.4	112672.6	22617.1					
		1		AGF		LPD-1	4.9	100%	4.9	0%	3%	97%	0.0	0.1	4.8	1.845393	10.9	1.4	32.8	6.6	0.0	0.0	0.0	0.0	0.0	0.3	1.6	0.2	4.8	1.0	8.8	51.7	6.6	155.7	31.2					
		4		WHEC	US Coast Guard	USCG	4.9	100%	19.6	0%	3%	97%	0.0	0.6	19.0	5.74	57.9	0.9	11.6	0.2	0.0	0.0	0.0	0.0	0.0	3.4	34.1	0.5	6.8	0.1	109.1	1101.0	16.7	219.6	4.0					
		149		Unknown		PC-1	4.9	100%	730.1	0%	3%	97%	0.0	21.9	708.2	6.5	12.5	1.1	2.5	0.4	0.0	0.0	0.0	0.0	0.0	142.4	272.9	23.0	55.0	7.7	4603.3	8824.1	743.6	1777.6	247.9					
		209		SSN	Submarines (No emissions)																																			
		42		SSBN	Submarines (No emissions)																																			
28A	Sm Obj Avoidance	9		CG	Cruiser	CG-2	1.8	100%	15.8	100%	0%	0%	15.8	0.0	0.0	107.78	47.1	8.8	21.0	2.6	1697.5	742.1	138.9	331.1	41.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0					
		14		DDG	Guided Missile Destroyer	DDG-2	1.8	100%	24.5	100%	0%	0%	24.5	0.0	0.0	103.99	48.9	8.0	17.9	2.5	2547.8	1198.1	196.7	439.5	60.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0					
		11		FFG	Guided Missile Frigate	FFG-2	1.8	100%	19.3	100%	0%	0%	19.3	0.0	0.0	66.82	67.7	7.8	11.6	3.3	1286.3	1303.6	150.3	222.7	62.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0					
		16		MCM		USCG	1.8	100%	28.0	100%	0%	0%	28.0	0.0	0.0	5.74	57.9	0.9	11.6	0.2	160.7	1621.5	24.6	323.4	5.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0					
		23		MHC		USCG	1.8	100%	40.3	100%	0%	0%	40.3	0.0	0.0	5.74	57.9	0.9	11.6	0.2	231.0	2330.9	35.4	464.9	8.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0					
29	Mine Neutralization	0																																						
30	Mining Exercise	2		MHC		USCG	0.5	100%	1.0	50%	40%	10%	0.5	0.4	0.1	5.74	57.9	0.9	11.6	0.2	2.9	29.0	0.4	5.8	0.1	2.3	23.2	0.4	4.6	0.1	0.6	5.8	0.1	1.2	0.0					
31	NSWC Land Demolition	6		CRRC		CRRC-2	4.0	90%	21.6	100%	0%	0%	21.6	0.0	0.0	0	0.0	2.3	0.0	0.0	0.0	0.6	49.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0					
						CRRC-3		10%	2.4	100%	0%	0%	2.4	0.0	0.0	0	0.1	6.3	0.0	0.0	0.0	0.2	15.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0					
32	NSWC UW Demo	85		CRRC		CRRC-2	6.0	90%	459.0	100%	0%	0%	459.0	0.0	0.0	0	0.0	2.3	0.0	0.0	0.0	12.1	1052.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0					
						CRRC-3		10%	51.0	100%	0%	0%	51.0	0.0	0.0	0	0.1	6.3	0.0	0.0	0.0	3.7	321.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0					
33	Mat Weave	36		CRRC		CRRC-2	4.0	90%	129.6	100%	0%	0%	129.6	0.0	0.0	0	0.0	2.3	0.0	0.0	0.0	3.4	297.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0					
						CRRC-3		10%	14.4	100%	0%	0%	14.4	0.0	0.0	0	0.1	6.3	0.0	0.0	0.0	1.0	90.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0					
34	NSWC Small Arms	24		CRRC		CRRC-2	6.0	90%	129.6	100%	0%	0%	129.6	0.0	0.0	0	0.0	2.3	0.0	0.0	0.0	3.4	297.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0					
						CRRC-3		10%	14.4	100%	0%	0%	14.4	0.0	0.0	0	0.1	6.3	0.0	0.0	0.0	1.0	90.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0					
35	NSWC Land Nav	0																																						
36	NSW UAV Operationa	0																																						

Table C-3. Surface Ship Air Emissions—Alternative 2

Scenario	Type Training	Number of Ships	Program Totals	Nomenclature	Ship/Boat Type	Vessel Mode	Ship Time on Range (hrs) (Hours)	Percent at Each Power Level (%)	Total Time on Range (hrs) (Hours)	Percentage 0-3 nm from shore (Percent)	Percentage 3-12 nm from Shore (Percent)	Percentage >12 nm from Shore (Percent)	Total Time 0-3 nm from shore (Hours)	Total Time 3-12 nm from shore (Hours)	Total Time >12 nm from shore (Hours)	Emissions Factors (lb/hr) CO	NOx	HC	SOx	PM10
37	Insertion/Extraction	0																		
38	NSW Boat Operations	245		MK V	MK V	MK-1	10.0	50%	1225.0	5%	42%	53%	61.3	514.5	649.3	1.94	14.8	0.5	2.4	0.2
						MK-3		50%	1225.0	5%	42%	53%	61.3	514.5	649.3	13.22	71.5	1.1	15.7	1.2
		75		RIB	Rigid Inflatable	RIB-3	10.0	50%	375.0	5%	42%	53%	18.8	157.5	198.8	0.08	3.0	0.0	0.4	0.0
						RIB-4		50%	375.0	5%	42%	53%	18.8	157.5	198.8	0.34	9.1	0.1	1.4	0.2
39	NSWG-1 Platoon Ops	4		PC	Coastal Patrol-Independent Low Speed (	PC-3	4.0	100%	16.0	20%	30%	50%	3.2	4.8	8.0	59.93	187.6	9.3	47.1	4.8
		49		CRRC		CRRC-5	0.5	100%	24.5	100%	0%	0%	24.5	0.0	0.0	0	0.1	12.9	0.0	0.0
		83		SOW	MK V	MK-3	0.5	100%	41.5	100%	0%	0%	41.5	0.0	0.0	13.22	71.5	1.1	15.7	1.2
40	Direct Action	2		PC	Coastal Patrol-Independent Low Speed (	PC-2	8.0	80%	12.8	30%	20%	50%	3.8	2.6	6.4	17.21	38.1	2.9	8.2	0.9
					Dynamic Maneuvering	PC-3		20%	3.2	30%	20%	50%	1.0	0.6	1.6	59.93	187.6	9.3	47.1	4.8
		4		SOW	MK V	MK-1	4.0	80%	12.8	30%	25%	45%	3.8	3.2	5.8	1.94	14.8	0.5	2.4	0.2
						MK-3		20%	3.2	30%	25%	45%	1.0	0.8	1.4	13.22	71.5	1.1	15.7	1.2
		1		LCAC	Landing Craft Air Cushion	LCAC	1.0	100%	1.0	100%	0%	0%	1.0	0.0	0.0	25.41	55.3	0.7	43.3	3.9
		12		CRRC	Combat Rubber Raiding Craft	CRRC-3	1.0	100%	12.0	100%	0%	0%	12.0	0.0	0.0	0	0.1	6.3	0.0	0.0
		12		SDV	Combat Rubber Raiding Craft	CRRC-3	1.0	100%	12.0	100%	0%	0%	12.0	0.0	0.0	0	0.1	6.3	0.0	0.0
41	Bombing Exercise - Land	0																		
42	CSAR	0																		
43	EOD Outside SHOBA	0																		
44	USCG Ops	149		Response	Coastal Patrol-Independent Low Speed (	PC-1	3.2	2%	9.5	80%	20%	0%	7.6	1.9	0.0	6.5	12.5	1.1	2.5	0.4
						PC-2		2%	9.5	80%	20%	0%	7.6	1.9	0.0	17.21	38.1	2.9	8.2	0.9
				Utility	Dynamic Maneuvering	PC-3		96%	457.7	80%	20%	0%	366.2	91.5	0.0	59.93	187.6	9.3	47.1	4.8
		149		Utility	Coastal Patrol-Independent Low Speed (	PC-1	3.2	15%	71.5	80%	20%	0%	57.2	14.3	0.0	6.5	12.5	1.1	2.5	0.4
						PC-2		60%	286.1	80%	20%	0%	228.9	57.2	0.0	17.21	38.1	2.9	8.2	0.9
					Dynamic Maneuvering	PC-3		25%	119.2	80%	20%	0%	95.4	23.8	0.0	59.93	187.6	9.3	47.1	4.8
		100		Cutter	US Coast Guard	USCG	3.2	100%	320.0	20%	20%	60%	64.0	64.0	192.0	5.74	57.9	0.9	11.6	0.2
		49		Cutter	US Coast Guard	USCG	3.2	100%	156.8	5%	5%	90%	7.8	7.8	141.1	5.74	57.9	0.9	11.6	0.2
45	NALF Airfield	0																		
46	Ship Torpedo Test	2		DDG	Guided Missile Destroyer	DDG-3	6.5	100%	13.0	0%	23%	77%	0.0	3.0	10.0	106.67	53.8	7.8	21.2	2.8
		2		DDH	Japanese Destroye Helo Deck (FMS)	CG-3	6.5	100%	13.0	0%	23%	77%	0.0	3.0	10.0	114.75	65.2	7.7	33.6	3.4
		2		DD	Japanese Destroyer (FMS)	CG-3	6.5	100%	13.0	0%	23%	77%	0.0	3.0	10.0	114.75	65.2	7.7	33.6	3.4
		6		FFH	Helicopter Frigate (Canadian)	FFG-3	6.5	100%	39.0	0%	23%	77%	0.0	9.0	30.0	120.04	78.1	11.6	16.1	4.3
47	UUV	15		BW	Boston Whalers	BW-1	10.0	100%	150.0	100%	0%	0%	150.0	0.0	0.0	0	0.1	7.5	0.0	0.0
		15		HS	Harbor Security	RIB-2	10.0	100%	150.0	100%	0%	0%	150.0	0.0	0.0	0.04	1.6	0.0	0.2	0.0
		30			Phanton DS4 (no emissions)					100%	0%	0%								
48	Sonobuoy QA/QC	62		AE	Acoustic Explorer	AE-2	4.0	100%	248.0	50%	30%	20%	124.0	74.4	49.6	20.17	20.9	1.0	6.0	1.6
49	Ocean Engineering	65		BW	Boston Whaler	BW-2	3.0	100%	195.0	100%	0%	0%	195.0	0.0	0.0	0	0.1	9.0	0.0	0.0
50	MM Mine Location	6		AE	Acoustic Explorer	AE-1	12.0	100%	72.0	100%	0%	0%	72.0	0.0	0.0	7.31	8.5	0.4	2.1	0.6
		30		BW	Boston Whaler	BW-2	12.0	100%	360.0	100%	0%	0%	360.0	0.0	0.0	0	0.1	9.0	0.0	0.0
51	Missile Flight Test	12		CG		CG-2	4.0	100%	48.0	0%	0%	100%	0.0	0.0	48.0	107.78	47.1	8.8	21.0	2.6
		24		DDG	Guided Missile Destroyer	DDG-2	4.0	100%	96.0	0%	0%	100%	0.0	0.0	96.0	103.99	48.9	8.0	17.9	2.5
52	NUWC UW Acoustic	139		FFG	Guided Missile Frigate	FFG-2	4.0	100%	556.0	0%	0%	100%	0.0	0.0	556.0	66.82	67.7	7.8	11.6	3.3
		38		AE	Acoustic Explorer	AE-1	4.0	100%	152.0	0%	0%	100%	0.0	0.0	152.0	7.31	8.5	0.4	2.1	0.6
		139		BW	Boston Whaler	BW-2	4.0	100%	556.0	0%	0%	100%	0.0	0.0	556.0	0	0.1	9.0	0.0	0.0
53	Other Tests (MCM, ASUW, FIREX)	3		CG	Cruiser	CG-2	4.0	100%	12.0	0%	0%	100%	0.0	0.0	12.0	107.78	47.1	8.8	21.0	2.6
		10		DDG	Guided Missile Destroyer	DDG-2	4.0	100%	40.0	0%	0%	100%	0.0	0.0	40.0	103.99	48.9	8.0	17.9	2.5
		1		FFH	Helicopter Frigate (Canadian)	FFG-2	4.0	100%	4.0	0%	0%	100%	0.0	0.0	4.0	66.82	67.7	7.8	11.6	3.3
		11		DD	Japanese Destroyer (FMS)	CG-2	4.0	100%	44.0	0%	0%	100%	0.0	0.0	44.0	107.78	47.1	8.8	21.02	2.6
		2		AOR	Canadian	AOE-1	4.0	100%	8.0	0%	0%	100%	0.0	0.0	8.0	3.73	22.0	2.8	66.1	13.3
	Total	####																		

Emissions

Scenario	Vessel Mode	Emissions 0-3 nm Offshore (lbs) CO	Nox	HC	Sox	PM	Emissions 3-12 nm Offshore - US Territory (lbs) CO	Nox	HC	Sox	PM	Emissions >12 nm Offshore - Outside US Territory CO	Nox	HC	Sox	PM	CO	Nox	HC	Sox	PM
38	MK-1	118.8	908.3	30.6	146.4	12.3	998.1	7630.0	257.3	1229.7	102.9	1259.5	9628.4	324.6	1551.7	129.9					
	MK-3	809.7	4378.2	64.3	958.6	70.4	6801.7	36776.5	540.2	8051.9	591.7	8583.1	46408.4	681.7	10160.8	746.6					
	RIB-3	1.5	56.3	0.2	6.8	0.8	12.6	472.5	1.6	56.7	6.3	15.9	596.3	2.0	71.6	8.0					
	RIB-4	6.4	171.4	1.1	27.0	2.8	53.6	1439.6	9.5	226.8	23.6	67.6	1816.6	11.9	286.2	29.8					
39	PC-3	191.8	600.4	29.8	150.8	15.3	287.7	900.5	44.7	226.2	22.9	479.4	1500.9	74.6	377.0	38.2					
	CRRC-5	0.0	3.6	316.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0					
	MK-3	548.6	2966.4	43.6	649.5	47.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0					
40	PC-2	66.1	146.5	11.3	31.6	3.5	44.1	97.6	7.5	21.1	2.4	110.1	244.1	18.8	52.7	5.9					
	PC-3	57.5	180.1	8.9	45.2	4.6	38.4	120.1	6.0	30.2	3.1	95.9	300.2	14.9	75.4	7.6					
	MK-1	7.4	56.9	1.9	9.2	0.8	6.2	47.5	1.6	7.6	0.6	11.2	85.4	2.9	13.8	1.2					
	MK-3	12.7	68.6	1.0	15.0	1.1	10.6	57.2	0.8	12.5	0.9	19.0	102.9	1.5	22.5	1.7					
	LCAC	25.4	55.3	0.7	43.3	3.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0					
	CRRC-3	0.0	0.9	75.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0					
	CRRC-3	0.0	0.9	75.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0					
44	PC-1	49.6	95.1	8.0	19.1	2.7	12.4	23.8	2.0	4.8	0.7	0.0	0.0	0.0	0.0	0.0					
	PC-2	131.3	291.0	22.4	62.8	7.0	32.8	72.7	5.6	15.7	1.8	0.0	0.0	0.0	0.0	0.0					
	PC-3	21945.3	68699.5	3412.8	17254.5	1746.7	5486.3	17174.9	853.2	4313.6	436.7	0.0	0.0	0.0	0.0	0.0					
	PC-1	371.9	712.9	60.1	143.6	20.0	93.0	178.2	15.0	35.9	5.0	0.0	0.0	0.0	0.0	0.0					
	PC-2	3938.7	8728.9	672.9	1883.6	210.6	984.7	2182.2	168.2	470.9	52.6	0.0	0.0	0.0	0.0	0.0					
	PC-3	5714.9	17890.5	888.8	4493.4	454.9	1428.7	4472.6	222.2	1123.3	113.7	0.0	0.0	0.0	0.0	0.0					
	USCG	367.4	3706.2	56.3	739.2	13.4	367.4	3706.2	56.3	739.2	13.4	1102.1	11118.7	169.0	2217.6	40.3					
	USCG	45.0	454.0	6.9	90.6	1.6	45.0	454.0	6.9	90.6	1.6	810.0	8172.3	124.2	1629.9	29.6					
46	DDG-3	0.0	0.0	0.0	0.0	0.0	321.7	162.4	23.6	64.0	8.4	1065.0	537.5	78.3	211.9	28.0					
	CG-3	0.0	0.0	0.0	0.0	0.0	346.1	196.7	23.1	101.2	10.4	1145.7	651.2	76.6	335.0	34.3					
	CG-3	0.0	0.0	0.0	0.0	0.0	346.1	196.7	23.1	101.2	10.4	1145.7	651.2	76.6	335.0	34.3					
	FFG-3	0.0	0.0	0.0	0.0	0.0	1086.1	706.7	105.3	145.5	38.9	3595.4	2339.6	348.6	481.6	128.8					
47	BW-1	0.0	11.3	1127.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0					
	RIB-2	6.0	238.5	1.5	25.5	3.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0					
48	AE-2	2501.1	2595.3	122.8	740.3	194.7	1500.6	1557.2	73.7	444.2	116.8	1000.4	1038.1	49.1	296.1	77.9					
49	BW-2	0.0	17.7	1758.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0					
50	AE-1	526.3	609.1	27.4	152.6	39.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0					
	BW-2	0.0	32.6	3246.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0					
51	CG-2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	5173.4	2261.8	423.4	1009.0	126.2					
	DDG-2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	9983.0	4694.4	770.9	1722.2	236.2					
52	FFG-2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	37151.9	37652.3	4342.4	6432.9	1807.0					
	AE-1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1111.1	1285.9	57.8	322.2	83.6					
	BW-2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	50.4	5013.7	0.0	0.0					
53	CG-2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1293.4	565.4	105.8	252.2	31.6					
	DDG-2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	4159.6	1956.0	321.2	717.6	98.4					
	FFG-2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	267.3	270.9	31.2	46.3	13.0					
	CG-2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	4742.3	2073.3	388.1	924.9	115.7					
	AOE-1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	29.8	175.9	22.3	529.1	106.2					
Total Emissions (SCI) tons		**12.09**	**19.82**	**5.99**	**12.03**	**5.51**	**71.36**	**45.13**	**6.65**	**22.83**	**7.51**	**670.52**	**521.13**	**62.50**	**328.43**	**90.70**	**55.85**	**35.60**	**5.03**	**14.24**	**2.28**
Total Emissions (SD) tons		**107.27**	**237.93**	**13.54**	**90.57**	**15.76**	**124.15**	**326.19**	**16.75**	**134.28**	**16.59**										
Total Emissions within US Territory (SCI)		**83.45**	**64.95**	**12.64**	**34.86**	**13.02**															
Total Emissions within US Territory (SD)		**231.42**	**564.12**	**30.29**	**224.86**	**32.36**															

Date: 13-May-2007

Notes: 1 - Ship nomenclature highlighted in yellow signifies no specific AQ Emissions data for that vessel.

For vessels without AQ emissions data, the following data was used:

Support (for USW)	TRB	AGF	LPD
Support (for Surf Firing)	PC	WHEC	USCG
MCM	USCG	Unknown (for Elec Combat)	PC
MHC	USCG	SOW	MKV
LSD	LPD	EFV	AAV
Unknown (for VBSS)	PC	DDH	CG
DD	CG	HS	RIB
FFH	FFG	AOR	AOE

Table C-4. Aircraft Air Emissions—No Action Alternative

Scenario	Type Training	A/C Sorties	Nomenclature	Ave. A/C Time on Range (hrs)	Total Time on Range (hrs)	% Below 3,000 ft	Time Below 3,000 ft	Percentage 0-3 nm from shore	Percentage 3-12 nm from Shore	Percentage >12 nm from Shore	Total Time 0-3 nm from shore	Total Time 3-12 nm from shore	Total Time >12 nm from shore	Scenario	Aircraft	Engines		Fuel Flow	Emission Indices, lbs/1,000 lbs fuel					Emissions Factors (lb/hr)					Emissions Emissions 0-3 nm Offshore (lbs)					Emissions 3-12 nm Offshore—US Territory (lbs)					Emissions >12 nm Offshore—Outside US Territory									
		No.		Hours	Hours	%	Hours	Percent			Hours			No.	Type	Engine Model	No.	lbs/hr	CO	NOx	HC	SOx	PM10	CO	NOx	HC	SOx	PM10	CO	NOx	HC	SOx	PM	CO	NOx	HC	SOx	PM	CO	NOx	HC	SOx	PM				SOx	PM
Training Operations																																							Offshore San Diego					Offshore Mexico				
1	Air Combat Maneuvers	10200	FA-18E/F	1.1	1123.1			1%	2%	97%					FA-18E/F	F414-GE-400 (assume a	2	4049	0.89	11.58	0.12	0.40	6.31	7.21	93.77	0.97	3.24	51.10																				
		624	AV-8B	1.2	748.8			1%	2%	97%					AV-8B	F402-RR-406A (assume	1	6381	7.70	8.60	0.54	0.40	3.80	49.13	54.88	3.45	2.55	24.25																				
2	Air Defense Exercise	107	E-2	1.0	107.0	50%	53.5	1%	2%	97%	0.54	1.07	51.90		E-2	T56-A-425 (assume 30%	2	1100	2.16	8.06	0.49	0.40	3.97	4.75	17.73	1.08	0.88	8.73	2.54	9.49	0.58	0.47	4.67	5.08	18.97	1.15	0.94	9.35	246.61	920.20	55.94	45.67	453.25					
		642	FA-18E/F	1.0	642.0	50%	321.0	1%	2%	97%	3.21	6.42	311.37		FA-18E/F	F414-GE-400 (assume a	2	4049	0.89	11.58	0.12	0.40	6.31	7.21	93.77	0.97	3.24	51.10	23.14	301.02	3.12	10.40	164.03	46.27	602.03	6.24	20.80	328.05	2244.11	29198.67	302.58	1008.59	15910.50					
		107	S-3B	1.0	107.0	50%	53.5	1%	2%	97%	0.54	1.07	51.90		S-3B	TF34-GE-400 (assume t	2	1145	14.10	4.07	1.86	0.40	3.62	32.29	9.32	4.26	0.92	8.29	17.27	4.99	2.28	0.49	4.44	34.55	9.97	4.56	0.98	8.87	1675.64	483.68	221.04	47.54	430.20					
		321	FA-18E/F	1.0	321.0	50%	160.5	1%	2%	97%	1.61	3.21	155.69		FA-18E/F	F414-GE-400 (assume a	2	4049	0.89	11.58	0.12	0.40	6.31	7.21	93.77	0.97	3.24	51.10	11.57	150.51	1.56	5.20	82.01	23.14	301.02	3.12	10.40	164.03	1122.06	14599.34	151.29	504.29	7955.25					
		107	Learjet	1.0	107.0	50%	53.5	1%	2%	97%	0.54	1.07	51.90		Learjet	TFE 731-2-2B	2	531.76	22.38	5.90	4.28	0.54	4.20	23.80	6.27	4.55	0.57	4.47	12.73	3.36	2.44	0.31	2.39	25.47	6.71	4.87	0.61	4.78	1235.18	325.63	236.22	29.80	231.80					
3	S-A MISSILEX	1	SH-60B	1.0	1.0	100%	1.0	1%	2%	97%	0.01	0.02	0.97		SH-60B	T700-GE-401C	2	600	6.25	6.40	0.55	0.40	4.20	7.50	7.68	0.66	0.48	5.04	0.08	0.08	0.01	0.00	0.05	0.15	0.15	0.01	0.01	0.10	7.28	7.45	0.64	0.47	4.89					
		1	P-3	3.0	3.0	67%	2.0	1%	2%	97%	0.02	0.04	1.94		P-3	T56-A-14 (assume ASU\	4	1200	1.82	8.43	0.41	0.40	3.97	8.74	40.46	1.97	1.92	19.06	0.17	0.81	0.04	0.04	0.38	0.35	1.62	0.08	0.08	0.76	16.96	78.54	3.82	3.73	36.99					
		1	Learjet	1.5	1.5	67%	1.0	1%	2%	97%	0.01	0.02	0.97		Learjet	TFE 731-2-2B	2	531.76	22.38	5.90	4.28	0.54	4.20	23.80	6.27	4.55	0.57	4.47	0.24	0.06	0.05	0.01	0.04	0.48	0.13	0.09	0.01	0.09	23.10	6.09	4.42	0.56	4.33					
		1	C-130	1.5	1.5	67%	1.0	1%	2%	97%	0.01	0.02	0.97		C-130	T56-A-425 (assume app	4	850	4.03	6.71	0.97	0.40	3.97	13.70	22.81	3.30	1.36	13.50	0.14	0.23	0.03	0.01	0.14	0.27	0.46	0.07	0.03	0.27	13.30	22.14	3.20	1.32	13.10					
4	S-A GUNEX	262	Learjet	1.5	393.0	50%	196.5	1%	2%	97%	1.97	3.93	190.61		Learjet	TFE 731-2-2B	2	531.76	22.38	5.90	4.28	0.54	4.20	23.80	6.27	4.55	0.57	4.47	46.77	12.33	8.94	1.13	8.78	93.54	24.66	17.89	2.26	17.55						4536.70	1196.00	867.61	109.46	851.39
5	A-A MISSILEX	52	FA-18A/C	2.0	104.0					100%					FA-18A/C	F404-GE-400 (assume a	2	3318	2.44	6.74	0.44	0.40	6.36	16.19	44.73	2.92	2.65	42.20																				
		78	FA-18E/F	2.0	156.0					100%					FA-18E/F	F414-GE-400 (assume a	2	4049	0.89	11.58	0.12	0.40	6.31	7.21	93.77	0.97	3.24	51.10																				
		13	E-2C	4.0	52.0					100%					E-2C	T56-A-425 (assume 40%	2	1100	2.16	8.06	0.49	0.40	3.97	4.75	17.73	1.08	0.88	8.73																				
		13	DC-130	4.0	52.0			1%	2%	97%					DC-130	T56-A-425 (assume app	4	850	4.03	6.71	0.97	0.40	3.97	13.70	22.81	3.30	1.36	13.50																				
6	Helicopter ASW TRACKEX	95	SH-60B	3.6	342.0	100%	342.0		24%	76%		80.71	261.29	6	SH-60B	T700-GE-401C	2	600	6.25	6.40	0.55	0.40	4.20	7.50	7.68	0.66	0.48	5.04						605.34	619.87	53.27	38.74	406.79	1959.66	2006.69	172.45	125.42	1316.89					
		449	SH-60F	3.6	1616.4	100%	1616.4		24%	76%		381.47	#####		SH-60F	T700-GE-401C	2	600	6.25	6.40	0.55	0.40	4.20	7.50	7.68	0.66	0.48	5.04						2861.03	2929.69	251.77	183.11	1922.61	9261.97	9484.26	815.05	592.77	6224.05					
7	Helicopter ASW TORPEX	65	SH-60B	3.6	234.0	100%	234.0		24%	76%		55.22	178.78	7	SH-60B	T700-GE-401C	2	600	6.25	6.40	0.55	0.40	4.20	7.50	7.68	0.66	0.48	5.04						414.18	424.12	36.45	26.51	278.33	1340.82	1373.00	117.99	85.81	901.03					
		122	SH-60F	3.6	439.2	100%	439.2		24%	76%		103.65	335.55		SH-60F	T700-GE-401C	2	600	6.25	6.40	0.55	0.40	4.20	7.50	7.68	0.66	0.48	5.04						777.38	796.04	68.41	49.75	522.40	2516.62	2577.01	221.46	161.06	1691.17					
		16	Other Helo (SH-3)	3.6	57.6	100%	57.6		24%	76%		13.59	44.01		Other Helo (SH	T58-GE-402 (assume 49	2	529	21.28	3.88	2.20	0.40	4.00	22.51	4.11	2.33	0.42	4.23						306.05	55.80	31.64	5.75	57.53	990.77	180.65	102.43	18.62	186.24					
8	MPA ASW TRACKEX	25	P-3	6.0	150.0	75%	112.5	5%	10%	85%	5.63	11.25	95.63		P-3	T56-A-14 (assume ASU\	4	1200	1.82	8.43	0.41	0.40	3.97	8.74	40.46	1.97	1.92	19.06	49.14	227.61	11.07	10.80	107.19	98.28	455.22	22.14	21.60	214.38	835.38	3869.37	188.19	183.60	1822.23					
9	MPA ASW TORPEX	35	P-3	2.0	70.0	100%	70.0	1%	2%	97%	0.70	1.40	67.90		P-3	T56-A-14 (assume ASU\	4	1200	1.82	8.43	0.41	0.40	3.97	8.74	40.46	1.97	1.92	19.06	6.12	28.32	1.38	1.34	13.34	12.23	56.65	2.76	2.69	26.68	593.17	2747.51	133.63	130.37	1293.90					
		9	SH-60B	2.0	18.0	100%	18.0	1%	2%	97%	0.18	0.36	17.46		SH-60B	T700-GE-401C	2	600	6.25	6.40	0.55	0.40	4.20	7.50	7.68	0.66	0.48	5.04	1.35	1.38	0.12	0.09	0.91	2.70	2.76	0.24	0.17	1.81	130.95	134.09	11.52	8.38	88.00					
10	EER/IEER ASW	2	P-3	6.0	12.0	75%	9.0			100%			9.00		P-3	T56-A-14 (assume ASU\	4	1200	1.82	8.43	0.41	0.40	3.97	8.74	40.46	1.97	1.92	19.06											78.62	364.18	17.71	17.28	171.50					
11	Surface Ship ASW TRACKEX																																															
12	Surface Ship ASW TORPEX	7	Other Helo (SH-3)	3.7	25.9	100%	25.9	1%	2%	97%	0.26	0.52	25.12		Other Helo (SH	T58-GE-402 (assume 49	2	529	21.28	3.88	2.20	0.40	4.00	22.51	4.11	2.33	0.42	4.23	5.83	1.06	0.60	0.11	1.10	11.66	2.13	1.21	0.22	2.19	565.63	103.13	58.48	10.63	106.32					
13	Submarine ASW TORPEX																																															
14	Submarine ASW TORPEX																																															
15	VBSS	12	SH-60B	4.0	48.0	100%	48.0			100%			48.00		SH-60B	T700-GE-401C	2	600	6.25	6.40	0.55	0.40	4.20	7.50	7.68	0.66	0.48	5.04											360.00	368.64	31.68	23.04	241.92					
		1	SH-60F	4.0	4.0	100%	4.0			100%			4.00																																			
16	A-S MISSILEX	26	SH-60B	3.0	78.0	100%	78.0	1%	2%	97%	0.78	1.56	75.66		SH-60B	T700-GE-401C	2	600	6.25	6.40	0.55	0.40	4.20	7.50	7.68	0.66	0.48	5.04	5.85	5.99	0.51	0.37	3.93	11.70	11.98	1.03	0.75	7.86	567.45	581.07	49.94	36.32	381.33					
		13	SH-60F	3.0	39.0	100%	39.0	1%	2%	97%	0.39	0.78	37.83		SH-60F	T700-GE-401C	2	600	6.25	6.40	0.55	0.40	4.20	7.50	7.68	0.66	0.48	5.04	2.93	3.00	0.26	0.19	1.97	5.85	5.99	0.51	0.37	3.93	283.73	290.53	24.97	18.16	190.66					
		14	FA-18A/C	2.0	28.0			1%	2%	97%					FA-18A/C	F404-GE-400 (assume a	2	3318	2.44	6.74	0.44	0.40	6.36	16.19	44.73	2.92	2.65	42.20																				
		14	FA-18E/F	2.0	28.0			1%	2%	97%					FA-18E/F	F414-GE-400 (assume a	2	4049	0.89	11.58	0.12	0.40	6.31	7.21	93.77	0.97	3.24	51.10																				
		11	S-3B	3.0	33.0	100%	33.0	1%	2%	97%	0.33	0.66	32.01		S-3B	TF34-GE-400 (assume t	2	1145	14.10	4.07	1.86	0.40	3.62	32.29	9.32	4.26	0.92	8.29	10.66	3.08	1.41	0.30	2.74	21.31	6.15	2.81	0.60	5.47	1033.57	298.34	136.34	29.32	265.36					
17	A-S BOMBEX	17	FA-18A/C	1.0	17.0	10%	1.7		50%	50%		0.85	0.85		FA-18A/C	F404-GE-400 (assume a	2	3318	2.44	6.74	0.44	0.40	6.36	16.19	44.73	2.92	2.65	42.20						13.76	38.02	2.48	2.26	35.87	13.76	38.02	2.48	2.26	35.87					
		17	FA-18E/F	1.0	17.0	10%	1.7		50%	50%		0.85	0.85		FA-18E/F	F414-GE-400 (assume a	2	4049	0.89	11.58	0.12	0.40	6.31	7.21	93.77	0.97	3.24	51.10						6.13	79.71	0.83	2.75	43.43	6.13	79.71	0.83	2.75	43.43					
		9	P-3	1.0	9.0	10%	0.9		50%	50%		0.45	0.45		P-3	T56-A-14 (assume ASU\	4	1200	1.82	8.43	0.41	0.40	3.97	8.74	40.46	1.97	1.92	19.06						3.93	18.21	0.89	0.86	8.58	3.93	18.21	0.89	0.86	8.58					
		15	S-3B	1.0	15.0	10%	1.5		50%	50%		0.75	0.75		S-3B	TF34-GE-400 (assume t	2	1145	14.10	4.07	1.86	0.40	3.62	32.29	9.32	4.26	0.92	8.29						24.22	6.99	3.19	0.69	6.22	24.22	6.99	3.19	0.69	6.22					
18	A-S GUNEX	76	SH-60B	1.0	76.0	100%	76.0		50%	50%		38.00	38.00		SH-60B	T700-GE-401C	2	600	6.25	6.40	0.55	0.40	4.20	7.50	7.68	0.66	0.48	5.04						285.00	291.84	25.08	18.24	191.52	285.00	291.84	25.08	18.24	191.52					
		26	SH-60F	1.0	26.0	100%	26.0		50%	50%		13.00	13.00		SH-60F	T700-GE-401C	2	600	6.25	6.40	0.55	0.40	4.20	7.50	7.68	0.66	0.48	5.04						97.50	99.84	8.58	6.24	65.52	97.50	99.84	8.58	6.24	65.52					
		1	HH-60	1.0	1.0	100%	1.0		50%	50%		0.50	0.50		HH-60	T700-GE-401C	2	600	6.25	6.40	0.55	0.40	4.20	7.50	7.68	0.66	0.48	5.04						3.75	3.84	0.33	0.24	2.52	3.75	3.84	0.33	0.24	2.52					
19	S-S GUNEX																																															
20	SINKEX	4	E-2	16.0	64.0	10%	6.4			100%			6.40		E-2	T56-A-425 (assume 30%	2	1100	2.16	8.06	0.49	0.40	3.97	4.75	17.73	1.08	0.88	8.73																30.41	113.48	6.90	5.63	55.90
		16	FA-18E/F	16.0	256.0	10%	25.6			100%			25.60		FA-18E/F	F414-GE-400 (assume a	2	4049	0.89	11.58	0.12	0.40	6.31	7.21	93.77	0.97	3.24	51.10																184.50	2400.64	24.88	82.92	1308.12
		2	P-3	16.0	32.0	10%	3.2			100%			3.20		P-3	T56-A-14 (assume ASU\	4	1200	1.82	8.43	0.41	0.40	3.97	8.74	40.46	1.97	1.92	19.06																27.96	129.48	6.30	6.14	60.98
		4	SH-60B	16.0	64.0	10%	6.4			100%			6.40		SH-60B	T700-GE-401C	2	600	6.25	6.40	0.55	0.40	4.20	7.50	7.68	0.66	0.48	5.04																48.00	49.15	4.22	3.07	32.26
21	Naval Surface Fire Support Exercise																																															
22	Expeditionary Fires Exercise	1	FA-18E/F	3.0	3.0	100%	3.0		100%			3.00			FA-18E/F	F414-GE-400 (assume a	2	4049	0.89	11.58	0.12	0.40	6.31	7.21	93.77	0.97	3.24	51.10						21.62	281.32	2.92	9.72	153.30										
		1	AH-1	3.0	3.0	100%	3.0		100%			3.00			AH-1	T700-GE-401 (assume c	2	425.1	10.54	5.55	0.56	0.40	4.20	8.96	4.72	0.48	0.34	3.57						26.88	14.16	1.43	1.02	10.71										
		1	AV-8B	3.0	3.0	100%	3.0		100%			3.00			AV-8B	F402-RR-406A (assume	1	6381	7.70	8.60	0.54	0.40	3.80	49.13	54.88	3.45	2.55	24.25						147.40	164.63	10.34	7.66	72.74										
23	USMC Battalion Landing		FA-18A/C	0.5		15%		20%	50%	30%					FA-18A/C	F404-GE-400 (assume a	2	3318	2.44	6.74	0.44	0.40	6.36	16.19	44.73	2.92	2.65	42.20																				
			FA-18E/F	0.5		15%		20%	50%	30%					FA-18E/F	F414-GE-400 (assume a	2	4049	0.89	11.58	0.12	0.40	6.31	7.21	93.77	0.97	3.24	51.10																				
			AV-8B	0.5		25%		90%	5%	5%					AV-8B	F402-RR-406A (assume	1	6381	7.70	8.60	0.54	0.40	3.80	49.13	54.88	3.45	2.55	24.25																				
			AH-1	1.0		100%		90%	5%	5%					AH-1	T700-GE-401 (assume c	2	425.1	10.54	5.55	0.56	0.40	4.20	8.96	4.72	0.48	0.34	3.57																				
			C-130	1.4				20%	50%	30%					C-130	T56-A-425 (assume app	4	850	4.03	6.71	0.97	0.40	3.97	13.70	22.81	3.30	1.36	13.50																				
			H-53	1.5		100%		90%	5%	5%					H-53	T64-GE-415 (assume cr	3	1488	2.13	8.08	0.15	0.40	2.21	9.51	36.07	0.67	1.79	9.87																				
			H-46	1.5		100%		90%	5%	5%					H-46	T58-GE-16	2	560	19.74	3.94	3.43	0.40	1.78	22.11	4.41	3.84	0.45	1.99																				
			UH-1	1.0		100%		90%	5%	5%					UH-1	T400-CP-400	2	346.2	1.01	5.79	0.13	0.40	4.20	0.70	4.01	0.09	0.28	2.91																				
24	USMC Stinger Firings																																															
25	Amphibious Landings and Raids																																															
25A	Amphibious Ops		AH-1	4.0		100%		100%							AH-1	T700-GE-401 (assume c	2	425.1	10.54	5.55	0.56	0.40	4.20	8.96	4.72	0.48	0.34	3.57																				
			CH-46	4.0		100%		100%							CH-46	T58-GE-16	2	560	19.74	3.94	3.43	0.40	1.78	22.11	4.41	3.84	0.45	1.99																				
			CH-53	4.0		100%		100%							CH-53	T64-GE-415 (assume cr	3	1488	2.13	8.08	0.15	0.40	2.21	9.51	36.07	0.67	1.79	9.87																				
			UH-1	4.0		100%		100%							UH-1	T400-CP-400	2	346.2	1.01	5.79	0.13	0.40	4.20	0.70	4.01	0.09	0.28	2.91																				
25B	Helicopter Assault		AH-1	2.0		60%		100%							AH-1	T700-GE-401 (assume c	2	425.1	10.54	5.55	0.56	0.40	4.20	8.96	4.72	0.48	0.34	3.57																				
			CH-46	2.0		60%		100%							CH-46	T58-GE-16	2	560	19.74	3.94	3.43	0.40	1.78	22.11	4.41	3.84	0.45	1.99																				
			CH-53	2.0		60%		100%							CH-53	T64-GE-415 (assume cr	3	1488	2.13	8.08	0.15	0.40	2.21	9.51	36.07	0.67	1.79	9.87																				
			AV-8B	2.0		60%		100%							AV-8B	F402-RR-406A (assume	1	6381	7.70	8.60	0.54	0.40	3.80	49.13	54.88	3.45	2.55	24.25																				
			UH-1	2.0		60%		100%							UH-1	T400-CP-400	2	346.2	1.01	5.79	0.13	0.40	4.20	0.70	4.01	0.09	0.28	2.91																				
25C	Armored Ops		AH-1	8.0		50%		100%							AH-1	T700-GE-401 (assume c	2	425.1	10.54	5.55	0.56	0.40	4.20	8.96	4.72	0.48	0.34	3.57																				
			AV-8B	8.0		50%		100%							AV-8B	F402-RR-406A (assume	1	6381	7.70	8.60	0.54	0.40	3.80	49.13	54.88	3.45	2.55	24.25																				
25D	Artillery Ops		AH-1	3.0		100%		100%							AH-1	T700-GE-401 (assume c	2	425.1	10.54	5.55	0.56	0.40	4.20	8.96	4.72	0.48	0.34	3.57																				
			CH-46	3.0		100%		100%							CH-46	T58-GE-16	2	560	19.74	3.94	3.43	0.40	1.78	22.11	4.41	3.84	0.45	1.99																				
			CH-53	3.0		100%		100%							CH-53	T64-GE-415 (assume cr	3	1488	2.13	8.08	0.15	0.40	2.21	9.51	36.07	0.67	1.79	9.87																				
25E	Amphibious Assault		AH-1	3.0		100%		100%							AH-1	T700-GE-401 (assume c	2	425.1	10.54	5.55	0.56	0.40	4.20	8.96	4.72	0.48	0.34	3.57																				
			CH-46	3.0		100%		100%							CH-46	T58-GE-16	2	560	19.74	3.94	3.43	0.40	1.78	22.11	4.41	3.84	0.45	1.99																				
			CH-53	3.0		100%		100%							CH-53	T64-GE-415 (assume cr	3	1488	2.13	8.08	0.15	0.40	2.21	9.51	36.07	0.67	1.79	9.87																				
			UH-1	3.0		100%		100%							UH-1	T400-CP-400	2	346.2	1.01	5.79	0.13	0.40	4.20	0.70	4.01	0.09	0.28	2.91																				
25F	Combat Engineer		None																																													
25G	AAV Ops		AH-1	4.0		100%		100%							AH-1	T700-GE-401 (assume c	2	425.1	10.54	5.55	0.56	0.40	4.20	8.96	4.72	0.48	0.34	3.57																				
25H	EFV Ops		AH-1	4.0		100%		100%							AH-1	T700-GE-401 (assume c	2	425.1	10.54	5.55	0.56	0.40	4.20	8.96	4.72	0.48	0.34	3.57																				
25I	Assault Amphibian School		None																																													
26	Amphibious Operations - CPAAA																																															
26A	Amphibious Operations		None																																													
26B	Amphibious Operations	24	CH-46	4.2	101.0	100%	101.0	79%	21%		79.42	21.52			CH-46	T58-GE-16	2	560	19.74	3.94	3.43	0.40	1.78	22.11	4.41	3.84	0.45	1.99	1755.82	350.45	305.09	35.58	158.33	475.81	94.97	82.68	9.64	42.91										
		24	CH-53	4.2	101.0	100%	101.0	79%	21%		79.42	21.52			CH-53	T64-GE-415 (assume cr	3	1488	2.13	8.08	0.15	0.40	2.21	9.51	36.07	0.67	1.79	9.87	755.13	2864.52	53.18	141.81	783.49	204.63	776.26	14.41	38.43	212.32										
26C	Amphibious Operations		None																																													
26D	Amphibious Operations		None																																													
26E	Amphibious Operations	68	AV-8B	0.5	34.0	97%	33.0	50%	30%	20%	16.49	9.89	6.60		AV-8B	F402-RR-406A (assume	1	6381	7.70	8.60	0.54	0.40	3.80	49.13	54.88	3.45	2.55	24.25	810.21	904.92	56.82	42.09	399.85	486.13	542.95	34.09	25.25	239.91	324.09	361.97	22.73	16.84	159.94					
		80	AH-1	0.5	40.0	97%	38.8	50%	30%	20%	19.40	11.64	7.76		AH-1	T700-GE-401 (assume c	2	425.1	10.54	5.55	0.56	0.40	4.20	8.96	4.72	0.48	0.34	3.57	173.85	91.54	9.24	6.60	69.27	104.31	54.92	5.54	3.96	41.56	69.54	36.62	3.69	2.64	27.71					
		59	UH-1	0.5	29.5	97%	28.6	50%	30%	20%	14.31	8.58	5.72		UH-1	T400-CP-400	2	346.2	1.01	5.79	0.13	0.40	4.20	0.70	4.01	0.09	0.28	2.91	10.01	57.36	1.29	3.96	41.61	6.00	34.42	0.77	2.38	24.96	4.00	22.94	0.52	1.59	16.64					

Scenario No.	Type Training	A/C Sorties No.	Nomenclature	Ave. A/C Time on Range (hrs) Hours	Total Time on Range (hrs) Hours	% Below 3,000 ft %	Time Below 3,000 ft Hours	Percentage 0-3 nm from shore (Percent)	Percentage 3-12 nm from Shore (Percent)	Percentage >12 nm from Shore (Percent)	Total Time 0-3 nm from shore (Hours)	Total Time 3-12 nm from shore (Hours)	Total Time >12 nm from shore (Hours)	Scenario No.	Aircraft Type	Engines Engine Model	No.	Fuel Flow lbs/hr
		62	CH-46	0.5	31.0	97%	30.1	50%	30%	20%	15.04	9.02	6.01		CH-46	T58-GE-16	2	560
		228	CH-53	0.5	114.0	97%	110.6	50%	30%	20%	55.29	33.17	22.12		CH-53	T64-GE-415 (assume cr	3	1488
26F	Amphibious Operations		None															
26G	Amphibious Operations		None															
27	Electronic Combat Exercise	60	SH-60B	2.1	126.0	100%	126.0		3%	97%		3.78	122.22		SH-60B	T700-GE-401C	2	600
		37	SH-60F	2.1	77.7	100%	77.7		3%	97%		2.33	75.37		SH-60F	T700-GE-401C	2	600
		3	HH-60	2.1	6.3	100%	6.3		3%	97%		0.19	6.11		HH-60	T700-GE-401C	2	600
		31	P-3	2.0	62.0				3%	97%					P-3	T56-A-14 (assume ASU\	4	1200
		202	FA-18A/C	2.0	404.0				3%	97%					FA-18A/C	F404-GE-400 (assume a	2	3318
		203	FA-18E/F	2.0	406.0				3%	97%					FA-18E/F	F414-GE-400 (assume a	2	4049
		15	E-2C	2.0	30.0				3%	97%					E-2C	T56-A-425 (assume 40%	2	1100
		17	EA-6B	2.0	34.0				3%	97%					EA-6B	J52-P-408A (assume ap	2	4227
		144	Learjet	2.0	288.0				3%	97%					Learjet	TFE 731-2-2B	2	531.76
		8	Unknown	2.0	16.0				3%	97%					Unknown	TFE 731-2-2B	2	531.76
28A	Small Object Avoidance	15	MH-60R	1.8	26.3	100%	26.3	100%			26.25				MH-60R	T700-GE-401C	2	600
29	Mine Neutralization																	
30	Mine Laying	5	P-3	0.9	4.5	67%	3.0	50%	40%	10%	1.50	1.20	0.30		P-3	T56-A-14 (assume ASU\	4	1200
		11	FA-18A/C	0.5	5.5	7%	0.4	50%	40%	10%	0.18	0.15	0.04		FA-18A/C	F404-GE-400 (assume a	2	3318
		10	FA-18E/F	0.5	5.0	7%	0.3	50%	40%	10%	0.17	0.13	0.03		FA-18E/F	F414-GE-400 (assume a	2	4049
31	NSW Center Land Demolitions																	
32	NSWC Underwater Demolitions		NONE															
33	NSWC Underwater Mat Weave		NONE															
34	NSWC BUD/S Small Arms Training	10	SH-60F	6.0	60.0	100%	60.0	100%			60.00				SH-60F	T700-GE-401C	2	600
35	NSWC BUD/S Land Navigation		NONE															
36	NSW UAV Operations	16	Neptune/Scan	1.0	16.0	100%	16.0	100%			16.00							
37	Insertion/Extraction	5	C-130	2.0	10.0	50%	5.0		5%	95%		0.25	4.75		C-130	T56-A-425 (assume appı	4	850
38	NSW Boat Operations																	
39	NSW GRU ONE SEAL Platoon Ops	3	SH-60B	8.0	24.0	100%	24.0	20%	30%	50%	4.80	7.20	12.00		SH-60B	T700-GE-401C	2	600
		1	SH-60F	8.0	8.0	100%	8.0	20%	30%	50%	1.60	2.40	4.00		SH-60F	T700-GE-401C	2	600
		6	CH-46	8.0	48.0	100%	48.0	20%	30%	50%	9.60	14.40	24.00		CH-46	T58-GE-16	2	560
40	Direct Action																	
41	Bombing Exercise - Land	2	SH-60F	2.5	5.0	100%	5.0	40%	40%	20%	2.00	2.00	1.00		SH-60F	T700-GE-401C	2	600
		389	FA-18A/C	1.0	389.0	10%	38.9	10%	30%	60%	3.89	11.67	23.34		FA-18A/C	F404-GE-400 (assume a	2	3318
		388	FA-19E/F	1.0	388.0	10%	38.8	10%	30%	60%	3.88	11.64	23.28		FA-19E/F	F414-GE-400 (assume a	2	4049
		12	E-2	2.5	30.0					100%					E-2	T56-A-425 (assume 40%	2	1100
		7	EA-6B	2.5	17.5					100%					EA-6B	J52-P-408A (assume ap	2	4227
		6	AH-1	2.5	15.0	100%	15.0	40%	40%	20%	6.00	6.00	3.00		AH-1	T700-GE-401 (assume c	2	425.1
		1	AV-8B	1.0	1.0	20%	0.2	30%	50%	20%	0.06	0.10	0.04		AV-8B	F402-RR-406A (assume	1	6381
		3	KC-130	1.0	3.0			10%	30%	60%					KC-130	T56-A-425 (assume app	4	850
			H-53	2.5		100%		40%	40%	20%					H-53	T64-GE-415 (assume cr	3	1488
			H-46	2.5		100%		40%	40%	20%					H-46	T58-GE-16	2	560
42	Combat Search and Rescue	49	MH-60S	3.0	147.0	100%	147.0	40%	40%	20%	58.80	58.80	29.40		MH-60S	T700-GE-401C	2	600
		133	FA-18A/C	1.5	199.5	10%	20.0	10%	30%	60%	2.00	5.99	11.97		FA-18A/C	F404-GE-400 (assume a	2	3318
		133	FA-18E/F	1.5	199.5	10%	20.0	10%	30%	60%	2.00	5.99	11.97		FA-18E/F	F414-GE-400 (assume a	2	4049
		14	E-2	3.0	42.0					100%					E-2	T56-A-425 (assume 40%	2	1100
43	EOD Outside SHOBA																	
44	USCG Ops	70	HH-60	3.2	224.0	100%	224.0	50%	30%	20%	112.00	67.20	44.80		HH-60	T700-GE-401C	2	600
45	NALF Airfield		See NALF Ops															
46	Ship Torpedo Tests	3	SH-60B	3.0	9.0	100%	9.0		23%	77%		2.09	6.91		SH-60B	T700-GE-401C	2	600
		15	MH-60R	3.0	45.0	100%	45.0		23%	77%		10.44	34.56		MH-60R	T700-GE-401C	2	600
		2	SH-3	3.0	6.0	100%	6.0		23%	77%		1.39	4.61		SH-3	T58-GE-402 (assume 49	2	529
47	Unmanned Underwater Vehicle Test		NONE															
48	Sonobuoy QA/QC Test	2	P-3	5.0	10.0	100%	10.0	50%	30%	20%	5.00	3.00	2.00		P-3	T56-A-14 (assume ASU\	4	1200
		115	NC-12B Kingair	3.0	345.0	100%	345.0	50%	30%	20%	172.50	103.50	69.00		NC-12B Kinga	PT6A-42 (assume appro	2	249
49	Ocean Engineering		NONE	NONE														
50	Marine Mammal Mine Shape Location		NONE	NONE														
51	Missile Flight Test	1	SH-60B	4.0	4.0	100%	4.0	5%	10%	85%	0.20	0.40	3.40		SH-60B	T700-GE-401C	2	600
		4	P-3	4.0	16.0	50%	8.0	5%	10%	85%	0.40	0.80	6.80		P-3	T56-A-14 (assume ASU\	4	1200
		6	FA-18A/C	4.0	24.0				5%	95%					FA-18A/C	F404-GE-400 (assume a	2	3318
		3	FA-18E/F	4.0	12.0				5%	95%					FA-18E/F	F414-GE-400 (assume a	2	4049
		2	Learjet	4.0	8.0				5%	95%					Learjet	TFE 731-2-2B	2	531.76
		1	Gulfstream	4.0	4.0				5%	95%					Gulfstream	BR700-710A1-10	2	1698
		1	Other Helo	4.0	4.0	100%	4.0	5%	10%	85%	0.20	0.40	3.40		Other Helo (S-	T58-GE-402 (assume 49	2	529
52	NUWC Underwater Acoustics Testing		NONE															
53	Other Tests	4	SH-60F	4.0	16.0	100%	16.0	5%	8%	77%	0.80	1.28	12.32		SH-60F	T700-GE-401C	2	600
		2	P-3	4.0	8.0	50%	4.0	5%	8%	77%	0.20	0.32	3.08		P-3	T56-A-14 (assume ASU\	4	1200
		2	Learjet	4.0	8.0			1%	2%	97%					Learjet	TFE 731-2-2B	2	531.76
		1	Other Helo	4.0	4.0	100%	4.0	5%	8%	77%	0.20	0.32	3.08		Other Helo (S-	T58-GE-402 (assume 49	2	529
	Totals	16354																

Scenario No.	Aircraft Type	Emission Indices, lbs/1,000 lbs fuel CO	NOx	HC	SOx	PM10	Emissions Factors (lb/hr) CO	NOx	HC	SOx	PM10	Emissions 0-3 nm Offshore (lbs) CO	NOx	HC	SOx	PM	Emissions 3-12 nm Offshore—US Territory (lbs) CO	NOx	HC	SOx	PM	Emissions >12 nm Offshore—Outside US Territory CO	NOx	HC	SOx	PM				SOx	PM
	CH-46	19.74	3.94	3.43	0.40	1.78	22.11	4.41	3.84	0.45	1.99	332.41	66.35	57.76	6.74	29.97	199.44	39.81	34.66	4.04	17.98	132.96	26.54	23.10	2.69	11.99					
	CH-53	2.13	8.08	0.15	0.40	2.21	9.51	36.07	0.67	1.79	9.87	525.72	1994.26	37.02	98.73	545.46	315.43	1196.56	22.21	59.24	327.28	210.29	797.70	14.81	39.49	218.18					
27	SH-60B	6.25	6.40	0.55	0.40	4.20	7.50	7.68	0.66	0.48	5.04						28.35	29.03	2.49	1.81	19.05	916.65	938.65	80.67	58.67	615.99					
	SH-60F	6.25	6.40	0.55	0.40	4.20	7.50	7.68	0.66	0.48	5.04						17.48	17.90	1.54	1.12	11.75	565.27	578.83	49.74	36.18	379.86					
	HH-60	6.25	6.40	0.55	0.40	4.20	7.50	7.68	0.66	0.48	5.04						1.42	1.45	0.12	0.09	0.95	45.83	46.93	4.03	2.93	30.80					
	P-3	1.82	8.43	0.41	0.40	3.97	8.74	40.46	1.97	1.92	19.06																				
	FA-18A/C	2.44	6.74	0.44	0.40	6.36	16.19	44.73	2.92	2.65	42.20																				
	FA-18E/F	0.89	11.58	0.12	0.40	6.31	7.21	93.77	0.97	3.24	51.10																				
	E-2C	2.16	8.06	0.49	0.40	3.97	4.75	17.73	1.08	0.88	8.73																				
	EA-6B	5.19	6.77	0.84	0.40	10.48	43.88	57.23	7.10	3.38	88.60																				
	Learjet	22.38	5.90	4.28	0.54	4.20	23.80	6.27	4.55	0.57	4.47																				
	Unknown	22.38	5.90	4.28	0.54	4.20	23.80	6.27	4.55	0.57	4.47																				
28A	MH-60R	6.25	6.40	0.55	0.40	4.20	7.50	7.68	0.66	0.48	5.04	196.88	201.60	17.33	12.60	132.30															
30	P-3	1.82	8.43	0.41	0.40	3.97	8.74	40.46	1.97	1.92	19.06	13.10	60.70	2.95	2.88	28.59	10.48	48.56	2.36	2.30	22.87	2.62	12.14	0.59	0.58	5.72					
	FA-18A/C	2.44	6.74	0.44	0.40	6.36	16.19	44.73	2.92	2.65	42.20	2.97	8.20	0.54	0.49	7.74	2.38	6.56	0.43	0.39	6.19	0.59	1.64	0.11	0.10	1.55					
	FA-18E/F	0.89	11.58	0.12	0.40	6.31	7.21	93.77	0.97	3.24	51.10	1.20	15.64	0.16	0.54	8.52	0.96	12.51	0.13	0.43	6.82	0.24	3.13	0.03	0.11	1.70					
34	SH-60F	6.25	6.40	0.55	0.40	4.20	7.50	7.68	0.66	0.48	5.04	450.00	460.80	39.60	28.80	302.40															
37	C-130	4.03	6.71	0.97	0.40	3.97	13.70	22.81	3.30	1.36	13.50						3.43	5.70	0.82	0.34	3.37	65.08	108.37	15.67	6.46	64.12					
39	SH-60B	6.25	6.40	0.55	0.40	4.20	7.50	7.68	0.66	0.48	5.04	36.00	36.86	3.17	2.30	24.19	54.00	55.30	4.75	3.46	36.29	90.00	92.16	7.92	5.76	60.48					
	SH-60F	6.25	6.40	0.55	0.40	4.20	7.50	7.68	0.66	0.48	5.04	12.00	12.29	1.06	0.77	8.06	18.00	18.43	1.58	1.15	12.10	30.00	30.72	2.64	1.92	20.16					
	CH-46	19.74	3.94	3.43	0.40	1.78	22.11	4.41	3.84	0.45	1.99	212.24	42.36	36.88	4.30	19.14	318.37	63.54	55.32	6.45	28.71	530.61	105.91	92.20	10.75	47.85					
41	SH-60F	6.25	6.40	0.55	0.40	4.20	7.50	7.68	0.66	0.48	5.04	15.00	15.36	1.32	0.96	10.08	15.00	15.36	1.32	0.96	10.08	7.50	7.68	0.66	0.48	5.04					
	FA-18A/C	2.44	6.74	0.44	0.40	6.36	16.19	44.73	2.92	2.65	42.20	62.99	173.99	11.36	10.33	164.18	188.96	521.96	34.07	30.98	492.53	377.92	1043.92	68.15	61.95	985.06					
	FA-19E/F	0.89	11.58	0.12	0.40	6.31	7.21	93.77	0.97	3.24	51.10	27.96	363.85	3.77	12.57	198.26	83.89	1091.54	11.31	37.70	594.79	167.78	2183.08	22.62	75.41	1189.57					
	E-2	2.16	8.06	0.49	0.40	3.97	4.75	17.73	1.08	0.88	8.73																				
	EA-6B	5.19	6.77	0.84	0.40	10.48	43.88	57.23	7.10	3.38	88.60																				
	AH-1	10.54	5.55	0.56	0.40	4.20	8.96	4.72	0.48	0.34	3.57	53.77	28.31	2.86	2.04	21.43	53.77	28.31	2.86	2.04	21.43	26.88	14.16	1.43	1.02	10.71					
	AV-8B	7.70	8.60	0.54	0.40	3.80	49.13	54.88	3.45	2.55	24.25	2.95	3.29	0.21	0.15	1.45	4.91	5.49	0.34	0.26	2.42	1.97	2.20	0.14	0.10	0.97					
	KC-130	4.03	6.71	0.97	0.40	3.97	13.70	22.81	3.30	1.36	13.50																				
	H-53	2.13	8.08	0.15	0.40	2.21	9.51	36.07	0.67	1.79	9.87																				
	H-46	19.74	3.94	3.43	0.40	1.78	22.11	4.41	3.84	0.45	1.99																				
42	MH-60S	6.25	6.40	0.55	0.40	4.20	7.50	7.68	0.66	0.48	5.04	441.00	451.58	38.81	28.22	296.35	441.00	451.58	38.81	28.22	296.35	220.50	225.79	19.40	14.11	148.18					
	FA-18A/C	2.44	6.74	0.44	0.40	6.36	16.19	44.73	2.92	2.65	42.20	32.30	89.23	5.83	5.30	84.20	96.91	267.69	17.48	15.89	252.60	193.82	535.38	34.95	31.77	505.19					
	FA-18E/F	0.89	11.58	0.12	0.40	6.31	7.21	93.77	0.97	3.24	51.10	14.38	187.08	1.94	6.46	101.94	43.14	561.24	5.82	19.39	305.82	86.27	1122.48	11.63	38.77	611.65					
	E-2	2.16	8.06	0.49	0.40	3.97	4.75	17.73	1.08	0.88	8.73																				
44	HH-60	6.25	6.40	0.55	0.40	4.20	7.50	7.68	0.66	0.48	5.04	840.00	860.16	73.92	53.76	564.48	504.00	516.10	44.35	32.26	338.69	336.00	344.06	29.57	21.50	225.79					
46	SH-60B	6.25	6.40	0.55	0.40	4.20	7.50	7.68	0.66	0.48	5.04						15.66	16.04	1.38	1.00	10.52	51.84	53.08	4.56	3.32	34.84					
	MH-60R	6.25	6.40	0.55	0.40	4.20	7.50	7.68	0.66	0.48	5.04						78.30	80.18	6.89	5.01	52.62	259.20	265.42	22.81	16.59	174.18					
	SH-3	21.28	3.88	2.20	0.40	4.00	22.51	4.11	2.33	0.42	4.23						31.34	5.71	3.24	0.59	5.89	103.75	18.92	10.73	1.95	19.50					
48	P-3	1.82	8.43	0.41	0.40	3.97	8.74	40.46	1.97	1.92	19.06	43.68	202.32	9.84	9.60	95.28	26.21	121.39	5.90	5.76	57.17	17.47	80.93	3.94	3.84	38.11					
	NC-12B Kinga	4.93	4.42	0.23	0.40	4.20	2.46	2.20	0.11	0.20	2.09	423.51	379.70	19.76	34.36	360.80	254.11	227.82	11.85	20.62	216.48	169.40	151.88	7.90	13.74	144.32					
51	SH-60B	6.25	6.40	0.55	0.40	4.20	7.50	7.68	0.66	0.48	5.04	1.50	1.54	0.13	0.10	1.01	3.00	3.07	0.26	0.19	2.02	25.50	26.11	2.24	1.63	17.14					
	P-3	1.82	8.43	0.41	0.40	3.97	8.74	40.46	1.97	1.92	19.06	3.49	16.19	0.79	0.77	7.62	6.99	32.37	1.57	1.54	15.24	59.40	275.16	13.38	13.06	129.58					
	FA-18A/C	2.44	6.74	0.44	0.40	6.36	16.19	44.73	2.92	2.65	42.20																				
	FA-18E/F	0.89	11.58	0.12	0.40	6.31	7.21	93.77	0.97	3.24	51.10																				
	Learjet	22.38	5.90	4.28	0.54	4.20	23.80	6.27	4.55	0.57	4.47																				
	Gulfstream	4.78	7.68	0.05	1.00	0.00	16.23	26.08	0.17	3.40	0.00																				
	Other Helo (S-	21.28	3.88	2.20	0.40	4.00	22.51	4.11	2.33	0.42	4.23	4.50	0.82	0.47	0.08	0.85	9.01	1.64	0.93	0.17	1.69	76.55	13.96	7.91	1.44	14.39					
53	SH-60F	6.25	6.40	0.55	0.40	4.20	7.50	7.68	0.66	0.48	5.04	6.00	6.14	0.53	0.38	4.03	9.60	9.83	0.84	0.61	6.45	92.40	94.62	8.13	5.91	62.09					
	P-3	1.82	8.43	0.41	0.40	3.97	8.74	40.46	1.97	1.92	19.06	1.75	8.09	0.39	0.38	3.81	2.80	12.95	0.63	0.61	6.10	26.91	124.63	6.06	5.91	58.69					
	Learjet	22.38	5.90	4.28	0.54	4.20	23.80	6.27	4.55	0.57	4.47																				
	Other Helo (S-	21.28	3.88	2.20	0.40	4.00	22.51	4.11	2.33	0.42	4.23	4.50	0.82	0.47	0.08	0.85	7.20	1.31	0.74	0.14	1.35	69.34	12.64	7.17	1.30	13.03					
							Total Emissions (SCI) tons					**1.13**	**1.76**	**0.12**	**0.10**	**1.14**	**3.91**	**5.52**	**0.39**	**0.30**	**3.54**	**16.45**	**40.16**	**1.85**	**1.81**	**23.16**	**2.41**	**1.94**	**0.45**	**0.10**	**1.15**
							Total Emissions (SD) tons					**2.60**	**3.59**	**0.30**	**0.19**	**1.30**	**1.15**	**1.63**	**0.12**	**0.09**	**0.62**										

Source: SCORE FY2004 Participants Conversion.xls

Table C-5. Aircraft Air Emissions—Alternative 1

Training Operations (activity data)

Scenario	Type Training	A/C Sorties (No.)	Nomenclature	Ave. A/C Time on Range (hrs) (Hours)	Total Time on Range (hrs) (Hours)	% Below 3,000 ft (%)	Time Below 3,000 ft (Hours)	Percentage 0-3 nm from shore	Percentage 3-12 nm from Shore	Percentage >12 nm from Shore	Total Time 0-3 nm from shore	Total Time 3-12 nm from shore	Total Time >12 nm from shore
1	Air Combat Maneuvers	11223	FA-18E/F	1.1	1123.1			1%	2%	97%			
		687	AV-8B	1.2	824.4			1%	2%	97%			
2	Air Defense Exercise	111	E-2	1.0	111.0	50%	55.5	1%	2%	97%	0.56	1.11	53.84
		665	FA-18E/F	1.0	665.0	50%	332.5	1%	2%	97%	3.33	6.65	322.53
			S-3B	1.0		50%		1%	2%	97%			
		333	FA-18E/F	1.0	333.0	50%	166.5	1%	2%	97%	1.67	3.33	161.51
		111	Learjet	1.0	111.0	50%	55.5	1%	2%	97%	0.56	1.11	53.84
3	S-A MISSILEX	4	SH-60B	1.0	4.0	100%	4.0	1%	2%	97%	0.04	0.08	3.88
		4	P-3	3.0	12.0	67%	8.0	1%	2%	97%	0.08	0.16	7.76
		4	Learjet	1.5	6.0	67%	4.0	1%	2%	97%	0.04	0.08	3.88
		4	C-130	1.5	6.0	67%	4.0	1%	2%	97%	0.04	0.08	3.88
4	S-A GUNEX	350	Learjet	1.5	525.0	50%	262.5	1%	2%	97%	2.63	5.25	254.63
5	A-A MISSILEX	52	FA-18A/C	2.0	104.0					100%			
		78	FA-18E/F	2.0	156.0					100%			
		13	E-2C	4.0	52.0					100%			
		13	DC-130	4.0	52.0			1%	2%	97%			
6	Helicopter ASW TRACKEX	1690	MH-60R	3.6	6084.0	100%	6084.0		24%	76%		#####	#####
7	Helicopter ASW TORPEX	245	MH-60R	3.6	882.0	100%	882.0		24%	76%		208.15	673.85
		21	Other Helo (SH-3)	3.6	75.6	100%	75.6		24%	76%		17.84	57.76
8	MPA ASW TRACKEX	28	P-3	6.0	168.0	75%	126.0	5%	10%	85%	6.30	12.60	107.10
9	MPA ASW TORPEX	37	P-3	2.0	74.0	100%	74.0	1%	2%	97%	0.74	1.48	71.78
		10	SH-60B	2.0	20.0	100%	20.0	1%	2%	97%	0.20	0.40	19.40
10	EER/IEER ASW	3	P-3	6.0	18.0	75%	13.5			100%			13.50
11	Surface Ship ASW TRACKEX												
12	Surface Ship ASW TORPEX	8	Other Helo (SH-3)	3.7	29.6	100%	29.6	1%	2%	97%	0.30	0.59	28.71
13	Submarine ASW TORPEX												
14	Submarine ASW TORPEX												
15	VBSS	18	MH-60R	4.0	72.0	100%	72.0			100%			72.00
16	A-S MISSILEX	41	MH-60R	3.0	123.0	100%	123.0	1%	2%	97%	1.23	2.46	119.31
		15	FA-18A/C	2.0	30.0			1%	2%	97%			
		15	FA-18E/F	2.0	30.0			1%	2%	97%			
			S-3B	3.0		100%		1%	2%	97%			
17	A-S BOMBEX	19	FA-18A/C	1.0	19.0	10%	1.9		50%	50%		0.95	0.95
		19	FA-18E/F	1.0	19.0	10%	1.9		50%	50%		0.95	0.95
		10	P-3	1.0	10.0	10%	1.0		50%	50%		0.50	0.50
			S-3B	1.0		10%			50%	50%			
18	A-S GUNEX	110	MH-60R	1.0	110.0	100%	110.0		50%	50%		55.00	55.00
19	S-S GUNEX												
20	SINKEX	4	E-2	16.0	64.0	10%	6.4			100%			6.40
		16	FA-18E/F	16.0	256.0	10%	25.6			100%			25.60
		2	P-3	16.0	32.0	10%	3.2			100%			3.20
		4	SH-60B	16.0	64.0	10%	6.4			100%			6.40
21	Naval Surface Fire Support Exercise												
22	Expeditionary Fires Exercise	1	FA-18E/F	3.0	3.0	100%	3.0		100%			3.00	
		1	AH-1	3.0	3.0	100%	3.0		100%			3.00	
		1	AV-8B	3.0	3.0	100%	3.0		100%			3.00	
23	USMC Battalion Landing	16	FA-18A/C	0.5	8.0	15%	1.2	20%	50%	30%	0.24	0.60	0.36
			FA-18E/F	0.5		15%		20%	50%	30%			
		6	AV-8B	0.5	3.0	25%	0.8	90%	5%	5%	0.68	0.04	0.04
		4	AH-1	1.0	4.0	100%	4.0	90%	5%	5%	3.60	0.20	0.20
		2	C-130	1.4	2.8			20%	50%	30%			
		4	H-53	1.5	6.0	100%	6.0	90%	5%	5%	5.40	0.30	0.30
		12	H-46	1.5	18.0	100%	18.0	90%	5%	5%	16.20	0.90	0.90
		3	UH-1	1.0	3.0	100%	3.0	90%	5%	5%	2.70	0.15	0.15
24	USMC Stinger Firings												
25	Amphibious Landings and Raids												
25A	Amphibious Ops		AH-1	4.0		100%		100%					
			CH-46	4.0		100%		100%					
			CH-53	4.0		100%		100%					
		32	UH-1	4.0	128.0	100%	128.0	100%			128.00		
25B	Helicopter Assault	32	AH-1	2.0	64.0	60%	38.4	100%			38.40		
		48	CH-46	2.0	96.0	60%	57.6	100%			57.60		
		24	CH-53	2.0	48.0	60%	28.8	100%			28.80		
		32	AV-8B	2.0	64.0	60%	38.4	100%			38.40		
		8	UH-1	2.0	16.0	60%	9.6	100%			9.60		
25C	Armored Ops	6	AH-1	8.0	48.0	50%	24.0	100%			24.00		
		6	AV-8B	8.0	48.0	50%	24.0	100%			24.00		
25D	Artillery Ops	24	AH-1	3.0	72.0	100%	72.0	100%			72.00		
		9	CH-46	3.0	27.0	100%	27.0	100%			27.00		
		9	CH-53	3.0	27.0	100%	27.0	100%			27.00		
25E	Amphibious Assault	16	AH-1	3.0	48.0	100%	48.0	100%			48.00		
			CH-46	3.0		100%		100%					
			CH-53	3.0		100%		100%					
		8	UH-1	3.0	24.0	100%	24.0	100%			24.00		
25F	Combat Engineer		None										
25G	AAV Ops	12	AH-1	4.0	48.0	100%	48.0	100%			48.00		
25H	EFV Ops	2	AH-1	4.0	8.0	100%	8.0	100%			8.00		
25I	Assault Amphibian School		None										
26	Amphibious Operations - CPAAA												
26A	Amphibious Operations		None										
26B	Amphibious Operations	28	CH-46	4.2	117.9	100%	117.9	79%	21%		92.65	25.11	
		28	CH-53	4.2	117.9	100%	117.9	79%	21%		92.65	25.11	
26C	Amphibious Operations		None										
26D	Amphibious Operations		None										
26E	Amphibious Operations	75	AV-8B	0.5	37.5	97%	36.4	50%	30%	20%	18.19	10.91	7.28
		89	AH-1	0.5	44.5	97%	43.2	50%	30%	20%	21.58	12.95	8.63
		65	UH-1	0.5	32.5	97%	31.5	50%	30%	20%	15.76	9.46	6.31

Engine data (Emission Indices, lbs/1,000 lbs fuel; Emissions Factors (lb/hr))

Scenario (training)	Scenario No.	Aircraft Type	Engines Engine Model	No.	Fuel Flow lbs/hr	EI CO	EI NOx	EI HC	EI SOx	EI PM10	EF CO	EF NOx	EF HC	EF SOx	EF PM10
1		FA-18E/F	F414-GE-400 (assume a	2	4049	0.89	11.58	0.12	0.40	6.31	7.21	93.77	0.97	3.24	51.10
1		AV-8B	F402-RR-406A (assume	1	6381	7.70	8.60	0.54	0.40	3.80	49.13	54.88	3.45	2.55	24.25
2		E-2	T56-A-425 (assume 30%	2	1100	2.16	8.06	0.49	0.40	3.97	4.75	17.73	1.08	0.88	8.73
2		FA-18E/F	F414-GE-400 (assume a	2	4049	0.89	11.58	0.12	0.40	6.31	7.21	93.77	0.97	3.24	51.10
2		S-3B	TF34-GE-400 (assume t	2	1145	14.10	4.07	1.86	0.40	3.62	32.29	9.32	4.26	0.92	8.29
2		FA-18E/F	F414-GE-400 (assume a	2	4049	0.89	11.58	0.12	0.40	6.31	7.21	93.77	0.97	3.24	51.10
2		Learjet	TFE 731-2-2B	2	531.76	22.38	5.90	4.28	0.54	4.20	23.80	6.27	4.55	0.57	4.47
3		SH-60B	T700-GE-401C	2	600	6.25	6.40	0.55	0.40	4.20	7.50	7.68	0.66	0.48	5.04
3		P-3	T56-A-14 (assume ASUV	4	1200	1.82	8.43	0.41	0.40	3.97	8.74	40.46	1.97	1.92	19.06
3		Learjet	TFE 731-2B	2	531.76	22.38	5.90	4.28	0.54	4.20	23.80	6.27	4.55	0.57	4.47
3		C-130	T56-A-425 (assume app	4	850	4.03	6.71	0.97	0.40	3.97	13.70	22.81	3.30	1.36	13.50
4		Learjet	TFE 731-2-2B	2	531.76	22.38	5.90	4.28	0.54	4.20	23.80	6.27	4.55	0.57	4.47
5		FA-18A/C	F404-GE-400 (assume a	2	3318	2.44	6.74	0.44	0.40	6.36	16.19	44.73	2.92	2.65	42.20
5		FA-18E/F	F414-GE-400 (assume a	2	4049	0.89	11.58	0.12	0.40	6.31	7.21	93.77	0.97	3.24	51.10
5		E-2C	T56-A-425 (assume 40%	2	1100	2.16	8.06	0.49	0.40	3.97	4.75	17.73	1.08	0.88	8.73
5		DC-130	T56-A-425 (assume app	4	850	4.03	6.71	0.97	0.40	3.97	13.70	22.81	3.30	1.36	13.50
6		MH-60R	T700-GE-401C	2	600	6.25	6.40	0.55	0.40	4.20	7.50	7.68	0.66	0.48	5.04
7	7	MH-60R	T700-GE-401C	2	600	6.25	6.40	0.55	0.40	4.20	7.50	7.68	0.66	0.48	5.04
7		Other Helo (SH	T58-GE-402 (assume 4	2	529	21.28	3.88	2.20	0.40	4.00	22.51	4.11	2.33	0.42	4.23
8		P-3	T56-A-14 (assume ASUV	4	1200	1.82	8.43	0.41	0.40	3.97	8.74	40.46	1.97	1.92	19.06
9		P-3	T56-A-14 (assume ASUV	4	1200	1.82	8.43	0.41	0.40	3.97	8.74	40.46	1.97	1.92	19.06
9		SH-60B	T700-GE-401C	2	600	6.25	6.40	0.55	0.40	4.20	7.50	7.68	0.66	0.48	5.04
10		P-3	T56-A-14 (assume ASUV	4	1200	1.82	8.43	0.41	0.40	3.97	8.74	40.46	1.97	1.92	19.06
12		Other Helo (SH	T58-GE-402 (assume 4	2	529	21.28	3.88	2.20	0.40	4.00	22.51	4.11	2.33	0.42	4.23
15		MH-60R	T700-GE-401C	2	600	6.25	6.40	0.55	0.40	4.20	7.50	7.68	0.66	0.48	5.04
16		MH-60R	T700-GE-401C	2	600	6.25	6.40	0.55	0.40	4.20	7.50	7.68	0.66	0.48	5.04
16		FA-18A/C	F404-GE-400 (assume a	2	3318	2.44	6.74	0.44	0.40	6.36	16.19	44.73	2.92	2.65	42.20
16		FA-18E/F	F414-GE-400 (assume a	2	4049	0.89	11.58	0.12	0.40	6.31	7.21	93.77	0.97	3.24	51.10
16		S-3B	TF34-GE-400 (assume t	2	1145	14.10	4.07	1.86	0.40	3.62	32.29	9.32	4.26	0.92	8.29
17		FA-18A/C	F404-GE-400 (assume a	2	3318	2.44	6.74	0.44	0.40	6.36	16.19	44.73	2.92	2.65	42.20
17		FA-18E/F	F414-GE-400 (assume a	2	4049	0.89	11.58	0.12	0.40	6.31	7.21	93.77	0.97	3.24	51.10
17		P-3	T56-A-14 (assume ASUV	4	1200	1.82	8.43	0.41	0.40	3.97	8.74	40.46	1.97	1.92	19.06
17		S-3B	TF34-GE-400 (assume t	2	1145	14.10	4.07	1.86	0.40	3.62	32.29	9.32	4.26	0.92	8.29
18		MH-60R	T700-GE-401C	2	600	6.25	6.40	0.55	0.40	4.20	7.50	7.68	0.66	0.48	5.04
20		E-2	T56-A-425 (assume 30%	2	1100	2.16	8.06	0.49	0.40	3.97	4.75	17.73	1.08	0.88	8.73
20		FA-18E/F	F414-GE-400 (assume a	2	4049	0.89	11.58	0.12	0.40	6.31	7.21	93.77	0.97	3.24	51.10
20		P-3	T56-A-14 (assume ASUV	4	1200	1.82	8.43	0.41	0.40	3.97	8.74	40.46	1.97	1.92	19.06
20		SH-60B	T700-GE-401C	2	600	6.25	6.40	0.55	0.40	4.20	7.50	7.68	0.66	0.48	5.04
22		FA-18E/F	F414-GE-400 (assume a	2	4049	0.89	11.58	0.12	0.40	6.31	7.21	93.77	0.97	3.24	51.10
22		AH-1	T700-GE-401 (assume c	2	425.1	10.54	5.55	0.56	0.40	4.20	8.96	4.72	0.48	0.34	3.57
22		AV-8B	F402-RR-406A (assume	1	6381	7.70	8.60	0.54	0.40	3.80	49.13	54.88	3.45	2.55	24.25
23		FA-18A/C	F404-GE-400 (assume a	2	3318	2.44	6.74	0.44	0.40	6.36	16.19	44.73	2.92	2.65	42.20
23		FA-18E/F	F414-GE-400 (assume a	2	4049	0.89	11.58	0.12	0.40	6.31	7.21	93.77	0.97	3.24	51.10
23		AV-8B	F402-RR-406A (assume	1	6381	7.70	8.60	0.54	0.40	3.80	49.13	54.88	3.45	2.55	24.25
23		AH-1	T700-GE-401 (assume c	2	425.1	10.54	5.55	0.56	0.40	4.20	8.96	4.72	0.48	0.34	3.57
23		C-130	T56-A-425 (assume app	4	850	4.03	6.71	0.97	0.40	3.97	13.70	22.81	3.30	1.36	13.50
23		H-53	T64-GE-415 (assume cn	3	1488	2.13	8.08	0.15	0.40	2.21	9.51	36.07	0.67	1.79	9.87
23		H-46	T58-GE-16	2	560	19.74	3.94	3.43	0.40	1.78	22.11	4.41	3.84	0.45	1.99
23		UH-1	T400-CP-400	2	346.2	1.01	5.79	0.13	0.40	4.20	0.70	4.01	0.09	0.28	2.91
25A		AH-1	T700-GE-401 (assume c	2	425.1	10.54	5.55	0.56	0.40	4.20	8.96	4.72	0.48	0.34	3.57
25A		CH-46	T58-GE-16	2	560	19.74	3.94	3.43	0.40	1.78	22.11	4.41	3.84	0.45	1.99
25A		CH-53	T64-GE-415 (assume cn	3	1488	2.13	8.08	0.15	0.40	2.21	9.51	36.07	0.67	1.79	9.87
25A		UH-1	T400-CP-400	2	346.2	1.01	5.79	0.13	0.40	4.20	0.70	4.01	0.09	0.28	2.91
25B		AH-1	T700-GE-401 (assume c	2	425.1	10.54	5.55	0.56	0.40	4.20	8.96	4.72	0.48	0.34	3.57
25B		CH-46	T58-GE-16	2	560	19.74	3.94	3.43	0.40	1.78	22.11	4.41	3.84	0.45	1.99
25B		CH-53	T64-GE-415 (assume cn	3	1488	2.13	8.08	0.15	0.40	2.21	9.51	36.07	0.67	1.79	9.87
25B		AV-8B	F402-RR-406A (assume	1	6381	7.70	8.60	0.54	0.40	3.80	49.13	54.88	3.45	2.55	24.25
25B		UH-1	T400-CP-400	2	346.2	1.01	5.79	0.13	0.40	4.20	0.70	4.01	0.09	0.28	2.91
25C		AH-1	T700-GE-401 (assume c	2	425.1	10.54	5.55	0.56	0.40	4.20	8.96	4.72	0.48	0.34	3.57
25C		AV-8B	F402-RR-406A (assume	1	6381	7.70	8.60	0.54	0.40	3.80	49.13	54.88	3.45	2.55	24.25
25D		AH-1	T700-GE-401 (assume c	2	425.1	10.54	5.55	0.56	0.40	4.20	8.96	4.72	0.48	0.34	3.57
25D		CH-46	T58-GE-16	2	560	19.74	3.94	3.43	0.40	1.78	22.11	4.41	3.84	0.45	1.99
25D		CH-53	T64-GE-415 (assume cn	3	1488	2.13	8.08	0.15	0.40	2.21	9.51	36.07	0.67	1.79	9.87
25E		AH-1	T700-GE-401 (assume c	2	425.1	10.54	5.55	0.56	0.40	4.20	8.96	4.72	0.48	0.34	3.57
25E		CH-46	T58-GE-16	2	560	19.74	3.94	3.43	0.40	1.78	22.11	4.41	3.84	0.45	1.99
25E		CH-53	T64-GE-415 (assume cn	3	1488	2.13	8.08	0.15	0.40	2.21	9.51	36.07	0.67	1.79	9.87
25E		UH-1	T400-CP-400	2	346.2	1.01	5.79	0.13	0.40	4.20	0.70	4.01	0.09	0.28	2.91
25G		AH-1	T700-GE-401 (assume c	2	425.1	10.54	5.55	0.56	0.40	4.20	8.96	4.72	0.48	0.34	3.57
25H		AH-1	T700-GE-401 (assume c	2	425.1	10.54	5.55	0.56	0.40	4.20	8.96	4.72	0.48	0.34	3.57
26B		CH-46	T58-GE-16	2	560	19.74	3.94	3.43	0.40	1.78	22.11	4.41	3.84	0.45	1.99
26B		CH-53	T64-GE-415 (assume cn	3	1488	2.13	8.08	0.15	0.40	2.21	9.51	36.07	0.67	1.79	9.87
26E		AV-8B	F402-RR-406A (assume	1	6381	7.70	8.60	0.54	0.40	3.80	49.13	54.88	3.45	2.55	24.25
26E		AH-1	T700-GE-401 (assume c	2	425.1	10.54	5.55	0.56	0.40	4.20	8.96	4.72	0.48	0.34	3.57
26E		UH-1	T400-CP-400	2	346.2	1.01	5.79	0.13	0.40	4.20	0.70	4.01	0.09	0.28	2.91

Emissions

Scenario	Aircraft	0-3 nm CO	0-3 nm NOx	0-3 nm HC	0-3 nm SOx	0-3 nm PM	3-12 nm CO	3-12 nm NOx	3-12 nm HC	3-12 nm SOx	3-12 nm PM	>12 nm Offshore San Diego CO	NOx	HC	SOx	PM	>12 nm Offshore Mexico CO	NOx	HC	SOx	PM
2	E-2	2.64	9.84	0.60	0.49	4.85	5.27	19.68	1.20	0.98	9.69	255.82	954.60	58.03	47.37	470.19					
2	FA-18E/F	23.96	311.80	3.23	10.77	169.90	47.93	623.60	6.46	21.54	339.80	2324.51	30244.73	313.42	1044.72	16480.51					
2	FA-18E/F	12.00	156.14	1.62	5.39	85.08	24.00	312.27	3.24	10.79	170.16	1164.00	15145.11	156.94	523.15	8252.64					
2	Learjet	13.21	3.48	2.53	0.32	2.48	26.42	6.96	5.05	0.64	4.96	1281.36	337.80	245.05	30.92	240.47					
3	SH-60B	0.30	0.31	0.03	0.02	0.20	0.60	0.61	0.05	0.04	0.40	29.10	29.80	2.56	1.86	19.56					
3	P-3	0.70	3.24	0.16	0.15	1.53	1.40	6.48	0.32	0.31	3.05	67.83	314.16	15.28	14.91	147.95					
3	Learjet	0.95	0.25	0.18	0.02	0.18	1.91	0.50	0.36	0.05	0.36	92.40	24.36	17.67	2.23	17.34					
3	C-130	0.55	0.91	0.13	0.05	0.54	1.10	1.83	0.26	0.11	1.08	53.19	88.56	12.80	5.28	52.40					
4	Learjet	62.48	16.47	11.95	1.51	11.73	124.96	32.94	23.90	3.02	23.45						6060.48	1597.71	1159.02	146.23	1137.35
6	MH-60R						10768.68	11027.13	947.64	689.20	7236.55	34861.32	35697.99	3067.80	2231.12	23426.81					
7	MH-60R						1561.14	1598.61	137.38	99.91	1049.09	5053.86	5175.15	444.74	323.45	3396.19					
7	Other Helo (SH-3)						401.69	73.24	41.53	7.55	75.51	1300.39	237.10	134.44	24.44	244.43					
8	P-3	55.04	254.92	12.40	12.10	120.05	110.07	509.85	24.80	24.19	240.11	935.63	4333.69	210.77	205.63	2040.90					
9	P-3	6.46	29.94	1.46	1.42	14.10	12.93	59.89	2.91	2.84	28.20	627.07	2904.51	141.26	137.82	1367.84					
9	SH-60B	1.50	1.54	0.13	0.10	1.01	3.00	3.07	0.26	0.19	2.02	145.50	148.99	12.80	9.31	97.78					
10	P-3											117.94	546.26	26.57	25.92	257.26					
12	Other Helo (SH-3)	6.66	1.22	0.69	0.13	1.25	13.33	2.43	1.38	0.25	2.51	646.43	117.86	66.83	12.15	121.51					
15	MH-60R											540.00	552.96	47.52	34.56	362.88					
16	MH-60R	9.23	9.45	0.81	0.59	6.20	18.45	18.89	1.62	1.18	12.40	894.83	916.30	78.74	57.27	601.32					
17	FA-18A/C						15.38	42.49	2.77	2.52	40.09	15.38	42.49	2.77	2.52	40.09					
17	FA-18E/F						6.85	89.09	0.92	3.08	48.54	6.85	89.09	0.92	3.08	48.54					
17	P-3						4.37	20.23	0.98	0.96	9.53	4.37	20.23	0.98	0.96	9.53					
18	MH-60R						412.50	422.40	36.30	26.40	277.20	412.50	422.40	36.30	26.40	277.20					
20	E-2																30.41	113.48	6.90	5.63	55.90
20	FA-18E/F																184.50	2400.64	24.88	82.92	1308.12
20	P-3																27.96	129.48	6.30	6.14	60.98
20	SH-60B																48.00	49.15	4.22	3.07	32.26
22	FA-18E/F						21.62	281.32	2.92	9.72	153.30										
22	AH-1						26.88	14.16	1.43	1.02	10.71										
22	AV-8B						147.40	164.63	10.34	7.66	72.74										
23	FA-18A/C	3.89	10.73	0.70	0.64	10.13	9.72	26.84	1.75	1.59	25.32	5.83	16.10	1.05	0.96	15.19					
23	AV-8B	33.17	37.04	2.33	1.72	16.37	1.84	2.06	0.13	0.10	0.91	1.84	2.06	0.13	0.10	0.91					
23	AH-1	32.26	16.99	1.71	1.22	12.86	1.79	0.94	0.10	0.07	0.71	1.79	0.94	0.10	0.07	0.71					
23	H-53	51.34	194.77	3.62	9.64	53.27	2.85	10.82	0.20	0.54	2.96	2.85	10.82	0.20	0.54	2.96					
23	H-46	358.16	71.49	62.23	7.26	32.30	19.90	3.97	3.46	0.40	1.79	19.90	3.97	3.46	0.40	1.79					
23	UH-1	1.89	10.82	0.24	0.75	7.85	0.10	0.60	0.01	0.04	0.44	0.10	0.60	0.01	0.04	0.44					
25A	UH-1	89.51	513.15	11.52	35.45	372.23															
25B	AH-1	344.11	181.19	18.28	13.06	137.12															
25B	CH-46	1273.47	254.18	221.28	25.80	114.83															
25B	CH-53	273.84	1038.79	19.28	51.43	284.12															
25B	AV-8B	1886.73	2107.26	132.32	98.01	931.12															
25B	UH-1	6.71	38.49	0.86	2.66	27.92															
25C	AH-1	215.07	113.25	11.43	8.16	85.70															
25C	AV-8B	1179.21	1317.04	82.70	61.26	581.95															
25D	AH-1	645.20	339.74	34.28	24.49	257.10															
25D	CH-46	596.94	119.15	103.72	12.10	53.83															
25D	CH-53	256.72	973.87	18.08	48.21	266.37															
25E	AH-1	430.13	226.49	22.85	16.32	171.40															
25E	UH-1	16.78	96.22	2.16	6.65	69.79															
25G	AH-1	430.13	226.49	22.85	16.32	171.40															
25H	AH-1	71.69	37.75	3.81	2.72	28.57															
26B	CH-46	2048.46	408.86	355.94	41.51	184.71	555.12	110.80	96.46	11.25	50.06										
26B	CH-53	880.98	3341.94	62.04	165.44	914.07	238.74	905.64	16.81	44.83	247.71										
26E	AV-8B	893.62	998.07	62.67	46.42	441.01	536.17	598.84	37.60	27.85	264.60	357.45	399.23	25.07	18.57	176.40					
26E	AH-1	193.40	101.84	10.28	7.34	77.07	116.04	61.10	6.17	4.40	46.24	77.36	40.74	4.11	2.94	30.83					
26E	UH-1	11.02	63.19	1.42	4.37	45.84	6.61	37.92	0.85	2.62	27.50	4.41	25.28	0.57	1.75	18.34					

Scenario	Type Training	A/C Sorties	Nomenclature	Ave. A/C Time on Range (hrs)	Total Time on Range (hrs)	% Below 3,000 ft	Time Below 3,000 ft	Percentage 0-3 nm from shore	Percentage 3-12 nm from Shore	Percentage >12 nm from Shore	Total Time 0-3 nm from shore	Total Time 3-12 nm from shore	Total Time >12 nm from shore	Scenario	Aircraft	Engines		Fuel Flow	Emission Indices, lbs/1,000 lbs fuel					Emissions Factors (lb/hr)					Emissions: Emissions 0-3 nm Offshore (lbs)					Emissions 3-12 nm Offshore—US Territory (lbs)					Emissions >12 nm Offshore—Outside US Territory									
		No.		Hours	Hours	%	Hours	Percent			Hours			No.	Type	Engine Model	No.	lbs/hr	CO	NOx	HC	SOx	PM10	CO	NOx	HC	SOx	PM10	CO	NOx	HC	SOx	PM	CO	NOx	HC	SOx	PM	CO	NOx	HC	SOx	PM	CO	NOx	HC	SOx	PM
		69	CH-46	0.5	34.5	97%	33.5	50%	30%	20%	16.73	10.04	6.69		CH-46	T58-GE-16	2	560	19.74	3.94	3.43	0.40	1.78	22.11	4.41	3.84	0.45	1.99	369.94	73.84	64.28	7.50	33.36	221.96	44.30	38.57	4.50	20.01	147.97	29.53	25.71	3.00	13.34					
		253	CH-53	0.5	126.5	97%	122.7	50%	30%	20%	61.35	36.81	24.54		CH-53	T64-GE-415 (assume cru	3	1488	2.13	8.08	0.15	0.40	2.21	9.51	36.07	0.67	1.79	9.87	583.36	2212.93	41.08	109.55	605.27	350.02	1327.76	24.65	65.73	363.16	233.34	885.17	16.43	43.82	242.11					
26F	Amphibious Operations		None																																													
26G	Amphibious Operations		None																																													
27	Electronic Combat Exercise	98	MH-60R	2.1	205.8	100%	205.8		3%	97%		6.17	199.63		MH-60R	T700-GE-401C	2	600	6.25	6.40	0.55	0.40	4.20	7.50	7.68	0.66	0.48	5.04						46.31	47.42	4.07	2.96	31.12	1497.20	1533.13	131.75	95.82	1006.12					
		3	HH-60	2.1	6.3	100%	6.3		3%	97%		0.19	6.11		HH-60	T700-GE-401C	2	600	6.25	6.40	0.55	0.40	4.20	7.50	7.68	0.66	0.48	5.04						1.42	1.45	0.12	0.09	0.95	45.83	46.93	4.03	2.93	30.80					
		31	P-3	2.0	62.0				3%	97%					P-3	T56-A-14 (assume ASU\	4	1200	1.82	8.43	0.41	0.40	3.97	8.74	40.46	1.97	1.92	19.06																				
		204	FA-18A/C	2.0	408.0				3%	97%					FA-18A/C	F404-GE-400 (assume a	2	3318	2.44	6.74	0.44	0.40	6.36	16.19	44.73	2.92	2.65	42.20																				
		205	FA-18E/F	2.0	410.0				3%	97%					FA-18E/F	F414-GE-400 (assume a	2	4049	0.89	11.58	0.12	0.40	6.31	7.21	93.77	0.97	3.24	51.10																				
		15	E-2C	2.0	30.0				3%	97%					E-2C	T56-A-425 (assume 40%	2	1100	2.16	8.06	0.49	0.40	3.97	4.75	17.73	1.08	0.88	8.73																				
		17	EA-6B	2.0	34.0				3%	97%					EA-6B	J52-P-408A (assume ap	2	4227	5.19	6.77	0.84	0.40	10.48	43.88	57.23	7.10	3.38	88.60																				
		145	Learjet	2.0	290.0				3%	97%					Learjet	TFE 731-2-2B	2	531.76	22.38	5.90	4.28	0.54	4.20	23.80	6.27	4.55	0.57	4.47																				
		8	Unknown	2.0	16.0				3%	97%					Unknown	TFE 731-2-2B	2	531.76	22.38	5.90	4.28	0.54	4.20	23.80	6.27	4.55	0.57	4.47																				
28A	Small Object Avoidance	16	MH-60R	1.8	28.0	100%	28.0	100%			28.00				MH-60R	T700-GE-401C	2	600	6.25	6.40	0.55	0.40	4.20	7.50	7.68	0.66	0.48	5.04	210.00	215.04	18.48	13.44	141.12															
29	Mine Neutralization	720	MH-60R	2.5	1800.0	100%	1800.0	55%	40%	5%	990.00	720.00	90.00		MH-60R	T700-GE-401C	2	600	6.25	6.40	0.55	0.40	4.20	7.50	7.68	0.66	0.48	5.04	7425.00	7603.20	653.40	475.20	4989.60	5400.00	5529.60	475.20	345.60	3628.80	675.00	691.20	59.40	43.20	453.60					
30	Mine Laying	5	P-3	0.9	4.5	67%	3.0	50%	40%	10%	1.50	1.20	0.30		P-3	T56-A-14 (assume ASU\	4	1200	1.82	8.43	0.41	0.40	3.97	8.74	40.46	1.97	1.92	19.06	13.10	60.70	2.95	2.88	28.59	10.48	48.56	2.36	2.30	22.87	2.62	12.14	0.59	0.58	5.72					
		11	FA-18A/C	0.5	5.5	7%	0.4	50%	40%	10%	0.18	0.15	0.04		FA-18A/C	F404-GE-400 (assume a	2	3318	2.44	6.74	0.44	0.40	6.36	16.19	44.73	2.92	2.65	42.20	2.97	8.20	0.54	0.49	7.74	2.38	6.56	0.43	0.39	6.19	0.59	1.64	0.11	0.10	1.55					
		10	FA-18E/F	0.5	5.0	7%	0.3	50%	40%	10%	0.17	0.13	0.03		FA-18E/F	F414-GE-400 (assume a	2	4049	0.89	11.58	0.12	0.40	6.31	7.21	93.77	0.97	3.24	51.10	1.20	15.64	0.16	0.54	8.52	0.96	12.51	0.13	0.43	6.82	0.24	3.13	0.03	0.11	1.70					
31	NSW Center Land Demolitions																																															
32	NSWC Underwater Demolitions		NONE																																													
33	NSWC Underwater Mat Weave		NONE																																													
34	NSWC BUD/S Small Arms Training	12	SH-60F	6.0	72.0	100%	72.0	100%			72.00				SH-60F	T700-GE-401C	2	600	6.25	6.40	0.55	0.40	4.20	7.50	7.68	0.66	0.48	5.04	540.00	552.96	47.52	34.56	362.88															
35	NSWC BUD/S Land Navigation		NONE																																													
36	NSW UAV Operations	3	Neptune/Scan	1.0	3.0	100%	3.0	100%			3.00																																					
37	Insertion/Extraction	10	C-130	2.0	20.0	50%	10.0		5%	95%		0.50	9.50		C-130	T56-A-425 (assume appi	4	850	4.03	6.71	0.97	0.40	3.97	13.70	22.81	3.30	1.36	13.50						6.85	11.41	1.65	0.68	6.75	130.17	216.73	31.33	12.92	128.23					
38	NSW Boat Operations																																															
39	NSW GRU ONE SEAL Platoon Ops	5	SH-60B	8.0	40.0	100%	40.0	20%	30%	50%	8.00	12.00	20.00		SH-60B	T700-GE-401C	2	600	6.25	6.40	0.55	0.40	4.20	7.50	7.68	0.66	0.48	5.04	60.00	61.44	5.28	3.84	40.32	90.00	92.16	7.92	5.76	60.48	150.00	153.60	13.20	9.60	100.80					
		2	SH-60F	8.0	16.0	100%	16.0	20%	30%	50%	3.20	4.80	8.00		SH-60F	T700-GE-401C	2	600	6.25	6.40	0.55	0.40	4.20	7.50	7.68	0.66	0.48	5.04	24.00	24.58	2.11	1.54	16.13	36.00	36.86	3.17	2.30	24.19	60.00	61.44	5.28	3.84	40.32					
		9	CH-46	8.0	72.0	100%	72.0	20%	30%	50%	14.40	21.60	36.00		CH-46	T58-GE-16	2	560	19.74	3.94	3.43	0.40	1.78	22.11	4.41	3.84	0.45	1.99	318.37	63.54	55.32	6.45	28.71	477.55	95.32	82.98	9.68	43.06	795.92	158.86	138.30	16.13	71.77					
40	Direct Action																																															
41	Bombing Exercise - Land	2	SH-60F	2.5	5.0	100%	5.0	40%	40%	20%	2.00	2.00	1.00		SH-60F	T700-GE-401C	2	600	6.25	6.40	0.55	0.40	4.20	7.50	7.68	0.66	0.48	5.04	15.00	15.36	1.32	0.96	10.08	15.00	15.36	1.32	0.96	10.08	7.50	7.68	0.66	0.48	5.04					
		435	FA-18A/C	1.0	435.0	10%	43.5	10%	30%	60%	4.35	13.05	26.10		FA-18A/C	F404-GE-400 (assume a	2	3318	2.44	6.74	0.44	0.40	6.36	16.19	44.73	2.92	2.65	42.20	70.43	194.56	12.70	11.55	183.59	211.30	583.68	38.10	34.64	550.77	422.61	1167.37	76.21	69.28	1101.55					
		434	FA-19E/F	1.0	434.0	10%	43.4	10%	30%	60%	4.34	13.02	26.04		FA-19E/F	F414-GE-400 (assume a	2	4049	0.89	11.58	0.12	0.40	6.31	7.21	93.77	0.97	3.24	51.10	31.28	406.98	4.22	14.06	221.77	93.84	1220.95	12.65	42.17	665.30	187.68	2441.90	25.30	84.35	1330.60					
		13	E-2	2.5	32.5					100%					E-2	T56-A-425 (assume 40%	2	1100	2.16	8.06	0.49	0.40	3.97	4.75	17.73	1.08	0.88	8.73																				
		8	EA-6B	2.5	20.0					100%					EA-6B	J52-P-408A (assume ap	2	4227	5.19	6.77	0.84	0.40	10.48	43.88	57.23	7.10	3.38	88.60																				
		7	AH-1	2.5	17.5	100%	17.5	40%	40%	20%	7.00	7.00	3.50		AH-1	T700-GE-401 (assume c	2	425.1	10.54	5.55	0.56	0.40	4.20	8.96	4.72	0.48	0.34	3.57	62.73	33.03	3.33	2.38	25.00	62.73	33.03	3.33	2.38	25.00	31.36	16.52	1.67	1.19	12.50					
		1	AV-8B	1.0	1.0	20%	0.2	30%	50%	20%	0.06	0.10	0.04		AV-8B	F402-RR-406A (assume	1	6381	7.70	8.60	0.54	0.40	3.80	49.13	54.88	3.45	2.55	24.25	2.95	3.29	0.21	0.15	1.45	4.91	5.49	0.34	0.26	2.42	1.97	2.20	0.14	0.10	0.97					
		3	KC-130	1.0	3.0			10%	30%	60%					KC-130	T56-A-425 (assume appi	4	850	4.03	6.71	0.97	0.40	3.97	13.70	22.81	3.30	1.36	13.50																				
			H-53	2.5		100%		40%	40%	20%					H-53	T64-GE-415 (assume cru	3	1488	2.13	8.08	0.15	0.40	2.21	9.51	36.07	0.67	1.79	9.87																				
			H-46	2.5		100%		40%	40%	20%					H-46	T58-GE-16	2	560	19.74	3.94	3.43	0.40	1.78	22.11	4.41	3.84	0.45	1.99																				
42	Combat Search and Rescue	56	MH-60S	3.0	168.0	100%	168.0	40%	40%	20%	67.20	67.20	33.60		MH-60S	T700-GE-401C	2	600	6.25	6.40	0.55	0.40	4.20	7.50	7.68	0.66	0.48	5.04	504.00	516.10	44.35	32.26	338.69	504.00	516.10	44.35	32.26	338.69	252.00	258.05	22.18	16.13	169.34					
		152	FA-18A/C	1.5	228.0	10%	22.8	10%	30%	60%	2.28	6.84	13.68		FA-18A/C	F404-GE-400 (assume a	2	3318	2.44	6.74	0.44	0.40	6.36	16.19	44.73	2.92	2.65	42.20	36.92	101.98	6.66	6.05	96.23	110.75	305.93	19.97	18.16	288.68	221.50	611.86	39.94	36.31	577.36					
		152	FA-18E/F	1.5	228.0	10%	22.8	10%	30%	60%	2.28	6.84	13.68		FA-18E/F	F414-GE-400 (assume a	2	4049	0.89	11.58	0.12	0.40	6.31	7.21	93.77	0.97	3.24	51.10	16.43	213.81	2.22	7.39	116.50	49.30	641.42	6.65	22.16	349.51	98.59	1282.84	13.29	44.31	699.03					
		16	E-2	3.0	48.0					100%					E-2	T56-A-425 (assume 40%	2	1100	2.16	8.06	0.49	0.40	3.97	4.75	17.73	1.08	0.88	8.73																				
43	EOD Outside SHOBA																																															
44	USCG Ops	70	HH-60	3.2	224.0	100%	224.0	50%	30%	20%	112.00	67.20	44.80		HH-60	T700-GE-401C	2	600	6.25	6.40	0.55	0.40	4.20	7.50	7.68	0.66	0.48	5.04	840.00	860.16	73.92	53.76	564.48	504.00	516.10	44.35	32.26	338.69	336.00	344.06	29.57	21.50	225.79					
45	NALF Airfield		See NALF Ops																																													
46	Ship Torpedo Tests	12	MH-60R	3.0	36.0	100%	36.0		23%	77%		8.35	27.65		MH-60R	T700-GE-401C	2	600	6.25	6.40	0.55	0.40	4.20	7.50	7.68	0.66	0.48	5.04						62.64	64.14	5.51	4.01	42.09	207.36	212.34	18.25	13.27	139.35					
47	Unmanned Underwater Vehicle Test		NONE																																													
48	Sonobuoy QA/QC Test	2	P-3	5.0	10.0	100%	10.0	50%	30%	20%	5.00	3.00	2.00		P-3	T56-A-14 (assume ASU\	4	1200	1.82	8.43	0.41	0.40	3.97	8.74	40.46	1.97	1.92	19.06	43.68	202.32	9.84	9.60	95.28	26.21	121.39	5.90	5.76	57.17	17.47	80.93	3.94	3.84	38.11					
		115	NC-12B Kingair	3.0	345.0	100%	345.0	50%	30%	20%	172.50	103.50	69.00		NC-12B Kinga	PT6A-42 (assume appro	2	249	4.93	4.42	0.23	0.40	4.20	2.46	2.20	0.11	0.20	2.09	423.51	379.70	19.76	34.36	360.80	254.11	227.82	11.85	20.62	216.48	169.40	151.88	7.90	13.74	144.32					
49	Ocean Engineering		NONE	NONE																																												
50	Marine Mammal Mine Shape Location		NONE	NONE																																												
51	Missile Flight Test	3	MH-60R	4.0	12.0	100%	12.0	5%	10%	85%	0.60	1.20	10.20		MH-60R	T700-GE-401C	2	600	6.25	6.40	0.55	0.40	4.20	7.50	7.68	0.66	0.48	5.04	4.50	4.61	0.40	0.29	3.02	9.00	9.22	0.79	0.58	6.05	76.50	78.34	6.73	4.90	51.41					
		12	P-3	4.0	48.0	50%	24.0	5%	10%	85%	1.20	2.40	20.40		P-3	T56-A-14 (assume ASU\	4	1200	1.82	8.43	0.41	0.40	3.97	8.74	40.46	1.97	1.92	19.06	10.48	48.56	2.36	2.30	22.87	20.97	97.11	4.72	4.61	45.73	178.21	825.47	40.15	39.17	388.74					
		18	FA-18A/C	4.0	72.0				5%	95%					FA-18A/C	F404-GE-400 (assume a	2	3318	2.44	6.74	0.44	0.40	6.36	16.19	44.73	2.92	2.65	42.20																				
		9	FA-18E/F	4.0	36.0				5%	95%					FA-18E/F	F414-GE-400 (assume a	2	4049	0.89	11.58	0.12	0.40	6.31	7.21	93.77	0.97	3.24	51.10																				
		6	Learjet	4.0	24.0				5%	95%					Learjet	TFE 731-2-2B	2	531.76	22.38	5.90	4.28	0.54	4.20	23.80	6.27	4.55	0.57	4.47																				
		3	Gulfstream	4.0	12.0				5%	95%					Gulfstream	BR700-710A1-10	2	1698	4.78	7.68	0.05	1.00	0.00	16.23	26.08	0.17	3.40	0.00																				
		3	MH-60R	4.0	12.0	100%	12.0	5%	10%	85%	0.60	1.20	10.20		MH-60R	T700-GE-401C	2	600	6.25	6.40	0.55	0.40	4.20	7.50	7.68	0.66	0.48	5.04	4.50	4.61	0.40	0.29	3.02	9.00	9.22	0.79	0.58	6.05	76.50	78.34	6.73	4.90	51.41					
52	NUWC Underwater Acoustics Testing		NONE																																													
53	Other Tests	2	SH-60F	4.0	8.0	100%	8.0	5%	8%	77%	0.40	0.64	6.16		SH-60F	T700-GE-401C	2	600	6.25	6.40	0.55	0.40	4.20	7.50	7.68	0.66	0.48	5.04	3.00	3.07	0.26	0.19	2.02	4.80	4.92	0.42	0.31	3.23	46.20	47.31	4.07	2.96	31.05					
		1	P-3	4.0	4.0	50%	2.0	5%	8%	77%	0.10	0.16	1.54		P-3	T56-A-14 (assume ASU\	4	1200	1.82	8.43	0.41	0.40	3.97	8.74	40.46	1.97	1.92	19.06	0.87	4.05	0.20	0.19	1.91	1.40	6.47	0.31	0.31	3.05	13.45	62.31	3.03	2.96	29.35					
		1	Learjet	4.0	4.0			1%	2%	97%					Learjet	TFE 731-2-2B	2	531.76	22.38	5.90	4.28	0.54	4.20	23.80	6.27	4.55	0.57	4.47																				
			Other Helo	4.0		100%		5%	8%	77%					Other Helo (S-	T58-GE-402 (assume 49	2	529	21.28	3.88	2.20	0.40	4.00	22.51	4.11	2.33	0.42	4.23																				
	Totals	19957																						**Total Emissions (SCI) tons**					**9.11**	**9.73**	**0.85**	**0.57**	**5.61**	**10.65**	**12.56**	**1.00**	**0.74**	**8.14**	**28.69**	**55.15**	**2.93**	**2.69**	**32.66**	**3.18**	**2.15**	**0.60**	**0.12**	**1.30**
																								Total Emissions (SD) tons					**2.91**	**4.03**	**0.34**	**0.22**	**1.43**	**1.26**	**1.80**	**0.13**	**0.10**	**0.68**										

Source: SCORE FY2004 Participants Conversion.xls

Table C-6. Aircraft Air Emissions—Alternative 2

Scenario	Type Training	A/C Sorties No.	Nomenclature	Ave. A/C Time on Range (hrs) Hours	Total Time on Range (hrs) Hours	% Below 3,000 ft %	Time Below 3,000 ft Hours	Percentage 0-3 nm from shore	Percentage 3-12 nm from Shore	Percentage >12 nm from Shore	Total Time 0-3 nm from shore Hours	Total Time 3-12 nm from shore	Total Time >12 nm from shore	Scenario No.	Aircraft Type	Engines Engine Model	No.	Fuel Flow lbs/hr	Emission Indices, lbs/1,000 lbs fuel CO	NOx	HC	SOx	PM10	Emissions Factors (lb/hr) CO	NOx	HC	SOx	PM10
Training Operations																												
1	Air Combat Maneuvers	11223	FA-18E/F	1.1	1123.1			1%	2%	97%					FA-18E/F	F414-GE-400 (assume a	2	4049	0.89	11.58	0.12	0.40	6.31	7.21	93.77	0.97	3.24	51.10
		687	AV-8B	1.2	824.4			1%	2%	97%					AV-8B	F402-RR-406A (assume	1	6381	7.70	8.60	0.54	0.40	3.80	49.13	54.88	3.45	2.55	24.25
2	Air Defense Exercise	117	E-2	1.0	117.0	50%	58.5	1%	2%	97%	0.59	1.17	56.75		E-2	T56-A-425 (assume 30%	2	1100	2.16	8.06	0.49	0.40	3.97	4.75	17.73	1.08	0.88	8.73
		703	FA-18E/F	1.0	703.0	50%	351.5	1%	2%	97%	3.52	7.03	340.96		FA-18E/F	F414-GE-400 (assume a	2	4049	0.89	11.58	0.12	0.40	6.31	7.21	93.77	0.97	3.24	51.10
			S-3B	1.0		50%		1%	2%	97%					S-3B	TF34-GE-400 (assume t	2	1145	14.10	4.07	1.86	0.40	3.62	32.29	9.32	4.26	0.92	8.29
		352	FA-18E/F	1.0	352.0	50%	176.0	1%	2%	97%	1.76	3.52	170.72		FA-18E/F	F414-GE-400 (assume a	2	4049	0.89	11.58	0.12	0.40	6.31	7.21	93.77	0.97	3.24	51.10
		117	Learjet	1.0	117.0	50%	58.5	1%	2%	97%	0.59	1.17	56.75		Learjet	TFE 731-2-2B	2	531.76	22.38	5.90	4.28	0.54	4.20	23.80	6.27	4.55	0.57	4.47
3	S-A MISSILEX	6	SH-60B	1.0	6.0	100%	6.0	1%	2%	97%	0.06	0.12	5.82		SH-60B	T700-GE-401C	2	600	6.25	6.40	0.55	0.40	4.20	7.50	7.68	0.66	0.48	5.04
		6	P-3	3.0	18.0	67%	12.0	1%	2%	97%	0.12	0.24	11.65		P-3	T56-A-14 (assume ASU\	4	1200	1.82	8.43	0.41	0.40	3.97	8.74	40.46	1.97	1.92	19.06
		6	Learjet	1.5	9.0	67%	6.0	1%	2%	97%	0.06	0.12	5.82		Learjet	TFE 731-2-2B	2	531.76	22.38	5.90	4.28	0.54	4.20	23.80	6.27	4.55	0.57	4.47
		6	C-130	1.5	9.0	67%	6.0	1%	2%	97%	0.06	0.12	5.82		C-130	T56-A-425 (assume app	4	850	4.03	6.71	0.97	0.40	3.97	13.70	22.81	3.30	1.36	13.50
4	S-A GUNEX	350	Learjet	1.5	525.0	50%	262.5	1%	2%	97%	2.63	5.25	254.63		Learjet	TFE 731-2-2B	2	531.76	22.38	5.90	4.28	0.54	4.20	23.80	6.27	4.55	0.57	4.47
5	A-A MISSILEX	52	FA-18A/C	2.0	104.0					100%					FA-18A/C	F404-GE-400 (assume a	2	3318	2.44	6.74	0.44	0.40	6.36	16.19	44.73	2.92	2.65	42.20
		78	FA-18E/F	2.0	156.0					100%					FA-18E/F	F414-GE-400 (assume a	2	4049	0.89	11.58	0.12	0.40	6.31	7.21	93.77	0.97	3.24	51.10
		13	E-2C	4.0	52.0					100%					E-2C	T56-A-425 (assume 40%	2	1100	2.16	8.06	0.49	0.40	3.97	4.75	17.73	1.08	0.88	8.73
		13	DC-130	4.0	52.0			1%	2%	97%					DC-130	T56-A-425 (assume app	4	850	4.03	6.71	0.97	0.40	3.97	13.70	22.81	3.30	1.36	13.50
6	Helicopter ASW TRACKEX	1690	MH-60R	3.6	6084.0	100%	6084.0		24%	76%		#####	#####		MH-60R	T700-GE-401C	2	600	6.25	6.40	0.55	0.40	4.20	7.50	7.68	0.66	0.48	5.04
7	Helicopter ASW TORPEX	245	MH-60R	3.6	882.0	100%	882.0		24%	76%		208.15	673.85	7	MH-60R	T700-GE-401C	2	600	6.25	6.40	0.55	0.40	4.20	7.50	7.68	0.66	0.48	5.04
		21	Other Helo (SH-3)	3.6	75.6	100%	75.6		24%	76%		17.84	57.76		Other Helo (SH	T58-GE-402 (assume 4%	2	529	21.28	3.88	2.20	0.40	4.00	22.51	4.11	2.33	0.42	4.23
8	MPA ASW TRACKEX	29	P-3	6.0	174.0	75%	130.5	5%	10%	85%	6.53	13.05	110.93		P-3	T56-A-14 (assume ASU\	4	1200	1.82	8.43	0.41	0.40	3.97	8.74	40.46	1.97	1.92	19.06
9	MPA ASW TORPEX	40	P-3	2.0	80.0	100%	80.0	1%	2%	97%	0.80	1.60	77.60		P-3	T56-A-14 (assume ASU\	4	1200	1.82	8.43	0.41	0.40	3.97	8.74	40.46	1.97	1.92	19.06
		10	SH-60B	2.0	20.0	100%	20.0	1%	2%	97%	0.20	0.40	19.40		SH-60B	T700-GE-401C	2	600	6.25	6.40	0.55	0.40	4.20	7.50	7.68	0.66	0.48	5.04
10	EER/IEER ASW	3	P-3	6.0	18.0	75%	13.5			100%			13.50		P-3	T56-A-14 (assume ASU\	4	1200	1.82	8.43	0.41	0.40	3.97	8.74	40.46	1.97	1.92	19.06
11	Surface Ship ASW TRACKEX																											
12	Surface Ship ASW TORPEX	8	Other Helo (SH-3)	3.7	29.6	100%	29.6	1%	2%	97%	0.30	0.59	28.71		Other Helo (SH	T58-GE-402 (assume 4%	2	529	21.28	3.88	2.20	0.40	4.00	22.51	4.11	2.33	0.42	4.23
13	Submarine ASW TORPEX																											
14	Submarine ASW TORPEX																											
15	VBSS	21	MH-60R	4.0	84.0	100%	84.0			100%			84.00		MH-60R	T700-GE-401C	2	600	6.25	6.40	0.55	0.40	4.20	7.50	7.68	0.66	0.48	5.04
16	A-S MISSILEX	41	MH-60R	3.0	123.0	100%	123.0	1%	2%	97%	1.23	2.46	119.31		MH-60R	T700-GE-401C	2	600	6.25	6.40	0.55	0.40	4.20	7.50	7.68	0.66	0.48	5.04
		15	FA-18A/C	2.0	30.0			1%	2%	97%					FA-18A/C	F404-GE-400 (assume a	2	3318	2.44	6.74	0.44	0.40	6.36	16.19	44.73	2.92	2.65	42.20
		15	FA-18E/F	2.0	30.0			1%	2%	97%					FA-18E/F	F414-GE-400 (assume a	2	4049	0.89	11.58	0.12	0.40	6.31	7.21	93.77	0.97	3.24	51.10
			S-3B	3.0		100%		1%	2%	97%					S-3B	TF34-GE-400 (assume t	2	1145	14.10	4.07	1.86	0.40	3.62	32.29	9.32	4.26	0.92	8.29
17	A-S BOMBEX	21	FA-18A/C	1.0	21.0	10%	2.1		50%	50%		1.05	1.05		FA-18A/C	F404-GE-400 (assume a	2	3318	2.44	6.74	0.44	0.40	6.36	16.19	44.73	2.92	2.65	42.20
		21	FA-18E/F	1.0	21.0	10%	2.1		50%	50%		1.05	1.05		FA-18E/F	F414-GE-400 (assume a	2	4049	0.89	11.58	0.12	0.40	6.31	7.21	93.77	0.97	3.24	51.10
		11	P-3	1.0	11.0	10%	1.1		50%	50%		0.55	0.55		P-3	T56-A-14 (assume ASU\	4	1200	1.82	8.43	0.41	0.40	3.97	8.74	40.46	1.97	1.92	19.06
			S-3B	1.0		10%			50%	50%					S-3B	TF34-GE-400 (assume t	2	1145	14.10	4.07	1.86	0.40	3.62	32.29	9.32	4.26	0.92	8.29
18	A-S GUNEX	131	MH-60R	1.0	131.0	100%	131.0		50%	50%		65.50	65.50		MH-60R	T700-GE-401C	2	600	6.25	6.40	0.55	0.40	4.20	7.50	7.68	0.66	0.48	5.04
19	S-S GUNEX																											
20	SINKEX	6	E-2	16.0	96.0	10%	9.6			100%			9.60		E-2	T56-A-425 (assume 30%	2	1100	2.16	8.06	0.49	0.40	3.97	4.75	17.73	1.08	0.88	8.73
		24	FA-18E/F	16.0	384.0	10%	38.4			100%			38.40		FA-18E/F	F414-GE-400 (assume a	2	4049	0.89	11.58	0.12	0.40	6.31	7.21	93.77	0.97	3.24	51.10
		3	P-3	16.0	48.0	10%	4.8			100%			4.80		P-3	T56-A-14 (assume ASU\	4	1200	1.82	8.43	0.41	0.40	3.97	8.74	40.46	1.97	1.92	19.06
		6	SH-60B	16.0	96.0	10%	9.6			100%			9.60		SH-60B	T700-GE-401C	2	600	6.25	6.40	0.55	0.40	4.20	7.50	7.68	0.66	0.48	5.04
21	Naval Surface Fire Support Exercise																											
22	Expeditionary Fires Exercise	1	FA-18E/F	3.0	3.0	100%	3.0		100%			3.00			FA-18E/F	F414-GE-400 (assume a	2	4049	0.89	11.58	0.12	0.40	6.31	7.21	93.77	0.97	3.24	51.10
		1	AH-1	3.0	3.0	100%	3.0		100%			3.00			AH-1	T700-GE-401 (assume c	2	425.1	10.54	5.55	0.56	0.40	4.20	8.96	4.72	0.48	0.34	3.57
		1	AV-8B	3.0	3.0	100%	3.0		100%			3.00			AV-8B	F402-RR-406A (assume	1	6381	7.70	8.60	0.54	0.40	3.80	49.13	54.88	3.45	2.55	24.25
23	USMC Battalion Landing	32	FA-18A/C	0.5	16.0	15%	2.4	20%	50%	30%	0.48	1.20	0.72		FA-18A/C	F404-GE-400 (assume a	2	3318	2.44	6.74	0.44	0.40	6.36	16.19	44.73	2.92	2.65	42.20
			FA-18E/F	0.5		15%		20%	50%	30%					FA-18E/F	F414-GE-400 (assume a	2	4049	0.89	11.58	0.12	0.40	6.31	7.21	93.77	0.97	3.24	51.10
		12	AV-8B	0.5	6.0	25%	1.5	90%	5%	5%	1.35	0.08	0.08		AV-8B	F402-RR-406A (assume	1	6381	7.70	8.60	0.54	0.40	3.80	49.13	54.88	3.45	2.55	24.25
		8	AH-1	1.0	8.0	100%	8.0	90%	5%	5%	7.20	0.40	0.40		AH-1	T700-GE-401 (assume c	2	425.1	10.54	5.55	0.56	0.40	4.20	8.96	4.72	0.48	0.34	3.57
		4	C-130	1.4	5.6			20%	50%	30%					C-130	T56-A-425 (assume app	4	850	4.03	6.71	0.97	0.40	3.97	13.70	22.81	3.30	1.36	13.50
		8	H-53	1.5	12.0	100%	12.0	90%	5%	5%	10.80	0.60	0.60		H-53	T64-GE-415 (assume cn	3	1488	2.13	8.08	0.15	0.40	2.21	9.51	36.07	0.67	1.79	9.87
		24	H-46	1.5	36.0	100%	36.0	90%	5%	5%	32.40	1.80	1.80		H-46	T58-GE-16	2	560	19.74	3.94	3.43	0.40	1.78	22.11	4.41	3.84	0.45	1.99
		6	UH-1	1.0	6.0	100%	6.0	90%	5%	5%	5.40	0.30	0.30		UH-1	T400-CP-400	2	346.2	1.01	5.79	0.13	0.40	4.20	0.70	4.01	0.09	0.28	2.91
24	USMC Stinger Firings																											
25	Amphibious Landings and Raids																											
25A	Amphibious Ops		AH-1	4.0		100%		100%							AH-1	T700-GE-401 (assume c	2	425.1	10.54	5.55	0.56	0.40	4.20	8.96	4.72	0.48	0.34	3.57
			CH-46	4.0		100%		100%							CH-46	T58-GE-16	2	560	19.74	3.94	3.43	0.40	1.78	22.11	4.41	3.84	0.45	1.99
			CH-53	4.0		100%		100%							CH-53	T64-GE-415 (assume cn	3	1488	2.13	8.08	0.15	0.40	2.21	9.51	36.07	0.67	1.79	9.87
		48	UH-1	4.0	192.0	100%	192.0	100%			192.00				UH-1	T400-CP-400	2	346.2	1.01	5.79	0.13	0.40	4.20	0.70	4.01	0.09	0.28	2.91
25B	Helicopter Assault	48	AH-1	2.0	96.0	60%	57.6	100%			57.60				AH-1	T700-GE-401 (assume c	2	425.1	10.54	5.55	0.56	0.40	4.20	8.96	4.72	0.48	0.34	3.57
		72	CH-46	2.0	144.0	60%	86.4	100%			86.40				CH-46	T58-GE-16	2	560	19.74	3.94	3.43	0.40	1.78	22.11	4.41	3.84	0.45	1.99
		36	CH-53	2.0	72.0	60%	43.2	100%			43.20				CH-53	T64-GE-415 (assume cn	3	1488	2.13	8.08	0.15	0.40	2.21	9.51	36.07	0.67	1.79	9.87
		48	AV-8B	2.0	96.0	60%	57.6	100%			57.60				AV-8B	F402-RR-406A (assume	1	6381	7.70	8.60	0.54	0.40	3.80	49.13	54.88	3.45	2.55	24.25
		12	UH-1	2.0	24.0	60%	14.4	100%			14.40				UH-1	T400-CP-400	2	346.2	1.01	5.79	0.13	0.40	4.20	0.70	4.01	0.09	0.28	2.91
25C	Armored Ops	8	AH-1	8.0	64.0	50%	32.0	100%			32.00				AH-1	T700-GE-401 (assume c	2	425.1	10.54	5.55	0.56	0.40	4.20	8.96	4.72	0.48	0.34	3.57
		8	AV-8B	8.0	64.0	50%	32.0	100%			32.00				AV-8B	F402-RR-406A (assume	1	6381	7.70	8.60	0.54	0.40	3.80	49.13	54.88	3.45	2.55	24.25
25D	Artillery Ops	32	AH-1	3.0	96.0	100%	96.0	100%			96.00				AH-1	T700-GE-401 (assume c	2	425.1	10.54	5.55	0.56	0.40	4.20	8.96	4.72	0.48	0.34	3.57
		12	CH-46	3.0	36.0	100%	36.0	100%			36.00				CH-46	T58-GE-16	2	560	19.74	3.94	3.43	0.40	1.78	22.11	4.41	3.84	0.45	1.99
		12	CH-53	3.0	36.0	100%	36.0	100%			36.00				CH-53	T64-GE-415 (assume cn	3	1488	2.13	8.08	0.15	0.40	2.21	9.51	36.07	0.67	1.79	9.87
25E	Amphibious Assault	24	AH-1	3.0	72.0	100%	72.0	100%			72.00				AH-1	T700-GE-401 (assume c	2	425.1	10.54	5.55	0.56	0.40	4.20	8.96	4.72	0.48	0.34	3.57
			CH-46	3.0		100%		100%							CH-46	T58-GE-16	2	560	19.74	3.94	3.43	0.40	1.78	22.11	4.41	3.84	0.45	1.99
			CH-53	3.0		100%		100%							CH-53	T64-GE-415 (assume cn	3	1488	2.13	8.08	0.15	0.40	2.21	9.51	36.07	0.67	1.79	9.87
		12	UH-1	3.0	36.0	100%	36.0	100%			36.00				UH-1	T400-CP-400	2	346.2	1.01	5.79	0.13	0.40	4.20	0.70	4.01	0.09	0.28	2.91
25F	Combat Engineer		None																									
25G	AAV Ops	16	AH-1	4.0	64.0	100%	64.0	100%			64.00				AH-1	T700-GE-401 (assume c	2	425.1	10.54	5.55	0.56	0.40	4.20	8.96	4.72	0.48	0.34	3.57
25H	EFV Ops	4	AH-1	4.0	16.0	100%	16.0	100%			16.00				AH-1	T700-GE-401 (assume c	2	425.1	10.54	5.55	0.56	0.40	4.20	8.96	4.72	0.48	0.34	3.57
25I	Assault Amphibian School		None																									
26	Amphibious Operations - CPAAA																											
26A	Amphibious Operations		None																									
26B	Amphibious Operations	30	CH-46	4.2	126.3	100%	126.3	79%	21%		99.27	26.90			CH-46	T58-GE-16	2	560	19.74	3.94	3.43	0.40	1.78	22.11	4.41	3.84	0.45	1.99
		30	CH-53	4.2	126.3	100%	126.3	79%	21%		99.27	26.90			CH-53	T64-GE-415 (assume cn	3	1488	2.13	8.08	0.15	0.40	2.21	9.51	36.07	0.67	1.79	9.87
26C	Amphibious Operations		None																									
26D	Amphibious Operations		None																									
26E	Amphibious Operations	75	AV-8B	0.5	37.5	97%	36.4	50%	30%	20%	18.19	10.91	7.28		AV-8B	F402-RR-406A (assume	1	6381	7.70	8.60	0.54	0.40	3.80	49.13	54.88	3.45	2.55	24.25
		89	AH-1	0.5	44.5	97%	43.2	50%	30%	20%	21.58	12.95	8.63		AH-1	T700-GE-401 (assume c	2	425.1	10.54	5.55	0.56	0.40	4.20	8.96	4.72	0.48	0.34	3.57
		65	UH-1	0.5	32.5	97%	31.5	50%	30%	20%	15.76	9.46	6.31		UH-1	T400-CP-400	2	346.2	1.01	5.79	0.13	0.40	4.20	0.70	4.01	0.09	0.28	2.91

Emissions

Scenario	Type Training	Aircraft Type	Emissions 0-3 nm Offshore (lbs) CO	NOx	HC	SOx	PM	Emissions 3-12 nm Offshore—US Territory (lbs) CO	NOx	HC	SOx	PM	Emissions >12 nm Offshore—Outside US Territory: Offshore San Diego CO	NOx	HC	SOx	PM	Offshore Mexico CO	NOx	HC	SOx	PM
1	Air Combat Maneuvers	FA-18E/F																					
		AV-8B																					
2	Air Defense Exercise	E-2	2.78	10.37	0.63	0.51	5.11	5.56	20.75	1.26	1.03	10.22	269.65	1006.20	61.17	49.94	495.61					
		FA-18E/F	25.33	329.62	3.42	11.39	179.61	50.67	659.24	6.83	22.77	359.22	2457.34	31973.00	331.33	1104.42	17422.25					
		S-3B																				
		FA-18E/F	12.68	165.04	1.71	5.70	89.93	25.37	330.09	3.42	11.40	179.87	1230.42	16009.24	165.90	553.00	8723.52					
		Learjet	13.92	3.67	2.66	0.34	2.61	27.85	7.34	5.33	0.67	5.23	1350.62	356.06	258.30	32.59	253.47					
3	S-A MISSILEX	SH-60B	0.45	0.46	0.04	0.03	0.30	0.90	0.92	0.08	0.06	0.60	43.65	44.70	3.84	2.79	29.33					
		P-3	1.05	4.86	0.24	0.23	2.29	2.10	9.72	0.47	0.46	4.58	101.74	471.24	22.92	22.36	221.92					
		Learjet	1.43	0.38	0.27	0.03	0.27	2.86	0.75	0.55	0.07	0.54	138.59	36.54	26.51	3.34	26.01					
		C-130	0.82	1.37	0.20	0.08	0.81	1.65	2.74	0.40	0.16	1.62	79.79	132.84	19.20	7.92	78.60					
4	S-A GUNEX	Learjet	62.48	16.47	11.95	1.51	11.73	124.96	32.94	23.90	3.02	23.45						6060.48	1597.71	1159.02	146.23	1137.35
5	A-A MISSILEX	FA-18A/C																				
		FA-18E/F																				
		E-2C																				
		DC-130																				
6	Helicopter ASW TRACKEX	MH-60R						10768.68	11027.13	947.64	689.20	7236.55	34861.32	35697.99	3067.80	2231.12	23426.81					
7	Helicopter ASW TORPEX	MH-60R						1561.14	1598.61	137.38	99.91	1049.09	5053.86	5175.15	444.74	323.45	3396.19					
		Other Helo (SH-3)						401.69	73.24	41.53	7.55	75.51	1300.39	237.10	134.44	24.44	244.43					
8	MPA ASW TRACKEX	P-3	57.00	264.03	12.84	12.53	124.34	114.00	528.06	25.68	25.06	248.68	969.04	4488.47	218.30	212.98	2113.79					
9	MPA ASW TORPEX	P-3	6.99	32.37	1.57	1.54	15.24	13.98	64.74	3.15	3.07	30.49	677.91	3140.01	152.72	148.99	1478.75					
		SH-60B	1.50	1.54	0.13	0.10	1.01	3.00	3.07	0.26	0.19	2.02	145.50	148.99	12.80	9.31	97.78					
10	EER/IEER ASW	P-3											117.94	546.26	26.57	25.92	257.26					
11	Surface Ship ASW TRACKEX																					
12	Surface Ship ASW TORPEX	Other Helo (SH-3)	6.66	1.22	0.69	0.13	1.25	13.33	2.43	1.38	0.25	2.51	646.43	117.86	66.83	12.15	121.51					
13	Submarine ASW TORPEX																					
14	Submarine ASW TORPEX																					
15	VBSS	MH-60R											630.00	645.12	55.44	40.32	423.36					
16	A-S MISSILEX	MH-60R	9.23	9.45	0.81	0.59	6.20	18.45	18.89	1.62	1.18	12.40	894.83	916.30	78.74	57.27	601.32					
		FA-18A/C																				
		FA-18E/F																				
		S-3B																				
17	A-S BOMBEX	FA-18A/C						17.00	46.96	3.07	2.79	44.32	17.00	46.96	3.07	2.79	44.32					
		FA-18E/F						7.57	98.46	1.02	3.40	53.65	7.57	98.46	1.02	3.40	53.65					
		P-3						4.80	22.26	1.08	1.06	10.48	4.80	22.26	1.08	1.06	10.48					
		S-3B																				
18	A-S GUNEX	MH-60R						491.25	503.04	43.23	31.44	330.12	491.25	503.04	43.23	31.44	330.12					
19	S-S GUNEX																					
20	SINKEX	E-2																45.62	170.23	10.35	8.45	83.85
		FA-18E/F																276.76	3600.95	37.32	124.39	1962.18
		P-3																41.93	194.23	9.45	9.22	91.47
		SH-60B																72.00	73.73	6.34	4.61	48.38
21	Naval Surface Fire Support Exercise																					
22	Expeditionary Fires Exercise	FA-18E/F						21.62	281.32	2.92	9.72	153.30										
		AH-1						26.88	14.16	1.43	1.02	10.71										
		AV-8B						147.40	164.63	10.34	7.66	72.74										
23	USMC Battalion Landing	FA-18A/C	7.77	21.47	1.40	1.27	20.26	19.43	53.67	3.50	3.19	50.65	11.66	32.20	2.10	1.91	30.39					
		FA-18E/F																				
		AV-8B	66.33	74.08	4.65	3.45	32.73	3.69	4.12	0.26	0.19	1.82	3.69	4.12	0.26	0.19	1.82					
		AH-1	64.52	33.97	3.43	2.45	25.71	3.58	1.89	0.19	0.14	1.43	3.58	1.89	0.19	0.14	1.43					
		C-130																				
		H-53	102.69	389.55	7.23	19.28	106.55	5.70	21.64	0.40	1.07	5.92	5.70	21.64	0.40	1.07	5.92					
		H-46	716.33	142.97	124.47	14.52	64.59	39.80	7.94	6.91	0.81	3.59	39.80	7.94	6.91	0.81	3.59					
		UH-1	3.78	21.65	0.49	1.50	15.70	0.21	1.20	0.03	0.08	0.87	0.21	1.20	0.03	0.08	0.87					
24	USMC Stinger Firings																					
25	Amphibious Landings and Raids																					
25A	Amphibious Ops	AH-1																				
		CH-46																				
		CH-53																				
		UH-1	134.27	769.73	17.28	53.18	558.35															
25B	Helicopter Assault	AH-1	516.16	271.79	27.42	19.59	205.68															
		CH-46	1910.20	381.27	331.91	38.71	172.25															
		CH-53	410.76	1558.19	28.93	77.14	426.19															
		AV-8B	2830.10	3160.89	198.47	147.02	1396.67															
		UH-1	10.07	57.73	1.30	3.99	41.88															
25C	Armored Ops	AH-1	286.76	151.00	15.24	10.88	114.27															
		AV-8B	1572.28	1756.05	110.26	81.68	775.93															
25D	Artillery Ops	AH-1	860.27	452.99	45.71	32.65	342.80															
		CH-46	795.92	158.86	138.30	16.13	71.77															
		CH-53	342.30	1298.49	24.11	64.28	355.16															
25E	Amphibious Assault	AH-1	645.20	339.74	34.28	24.49	257.10															
		CH-46																				
		CH-53																				
		UH-1	25.18	144.32	3.24	9.97	104.69															
25F	Combat Engineer	None																				
25G	AAV Ops	AH-1	573.51	301.99	30.47	21.77	228.53															
25H	EFV Ops	AH-1	143.38	75.50	7.62	5.44	57.13															
25I	Assault Amphibian School	None																				
26	Amphibious Operations - CPAAA																					
26A	Amphibious Operations	None																				
26B	Amphibious Operations	CH-46	2194.78	438.07	381.36	44.47	197.91	594.77	118.71	103.35	12.05	53.63										
		CH-53	943.91	3580.65	66.47	177.26	979.36	255.79	970.33	18.01	48.04	265.40										
26C	Amphibious Operations	None																				
26D	Amphibious Operations	None																				
26E	Amphibious Operations	AV-8B	893.62	998.07	62.67	46.42	441.01	536.17	598.84	37.60	27.85	264.60	357.45	399.23	25.07	18.57	176.40					
		AH-1	193.40	101.84	10.28	7.34	77.07	116.04	61.10	6.17	4.40	46.24	77.36	40.74	4.11	2.94	30.83					
		UH-1	11.02	63.19	1.42	4.37	45.84	6.61	37.92	0.85	2.62	27.50	4.41	25.28	0.57	1.75	18.34					

Scenario No.	Type Training	A/C Sorties	Nomenclature	Ave. A/C Time on Range (hrs) Hours	Total Time on Range (hrs) Hours	% Below 3,000 ft %	Time Below 3,000 ft Hours	Percentage 0-3 nm from shore	Percentage 3-12 nm from Shore	Percentage >12 nm from Shore	Total Time 0-3 nm from shore	Total Time 3-12 nm from shore	Total Time >12 nm from shore
								Percent			Hours		
		69	CH-46	0.5	34.5	97%	33.5	50%	30%	20%	16.73	10.04	6.69
		253	CH-53	0.5	126.5	97%	122.7	50%	30%	20%	61.35	36.81	24.54
26F	Amphibious Operations		None										
26G	Amphibious Operations		None										
27	Electronic Combat Exercise	101	MH-60R	2.1	212.1	100%	212.1		3%	97%		6.36	205.74
		3	HH-60	2.1	6.3	100%	6.3		3%	97%		0.19	6.11
		32	P-3	2.0	64.0				3%	97%			
		209	FA-18A/C	2.0	418.0				3%	97%			
		210	FA-18E/F	2.0	420.0				3%	97%			
		16	E-2C	2.0	32.0				3%	97%			
		18	EA-6B	2.0	36.0				3%	97%			
		149	Learjet	2.0	298.0				3%	97%			
		8	Unknown	2.0	16.0				3%	97%			
28A	Small Object Avoidance	16	MH-60R	1.8	28.0	100%	28.0	100%			28.00		
29	Mine Neutralization	720	MH-60R	2.5	1800.0	100%	1800.0	55%	40%	5%	990.00	720.00	90.00
30	Mine Laying	5	P-3	0.9	4.5	67%	3.0	50%	40%	10%	1.50	1.20	0.30
		12	FA-18A/C	0.5	6.0	7%	0.4	50%	40%	10%	0.20	0.16	0.04
		11	FA-18E/F	0.5	5.5	7%	0.4	50%	40%	10%	0.18	0.15	0.04
31	NSW Center Land Demolitions												
32	NSWC Underwater Demolitions		NONE										
33	NSWC Underwater Mat Weave		NONE										
34	NSWC BUD/S Small Arms Training	12	SH-60F	6.0	72.0	100%	72.0	100%			72.00		
35	NSWC BUD/S Land Navigation		NONE										
36	NSW UAV Operations	5	Neptune/Scan	1.0	5.0	100%	5.0	100%			5.00		
37	Insertion/Extraction	15	C-130	2.0	30.0	50%	15.0		5%	95%		0.75	14.25
38	NSW Boat Operations												
39	NSW GRU ONE SEAL Platoon Ops	6	SH-60B	8.0	48.0	100%	48.0	20%	30%	50%	9.60	14.40	24.00
		2	SH-60F	8.0	16.0	100%	16.0	20%	30%	50%	3.20	4.80	8.00
		12	CH-46	8.0	96.0	100%	96.0	20%	30%	50%	19.20	28.80	48.00
40	Direct Action												
41	Bombing Exercise - Land	2	SH-60F	2.5	5.0	100%	5.0	40%	40%	20%	2.00	2.00	1.00
		477	FA-18A/C	1.0	477.0	10%	47.7	10%	30%	60%	4.77	14.31	28.62
		476	FA-19E/F	1.0	476.0	10%	47.6	10%	30%	60%	4.76	14.28	28.56
		15	E-2	2.5	37.5					100%			
		9	EA-6B	2.5	22.5					100%			
		7	AH-1	2.5	17.5	100%	17.5	40%	40%	20%	7.00	7.00	3.50
		1	AV-8B	1.0	1.0	20%	0.2	30%	50%	20%	0.06	0.10	0.04
		4	KC-130	1.0	4.0			10%	30%	60%			
			H-53	2.5		100%		40%	40%	20%			
			H-46	2.5		100%		40%	40%	20%			
42	Combat Search and Rescue	56	MH-60S	3.0	168.0	100%	168.0	40%	40%	20%	67.20	67.20	33.60
		152	FA-18A/C	1.5	228.0	10%	22.8	10%	30%	60%	2.28	6.84	13.68
		152	FA-18E/F	1.5	228.0	10%	22.8	10%	30%	60%	2.28	6.84	13.68
		16	E-2	3.0	48.0					100%			
43	EOD Outside SHOBA												
44	USCG Ops	70	HH-60	3.2	224.0	100%	224.0	50%	30%	20%	112.00	67.20	44.80
54	NALF Airfield		See NALF Ops										
46	Ship Torpedo Tests	16	MH-60R	3.0	48.0	100%	48.0		23%	77%		11.14	36.86
47	Unmanned Underwater Vehicle Test		NONE										
48	Sonobuoy QA/QC Test	2	P-3	5.0	10.0	100%	10.0	50%	30%	20%	5.00	3.00	2.00
		118	NC-12B Kingair	3.0	354.0	100%	354.0	50%	30%	20%	177.00	106.20	70.80
49	Ocean Engineering		NONE	NONE									
50	Marine Mammal Mine Shape Location		NONE	NONE									
51	Missile Flight Test	4	MH-60R	4.0	16.0	100%	16.0	5%	10%	85%	0.80	1.60	13.60
		16	P-3	4.0	64.0	50%	32.0	5%	10%	85%	1.60	3.20	27.20
		24	FA-18A/C	4.0	96.0				5%	95%			
		12	FA-18E/F	4.0	48.0				5%	95%			
		8	Learjet	4.0	32.0				5%	95%			
		4	Gulfstream	4.0	16.0				5%	95%			
		4	MH-60R	4.0	16.0	100%	16.0	5%	10%	85%	0.80	1.60	13.60
52	NUWC Underwater Acoustics Testing		NONE										
53	Other Tests	2	MH-60R	4.0	8.0	100%	8.0	5%	8%	77%	0.40	0.64	6.16
		1	P-3	4.0	4.0	50%	2.0	5%	8%	77%	0.10	0.16	1.54
		1	Learjet	4.0	4.0			1%	2%	97%			
		1	Other Helo	4.0	4.0	100%	4.0	5%	8%	77%	0.20	0.32	3.08
	Totals	20402											

Scenario No.	Aircraft Type	Engine Model	No.	Fuel Flow lbs/hr	Emission Indices, lbs/1,000 lbs fuel CO	NOx	HC	SOx	PM10	Emissions Factors (lb/hr) CO	NOx	HC	SOx	PM10
	CH-46	T58-GE-16	2	560	19.74	3.94	3.43	0.40	1.78	22.11	4.41	3.84	0.45	1.99
	CH-53	T64-GE-415 (assume cr	3	1488	2.13	8.08	0.15	0.40	2.21	9.51	36.07	0.67	1.79	9.87
27	MH-60R	T700-GE-401C	2	600	6.25	6.40	0.55	0.40	4.20	7.50	7.68	0.66	0.48	5.04
	HH-60	T700-GE-401C	2	600	6.25	6.40	0.55	0.40	4.20	7.50	7.68	0.66	0.48	5.04
	P-3	T56-A-14 (assume ASU\	4	1200	1.82	8.43	0.41	0.40	3.97	8.74	40.46	1.97	1.92	19.06
	FA-18A/C	F404-GE-400 (assume a	2	3318	2.44	6.74	0.44	0.40	6.36	16.19	44.73	2.92	2.65	42.20
	FA-18E/F	F414-GE-400 (assume a	2	4049	0.89	11.58	0.12	0.40	6.31	7.21	93.77	0.97	3.24	51.10
	E-2C	T56-A-425 (assume 40%	2	1100	2.16	8.06	0.49	0.40	3.97	4.75	17.73	1.08	0.88	8.73
	EA-6B	J52-P-408A (assume ap	2	4227	5.19	6.77	0.84	0.40	10.48	43.88	57.23	7.10	3.38	88.60
	Learjet	TFE 731-2-2B	2	531.76	22.38	5.90	4.28	0.54	4.20	23.80	6.27	4.55	0.57	4.47
	Unknown	TFE 731-2-2B	2	531.76	22.38	5.90	4.28	0.54	4.20	23.80	6.27	4.55	0.57	4.47
28A	MH-60R	T700-GE-401C	2	600	6.25	6.40	0.55	0.40	4.20	7.50	7.68	0.66	0.48	5.04
29	MH-60R	T700-GE-401C	2	600	6.25	6.40	0.55	0.40	4.20	7.50	7.68	0.66	0.48	5.04
30	P-3	T56-A-14 (assume ASU\	4	1200	1.82	8.43	0.41	0.40	3.97	8.74	40.46	1.97	1.92	19.06
	FA-18A/C	F404-GE-400 (assume a	2	3318	2.44	6.74	0.44	0.40	6.36	16.19	44.73	2.92	2.65	42.20
	FA-18E/F	F414-GE-400 (assume a	2	4049	0.89	11.58	0.12	0.40	6.31	7.21	93.77	0.97	3.24	51.10
34	SH-60F	T700-GE-401C	2	600	6.25	6.40	0.55	0.40	4.20	7.50	7.68	0.66	0.48	5.04
37	C-130	T56-A-425 (assume appr	4	850	4.03	6.71	0.97	0.40	3.97	13.70	22.81	3.30	1.36	13.50
39	SH-60B	T700-GE-401C	2	600	6.25	6.40	0.55	0.40	4.20	7.50	7.68	0.66	0.48	5.04
	SH-60F	T700-GE-401C	2	600	6.25	6.40	0.55	0.40	4.20	7.50	7.68	0.66	0.48	5.04
	CH-46	T58-GE-16	2	560	19.74	3.94	3.43	0.40	1.78	22.11	4.41	3.84	0.45	1.99
41	SH-60F	T700-GE-401C	2	600	6.25	6.40	0.55	0.40	4.20	7.50	7.68	0.66	0.48	5.04
	FA-18A/C	F404-GE-400 (assume a	2	3318	2.44	6.74	0.44	0.40	6.36	16.19	44.73	2.92	2.65	42.20
	FA-19E/F	F414-GE-400 (assume a	2	4049	0.89	11.58	0.12	0.40	6.31	7.21	93.77	0.97	3.24	51.10
	E-2	T56-A-425 (assume 40%	2	1100	2.16	8.06	0.49	0.40	3.97	4.75	17.73	1.08	0.88	8.73
	EA-6B	J52-P-408A (assume ap	2	4227	5.19	6.77	0.84	0.40	10.48	43.88	57.23	7.10	3.38	88.60
	AH-1	T700-GE-401 (assume c	2	425.1	10.54	5.55	0.56	0.40	4.20	8.96	4.72	0.48	0.34	3.57
	AV-8B	F402-RR-406A (assume	1	6381	7.70	8.60	0.54	0.40	3.80	49.13	54.88	3.45	2.55	24.25
	KC-130	T56-A-425 (assume appr	4	850	4.03	6.71	0.97	0.40	3.97	13.70	22.81	3.30	1.36	13.50
	H-53	T64-GE-415 (assume cr	3	1488	2.13	8.08	0.15	0.40	2.21	9.51	36.07	0.67	1.79	9.87
	H-46	T58-GE-16	2	560	19.74	3.94	3.43	0.40	1.78	22.11	4.41	3.84	0.45	1.99
42	MH-60S	T700-GE-401C	2	600	6.25	6.40	0.55	0.40	4.20	7.50	7.68	0.66	0.48	5.04
	FA-18A/C	F404-GE-400 (assume a	2	3318	2.44	6.74	0.44	0.40	6.36	16.19	44.73	2.92	2.65	42.20
	FA-18E/F	F414-GE-400 (assume a	2	4049	0.89	11.58	0.12	0.40	6.31	7.21	93.77	0.97	3.24	51.10
	E-2	T56-A-425 (assume 40%	2	1100	2.16	8.06	0.49	0.40	3.97	4.75	17.73	1.08	0.88	8.73
44	HH-60	T700-GE-401C	2	600	6.25	6.40	0.55	0.40	4.20	7.50	7.68	0.66	0.48	5.04
46	MH-60R	T700-GE-401C	2	600	6.25	6.40	0.55	0.40	4.20	7.50	7.68	0.66	0.48	5.04
48	P-3	T56-A-14 (assume ASU\	4	1200	1.82	8.43	0.41	0.40	3.97	8.74	40.46	1.97	1.92	19.06
	NC-12B Kinga	PT6A-42 (assume appro	2	249	4.93	4.42	0.23	0.40	4.20	2.46	2.20	0.11	0.20	2.09
51	MH-60R	T700-GE-401C	2	600	6.25	6.40	0.55	0.40	4.20	7.50	7.68	0.66	0.48	5.04
	P-3	T56-A-14 (assume ASU\	4	1200	1.82	8.43	0.41	0.40	3.97	8.74	40.46	1.97	1.92	19.06
	FA-18A/C	F404-GE-400 (assume a	2	3318	2.44	6.74	0.44	0.40	6.36	16.19	44.73	2.92	2.65	42.20
	FA-18E/F	F414-GE-400 (assume a	2	4049	0.89	11.58	0.12	0.40	6.31	7.21	93.77	0.97	3.24	51.10
	Learjet	TFE 731-2-2B	2	531.76	22.38	5.90	4.28	0.54	4.20	23.80	6.27	4.55	0.57	4.47
	Gulfstream	BR700-710A1-10	2	1698	4.78	7.68	0.05	1.00	0.00	16.23	26.08	0.17	3.40	0.00
	MH-60R	T700-GE-401C	2	600	6.25	6.40	0.55	0.40	4.20	7.50	7.68	0.66	0.48	5.04
53	MH-60R	T700-GE-401C	2	600	6.25	6.40	0.55	0.40	4.20	7.50	7.68	0.66	0.48	5.04
	P-3	T56-A-14 (assume ASU\	4	1200	1.82	8.43	0.41	0.40	3.97	8.74	40.46	1.97	1.92	19.06
	Learjet	TFE 731-2-2B	2	531.76	22.38	5.90	4.28	0.54	4.20	23.80	6.27	4.55	0.57	4.47
	Other Helo (S-	T58-GE-402 (assume 49	2	529	21.28	3.88	2.20	0.40	4.00	22.51	4.11	2.33	0.42	4.23

Emissions

Scenario No.	Aircraft Type	Emissions 0-3 nm Offshore (lbs) CO	NOx	HC	SOx	PM	Emissions 3-12 nm Offshore—US Territory (lbs) CO	NOx	HC	SOx	PM	Emissions >12 nm Offshore—Outside US Territory CO	NOx	HC	SOx	PM	CO	NOx	HC	SOx	PM
	CH-46	369.94	73.84	64.28	7.50	33.36	221.96	44.30	38.57	4.50	20.01	147.97	29.53	25.71	3.00	13.34					
	CH-53	583.36	2212.93	41.08	109.55	605.27	350.02	1327.76	24.65	65.73	363.16	233.34	885.17	16.43	43.82	242.11					
27	MH-60R						47.72	48.87	4.20	3.05	32.07	1543.03	1580.06	135.79	98.75	1036.91					
	HH-60						1.42	1.45	0.12	0.09	0.95	45.83	46.93	4.03	2.93	30.80					
	P-3																				
	FA-18A/C																				
	FA-18E/F																				
	E-2C																				
	EA-6B																				
	Learjet																				
	Unknown																				
28A	MH-60R	210.00	215.04	18.48	13.44	141.12															
29	MH-60R	7425.00	7603.20	653.40	475.20	4989.60	5400.00	5529.60	475.20	345.60	3628.80	675.00	691.20	59.40	43.20	453.60					
30	P-3	13.10	60.70	2.95	2.88	28.59	10.48	48.56	2.36	2.30	22.87	2.62	12.14	0.59	0.58	5.72					
	FA-18A/C	3.24	8.95	0.58	0.53	8.45	2.59	7.16	0.47	0.42	6.76	0.65	1.79	0.12	0.11	1.69					
	FA-18E/F	1.32	17.20	0.18	0.59	9.37	1.06	13.76	0.14	0.48	7.50	0.26	3.44	0.04	0.12	1.87					
34	SH-60F	540.00	552.96	47.52	34.56	362.88															
37	C-130						10.28	17.11	2.47	1.02	10.12	195.25	325.10	47.00	19.38	192.35					
39	SH-60B	72.00	73.73	6.34	4.61	48.38	108.00	110.59	9.50	6.91	72.58	180.00	184.32	15.84	11.52	120.96					
	SH-60F	24.00	24.58	2.11	1.54	16.13	36.00	36.86	3.17	2.30	24.19	60.00	61.44	5.28	3.84	40.32					
	CH-46	424.49	84.73	73.76	8.60	38.28	636.73	127.09	110.64	12.90	57.42	1061.22	211.81	184.40	21.50	95.69					
41	SH-60F	15.00	15.36	1.32	0.96	10.08	15.00	15.36	1.32	0.96	10.08	7.50	7.68	0.66	0.48	5.04					
	FA-18A/C	77.24	213.35	13.93	12.66	201.32	231.71	640.04	41.78	37.98	603.95	463.41	1280.08	83.57	75.97	1207.91					
	FA-19E/F	34.31	446.37	4.63	15.42	243.23	102.92	1339.10	13.88	46.26	729.68	205.84	2678.21	27.75	92.51	1459.37					
	E-2																				
	EA-6B																				
	AH-1	62.73	33.03	3.33	2.38	25.00	62.73	33.03	3.33	2.38	25.00	31.36	16.52	1.67	1.19	12.50					
	AV-8B	2.95	3.29	0.21	0.15	1.45	4.91	5.49	0.34	0.26	2.42	1.97	2.20	0.14	0.10	0.97					
	KC-130																				
	H-53																				
	H-46																				
42	MH-60S	504.00	516.10	44.35	32.26	338.69	504.00	516.10	44.35	32.26	338.69	252.00	258.05	22.18	16.13	169.34					
	FA-18A/C	36.92	101.98	6.66	6.05	96.23	110.75	305.93	19.97	18.16	288.68	221.50	611.86	39.94	36.31	577.36					
	FA-18E/F	16.43	213.81	2.22	7.39	116.50	49.30	641.42	6.65	22.16	349.51	98.59	1282.84	13.29	44.31	699.03					
	E-2																				
44	HH-60	840.00	860.16	73.92	53.76	564.48	504.00	516.10	44.35	32.26	338.69	336.00	344.06	29.57	21.50	225.79					
46	MH-60R						83.52	85.52	7.35	5.35	56.13	276.48	283.12	24.33	17.69	185.79					
48	P-3	43.68	202.32	9.84	9.60	95.28	26.21	121.39	5.90	5.76	57.17	17.47	80.93	3.94	3.84	38.11					
	NC-12B Kinga	434.56	389.61	20.27	35.26	370.21	260.74	233.76	12.16	21.16	222.13	173.82	155.84	8.11	14.10	148.09					
51	MH-60R	6.00	6.14	0.53	0.38	4.03	12.00	12.29	1.06	0.77	8.06	102.00	104.45	8.98	6.53	68.54					
	P-3	13.98	64.74	3.15	3.07	30.49	27.96	129.48	6.30	6.14	60.98	237.62	1100.62	53.53	52.22	518.32					
	FA-18A/C																				
	FA-18E/F																				
	Learjet																				
	Gulfstream																				
	MH-60R	6.00	6.14	0.53	0.38	4.03	12.00	12.29	1.06	0.77	8.06	102.00	104.45	8.98	6.53	68.54					
53	MH-60R	3.00	3.07	0.26	0.19	2.02	4.80	4.92	0.42	0.31	3.23	46.20	47.31	4.07	2.96	31.05					
	P-3	0.87	4.05	0.20	0.19	1.91	1.40	6.47	0.31	0.31	3.05	13.45	62.31	3.03	2.96	29.35					
	Learjet																				
	Other Helo (S-	4.50	0.82	0.47	0.08	0.85	7.20	1.31	0.74	0.14	1.35	69.34	12.64	7.17	1.30	13.03					
Total Emissions (SCI) tons		11.10	11.63	1.06	0.68	6.50	10.85	12.82	1.03	0.75	8.31	29.40	57.41	3.04	2.79	33.91	3.25	2.82	0.61	0.15	1.66
Total Emissions (SD) tons		3.02	4.16	0.35	0.23	1.47	1.29	1.84	0.14	0.10	0.69										

Source: SCORE FY2004 Participants Conversion.xls

Table C-7. Takeoffs/Landings from NALF SCI—No Action Alternative

Aircraft Type	Engine Model	Type of Operation	Baseline Total Number of "Operations"	Emissions per Operation, lbs/operation					Total Emissions, tons/year				
				CO	NOx	HC	SO2	PM10	CO	NOx	HC	SO2	PM10
Navy/Marines													
F/A-18C/D[1]	F404-GE-400		**9,617**										
		Start/Taxi/TO	**961**	69.38	10.23	24.47	0.49	7.04	33.34	4.92	11.76	0.24	3.38
		Touch and Go	**3,845**	0.95	4.77	0.19	0.18	2.55	1.83	9.17	0.37	0.35	4.90
		Arrival with Break	**192**	29.09	2.898	11.728	0.205	4.638	2.79	0.28	1.13	0.02	0.45
		Straight In Arrival	**769**	27.17	2.498	11.118	0.215	4.828	10.45	0.96	4.27	0.08	1.86
		Transit	**4**										
		Total FA-18A/C	**9,617**						**48.41**	**15.33**	**17.53**	**0.68**	**10.59**
F/A-18E/F[1]	F414-GE-400		**3,147**										
		Start/Taxi/TO	**315**	209.67	16.41	31.66	0.58	7.9	32.97	2.58	4.98	0.09	1.24
		Touch and Go	**1,258**	0.47	9.01	0.07	0.22	3.04	0.30	5.67	0.04	0.14	1.91
		Arrival with Break	**63**	22.397	5.732	13.531	0.235	5.2	0.70	0.18	0.43	0.01	0.16
		Straight In Arrival	**252**	20.957	5.462	13.011	0.255	5.61	2.64	0.69	1.64	0.03	0.71
		Transit	**1**										
		Total FA-18E/F	**3,147**						**36.61**	**9.12**	**7.09**	**0.27**	**4.02**
F-14[2]	F110-GE-400		**582**										
		Start/Taxi/TO (assum	**58**	21.41	13.63	4.82	0.71	15.25	0.62	0.40	0.14	0.02	0.44
		Touch and Go	**233**	1.21	4.47	0.5	0.17	2.62	0.14	0.52	0.06	0.02	0.30
		Arrival with Break	**12**	8.87	3.03	2.10	0.29	7.10	0.05	0.02	0.01	0.00	0.04
		Straight In Arrival	**47**	8.05	4.53	1.95	0.34	7.28	0.19	0.11	0.05	0.01	0.17
		Transit	**0**										
		Total F-14	**582**						**1.00**	**1.04**	**0.26**	**0.05**	**0.96**
EA-6B[3]	J52-P-408A		**1,198**										
		Start/Taxi/TO	**120**	30.53	5.51	15.04	0.39	14.03	1.83	0.33	0.90	0.02	0.84
		Touch and Go	**479**	2.95	4.65	0.5	0.24	5.83	0.71	1.11	0.12	0.06	1.40
		Arrival with Break	**0**	19.812	5.426	8.793	0.372	12.367	0.00	0.00	0.00	0.00	0.00
		Straight In Arrival	**120**	19.972	5.526	8.723	0.402	13.357	1.20	0.33	0.52	0.02	0.80
		Total EA-6B	**1,198**						**3.73**	**1.77**	**1.54**	**0.10**	**3.04**
E-2[4]	T56-A-425/427		**603**										
		Start/Taxi/TO	**30**	8.08	3.83	5.56	0.23	2.29	0.12	0.06	0.08	0.00	0.03
		Touch and Go	**263**	0.5	2.85	0.11	0.13	1.26	0.07	0.37	0.01	0.02	0.17
		Arrival with Break	**0**	1.371	3.561	0.478	0.215	6.199	0.00	0.00	0.00	0.00	0.00
		Straight In Arrival	**30**	1.321	2.251	0.468	0.12	4.759	0.02	0.03	0.01	0.00	0.07
		Transit	**17**										
		Total E-2	**603**						**0.21**	**0.47**	**0.11**	**0.02**	**0.27**
C-2[5]	T56-A-425		**402**										
		Start/Taxi/TO	**8**	8.11	3.93	5.57	0.24	2.3	0.03	0.02	0.02	0.00	0.01
		Touch and Go	**0**	0.5	2.85	0.11	0.13	1.26	0.00	0.00	0.00	0.00	0.00
		GCA Box	**386**	0.8	4.2	0.18	0.19	1.9	0.15	0.81	0.03	0.04	0.37
		Straight In Arrival	**8**	1.321	2.251	0.468	0.12	1.225	0.01	0.01	0.00	0.00	0.00
		Total C2	402						**0.19**	**0.84**	**0.06**	**0.04**	**0.38**
P-3[6]	T56-A-16		**201**										
		Start/Taxi/TO	**2**	21.1	12.04	13.46	0.77	5.49	0.02	0.01	0.02	0.00	0.01
		Touch and Go	**0**	0.77	5.67	0.17	0.24	2.42	0.00	0.00	0.00	0.00	0.00
		GCA Box	**197**	1.13	8.7	0.26	0.37	3.69	0.11	0.85	0.03	0.04	0.36
		Straight In Arrival	**2**	16.4	9.17	11.13	0.56	5.29	0.02	0.01	0.01	0.00	0.01
		Total P3	201						**0.15**	**0.88**	**0.05**	**0.04**	**0.37**
C-9[7]	JT8D-9		**789**										
		Start/Taxi/TO	**355**	17.13	11.91	4.68	0.56	16.01	3.04	2.11	0.83	0.10	2.84
		Touch and Go	**0**	3.18	4.83	0.55	0.22	8.1	0.00	0.00	0.00	0.00	0.00
		Straight In Arrival	**355**	16.19	6.71	4.1	0.45	17.1	2.87	1.19	0.73	0.08	3.04
		GCA Box	**79**	5.77	7.2	1.09	0.35	12.87	0.23	0.28	0.04	0.01	0.51

Aircraft Type	Engine Model	Type of Operation	Baseline Total Number of "Operations"	CO	NOx	HC	SO2	PM10	CO	NOx	HC	SO2	PM10
		Total C-9	789						**6.14**	**3.59**	**1.60**	**0.19**	**6.39**
H-3[8]	T58-GE-402		**603**										
		Start/Taxi/TO	**268**	15.63	0.79	5.13	0.1	0.85	2.10	0.11	0.69	0.01	0.11
		Touch and Go	**30**	2.14	0.5	0.36	0.05	0.24	0.03	0.01	0.01	0.00	0.00
		Arrival	**268**	12.491	0.786	3.483	0.097	0.807	1.67	0.11	0.47	0.01	0.11
		Transits	**7**										
		Total H-3	603						**3.80**	**0.22**	**1.16**	**0.03**	**0.23**
H-60[9]	T700-GE-401C		**402**										
		Start/Taxi/TO	**184**	5.16	1.59	0.62	0.12	1.04	0.47	0.15	0.06	0.01	0.10
		Touch and Go	**4**	0.94	1.14	0.09	0.07	0.72	0.00	0.00	0.00	0.00	0.00
		Arrival	**184**	4.595	1.14	0.635	0.095	0.725	0.42	0.10	0.06	0.01	0.07
		Transits	**27**										
		Total H-60	402						**0.90**	**0.25**	**0.12**	**0.02**	**0.16**
AV-8B[10]	F402-RR-408		**201**										
		Start/Taxi/TO	**52**	14.652	2.044	0.916	0.206	5.574	0.38	0.05	0.02	0.01	0.15
		Touch and Go	**48**	4.39	7.33	0.18	0.35	5.08	0.11	0.18	0.00	0.01	0.12
		Arrival	**52**	21.92	3.35	1.33	0.33	8.76	0.57	0.09	0.03	0.01	0.23
		Arrival with Break	**0**	21.57	2.53	1.33	0.28	8.16	0.00	0.00	0.00	0.00	0.00
		Total AV-8B	201						**1.06**	**0.32**	**0.06**	**0.02**	**0.50**
S-3[11]	TF34-GE-400		**2,360**										
		Start/Taxi/TO	**236**	29.92	2.47	5.53	0.25	1.61	3.52	0.29	0.65	0.03	0.19
		Touch and Go	**943**	2.17	0.95	0.26	0.08	0.61	1.02	0.45	0.12	0.04	0.29
		Arrival with Break	**47**	12.905	2.081	2.172	0.199	1.511	0.30	0.05	0.05	0.00	0.04
		Straight In Arrival	**189**	12.325	1.561	2.122	0.169	1.291	1.16	0.15	0.20	0.02	0.12
		Transits	**3**										
		Total S-3	2,360						**6.01**	**0.93**	**1.03**	**0.09**	**0.63**
		TOTAL NAVY/MARINES	**20,105**										
Other Military													
B-1			**298**										
		Departure from Low Approach	**134**	0.708	13.5	0.032	0.787	0.781	0.05	0.91	0.00	0.05	0.05
		GCA Box	**134**	0.373	8.73	0.0168	0.415	0.342	0.03	0.59	0.00	0.03	0.02
		Transit	**30**										
		Total B-1	**298**						**0.07**	**1.49**	**0.00**	**0.08**	**0.08**
F-16			**298**										
		Touch and Go	**119**	1.25	9.06	0.096	0.964	1.25	0.07	0.54	0.01	0.06	0.07
		Arrival with Break	**24**	24.97	3.32	15.97	0.26	5.48	0.30	0.04	0.19	0.00	0.07
		Straight In Arrival	**6**	25.00	3.75	15.99	0.27	5.54	0.07	0.01	0.05	0.00	0.02
		Transit	**30**										
		Total F-16	**298**						**0.45**	**0.59**	**0.24**	**0.06**	**0.16**
T-38			**149**										
		Touch and Go	**60**	1.10	1.87	0.08	0.06	0.52	0.03	0.06	0.00	0.00	0.02
		Arrival with Break	**12**	9.05	2.19	5.43	0.14	2.49	0.05	0.01	0.03	0.00	0.01
		Straight In Arrival	**3**	8.69	2.05	5.28	0.12	2.17	0.01	0.00	0.01	0.00	0.00
		Transit	**15**										
		Total T-38	**149**						**0.10**	**0.07**	**0.04**	**0.00**	**0.03**
		TOTAL OTHER MILITARY	**745**										
Air Carrier													
SW-4[18]	PT6A-45		**3,263**										
		Start/Taxi/TO	**1,632**	0.75	0.49	0.12	0.07	0.08	0.61	0.40	0.10	0.06	0.06
		Straight In Arrival	**1,632**	1.14	0.67	0.12	0.12	0.15	0.93	0.54	0.10	0.10	0.12
		Total SW-4	**3,263**						**1.54**	**0.94**	**0.19**	**0.16**	**0.18**
		TOTAL AIR CARRIER	**3,263**										
Gen. Aviation													
Cessna 421[14]	TSIO-360C		**996**										

Aircraft Type	Engine Model	Type of Operation	Baseline Total Number of "Operations"	CO	NOx	HC	SO2	PM10	CO	NOx	HC	SO2	PM10
		Start/Taxi/TO	**486**	21.39	0.09	1.19	0.01	0.20	5.20	0.02	0.29	0.00	0.05
		Straight In Arrival	**486**	3.99	0.01	0.39	0.00	0.03	0.97	0.00	0.10	0.00	0.01
		Transits	**23**										
		Total Cessna 421	**996**						**6.17**	**0.02**	**0.39**	**0.00**	**0.05**
Piper Navajo[15]	TI0-540		**747**										
		Start/Taxi/TO	**362**	64.41	0.03	1.56	0.01	0.20	11.66	0.01	0.28	0.00	0.04
		Straight In Arrival	**362**	13.83	0.00	0.45	0.00	0.03	2.50	0.00	0.08	0.00	0.00
		Transits	**23**										
		Total Piper Navajo	**747**						**14.16**	**0.01**	**0.36**	**0.00**	**0.04**
Beech King[16]	PT6A-34B		**521**										
		Start/Taxi/TO	**261**	12.42	0.58	10.40	0.17	0.20	1.62	0.08	1.35	0.02	0.03
		Straight In Arrival	**261**	4.01	0.14	3.50	0.04	0.03	0.52	0.02	0.46	0.01	0.00
		Total Beech King	**521**						**2.14**	**0.09**	**1.81**	**0.03**	**0.03**
		TOTAL GENERAL AVIATION	**2,264**										
		GRAND TOTAL	**26,377**	**Total NALF Emissions, tons per year, NAA**					**132.86**	**37.97**	**33.63**	**1.89**	**28.11**

Date: 13-May-2007

NOTES:

1 Start/Taxi/TO: Departure, AESO 9815 Rev E; Touch and Go: Touch and Go, AESO 9933B; Arrival with Break: Arrival with Break, AESO 9815 Rev E; Straight-In Arrival: Arrival, AESO 9815 Rev E

2 Start/Taxi/TO: Departure, AESO 9813 Rev G; Touch and Go: Touch and Go, AESO 9945 Rev B; Arrival with Break: Arrival with Break, AESO 9813 Rev G; Straight-In Arrival: Arrival, AESO 9813 Rev G

3 Start/Taxi/TO: Departure, AESO 9917 Rev B; Touch and Go: Touch and Go, AESO 9941 Rev A; Arrival with Break: Arrival with Break, AESO 9917 Rev B; Straight-In Arrival: Arrival, AESO 9917 Rev B

4 Start/Taxi/TO: Departure, AESO 9920 Rev B; Touch and Go: Touch and Go, AESO 9943 Rev B; Arrival with Break: Arrival with Break, AESO 9920 Rev B; Straight-In Arrival: Arrival, AESO 9920 Rev B

5 Start/Taxi/TO: Departure, AESO 9919 Rev B; Touch and Go: Touch and Go, AESO 9936 Rev B; GCA Box: GCA Box, AESO 9936 Rev B; Straight-In Arrival: Straight Arrival, AESO 9919 Rev B

6 Start/Taxi/TO: Departure, AESO 9911 Rev B; Touch and Go: Touch and Go, AESO 9948 Rev B; Straight-In Arrival: Straight Arrival, AESO 9911 Rev B; GCA Box: GCA Box, AESO 9948 Rev B

7 Start/Taxi/TO: Departure, AESO 9926; Straight-In Arrival: Arrival, AESO 9926; GCA Box: GCA Box, AESO 9942 Rev A, Touch and Go: Touch and Go, AESO 9942 Rev A

8 Start/Taxi/TO: Departure, AESO 9927 Rev A; Touch and Go: Touch and Go, AESO 9934 Rev B; Straight-In Arrival: Straight Arrival, AESO 9927 Rev A

9 Start/Taxi/TO: Departure, AESO 9929; Touch and Go: Touch and Go, AESO 9953; Straight-In Arrival: Straight Arrival, AESO 9929

10 Start/Taxi/TO: Conventional Takeoff, AESO 9913 Rev C; Arrival: Slow Landing without Break, AESO 9913 Rev C; Arrival with Break: Slow Landing with Break, AESO 9913 Rev C, Touch and Go: Touch and Go, AESO 9963 Rev A

11 Start/Taxi/TO: Departure, AESO 9915 Rev A; Touch and Go: Touch and Go, AESO 9954; Arrival with Break: Arrival with Break, AESO 9915 Rev A; Straight-In Arrival: Arrival, AESO 9915 Rev A

14 Straight In Arrival: Assumed 27% of time-in-mode for taxi operations is associated with arrival. Emission factors from AP-42, Volume IV, Table II-1-7, 501D22A, emissions for Idle X 27%, Approach.

Start/Taxi/TO: Assumed 73% of time-in-mode for taxi operations is associated with start/taxi/to. Emission factors from AP-42, Volume IV, Table II-1-7, TSIO-360C, emissions for Idle X 73%, takeoff, and climbout.

15 Straight In Arrival: Assumed 27% of time-in-mode for taxi operations is associated with arrival. Emission factors from AP-42, Volume IV, Table II-1-7, TSIO-360C, emissions for Idle X 27%, Approach.

Start/Taxi/TO: Assumed 73% of time-in-mode for taxi operations is associated with start/taxi/to. Emission factors from AP-42, Volume IV, Table II-1-7, TIO-540, emissions for Idle X 73%, takeoff, and climbout.

16 Straight In Arrival: Assumed 27% of time-in-mode for taxi operations is associated with arrival. Emission factors from AP-42, Volume IV, Table II-1-7, TIO-540, emissions for Idle X 27%, Approach.

17 Start/Taxi/TO: Assumed 73% of time-in-mode for taxi operations is associated with start/taxi/to. Emission factors from AP-42, Volume IV, Table II-1-7, PT6A-41, emissions for Idle X 73%, takeoff, and climbout.

Straight In Arrival: Assumed 27% of time-in-mode for taxi operations is associated with arrival. Emission factors from AP-42, Volume IV, Table II-1-7, PT6A-41, emissions for Idle X 27%, Approach.

Table C-8. Takeoffs/Landings from NALF San Clemente Island—Alternative 1

Aircraft Type	Engine Model	Type of Operation	Total Number of Operations	Emissions per Operation, lbs/operation: CO	NOx	HC	SO2	PM10	Total Emissions, tons/year: CO	NOx	HC	SO2	PM10
Navy/Marines													
F/A-18C/D[1]	F404-GE-400		9,617										
		Start/Taxi/TO	961	69.38	10.23	24.47	0.49	7.04	33.34	4.92	11.76	0.24	3.38
		Touch and Go	3,845	0.95	4.77	0.19	0.18	2.55	1.83	9.17	0.37	0.35	4.90
		Arrival with Break	192	29.09	2.898	11.728	0.205	4.638	2.79	0.28	1.13	0.02	0.45
		Straight In Arrival	769	27.17	2.498	11.118	0.215	4.828	10.45	0.96	4.27	0.08	1.86
		Transit	4										
		Total FA-18A/C	9,617						**48.41**	**15.33**	**17.53**	**0.68**	**10.59**
F/A-18E/F[1]	F414-GE-400		4,196										
		Start/Taxi/TO	419	209.67	16.41	31.66	0.58	7.9	43.96	3.44	6.64	0.12	1.66
		Touch and Go	1,678	0.47	9.01	0.07	0.22	3.04	0.39	7.56	0.06	0.18	2.55
		Arrival with Break	84	22.397	5.732	13.531	0.235	5.2	0.94	0.24	0.57	0.01	0.22
		Straight In Arrival	336	20.957	5.462	13.011	0.255	5.61	3.52	0.92	2.18	0.04	0.94
		Transit	2										
		Total FA-18	4,196						**48.81**	**12.16**	**9.45**	**0.36**	**5.37**
EA-6B[3]	J52-P-408A		1,141										
		Start/Taxi/TO	114	30.53	5.51	15.04	0.39	14.03	1.74	0.31	0.86	0.02	0.80
		Touch and Go	456	2.95	4.65	0.5	0.24	5.83	0.67	1.06	0.11	0.05	1.33
		Arrival with Break	0	19.812	5.426	8.793	0.372	12.367	0.00	0.00	0.00	0.00	0.00
		Straight In Arrival	114	19.972	5.526	8.723	0.402	13.357	1.14	0.31	0.50	0.02	0.76
		Total EA-6B	1,141						**3.55**	**1.69**	**1.47**	**0.10**	**2.89**
E-2[4]	T56-A-425/427		603										
		Start/Taxi/TO	30	8.08	3.83	5.56	0.23	2.29	0.12	0.06	0.08	0.00	0.03
		Touch and Go	263	0.5	2.85	0.11	0.13	1.26	0.07	0.37	0.01	0.02	0.17
		Arrival with Break	0	1.371	3.561	0.478	0.215	6.199	0.00	0.00	0.00	0.00	0.00
		Straight In Arrival	30	1.321	2.251	0.468	0.12	4.759	0.02	0.03	0.01	0.00	0.07
		Transit	17										
		Total E-2	603						**0.21**	**0.47**	**0.11**	**0.02**	**0.27**
C-2[5]	T56-A-425		421										
		Start/Taxi/TO	8	8.11	3.93	5.57	0.24	2.3	0.03	0.02	0.02	0.00	0.01
		Touch and Go	0	0.5	2.85	0.11	0.13	1.26	0.00	0.00	0.00	0.00	0.00
		GCA Box	404	0.8	4.2	0.18	0.19	1.9	0.16	0.85	0.04	0.04	0.38
		Straight In Arrival	8	1.321	2.251	0.468	0.12	1.225	0.01	0.01	0.00	0.00	0.01
		Total C2	421						**0.20**	**0.87**	**0.06**	**0.04**	**0.40**
P-3[5]	T56-A-16		210										
		Start/Taxi/TO	2	21.1	12.04	13.46	0.77	5.49	0.02	0.01	0.02	0.00	0.01
		Touch and Go	0	0.77	5.67	0.17	0.24	2.42	0.00	0.00	0.00	0.00	0.00
		Straight In Arrival	205	1.13	8.7	0.26	0.37	3.69	0.12	0.89	0.03	0.04	0.38
		GCA Box	2	16.4	9.17	11.13	0.56	5.29	0.02	0.01	0.01	0.00	0.01
		Total P3	210						**0.16**	**0.92**	**0.06**	**0.04**	**0.39**
C-9[6]	JT8D-9	338	751										
		Start/Taxi/TO	338	17.13	11.91	4.68	0.56	16.01	2.89	2.01	0.79	0.09	2.71
		Touch and Go	0	3.18	4.83	0.55	0.22	8.1	0.00	0.00	0.00	0.00	0.00
		Straight In Arrival	338	16.19	6.71	4.1	0.45	17.1	2.74	1.13	0.69	0.08	2.89
		GCA Box	75	5.77	7.2	1.09	0.35	12.87	0.22	0.27	0.04	0.01	0.48
		Total C-9	751						**5.85**	**3.42**	**1.52**	**0.18**	**6.08**
H-3[8]	T58-GE-402		402										
		Start/Taxi/TO	179	15.63	0.79	5.13	0.1	0.85	1.40	0.07	0.46	0.01	0.08
		Touch and Go	20	2.14	0.5	0.36	0.05	0.24	0.02	0.00	0.00	0.00	0.00
		Arrival	179	12.491	0.786	3.483	0.097	0.807	1.12	0.07	0.31	0.01	0.07
		Transits	5										
		Total C2	402						**2.53**	**0.15**	**0.77**	**0.02**	**0.15**
H-60[9]	T700-GE-401C		517										
		Start/Taxi/TO	236	5.16	1.59	0.62	0.12	1.04	0.61	0.19	0.07	0.01	0.12
		Touch and Go	5	0.94	1.14	0.09	0.07	0.72	0.00	0.00	0.00	0.00	0.00
		Arrival	236	4.595	1.14	0.635	0.095	0.725	0.54	0.13	0.08	0.01	0.09

Aircraft Type	Engine Model	Type of Operation	Total Number of Operations	Emissions per Operation, lbs/operation: CO	NOx	HC	SO2	PM10	Total Emissions, tons/year: CO	NOx	HC	SO2	PM10
		Transits	34										
		Total H-60	517						**1.15**	**0.33**	**0.15**	**0.03**	**0.21**
AV-8B[10]	F402-RR-408		764										
		Start/Taxi/TO	199	14.652	2.044	0.916	0.206	5.574	1.46	0.20	0.09	0.02	0.55
		Touch and Go	183	4.39	7.33	0.18	0.35	5.08	0.40	0.67	0.02	0.03	0.47
		Arrival	199	21.92	3.35	1.33	0.33	8.76	2.18	0.33	0.13	0.03	0.87
		Arrival with Break	0	21.57	2.53	1.33	0.28	8.16	0.00	0.00	0.00	0.00	0.00
		Total AV-8B	764						**4.03**	**1.21**	**0.24**	**0.09**	**1.89**
F-35	F135-PW-100		100										
		Start/Taxi/TO	0						0.00	0.00	0.00	0.00	0.00
		Touch and Go	50	0.94	22.88	0.19	0.91	4.33	0.02	0.57	0.00	0.02	0.11
		Arrival	0						0.00	0.00	0.00	0.00	0.00
		Transits	0										
		Total H-60	100						**0.02**	**0.57**	**0.00**	**0.02**	**0.11**
S-3[11]	TF34-GE-400		0										
		Start/Taxi/TO	0	29.92	2.47	5.53	0.25	1.61	0.00	0.00	0.00	0.00	0.00
		Touch and Go	0	2.17	0.95	0.26	0.08	0.61	0.00	0.00	0.00	0.00	0.00
		Arrival with Break	0	12.905	2.081	2.172	0.199	1.511	0.00	0.00	0.00	0.00	0.00
		Straight In Arrival	0	12.325	1.561	2.122	0.169	1.291	0.00	0.00	0.00	0.00	0.00
		Transits	0										
		Total S-3	0						**0.00**	**0.00**	**0.00**	**0.00**	**0.00**
Other Military													
KC-135[11]	F108-100		48										
		Departure from L	22	0.708	13.5	0.032	0.787	0.781	0.01	0.15	0.00	0.01	0.01
		GCA Box	22	0.373	8.73	0.0168	0.415	0.342	0.00	0.09	0.00	0.00	0.00
		Transit	5										
		Total KC-135	48						**0.01**	**0.24**	**0.00**	**0.01**	**0.01**
KC-10	CF6-50C2		100										
		Departure from L	45	20.98	49.41	2.53	2.54	0.33	0.47	1.11	0.06	0.06	0.01
		GCA Box	45	24.03	11.49	2.60	1.71	0.01	0.54	0.26	0.06	0.04	0.00
		Transit	10										
		Total KC-10	100						**1.01**	**1.37**	**0.12**	**0.10**	**0.01**
C-17	F117-PW-100		200										
		Start/Taxi/TO	100	23.54	64.03	2.24	1.52	0.02	1.18	3.20	0.11	0.08	0.00
		Straight In Arrival	100	25.09	17.40	2.44	1.10	0.01	1.25	0.87	0.12	0.05	0.00
		Total C-17	200						**2.43**	**4.07**	**0.23**	**0.13**	**0.00**
B-1	F108-100		398										
		Departure from Low Approach	179	0.708	13.5	0.032	0.787	0.781	0.06	1.21	0.00	0.07	0.07
		GCA Box	179	0.373	8.73	0.0168	0.415	0.342	0.03	0.78	0.00	0.04	0.03
		Transit	40										
		Total KC-135	398						**0.10**	**1.99**	**0.00**	**0.11**	**0.10**
E-3[12] or F-16	TF33-100A		315										
		Touch and Go	126	1.25	9.06	0.096	0.964	1.25	0.08	0.57	0.01	0.06	0.08
		Arrival with Break	25	24.97	3.32	15.97	0.26	5.48	0.31	0.04	0.20	0.00	0.07
		Straight In Arrival	6	25.00	3.75	15.99	0.27	5.54	0.08	0.01	0.05	0.00	0.02
		Transit	32										
		Total F-16	315						**0.47**	**0.62**	**0.26**	**0.06**	**0.17**
T-38			158										
		Touch and Go	63	1.10	1.87	0.08	0.06	0.52	0.03	0.06	0.00	0.00	0.02
		Arrival with Break	13	9.05	2.19	5.43	0.14	2.49	0.06	0.01	0.03	0.00	0.02
		Straight In Arrival	3	8.69	2.05	5.28	0.12	2.17	0.01	0.00	0.01	0.00	0.00
		Transit	16										
		Total T-38	158						**0.11**	**0.08**	**0.05**	**0.00**	**0.04**
Air Carrier													
SW-4[17]	PT6A-45		5,284										
		Start/Taxi/TO	2,642	0.75	0.49	0.12	0.07	0.08	1.00	0.65	0.15	0.10	0.10
		Straight In Arrival	2,642	1.14	0.67	0.12	0.12	0.15	1.50	0.88	0.16	0.16	0.20
		Total SW-4	5,284						**2.50**	**1.53**	**0.31**	**0.25**	**0.30**
Gen. Aviation													

Aircraft Type	Engine Model	Type of Operation	Total Number of Operations	Emissions per Operation, lbs/operation CO	NOx	HC	SO2	PM10	Total Emissions, tons/year CO	NOx	HC	SO2	PM10
Cessna 421[14]	TSIO-360C		1,424										
		Start/Taxi/TO	695	21.387	0.086943	1.1906	0.006083	0.196921	7.43	0.03	0.41	0.00	0.07
		Straight In Arrival	695	3.993	0.011157	0.3929	0.001577	0.026279	1.39	0.00	0.14	0.00	0.01
		Transits	34										
		Total Cessna 421	1,424						**8.82**	**0.03**	**0.55**	**0.00**	**0.08**
Piper Navajo[15]	TI0-540		1,067										
		Start/Taxi/TO	517	64.413	0.030849	1.5634	0.012659	0.196921	16.65	0.01	0.40	0.00	0.05
		Straight In Arrival	517	13.827	0.003841	0.4531	0.003174	0.026279	3.57	0.00	0.12	0.00	0.01
		Transits	33										
		Total Piper Navajo	1,067						**20.23**	**0.01**	**0.52**	**0.00**	**0.06**
Beech King[16]	PT6A-34B		744										
		Start/Taxi/TO	372	12.416	0.58223	10.397	0.1746	0.196921	2.31	0.11	1.93	0.03	0.04
		Straight In Arrival	372	4.0123	0.13557	3.4978	0.0436	0.026279	0.75	0.03	0.65	0.01	0.00
		Total Beech King	744						**3.06**	**0.13**	**2.58**	**0.04**	**0.04**
		Total Operation	**28460**	**Total NALF Emissions, tons per year, Alt 1**					**153.67**	**47.18**	**35.98**	**2.30**	**29.14**

Date: 13-May-2007

NOTES:

1 Start/Taxi/TO: Departure, AESO 9815 Rev E; Touch and Go: Touch and Go, AESO 9933B; Arrival with Break: Arrival with Break, AESO 9815 Rev E; Straight-In Arrival: Arrival, AESO 9815 Rev E

2 Start/Taxi/TO: Departure, AESO 9917 Rev B; Touch and Go: Touch and Go, AESO 9941 Rev A; Arrival with Break: Arrival with Break, AESO 9917 Rev B; Straight-In Arrival: Arrival, AESO 9917 Rev B

3 Start/Taxi/TO: Departure, AESO 9920 Rev B; Touch and Go: Touch and Go, AESO 9943 Rev B; Arrival with Break: Arrival with Break, AESO 9920 Rev B; Straight-In Arrival: Arrival, AESO 9920 Rev B

4 Start/Taxi/TO: Departure, AESO 9919 Rev B; Touch and Go: Touch and Go, AESO 9936 Rev B; GCA Box: GCA Box, AESO 9936 Rev B; Straight-In Arrival: Straight Arrival, AESO 9919 Rev B

5 Start/Taxi/TO: Departure, AESO 9911 Rev B; Touch and Go: Touch and Go, AESO 9948 Rev B; Straight-In Arrival: Straight Arrival, AESO 9911 Rev B; GCA Box: GCA Box, AESO 9948 Rev B

6 Start/Taxi/TO: Departure, AESO 9926; Straight-In Arrival: Arrival, AESO 9926; GCA Box: GCA Box, AESO 9942 Rev A, Touch and Go: Touch and Go, AESO 9942 Rev A

7 Start/Taxi/TO: Departure, AESO 9927 Rev A; Touch and Go: Touch and Go, AESO 9934 Rev B; Straight-In Arrival: Straight Arrival, AESO 9927 Rev A

8 Start/Taxi/TO: Departure, AESO 9929; Touch and Go: Touch and Go, AESO 9953; Straight-In Arrival: Straight Arrival, AESO 9929

9 Start/Taxi/TO: Conventional Takeoff, AESO 9913 Rev C; Arrival: Slow Landing without Break, AESO 9913 Rev C; Arrival with Break: Slow Landing with Break, AESO 9913 Rev C, Touch and Go: Touch and Go, AESO 9963 Rev A

10 Start/Taxi/TO: Departure, AESO 9915 Rev A; Touch and Go: Touch and Go, AESO 9954; Arrival with Break: Arrival with Break, AESO 9915 Rev A; Straight-In Arrival: Arrival, AESO 9915 Rev A

11 Departure from Low Approach: Departure, AESO Memorandum 2000-09 Rev B; GCA Box: GCA Box, AESO Memorandum 2000-10, Rev B.

12 To be Provided

13 Start/Taxi/TO: Assumed 73% of time-in-mode for taxi operations is associated with start/taxi/to. Emission factors from AP-42, Volume IV, Table II-1-7, 501D22A, emissions for Idle X 73%, takeoff, and climbout.
Straight In Arrival: Assumed 27% of time-in-mode for taxi operations is associated with arrival. Emission factors from AP-42, Volume IV, Table II-1-7, 501D22A, emissions for Idle X 27%, Approach.

14 Start/Taxi/TO: Assumed 73% of time-in-mode for taxi operations is associated with start/taxi/to. Emission factors from AP-42, Volume IV, Table II-1-7, TSIO-360C, emissions for Idle X 73%, takeoff, and climbout.
Straight In Arrival: Assumed 27% of time-in-mode for taxi operations is associated with arrival. Emission factors from AP-42, Volume IV, Table II-1-7, TSIO-360C, emissions for Idle X 27%, Approach.

15 Start/Taxi/TO: Assumed 73% of time-in-mode for taxi operations is associated with start/taxi/to. Emission factors from AP-42, Volume IV, Table II-1-7, TIO-540, emissions for Idle X 73%, takeoff, and climbout.
Straight In Arrival: Assumed 27% of time-in-mode for taxi operations is associated with arrival. Emission factors from AP-42, Volume IV, Table II-1-7, TIO-540, emissions for Idle X 27%, Approach.

16 Start/Taxi/TO: Assumed 73% of time-in-mode for taxi operations is associated with start/taxi/to. Emission factors from AP-42, Volume IV, Table II-1-7, PT6A-41, emissions for Idle X 73%, takeoff, and climbout.
Straight In Arrival: Assumed 27% of time-in-mode for taxi operations is associated with arrival. Emission factors from AP-42, Volume IV, Table II-1-7, PT6A-41, emissions for Idle X 27%, Approach.

17 Start/Taxi/TO: Assumed SW4 is represented by Fairchild SA-227 Metroliner, emissions from EDMS.

Table C-9. Takeoffs/Landings from NALF San Clemente Island—Alternative 2

Aircraft Type	Engine Model	Type of Operation	Total Number of Operations	Emissions per Operation, lbs/operation CO	NOx	HC	SO2	PM10	Total Emissions, tons/year CO	NOx	HC	SO2	PM10
		GRAND TOTAL	**25,120**										
Navy/Marines													
F/A-18C/D[1]	F404-GE-400		9,617										
		Start/Taxi/TO	961	69.38	10.23	24.47	0.49	7.04	33.34	4.92	11.76	0.24	3.38
		Touch and Go	3,845	0.95	4.77	0.19	0.18	2.55	1.83	9.17	0.37	0.35	4.90
		Arrival with Break	192	29.09	2.898	11.728	0.205	4.638	2.79	0.28	1.13	0.02	0.45
		Straight In Arrival	769	27.17	2.498	11.118	0.215	4.828	10.45	0.96	4.27	0.08	1.86
		Transit	4										
		Total FA-18	9,617						**48.41**	**15.33**	**17.53**	**0.68**	**10.59**
F/A-18E/F[1]	F414-GE-400		4,496										
		Start/Taxi/TO	449	209.67	16.41	31.66	0.58	7.9	47.11	3.69	7.11	0.13	1.77
		Touch and Go	1,798	0.47	9.01	0.07	0.22	3.04	0.42	8.10	0.06	0.20	2.73
		Arrival with Break	90	22.397	5.732	13.531	0.235	5.2	1.01	0.26	0.61	0.01	0.23
		Straight In Arrival	360	20.957	5.462	13.011	0.255	5.61	3.77	0.98	2.34	0.05	1.01
		Transit	2										
		Total FA-18	4,496						**52.30**	**13.03**	**10.12**	**0.38**	**5.75**
EA-6B[3]	J52-P-408A		1,255										
		Start/Taxi/TO	125	30.53	5.51	15.04	0.39	14.03	1.91	0.35	0.94	0.02	0.88
		Touch and Go	502	2.95	4.65	0.5	0.24	5.83	0.74	1.17	0.13	0.06	1.46
		Arrival with Break	0	19.812	5.426	8.793	0.372	12.367	0.00	0.00	0.00	0.00	0.00
		Straight In Arrival	125	19.972	5.526	8.723	0.402	13.357	1.25	0.35	0.55	0.03	0.84
		Total EA-6B	1,255						**3.91**	**1.86**	**1.62**	**0.11**	**3.18**
E-2[4]	T56-A-425/427		660										
		Start/Taxi/TO	33	8.08	3.83	5.56	0.23	2.29	0.13	0.06	0.09	0.00	0.04
		Touch and Go	288	0.5	2.85	0.11	0.13	1.26	0.07	0.41	0.02	0.02	0.18
		Arrival with Break	0	1.371	3.561	0.478	0.215	6.199	0.00	0.00	0.00	0.00	0.00
		Straight In Arrival	33	1.321	2.251	0.468	0.12	4.759	0.02	0.04	0.01	0.00	0.08
		Transit	18										
		Total E-2	660						**0.23**	**0.51**	**0.12**	**0.02**	**0.30**
C-2[5]	T56-A-425		460										
		Start/Taxi/TO	9	8.11	3.93	5.57	0.24	2.3	0.04	0.02	0.03	0.00	0.01
		Touch and Go	0	0.5	2.85	0.11	0.13	1.26	0.00	0.00	0.00	0.00	0.00
		GCA Box	442	0.8	4.2	0.18	0.19	1.9	0.18	0.93	0.04	0.04	0.42
		Straight In Arrival	9	1.321	2.251	0.468	0.12	1.225	0.01	0.01	0.00	0.00	0.01
		Total C2	460						**0.22**	**0.96**	**0.07**	**0.04**	**0.44**
P-3[5]	T56-A-16		229										
		Start/Taxi/TO	3	21.1	12.04	13.46	0.77	5.49	0.03	0.02	0.02	0.00	0.01
		Touch and Go	0	0.77	5.67	0.17	0.24	2.42	0.00	0.00	0.00	0.00	0.00
		Straight In Arrival	224	1.13	8.7	0.26	0.37	3.69	0.13	0.97	0.03	0.04	0.41
		GCA Box	3	16.4	9.17	11.13	0.56	5.29	0.02	0.01	0.01	0.00	0.01
		Total P3	229						**0.17**	**1.00**	**0.06**	**0.04**	**0.43**
C-9[6]	JT8D-9		826										
		Start/Taxi/TO	372	17.13	11.91	4.68	0.56	16.01	3.18	2.21	0.87	0.10	2.98
		Touch and Go	0	3.18	4.83	0.55	0.22	8.1	0.00	0.00	0.00	0.00	0.00
		Straight In Arrival	372	16.19	6.71	4.1	0.45	17.1	3.01	1.25	0.76	0.08	3.18
		GCA Box	83	5.77	7.2	1.09	0.35	12.87	0.24	0.30	0.05	0.01	0.53
		Total C-9	826						**6.43**	**3.76**	**1.68**	**0.20**	**6.69**
H-3[8]	T58-GE-402		431										
		Start/Taxi/TO	192	15.63	0.79	5.13	0.1	0.85	1.50	0.08	0.49	0.01	0.08
		Touch and Go	21	2.14	0.5	0.36	0.05	0.24	0.02	0.01	0.00	0.00	0.00
		Arrival	192	12.491	0.786	3.483	0.097	0.807	1.20	0.08	0.33	0.01	0.08
		Transits	5										
		Total C2	431						**2.72**	**0.16**	**0.83**	**0.02**	**0.16**
H-60[9]	T700-GE-401C		536										
		Start/Taxi/TO	245	5.16	1.59	0.62	0.12	1.04	0.63	0.19	0.08	0.01	0.13
		Touch and Go	5	0.94	1.14	0.09	0.07	0.72	0.00	0.00	0.00	0.00	0.00

Aircraft Type	Engine Model	Type of Operation	Total Number of Operations	Emissions per Operation, lbs/operation					Total Emissions, tons/year				
				CO	NOx	HC	SO2	PM10	CO	NOx	HC	SO2	PM10
		Arrival	245	4.595	1.14	0.635	0.095	0.725	0.56	0.14	0.08	0.01	0.09
		Transits	35										
		Total H-60	536						**1.20**	**0.34**	**0.15**	**0.03**	**0.22**
AV-8B[10]	F402-RR-408		1,146										
		Start/Taxi/TO	298	14.652	2.044	0.916	0.206	5.574	2.18	0.30	0.14	0.03	0.83
		Touch and Go	275	4.39	7.33	0.18	0.35	5.08	0.60	1.01	0.02	0.05	0.70
		Arrival	298	21.92	3.35	1.33	0.33	8.76	3.27	0.50	0.20	0.05	1.31
		Arrival with Break	0	21.57	2.53	1.33	0.28	8.16	0.00	0.00	0.00	0.00	0.00
		Total AV-8B	1,146						**6.05**	**1.81**	**0.36**	**0.13**	**2.83**
F-35	F135-PW-100		200										
		Start/Taxi/TO	0						0.00	0.00	0.00	0.00	0.00
		Touch and Go	100	0.94	22.88	0.19	0.91	4.33	0.05	1.14	0.01	0.05	0.22
		Arrival	0						0.00	0.00	0.00	0.00	0.00
		Transits	0										
		Total H-60	200						**0.05**	**1.14**	**0.01**	**0.05**	**0.22**
S-3[10]	TF34-GE-400		0										
		Start/Taxi/TO	0	29.92	2.47	5.53	0.25	1.61	0.00	0.00	0.00	0.00	0.00
		Touch and Go	0	2.17	0.95	0.26	0.08	0.61	0.00	0.00	0.00	0.00	0.00
		Arrival with Break	0	12.905	2.081	2.172	0.199	1.511	0.00	0.00	0.00	0.00	0.00
		Straight In Arrival	0	12.325	1.561	2.122	0.169	1.291	0.00	0.00	0.00	0.00	0.00
		Transits	0										
		Total S-3	0						**0.00**	**0.00**	**0.00**	**0.00**	**0.00**
Other Military													
KC-135[11]	F108-100		30										
		Departure from Lo	14	0.708	13.5	0.032	0.787	0.781	0.00	0.09	0.00	0.01	0.01
		GCA Box	14	0.373	8.73	0.0168	0.415	0.342	0.00	0.06	0.00	0.00	0.00
		Transit	3										
		Total KC-135	30						**0.01**	**0.15**	**0.00**	**0.01**	**0.01**
KC-10	CF6-50C2		100										
		Departure from Lo	45	20.98	49.41	2.53	2.54	0.33	0.47	1.11	0.06	0.06	0.01
		GCA Box	45	24.03	11.49	2.60	1.71	0.01	0.54	0.26	0.06	0.04	0.00
		Transit	10										
		Total KC-10	100						**1.01**	**1.37**	**0.12**	**0.10**	**0.01**
C-17	F117-PW-100		400										
		Start/Taxi/TO	200	23.54	64.03	2.24	1.52	0.02	2.35	6.40	0.22	0.15	0.00
		Straight In Arrival	200	25.09	17.40	2.44	1.10	0.01	2.51	1.74	0.24	0.11	0.00
		Total C-17	400						**4.86**	**8.14**	**0.47**	**0.26**	**0.00**
B-1	F108-100		426										
		Departure from Low Approach	192	0.708	13.5	0.032	0.787	0.781	0.07	1.29	0.00	0.08	0.07
		GCA Box	192	0.373	8.73	0.0168	0.415	0.342	0.04	0.84	0.00	0.04	0.03
		Transit	43						**0.10**	**2.13**	**0.00**	**0.12**	**0.11**
		Total B-1	426										
E-3[12] or F-16	TF33-100A		355										
		Touch and Go	142	1.25	9.06	0.096	0.964	1.25	0.09	0.64	0.01	0.07	0.09
		Arrival with Break	28	24.97	3.32	15.97	0.26	5.48	0.35	0.05	0.23	0.00	0.08
		Straight In Arrival	7	25.00	3.75	15.99	0.27	5.54	0.09	0.01	0.06	0.00	0.02
		Transit	36										
		Total F-16	355						**0.53**	**0.70**	**0.29**	**0.07**	**0.19**
T-38			178										
		Touch and Go	71	1.10	1.87	0.08	0.06	0.52	0.04	0.07	0.00	0.00	0.02
		Arrival with Break	14	9.05	2.19	5.43	0.14	2.49	0.06	0.02	0.04	0.00	0.02
		Straight In Arrival	4	8.69	2.05	5.28	0.12	2.17	0.02	0.00	0.01	0.00	0.00
		Transit	18										
		Total T-38	178						**0.12**	**0.09**	**0.05**	**0.00**	**0.04**
Air Carrier													
SW-4[17]	PT6A-45		6,838										
		Start/Taxi/TO	3,419	0.75	0.49	0.12	0.07	0.08	1.29	0.84	0.20	0.12	0.13
		Straight In Arrival	3,419	1.14	0.67	0.12	0.12	0.15	1.94	1.14	0.20	0.20	0.25
		Total SW-4	6,838						**3.23**	**1.98**	**0.40**	**0.33**	**0.39**

Aircraft Type	Engine Model	Type of Operation	Total Number of Operations	Emissions per Operation, lbs/operation					Total Emissions, tons/year				
				CO	NOx	HC	SO2	PM10	CO	NOx	HC	SO2	PM10
Gen. Aviation													
Cessna 421[14]	TSIO-360C		1,518										
		Start/Taxi/TO	741	21.387	0.086943	1.1906	0.006083	0.196921	7.93	0.03	0.44	0.00	0.07
		Straight In Arrival	741	3.993	0.011157	0.3929	0.001577	0.026279	1.48	0.00	0.15	0.00	0.01
		Transits	36										
		Total Cessna 421	1,518						**9.41**	**0.04**	**0.59**	**0.00**	**0.08**
Piper Navajo[15]	TI0-540		1,138										
		Start/Taxi/TO	551	64.413	0.030849	1.5634	0.012659	0.196921	17.76	0.01	0.43	0.00	0.05
		Straight In Arrival	551	13.827	0.003841	0.4531	0.003174	0.026279	3.81	0.00	0.12	0.00	0.01
		Transits	35										
		Total Piper Navajo	1,138						**21.57**	**0.01**	**0.56**	**0.00**	**0.06**
Beech King[16]	PT6A-34B		789										
		Start/Taxi/TO	395	12.416	0.58223	10.397	0.1746	0.196921	2.45	0.11	2.05	0.03	0.04
		Straight In Arrival	395	4.0123	0.13557	3.4978	0.0436	0.026279	0.79	0.03	0.69	0.01	0.01
		Total Beech King	789						**3.24**	**0.14**	**2.74**	**0.04**	**0.04**
			31628	**Total NALF Emissions, tons per year, Alt 2**					**165.78**	**54.63**	**37.75**	**2.65**	**31.72**

Date: 13-May-2007

NOTES:

1 Start/Taxi/TO: Departure, AESO 9815 Rev E; Touch and Go: Touch and Go, AESO 9933B; Arrival with Break: Arrival with Break, AESO 9815 Rev E; Straight-In Arrival: Arrival, AESO 9815 Rev E

2 Start/Taxi/TO: Departure, AESO 9917 Rev B; Touch and Go: Touch and Go, AESO 9941 Rev A; Arrival with Break: Arrival with Break, AESO 9917 Rev B; Straight-In Arrival: Arrival, AESO 9917 Rev B

3 Start/Taxi/TO: Departure, AESO 9920 Rev B; Touch and Go: Touch and Go, AESO 9943 Rev B; Arrival with Break: Arrival with Break, AESO 9920 Rev B; Straight-In Arrival: Arrival, AESO 9920 Rev B

4 Start/Taxi/TO: Departure, AESO 9919 Rev B; Touch and Go: Touch and Go, AESO 9936 Rev B; GCA Box: GCA Box, AESO 9936 Rev B; Straight-In Arrival: Straight Arrival, AESO 9919 Rev B

5 Start/Taxi/TO: Departure, AESO 9911 Rev B; Touch and Go: Touch and Go, AESO 9948 Rev B; Straight-In Arrival: Straight Arrival, AESO 9911 Rev B; GCA Box: GCA Box, AESO 9948 Rev B

6 Start/Taxi/TO: Departure, AESO 9926; Straight-In Arrival: Arrival, AESO 9926; GCA Box: GCA Box, AESO 9942 Rev A, Touch and Go: Touch and Go, AESO 9942 Rev A

7 Start/Taxi/TO: Departure, AESO 9927 Rev A; Touch and Go: Touch and Go, AESO 9934 Rev B; Straight-In Arrival: Straight Arrival, AESO 9927 Rev A

8 Start/Taxi/TO: Departure, AESO 9929; Touch and Go: Touch and Go, AESO 9953; Straight-In Arrival: Straight Arrival, AESO 9929

9 Start/Taxi/TO: Conventional Takeoff, AESO 9913 Rev C; Arrival: Slow Landing without Break, AESO 9913 Rev C; Arrival with Break: Slow Landing with Break, AESO 9913 Rev C, Touch and Go: Touch and Go, AESO 9963 Rev A

10 Start/Taxi/TO: Departure, AESO 9915 Rev A; Touch and Go: Touch and Go, AESO 9954; Arrival with Break: Arrival with Break, AESO 9915 Rev A; Straight-In Arrival: Arrival, AESO 9915 Rev A

11 Departure from Low Approach: Departure, AESO Memorandum 2000-09 Rev B; GCA Box: GCA Box, AESO Memorandum 2000-10, Rev B.

12 To be Provided

13 Start/Taxi/TO: Assumed 73% of time-in-mode for taxi operations is associated with start/taxi/to. Emission factors from AP-42, Volume IV, Table II-1-7, 501D22A, emissions for Idle X 73%, takeoff, and climbout.
Straight In Arrival: Assumed 27% of time-in-mode for taxi operations is associated with arrival. Emission factors from AP-42, Volume IV, Table II-1-7, 501D22A, emissions for Idle X 27%, Approach.

14 Start/Taxi/TO: Assumed 73% of time-in-mode for taxi operations is associated with start/taxi/to. Emission factors from AP-42, Volume IV, Table II-1-7, TSIO-360C, emissions for Idle X 73%, takeoff, and climbout.
Straight In Arrival: Assumed 27% of time-in-mode for taxi operations is associated with arrival. Emission factors from AP-42, Volume IV, Table II-1-7, TSIO-360C, emissions for Idle X 27%, Approach.

15 Start/Taxi/TO: Assumed 73% of time-in-mode for taxi operations is associated with start/taxi/to. Emission factors from AP-42, Volume IV, Table II-1-7, TIO-540, emissions for Idle X 73%, takeoff, and climbout.
Straight In Arrival: Assumed 27% of time-in-mode for taxi operations is associated with arrival. Emission factors from AP-42, Volume IV, Table II-1-7, TIO-540, emissions for Idle X 27%, Approach.

16 Start/Taxi/TO: Assumed 73% of time-in-mode for taxi operations is associated with start/taxi/to. Emission factors from AP-42, Volume IV, Table II-1-7, PT6A-41, emissions for Idle X 73%, takeoff, and climbout.
Straight In Arrival: Assumed 27% of time-in-mode for taxi operations is associated with arrival. Emission factors from AP-42, Volume IV, Table II-1-7, PT6A-41, emissions for Idle X 27%, Approach.

17 Start/Taxi/TO: Assumed SW4 is represented by Fairchild SA-227 Metroliner, emissions from EDMS.

Table C-10. SOCAL Ordnance Expenditures—No Action Alternative

NOTE: Units of Measure (UOM) for ordnance rounds are 1 each (ea.) and for Demolitions and Other Ordnance are in pounds Net Explosive Weight (NEW).

								Emission Factor (lb per lb or lb per item)							Emissions, tons/year						
Ordnance Group	AQ Data	Ordnance Type	Fate	Quantity Fired	Consolidated Nos.	NEW ea.	UOM/ Cum NEW	CO2	CO	Nox	PM10	PM2.5	SO2	Lead	CO2	CO	Nox	PM10	PM2.5	SO2	Lead
BOMB		CBU MK20 ROCKEYE	Clusters Explode Underwater	13		99	ea.														
	No Data	GBU32I JDAM	Clusters Explode Underwater	9		385	ea.														
	No Data	LGTR	Rocket fires Inert warhead	103		0	ea.														
		MK76	Only small spotting charge	1,496		Neg.	ea.														
	No Data	BDU 48	Only small spotting charge	93		Neg.	ea.														
		MK82 HE	31 in water; 383 on land	418		192	ea.		0.3184						0	12.77676	0	0	0	0	0
	No Data	GBU12 500 lb	6 in water; 6 on land	12		192	ea.														
	NA	MK82 INERT	No emissions	18		0	ea.														
	No Data	BDU 45		162		0	ea.														
		MK83 HE		116		445	ea.		0.1482						0	3.825042	0	0	0	0	0
	No Data	GBU 16	14 in water; 14 on land	28		445	ea.														
	NA	MK83 INERT		93		0	ea.														
		Total:		2,561	0																
OTHER ORD	No AQ data	Type		No.		NEW															
	CNAP & SPAWAR	EER/IEER AN/SQQ-110	Explode deep in water			4.2	0	1.2	0.0044	0.011				0.00004	0	0	0	0	0	0	0
	No Data	BLASTING CAP MK11	On Land only	1,113		Neg.	0														
		Detonator		120																	
	No Data	FIRING DEVICE	2 in water; 48 on land	54		Neg.	0														
	No Data	FUSE	6 in water; 94 on land	1,080		Neg.	0														
		GRENADE SIMULATOR	Land	290		0.0813	23.6	6.30E-01	0.021	6.30E-03	2.10E-02	1.50E-02	1.20E-04	1.40E-04	0.007427	0.000248	7.42676E-05	0.000248	0.000177	1.41462E-06	1.65E-06
		Grenades	Land	896		0.0813	72.8	6.30E-01	0.021	6.30E-03	2.10E-02	1.50E-02	1.20E-04	1.40E-04	0.022946	0.000765	0.000229461	0.000765	0.000546	4.37069E-06	5.1E-06
		Haversacks		75		20.0000	1500.0	6.30E-01	0.021	6.30E-03	2.10E-02	1.50E-02	1.20E-04	1.40E-04							
		K143 Antipersonnel Mine		124																	
	No Data	M1A2 BANGALORE TORP	Land	109		10.00	1090								0	0	0	0	0	0	0
		M7 BANDOLEER MK57 (Claymore mine)	Land	40		8.16	326.4		0.15108						0	0.024656	0	0	0	0	0
	AP-42	M112 DEMO CHARGE	Land	105		1.20	126	7.90E-01	2.60E-02	7.90E-03	2.60E-02	1.90E-02		1.70E-04	0.04977	0.001638	0.0004977	0.001638	0.001197	0	1.07E-05
	No Data	M700 BLASTING FUSE	Land	1,000		0.001	1														
	No Data	MK20 Cable Cutter	Land	69		0.0028	0.2														
	No Data	MK22 Projectile Unit	Land	105		Neg.	Neg.														
	No Data	MK36 M0 DEMO CHARGE	Land	30		4.10	123								0	0	0	0	0	0	0
	No Data	MK75 CHARGE	In Shallow water	105		50.00	5,250								0	0	0	0	0	0	0
	No Data	MK84 [86] EOD Shaped Charge	On Land only	109		0.08	8.72								0	0	0	0	0	0	0
	No Data	MK120 NONELEC DET (ft)	On Land only	512		0.00001	0.0073														
	No Data	MK123 NONELEC DET (ft)	On Land only	2,120		0.00001	0.0303														
	No Data	MK138 DEMO CHG ASSEMBLY	In water			20.00	0	6.30E-01	0.021	6.30E-03	2.10E-02	1.50E-02	1.20E-04	1.40E-04	0	0	0	0	0	0	0
	No Data	MK140 FLEXIBLE CHARGE	On Land only	150		0.04	6.6														
	No Data	PBXN-109 TEST Det Cord	On Land only	16		0.0060	0.096														
	No Data	SIGNAL MK 18(G950) SMOKE	On Land only	355		0.23	82.786														
	No Data	C4 1.25 LB	98 in water; 19,156 on land	19,260		1.25	24075	6.30E-01	0.021	6.30E-03	2.10E-02	1.50E-02	1.20E-04	1.40E-04	7.58E+00	0.252788	0.07583625	0.252788	0.180563	0.0014445	0.001685
	No Data	C4 5 LB	On Land only			5.00	0	6.30E-01	0.021	6.30E-03	2.10E-02	1.50E-02	1.20E-04	1.40E-04	0	0	0	0	0	0	0

Ordnance Group	AQ Data	Ordnance Type	Fate	Quantity Fired	Consolidated Nos.	NEW ea.	UOM/ Cum NEW	CO2	CO	Nox	PM10	PM2.5	SO2	Lead	CO2	CO	Nox	PM10	PM2.5	SO2	Lead
	No Data	C4 15 LB	On Land only	20		15.00	300	6.30E-01	0.021	6.30E-03	2.10E-02	1.50E-02	1.20E-04	1.40E-04	9.45E-02	0.00315	0.000945	0.00315	0.00225	0.000018	0.000021
	No Data	C4 40 LB	On Land only	3,600		40.00	144000	6.30E-01	0.021	6.30E-03	2.10E-02	1.50E-02	1.20E-04	1.40E-04	4.54E+01	1.512	0.4536	1.512	1.08	0.00864	0.01008
	No Data	C4 100 LB	On Land only	400		100.00	40000	6.30E-01	0.021	6.30E-03	2.10E-02	1.50E-02	1.20E-04	1.40E-04	12.6	0.42	0.126	0.42	0.3	0.0024	0.0028
	No Data	C4 300 LB	On Land only	12,260		1.00	12260	6.30E-01	0.021	6.30E-03	2.10E-02	1.50E-02	1.20E-04	1.40E-04	3.8619	0.12873	0.038619	0.12873	0.09195	0.0007356	0.000858
	No Data	C4 500 LB	On Land only	15,100		1.00	15100	6.30E-01	0.021	6.30E-03	2.10E-02	1.50E-02	1.20E-04	1.40E-04	4.7565	0.15855	0.047565	0.15855	0.11325	0.000906	0.001057
	No Data	TNT Blocks 0.5 lbd	On Land only	885		1.00	885		0.398							0.176115					
	No Data	DEMO SHEET	On Land only	263		6.00	1578														
	No Data	DETONATING CORD	3000 ft in water; 10300 land	34,000		0.006	204														
	No Data	DEMO CHARGE	Land	30		5.00	150														
	AP-42	SIMULATED ARTILLERY	M110 Land	210		0.1375	28.875	6.30E-01	0.021	6.30E-03	2.10E-02	1.50E-02	1.20E-04	1.40E-04	0.009096	0.000303	9.09563E-05	0.000303	0.000217	1.7325E-06	2.02E-06
		Totals		**94,605**			**247,192**														
GUNFIRE (Large)	AP-42	155MM HE		238			ea.	6.51	2.35E+01	1.43E+00	0.496	0.2418		2.26E-03	0.77469	2.794215	0.169694	0.059024	0.028774	0	0.000269
	AP-42	155MM ILL		8			ea.	1.8	2.62E-02	9.40E-02	3	3		5.80E-05	0.0072	0.000105	0.000376	0.012	0.012	0	2.32E-07
		122 MM		40																	
5"/54		5"/54 BLP	BLP is INERT	5,178			ea.	1.60E-02	2.00E-02		1.20E-03	9.30E-04		6.00E-06	0.041424	0.05178	0	0.003107	0.002408	0	1.55E-05
		5"/54 HCVT+32 (EOD)		195			ea.	1.60E-02	2.00E-02		1.20E-03	9.30E-04		6.00E-06	0.00156	0.00195	0	0.000117	9.07E-05	0	5.85E-07
		5"/54 HECVT	1700 in water; 2242 on land	2,442			ea.	1.60E-02	2.00E-02		1.20E-03	9.30E-04		6.00E-06	0.019536	0.02442	0	0.001465	0.001136	0	7.33E-06
		5"/54 HEPD		85			ea.	1.60E-02	2.00E-02		1.20E-03	9.30E-04		6.00E-06	0.00068	0.00085	0	0.000051	3.95E-05	0	2.55E-07
		5"/54 HEVT		183			ea.	1.60E-02	2.00E-02		1.20E-03	9.30E-04		6.00E-06	0.001464	0.00183	0	0.00011	8.51E-05	0	5.49E-07
		5"/54 ILL		110			ea.	1.50E-02	1.40E-02	3.60E-04	9.20E-04	7.60E-04		1.30E-06	0.000825	0.00077	0.0000198	5.06E-05	4.18E-05	0	7.15E-08
		5"54/54 VTNF		50			ea.	1.60E-02	2.00E-02		1.20E-03	9.30E-04		6.00E-06	0.0004	0.0005	0	0.00003	2.33E-05	0	1.5E-07
5"/62		5"/62		631			ea.	1.60E-02	2.00E-02		1.20E-03	9.30E-04		6.00E-06	0.005048	0.00631	0	0.000379	0.000293	0	1.89E-06
		5"/62 HE-MFF		84			ea.	1.60E-02	2.00E-02		1.20E-03	9.30E-04		6.00E-06	0.000672	0.00084	0	5.04E-05	3.91E-05	0	2.52E-07
		5"/62 HECVT	100 in water; 768 on land	831			ea.	1.60E-02	2.00E-02		1.20E-03	9.30E-04		6.00E-06	0.006648	0.00831	0	0.000499	0.000386	0	2.49E-06
		5"/62 HEET		8			ea.	1.60E-02	2.00E-02		1.20E-03	9.30E-04		6.00E-06	0.000064	0.00008	0	4.8E-06	3.72E-06	0	2.4E-08
		5"/62 KEET		37			ea.	1.60E-02	2.00E-02		1.20E-03	9.30E-04		6.00E-06	0.000296	0.00037	0	2.22E-05	1.72E-05	0	1.11E-07
60mm	AP-42	60MM		234			ea.	2.90E-01	3.00E-02	4.20E-03	3.20E-02	1.70E-02		2.30E-04	0.03393	0.00351	0.0004914	0.003744	0.001989	0	2.69E-05
		60MM WP					ea.	2.90E-01	3.00E-02	4.20E-03	3.20E-02	1.70E-02		2.30E-04	0	0	0	0	0	0	0
76mm		76MM BLP	INERT	1,534			ea.	1.44E-02	1.80E-02		1.08E-03	8.37E-04		5.40E-06	0.011045	0.013806	0	0.000828	0.000642	0	4.14E-06
	AP-42	81MM HE		303			ea.	1.60E-02	2.00E-02		1.20E-03	9.30E-04		6.00E-06	0.002424	0.00303	0	0.000182	0.000141	0	9.09E-07
	AP-42	81MM ILL		18			ea.	1.50E-02	1.40E-02	3.60E-04	9.20E-04	7.60E-04		1.30E-06	0.000135	0.000126	0.00000324	8.28E-06	6.84E-06	0	1.17E-08
CAS	No data	GAU-17 30mm					ea.														
		Total:		**12,209**																	
GUNFIRE (small)	AMW 114,1125	20MM	Fired by aircraft at low alt.	1,429,225			ea.														
		25MM	Fired by ship	55,309			ea.														
	No Data	30MM EFV Main Gun	Fired on land or sea	1,425			ea.														
	AP-42	40MM	NSW on land	4,260			ea.	2.60E-04	3.50E-04	3.60E-05	2.60E-05	2.30E-05		6.70E-04	0.000554	0.000746	0.00007668	5.54E-05	4.9E-05	0	0.001427
	AP-42	40MM HE	NSW on land	745			ea.	6.60E-02	7.00E-03	1.60E-03	1.30E-02	6.60E-03		7.30E-05	0.024585	0.002608	0.000596	0.004843	0.002459	0	2.72E-05
	No Data	40MM ILL	NSW on land	352			ea.	2.60E-04	3.50E-04	3.60E-05	2.60E-05	2.30E-05		6.70E-04	4.58E-05	6.16E-05	0.000006336	4.58E-06	4.05E-06	0	0.000118
	AP-42	40MM PRACTICE	NSW on land	2,548			ea.	2.60E-04	3.50E-04	3.60E-05	2.60E-05	2.30E-05		6.70E-04	0.000331	0.000446	0.000045864	3.31E-05	2.93E-05	0	0.000854
	AP-42	.45 CAL	NSW and USMC	5,730			ea.	2.20E-04	2.60E-04	8.10E-06	3.70E-05	3.10E-05		1.20E-05	0.00063	0.000745	2.32065E-05	0.000106	8.88E-05	0	3.44E-05
	AP-42	5.56	NSW and USMC	1,457,152			ea.	8.70E-04	1.60E-03	8.50E-05	3.90E-05	2.80E-05		5.10E-06	0.633861	1.165722	0.06192896	0.028414	0.0204	0	0.003716
	AP-42	5.56 BLANK	NSW and USMC	2,450			ea.	2.30E-04	2.80E-04	2.00E-05	6.90E-06	2.00E-06		9.70E-07	0.000282	0.000343	0.0000245	8.45E-06	2.45E-06	0	1.19E-06
	AP-42	.50CAL	NSW and USMC	262,957			ea.	5.10E-03	1.10E-02	1.20E-03	3.10E-04	1.90E-04		1.30E-05	0.67054	1.446264	0.1577742	0.040758	0.024981	0	0.001709
		.50CAL	USCG	12,000			ea.	5.10E-03	1.10E-02	1.20E-03	3.10E-04	1.90E-04		1.30E-05	0.0306	0.066	0.0072	0.00186	0.00114	0	0.000078
	AP-42	.50CAL BLANK	NSW and USMC	10,000			ea.	2.10E-03	1.80E-03	2.80E-05	9.80E-05	8.80E-05		1.20E-05	0.0105	0.009	0.00014	0.00049	0.00044	0	0.00006
	AP-42	7.62	NSW and USMC	110,440			ea.	1.20E-03	2.30E-03	9.70E-05	5.10E-05	3.80E-05		4.90E-06	0.066264	0.127006	0.00535634	0.002816	0.002098	0	0.000271
		7.62	USCG	21,000			ea.	1.20E-03	2.30E-03	9.70E-05	5.10E-05	3.80E-05		4.90E-06	0.0126	0.02415	0.0010185	0.000536	0.000399	0	5.15E-05
	AP-42	9MM	NSW and USMC	1,060,000			ea.	2.00E-04	3.10E-04	1.50E-05	2.40E-05	2.00E-05		6.80E-06	0.106	0.1643	0.00795	0.01272	0.0106	0	0.003604
	No Data	.300 WIN MAG	Environmental Contractors				ea.	2.00E-04	3.10E-04	1.50E-05	2.40E-05	2.00E-05		6.80E-06	0	0	0	0	0	0	0
	No Data	.223 Rifle Rounds	Environmental Contractors				ea.	6.80E-05	7.20E-05	3.10E-06	2.60E-06	1.90E-06		1.80E-06	0	0	0	0	0	0	0
	No Data	.22 Magnum	Environmental Contractors				ea.	7.50E-05	8.00E-05	5.00E-06	3.40E-06	2.60E-06		1.90E-06	0	0	0	0	0	0	0
	AP-42	.22 Long Rifle	Environmental Contractors				ea.	6.80E-05	7.20E-05	3.10E-06	2.60E-06	1.90E-06		1.80E-06	0	0	0	0	0	0	0
		12 Guage Shotgun	Environmental Contractors				ea.	5.10E-03	1.10E-02	1.20E-03	3.10E-04	1.90E-04		1.30E-05	0	0	0	0	0	0	0
		Total:		**4,435,593**																	
MINE SHAPE	AP-42	M18A1		105			ea.	1.6	2.00E-02	1.80E-02	4.90E-02	2.60E-02		5.70E-05	0.084	0.00105	0.000945	0.002573	0.001365	0	2.99E-06
		MK76		64			ea.														
		MK62		12			ea.	No emissions													
		Total:		**181**																	
MISSILE		AGM-114B	Fired at low altitude	14			ea.														
		AGM-65 Maverick		3																	
		AGM-84		7																	
		AIM-120	Fired well above 3,000 ft	4			ea.														
		AIM-7	Fired well above 3,000 ft	7			ea.														
		AIM-9	Fired well above 3,000 ft	5			ea.														
		BGM-71E TOW-A	Fired at ground level	1			ea.														
		GBU-9		9																	
		HARM		2																	
AW 25		NSM	Fired at ocean surface				ea.														
		JSOW	No emissions	3			ea.														
		Japanese Missile Tests					ea.														
		Tactical Tomahawk					ea.														
		Seasparrow Missile		2																	
		SLAM ER		1																	
		SM2 or equivalent	Fired from ship-to-air	5			ea.														
		Total:		**63**																	
ROCKET		2.75" RKT		353			ea.	4.50E-01	5.60E-02	7.10E-03	6.10E-02	3.80E-02		1.20E-03	0.079425	0.009884	0.00125315	0.010767	0.006707	0	0.000212
		2.75" RKT HE					ea.	4.50E-01	5.60E-02	7.10E-03	6.10E-02	3.80E-02		1.20E-03	0	0	0	0	0	0	0
		2.75" RKT I	INERT Warhead				ea.	4.50E-01	5.60E-02	7.10E-03	6.10E-02	3.80E-02		1.20E-03	0	0	0	0	0	0	0
		Total:		**353**																	

Ordnance Group	AQ Data	Ordnance Type	Fate	Quantity Fired	Consolidated Nos.	NEW ea.	UOM/ Cum NEW	CO2	CO	Nox	PM10	PM2.5	SO2	Lead	CO2	CO	Nox	PM10	PM2.5	SO2	Lead
FLARES		**FLARES****		**647**			**ea.**														
SMOKE		MK58 Marine Location Marker		8			ea.	1	1.30E-02	1.20E-02	3.20E-02	1.70E-02	6.10E-05	3.80E-05	0.004	0.000052	0.000048	0.000128	0.000068	0.000000244	1.52E-07
		SMOKE GRENADE		76			ea.	1	1.30E-02	1.20E-02	3.20E-02	1.70E-02	6.10E-05	3.80E-05	0.038	0.000494	0.000456	0.001216	0.000646	0.000002318	1.44E-06
		Total:		**84**																	
TORPEDO	NA	MK30	No emissions	235			ea.														
	NA	MK39	No emissions	992			ea.														
	NA	MK46	No emissions	8			ea.														
	NA	MK46-HOVER	No emissions				ea.														
	NA	MK46-LAMPS	No emissions				ea.														
	NA	MK-46-REX-FLYIN	No emissions				ea.														
	NA	MK46-REX-HOVER	No emissions				ea.														
	NA	MK46-REX-LAMPS	No emissions				ea.														
	NA	MK46-EXTORP	No emissions	66			ea.														
	NA	MK50-REX-FLYIN	No emissions	12			ea.														
	NA	MK50-REX-LAMPS	No emissions				ea.														
	NA	REXTORP-46	No emissions	98			ea.														
	NA	REXTORP-50	No emissions	16			ea.														
	NA	MK46-REX-SVTT	No emissions	12			ea.														
	NA	MK46-SVTT	No emissions				ea.														
	NA	MK46-VLA	No emissions				ea.														
	NA	REXTORP	No emissions				ea.														
	NA	MK48-ADCAP	No emissions	69			ea.														
	NA	MK48-ER	No emissions				ea.														
	NA	MK48-STD	No emissions				ea.														
	NA	MK54	No emissions	2			ea.														
		SSN	No emissions	58			ea.														
		Total:		**1,568**																	
		GRAND TOTAL ROUNDS		**4,547,864**																	
		GRAND TOTAL POUNDS NEW					**247,192**														
													SOCAL/SCI		76.97	25.12	1.15	2.66	1.89	0.01	0.03
													SOCAL/SD		0.04	0.09	0.01	0.00	0.00	0.00	0.00

Date: 13-May-2007

Table C-11. SOCAL Ordnance Expenditures—Alternative 1

NOTE: Units of Measure (UOM) for ordnance rounds are 1 each (ea.) and for Demolitions and Other Ordnance are in pounds Net Explosive Weight (NEW).

Ordnance Group	AQ Data	Ordnance Type	Fate	Quantity Fired	Consolidated Nos.	NEW ea.	UOM/ Cum NEW	Emission Factor (lb per lb or lb per item) CO2	CO	Nox	PM10	PM2.5	SO2	Lead	Emissions, tons/year CO2	CO	Nox	PM10	PM2.5	SO2	Lead
BOMB		CBU MK20 ROCKEYE	Clusters Explode Underwater	14		99	ea.														
	No Data	GBU32I JDAM	Clusters Explode Underwater	10		385	ea.														
	No Data	LGTR	Rocket fires Inert warhead	226		0	ea.														
		MK76	Only small spotting charge	1,675		Neg.	ea.														
	No Data	BDU 48	Only small spotting charge	105		Neg.	ea.														
		MK82 HE	31 in water; 383 on land	478		192	ea.		0.3184						0	14.61074	0	0	0	0	0
	No Data	GBU12 500 lb	6 in water; 6 on land	13		192	ea.														
	NA	MK82 INERT	No emissions	20		0	ea.														
	No Data	BDU 45		181		0	ea.														
		MK83 HE		134		445	ea.		0.1482						0	4.418583	0	0	0	0	0
	No Data	GBU 16	14 in water; 14 on land	31		445	ea.														
	NA	MK83 INERT		105		0	ea.														
		Total:		**2,992**	**0**																
OTHER ORD	**No AQ data**	**Type**		**No.**		**NEW**															
	CNAP & SPAWAR	EER/IEER AN/SQQ-110	Explode deep in water			4.2	0	1.2	0.0044	0.011				0.00004	0	0	0	0	0	0	0
	No Data	BLASTING CAP MK11	On Land only	2,156		Neg.	0														
		Detonator		240																	
	No Data	FIRING DEVICE	2 in water; 48 on land	91		Neg.	0														
	No Data	FUSE	6 in water; 94 on land	1,728		Neg.	0														
		GRENADE SIMULATOR	Land	460		0.0813	37.4	6.30E-01	0.021	6.30E-03	2.10E-02	1.50E-02	1.20E-04	1.40E-04	0.01178	0.000393	0.000117804	0.000393	0.00028	2.24388E-06	2.62E-06
		Grenades	Land	1,787		0.0813	145.3	6.30E-01	0.021	6.30E-03	2.10E-02	1.50E-02	1.20E-04	1.40E-04	0.045764	0.001525	0.000457642	0.001525	0.00109	8.71699E-06	1.02E-05
		Haversacks		88		20.0000	1760.0	6.30E-01	0.021	6.30E-03	2.10E-02	1.50E-02	1.20E-04	1.40E-04							
		K143 Antipersonnel Mine		240																	
	No Data	M1A2 BANGALORE TORP	Land	248		10.00	2480								0	0	0	0	0	0	0
		M7 BANDOLEER MK57 (Claymore mine)	Land	68		8.16	554.88		0.15108						0	0.041916	0	0	0	0	0
	AP-42	M112 DEMO CHARGE	Land	158		1.20	189.6	7.90E-01	2.60E-02	7.90E-03	2.60E-02	1.90E-02		1.70E-04	0.074892	0.002465	0.00074892	0.002465	0.001801	0	1.61E-05
	No Data	M700 BLASTING FUSE	Land	1,506		0.001	1.506														
	No Data	MK20 Cable Cutter	Land	163		0.0028	0.5														
	No Data	MK22 Projectile Unit	Land	158		Neg.	Neg.														
	No Data	MK36 M0 DEMO CHARGE	Land	45		4.10	184.5								0	0	0	0	0	0	0
	No Data	MK75 CHARGE	In Shallow water	217		50.00	10,850								0	0	0	0	0	0	0
	No Data	MK84 [86] EOD Shaped Charge	On Land only	166		0.08	13.28								0	0	0	0	0	0	0
	No Data	MK120 NONELEC DET (ft)	On Land only	771		0.00001	0.0110														
	No Data	MK123 NONELEC DET (ft)	On Land only	3,192		0.00001	0.0456														
	No Data	MK138 DEMO CHG ASSEMBLY	In water			20.00	0	6.30E-01	0.021	6.30E-03	2.10E-02	1.50E-02	1.20E-04	1.40E-04	0	0	0	0	0	0	0
	No Data	MK140 FLEXIBLE CHARGE	On Land only	226		0.04	9.944														
		MK258		360																	
	No Data	PBXN-109 TEST Det Cord	On Land only	30		0.0060	0.18														
	No Data	SIGNAL MK 18(G950) SMOKE	On Land only	530		0.23	123.596														
	No Data	C4 1 LB		415		1.00	415	6.30E-01	0.021	6.30E-03	2.10E-02	1.50E-02	1.20E-04	1.40E-04	1.31E-01	0.004358	0.00130725	0.004358	0.003113	0.0000249	2.91E-05

Ordnance Group	AQ Data	Ordnance Type	Fate	Quantity Fired	Consolidated Nos.	NEW ea.	UOM/ Cum NEW	CO2	CO	Nox	PM10	PM2.5	SO2	Lead	CO2	CO	Nox	PM10	PM2.5	SO2	Lead
	No Data	C4 1.25 LB	98 in water; 19,156 on land	31,872		1.25	39840	6.30E-01	0.021	6.30E-03	2.10E-02	1.50E-02	1.20E-04	1.40E-04	1.25E+01	0.41832	0.125496	0.41832	0.2988	0.0023904	0.002789
	No Data	C4 5 LB	On Land only			5.00	0	6.30E-01	0.021	6.30E-03	2.10E-02	1.50E-02	1.20E-04	1.40E-04	0	0	0	0	0	0	0
	No Data	C4 15 LB	On Land only	40		15.00	600	6.30E-01	0.021	6.30E-03	2.10E-02	1.50E-02	1.20E-04	1.40E-04	1.89E-01	0.0063	0.00189	0.0063	0.0045	0.000036	0.000042
	No Data	C4 40 LB	On Land only	3,762		40.00	150480	6.30E-01	0.021	6.30E-03	2.10E-02	1.50E-02	1.20E-04	1.40E-04	4.74E+01	1.58004	0.474012	1.58004	1.1286	0.0090288	0.010534
	No Data	C4 100 LB	On Land only	500		100.00	50000	6.30E-01	0.021	6.30E-03	2.10E-02	1.50E-02	1.20E-04	1.40E-04	15.75	0.525	0.1575	0.525	0.375	0.003	0.0035
	No Data	C4 300 LB	On Land only	12,896		1.00	12896	6.30E-01	0.021	6.30E-03	2.10E-02	1.50E-02	1.20E-04	1.40E-04	4.06224	0.135408	0.0406224	0.135408	0.09672	0.00077376	0.000903
	No Data	C4 500 LB	On Land only	15,863		1.00	15863	6.30E-01	0.021	6.30E-03	2.10E-02	1.50E-02	1.20E-04	1.40E-04	4.996845	0.166562	0.04996845	0.166562	0.118973	0.00095178	0.00111
	No Data	TNT Blocks 0.5 lbd	On Land only	925		1.00	925		0.398							0.184075					
	No Data	DEMO SHEET	On Land only	462		6.00	2772														
	No Data	DETONATING CORD	3000 ft in water; 10300 land	74,500		0.006	447														
	No Data	DEMO CHARGE	Land	57		5.00	285														
	AP-42	SIMULATED ARTILLERY	M110 Land	316		0.1375	43.45	6.30E-01	0.021	6.30E-03	2.10E-02	1.50E-02	1.20E-04	1.40E-04	0.013687	0.000456	0.000136868	0.000456	0.000326	0.000002607	3.04E-06
			Totals	**156,236**			**290,917**														
GUNFIRE (Large)	AP-42	155MM HE		1,101			ea.	6.51	2.35E+01	1.43E+00	0.496	0.2418		2.26E-03	3.583755	12.92618	0.785013	0.273048	0.133111	0	0.001246
	AP-42	155MM ILL		57			ea.	1.8	2.62E-02	9.40E-02	3	3		5.80E-05	0.0513	0.000747	0.002679	0.0855	0.0855	0	1.65E-06
		122 MM		40																	
5"/54		5"/54 BLP	BLP is INERT	5,822			ea.	1.60E-02	2.00E-02		1.20E-03	9.30E-04		6.00E-06	0.046576	0.05822	0	0.003493	0.002707	0	1.75E-05
		5"/54 HCVT+32 (EOD)		207			ea.	1.60E-02	2.00E-02		1.20E-03	9.30E-04		6.00E-06	0.001656	0.00207	0	0.000124	9.63E-05	0	6.21E-07
		5"/54 HECVT	1700 in water; 2242 on land	2,585			ea.	1.60E-02	2.00E-02		1.20E-03	9.30E-04		6.00E-06	0.02068	0.02585	0	0.001551	0.001202	0	7.76E-06
		5"/54 HEPD		90			ea.	1.60E-02	2.00E-02		1.20E-03	9.30E-04		6.00E-06	0.00072	0.0009	0	0.000054	4.19E-05	0	2.7E-07
		5"/54 HEVT		195			ea.	1.60E-02	2.00E-02		1.20E-03	9.30E-04		6.00E-06	0.00156	0.00195	0	0.000117	9.07E-05	0	5.85E-07
		5"/54 ILL		117			ea.	1.50E-02	1.40E-02	3.60E-04	9.20E-04	7.60E-04		1.30E-06	0.000878	0.000819	0.00002106	5.38E-05	4.45E-05	0	7.61E-08
		5"54/54 VTNF		53			ea.	1.60E-02	2.00E-02		1.20E-03	9.30E-04		6.00E-06	0.000424	0.00053	0	3.18E-05	2.46E-05	0	1.59E-07
5"/62		5"/62		1,136			ea.	1.60E-02	2.00E-02		1.20E-03	9.30E-04		6.00E-06	0.009088	0.01136	0	0.000682	0.000528	0	3.41E-06
		5"/62 HE-MFF		70			ea.	1.60E-02	2.00E-02		1.20E-03	9.30E-04		6.00E-06	0.00056	0.0007	0	0.000042	3.26E-05	0	2.1E-07
		5"/62 HECVT	100 in water; 768 on land	814			ea.	1.60E-02	2.00E-02		1.20E-03	9.30E-04		6.00E-06	0.006512	0.00814	0	0.000488	0.000379	0	2.44E-06
		5"/62 HEET		3			ea.	1.60E-02	2.00E-02		1.20E-03	9.30E-04		6.00E-06	0.000024	0.00003	0	1.8E-06	1.4E-06	0	9E-09
		5"/62 KEET		15			ea.	1.60E-02	2.00E-02		1.20E-03	9.30E-04		6.00E-06	0.00012	0.00015	0	0.000009	6.98E-06	0	4.5E-08
60mm	AP-42	60MM		245			ea.	2.90E-01	3.00E-02	4.20E-03	3.20E-02	1.70E-02		2.30E-04	0.035525	0.003675	0.0005145	0.00392	0.002083	0	2.82E-05
		60MM WP					ea.	2.90E-01	3.00E-02	4.20E-03	3.20E-02	1.70E-02		2.30E-04	0	0	0	0	0	0	0
76mm		76MM BLP	INERT	1,872			ea.	1.44E-02	1.80E-02		1.08E-03	8.37E-04		5.40E-06	0.013478	0.016848	0	0.001011	0.000783	0	5.05E-06
	AP-42	81MM HE		324			ea.	1.60E-02	2.00E-02		1.20E-03	9.30E-04		6.00E-06	0.002592	0.00324	0	0.000194	0.000151	0	9.72E-07
	AP-42	81MM ILL		21			ea.	1.50E-02	1.40E-02	3.60E-04	9.20E-04	7.60E-04		1.30E-06	0.000158	0.000147	0.00000378	9.66E-06	7.98E-06	0	1.37E-08
		122MM Main Tank Gun		120																	
CAS	No data	GAU-17 30mm					ea.														
		Total:		**14,887**																	
GUNFIRE (small)	AMW 114,1125	20MM	Fired by aircraft at low alt.	1,906,588			ea.														
		25MM	Fired by ship	61,479			ea.														
	No Data	30MM EFV Main Gun	Fired on land or sea	2,759			ea.														
	AP-42	40MM	NSW on land	5,880			ea.	2.60E-04	3.50E-04	3.60E-05	2.60E-05	2.30E-05		6.70E-04	0.000764	0.001029	0.00010584	7.64E-05	6.76E-05	0	0.00197
	AP-42	40MM HE	NSW on land	833			ea.	6.60E-02	7.00E-03	1.60E-03	1.30E-02	6.60E-03		7.30E-05	0.027489	0.002916	0.0006664	0.005415	0.002749	0	3.04E-05
	No Data	40MM ILL	NSW on land	422			ea.	2.60E-04	3.50E-04	3.60E-05	2.60E-05	2.30E-05		6.70E-04	5.49E-05	7.39E-05	0.000007596	5.49E-06	4.85E-06	0	0.000141
	AP-42	40MM PRACTICE	NSW on land	2,771			ea.	2.60E-04	3.50E-04	3.60E-05	2.60E-05	2.30E-05		6.70E-04	0.00036	0.000485	0.000049878	3.6E-05	3.19E-05	0	0.000928
	AP-42	.45 CAL	NSW and USMC	6,869			ea.	2.20E-04	2.60E-04	8.10E-06	3.70E-05	3.10E-05		1.20E-05	0.000756	0.000893	2.78195E-05	0.000127	0.000106	0	4.12E-05
	AP-42	5.56	NSW and USMC	2,800,472			ea.	8.70E-04	1.60E-03	8.50E-05	3.90E-05	2.80E-05		5.10E-06	1.218205	2.240378	0.11902006	0.054609	0.039207	0	0.007141
	AP-42	5.56 BLANK	NSW and USMC	3,689			ea.	2.30E-04	2.80E-04	2.00E-05	6.90E-06	2.00E-06		9.70E-07	0.000424	0.000516	0.00003689	1.27E-05	3.69E-06	0	1.79E-06
	AP-42	.50CAL	NSW and USMC	305,988			ea.	5.10E-03	1.10E-02	1.20E-03	3.10E-04	1.90E-04		1.30E-05	0.780269	1.682934	0.1835928	0.047428	0.029069	0	0.001989
		.50CAL	USCG	15,059			ea.	5.10E-03	1.10E-02	1.20E-03	3.10E-04	1.90E-04		1.30E-05	0.0384	0.082825	0.0090354	0.002334	0.001431	0	9.79E-05
	AP-42	.50CAL BLANK	NSW and USMC	10,000			ea.	2.10E-03	1.80E-03	2.80E-05	9.80E-05	8.80E-05		1.20E-05	0.0105	0.009	0.00014	0.00049	0.00044	0	0.00006
	AP-42	7.62	NSW and USMC	190,240			ea.	1.20E-03	2.30E-03	9.70E-05	5.10E-05	3.80E-05		4.90E-06	0.114144	0.218776	0.00922664	0.004851	0.003615	0	0.000466
		7.62	USCG	21,000			ea.	1.20E-03	2.30E-03	9.70E-05	5.10E-05	3.80E-05		4.90E-06	0.0126	0.02415	0.0010185	0.000536	0.000399	0	5.15E-05
	AP-42	9MM	NSW and USMC	2,118,024			ea.	2.00E-04	3.10E-04	1.50E-05	2.40E-05	2.00E-05		6.80E-06	0.211802	0.328294	0.01588518	0.025416	0.02118	0	0.007201
	No Data	.300 WIN MAG	Environmental Contractors				ea.	2.00E-04	3.10E-04	1.50E-05	2.40E-05	2.00E-05		6.80E-06	0	0	0	0	0	0	0
	No Data	.223 Rifle Rounds	Environmental Contractors				ea.	6.80E-05	7.20E-05	3.10E-06	2.60E-06	1.90E-06		1.80E-06	0	0	0	0	0	0	0
	No Data	.22 Magnum	Environmental Contractors				ea.	7.50E-05	8.00E-05	5.00E-06	3.40E-06	2.60E-06		1.90E-06	0	0	0	0	0	0	0
	AP-42	.22 Long Rifle	Environmental Contractors				ea.	6.80E-05	7.20E-05	3.10E-06	2.60E-06	1.90E-06		1.80E-06	0	0	0	0	0	0	0
		12 Guage Shotgun	Environmental Contractors				ea.	5.10E-03	1.10E-02	1.20E-03	3.10E-04	1.90E-04		1.30E-05	0	0	0	0	0	0	0
		Total:		**7,452,073**																	
MINE SHAPE	AP-42	M18A1		132			ea.	1.6	2.00E-02	1.80E-02	4.90E-02	2.60E-02		5.70E-05	0.1056	0.00132	0.001188	0.003234	0.001716	0	3.76E-06
		MK76		64			ea.														
		MK62		12			ea.	No emissions													
		Total:		**208**																	
MISSILE		AGM-114B	Fired at low altitude	16			ea.														
		AGM-65 Maverick		6																	
		AGM-84		10																	
		AIM-120	Fired well above 3,000 ft	4			ea.														
		AIM-7	Fired well above 3,000 ft	7			ea.														
		AIM-9	Fired well above 3,000 ft	5			ea.														
		BGM-71E TOW-A	Fired at ground level	1			ea.														
		GBU-9		9																	
		HARM		4																	
		NSM	Fired at ocean surface	1			ea.														
AW 25		JSOW	No emissions	5			ea.														
		Japanese Missile Tests		5			ea.														
		Tactical Tomahawk		2			ea.														
		Seasparrow Missile		8																	
		SLAM ER		2																	
		Stinger		51																	
		SM2 or equivalent	Fired from ship-to-air	7			ea.														
		Total:		**143**																	

Ordnance Group	AQ Data	Ordnance Type	Fate	Quantity Fired	Consolidated Nos.	NEW ea.	UOM/ Cum NEW	CO2	CO	Nox	PM10	PM2.5	SO2	Lead	CO2	CO	Nox	PM10	PM2.5	SO2	Lead
ROCKET		2.75" RKT		396			ea.	4.50E-01	5.60E-02	7.10E-03	6.10E-02	3.80E-02		1.20E-03	0.0891	0.011088	0.0014058	0.012078	0.007524	0	0.000238
		2.75" RKT HE					ea.	4.50E-01	5.60E-02	7.10E-03	6.10E-02	3.80E-02		1.20E-03	0	0	0	0	0	0	0
		2.75" RKT I	INERT Warhead				ea.	4.50E-01	5.60E-02	7.10E-03	6.10E-02	3.80E-02		1.20E-03	0	0	0	0	0	0	0
		Total:		**396**																	
FLARES		**FLARES****		**962**			**ea.**														
SMOKE		MK58 Marine Location Marker		8			ea.	1	1.30E-02	1.20E-02	3.20E-02	1.70E-02	6.10E-05	3.80E-05	0.004	0.000052	0.000048	0.000128	0.000068	0.000000244	1.52E-07
		SMOKE GRENADE		120			ea.	1	1.30E-02	1.20E-02	3.20E-02	1.70E-02	6.10E-05	3.80E-05	0.06	0.00078	0.00072	0.00192	0.00102	0.00000366	2.28E-06
		Total:		**128**																	
TORPEDO	NA	MK30	No emissions	601			ea.														
	NA	MK39	No emissions	1,406			ea.														
	NA	MK46	No emissions	8			ea.														
	NA	MK46-HOVER	No emissions				ea.														
	NA	MK46-LAMPS	No emissions				ea.														
	NA	MK-46-REX-FLYIN	No emissions				ea.														
	NA	MK46-REX-HOVER	No emissions				ea.														
	NA	MK46-REX-LAMPS	No emissions				ea.														
	NA	MK46-EXTORP	No emissions	85			ea.														
	NA	MK50-REX-FLYIN	No emissions	12			ea.														
	NA	MK50-REX-LAMPS	No emissions				ea.														
	NA	REXTORP-46	No emissions	124			ea.														
	NA	REXTORP-50	No emissions	20			ea.														
	NA	MK46-REX-SVTT	No emissions	14			ea.														
	NA	MK46-SVTT	No emissions				ea.														
	NA	MK46-VLA	No emissions				ea.														
	NA	REXTORP	No emissions				ea.														
	NA	MK48-ADCAP	No emissions	84			ea.														
	NA	MK48-ER	No emissions				ea.														
	NA	MK48-STD	No emissions				ea.														
	NA	MK54	No emissions	1			ea.														
		SSN	No emissions	89			ea.														
		Total:		**2,444**																	
		GRAND TOTAL ROUNDS		**7,630,469**																	
		GRAND TOTAL POUNDS NEW					**290,917**														
													SOCAL/SCI		91.62481	39.65623	1.972609576	3.366984	2.362794	0.016223112	0.040467
													SOCAL/SD		0.051	0.106975	0.0100539	0.00287	0.00183	0	0.000149

Date: 13-May-2007

Table C-12. SOCAL Ordnance Expenditures—Alternative 2

NOTE: Units of Measure (UOM) for ordnance rounds are 1 each (ea.) and for Demolitions and Other Ordnance are in pounds Net Explosive Weight (NEW).

Ordnance Group	AQ Data	Ordnance Type	Fate	Quantity Fired	Consolidated Nos.	NEW ea.	UOM/ Cum NEW	Emission Factor (lb per lb or lb per item) CO2	CO	Nox	PM10	PM2.5	SO2	Lead	Emissions, tons/year CO2	CO	Nox	PM10	PM2.5	SO2	Lead
BOMB		CBU MK20 ROCKEYE	Clusters Explode Underwater	16		99	ea.														
	No Data	GBU32I JDAM	Clusters Explode Underwater	10		385	ea.														
	No Data	LGTR	Rocket fires Inert warhead	238		0	ea.														
		MK76	Only small spotting charge	1,854		Neg.	ea.														
	No Data	BDU 48	Only small spotting charge	117		Neg.	ea.														
		MK82 HE	31 in water; 383 on land	534		192	ea.		0.3184						0	16.32246	0	0	0	0	0
	No Data	GBU12 500 lb	6 in water; 6 on land	13		192	ea.														
	NA	MK82 INERT	No emissions	22		0	ea.														
	No Data	BDU 45		199		0	ea.														
		MK83 HE		147		445	ea.		0.1482						0	4.847252	0	0	0	0	0
	No Data	GBU 16	14 in water; 14 on land	32		445	ea.														
	NA	MK83 INERT		116		0	ea.														
		Total:		3,298	0																
OTHER ORD	No AQ data	Type		No.		NEW															
	CNAP & SPAWAR	EER/IEER AN/SQQ-110	Explode deep in water			4.2	0	1.2	0.0044	0.011				0.00004	0	0	0	0	0	0	0
	No Data	BLASTING CAP MK11	On Land only	2,565		Neg.	0														
		Detonator		288																	
	No Data	FIRING DEVICE	2 in water; 48 on land	105		Neg.	0														
	No Data	FUSE	6 in water; 94 on land	2,076		Neg.	0														
		GRENADE SIMULATOR	Land	561		0.0813	45.6	6.30E-01	0.021	6.30E-03	2.10E-02	1.50E-02	1.20E-04	1.40E-04	0.014367	0.000479	0.000143669	0.000479	0.000342	2.73656E-06	3.19E-06
		Grenades	Land	2,143		0.0813	174.2	6.30E-01	0.021	6.30E-03	2.10E-02	1.50E-02	1.20E-04	1.40E-04	0.054881	0.001829	0.000548812	0.001829	0.001307	1.04536E-05	1.22E-05
		Haversacks		105		20.0000	2100.0	6.30E-01	0.021	6.30E-03	2.10E-02	1.50E-02	1.20E-04	1.40E-04							
		K143 Antipersonnel Mine		288																	
	No Data	M1A2 BANGALORE TORP	Land	277		10.00	2770								0	0	0	0	0	0	0
		M7 BANDOLEER MK57 (Claymore mine)	Land	77		8.16	628.32		0.15108						0	0.047463	0	0	0	0	0
	AP-42	M112 DEMO CHARGE	Land	206		1.20	247.2	7.90E-01	2.60E-02	7.90E-03	2.60E-02	1.90E-02		1.70E-04	0.097644	0.003214	0.00097644	0.003214	0.002348	0	2.1E-05
	No Data	M700 BLASTING FUSE	Land	1,965		0.001	1.965														
	No Data	MK20 Cable Cutter	Land	181		0.0028	0.5														
	No Data	MK22 Projectile Unit	Land	206		Neg.	Neg.														
	No Data	MK36 M0 DEMO CHARGE	Land	59		4.10	241.9								0	0	0	0	0	0	0
	No Data	MK75 CHARGE	In Shallow water	244		50.00	12,200								0	0	0	0	0	0	0
	No Data	MK84 [86] EOD Shaped Charge	On Land only	214		0.08	17.12								0	0	0	0	0	0	0
	No Data	MK120 NONELEC DET (ft)	On Land only	1,006		0.00001	0.0144														
	No Data	MK123 NONELEC DET (ft)	On Land only	4,165		0.00001	0.0595														
	No Data	MK138 DEMO CHG ASSEMBLY	In water			20.00	0	6.30E-01	0.021	6.30E-03	2.10E-02	1.50E-02	1.20E-04	1.40E-04	0	0	0	0	0	0	0
	No Data	MK140 FLEXIBLE CHARGE	On Land only	295		0.04	12.98														
		MK258		360																	
	No Data	PBXN-109 TEST Det Cord	On Land only	30		0.0060	0.18														
	No Data	SIGNAL MK 18(G950) SMOKE	On Land only	686		0.23	159.9752														
	No Data	C4 1 LB		830		1.00	830	6.30E-01	0.021	6.30E-03	2.10E-02	1.50E-02	1.20E-04	1.40E-04	2.61E-01	0.008715	0.0026145	0.008715	0.006225	0.0000498	5.81E-05

Ordnance Group	AQ Data	Ordnance Type	Fate	Quantity Fired	Consolidated Nos.	NEW ea.	UOM/ Cum NEW	CO2	CO	Nox	PM10	PM2.5	SO2	Lead	CO2	CO	Nox	PM10	PM2.5	SO2	Lead
	No Data	C4 1.25 LB	98 in water; 19,156 on land	37,403		1.25	46753.75	6.30E-01	0.021	6.30E-03	2.10E-02	1.50E-02	1.20E-04	1.40E-04	1.47E+01	0.490914	0.147274313	0.490914	0.350653	0.002805225	0.003273
	No Data	C4 5 LB	On Land only			5.00	0	6.30E-01	0.021	6.30E-03	2.10E-02	1.50E-02	1.20E-04	1.40E-04	0	0	0	0	0	0	0
	No Data	C4 15 LB	On Land only	48		15.00	720	6.30E-01	0.021	6.30E-03	2.10E-02	1.50E-02	1.20E-04	1.40E-04	2.27E-01	0.00756	0.002268	0.00756	0.0054	0.0000432	5.04E-05
	No Data	C4 40 LB	On Land only	4,385		40.00	175400	6.30E-01	0.021	6.30E-03	2.10E-02	1.50E-02	1.20E-04	1.40E-04	5.53E+01	1.8417	0.55251	1.8417	1.3155	0.010524	0.012278
	No Data	C4 100 LB	On Land only	1,000		100.00	100000	6.30E-01	0.021	6.30E-03	2.10E-02	1.50E-02	1.20E-04	1.40E-04	31.5	1.05	0.315	1.05	0.75	0.006	0.007
	No Data	C4 300 LB	On Land only	15,000		1.00	15000	6.30E-01	0.021	6.30E-03	2.10E-02	1.50E-02	1.20E-04	1.40E-04	4.725	0.1575	0.04725	0.1575	0.1125	0.0009	0.00105
	No Data	C4 500 LB	On Land only	18,459		1.00	18459	6.30E-01	0.021	6.30E-03	2.10E-02	1.50E-02	1.20E-04	1.40E-04	5.814585	0.19382	0.05814585	0.19382	0.138443	0.00110754	0.001292
	No Data	TNT Blocks 0.5 lbd	On Land only	1,078		1.00	1078		0.398							0.214522					
	No Data	DEMO SHEET	On Land only	546		6.00	3276														
	No Data	DETONATING CORD	3000 ft in water; 10300 land	85,000		0.006	510														
	No Data	DEMO CHARGE	Land	57		5.00	285														
	AP-42	SIMULATED ARTILLERY	M110 Land	413		0.1375	56.7875	6.30E-01	0.021	6.30E-03	2.10E-02	1.50E-02	1.20E-04	1.40E-04	0.017888	0.000596	0.000178881	0.000596	0.000426	3.40725E-06	3.98E-06
		Totals		182,321			380,969														
GUNFIRE (Large)	AP-42	155MM HE		1,504			ea.	6.51	2.35E+01	1.43E+00	0.496	0.2418		2.26E-03	4.89552	17.65756	1.072352	0.372992	0.181834	0	0.001702
	AP-42	155MM ILL		75			ea.	1.8	2.62E-02	9.40E-02	3	3		5.80E-05	0.0675	0.000983	0.003525	0.1125	0.1125	0	2.18E-06
		122 MM		80																	
5"/54		5"/54 BLP	BLP is INERT	5,901			ea.	1.60E-02	2.00E-02		1.20E-03	9.30E-04		6.00E-06	0.047208	0.05901	0	0.003541	0.002744	0	1.77E-05
		5"/54 HCVT+32 (EOD)		216			ea.	1.60E-02	2.00E-02		1.20E-03	9.30E-04		6.00E-06	0.001728	0.00216	0	0.00013	0.0001	0	6.48E-07
		5"/54 HECVT	1700 in water; 2242 on land	2,881			ea.	1.60E-02	2.00E-02		1.20E-03	9.30E-04		6.00E-06	0.023048	0.02881	0	0.001729	0.00134	0	8.64E-06
		5"/54 HEPD		94			ea.	1.60E-02	2.00E-02		1.20E-03	9.30E-04		6.00E-06	0.000752	0.00094	0	5.64E-05	4.37E-05	0	2.82E-07
		5"/54 HEVT		202			ea.	1.60E-02	2.00E-02		1.20E-03	9.30E-04		6.00E-06	0.001616	0.00202	0	0.000121	9.39E-05	0	6.06E-07
		5"/54 ILL		122			ea.	1.50E-02	1.40E-02	3.60E-04	9.20E-04	7.60E-04		1.30E-06	0.000915	0.000854	0.00002196	5.61E-05	4.64E-05	0	7.93E-08
		5"54/54 VTNF		55			ea.	1.60E-02	2.00E-02		1.20E-03	9.30E-04		6.00E-06	0.00044	0.00055	0	0.000033	2.56E-05	0	1.65E-07
5"/62		5"/62		1,139			ea.	1.60E-02	2.00E-02		1.20E-03	9.30E-04		6.00E-06	0.009112	0.01139	0	0.000683	0.00053	0	3.42E-06
		5"/62 HE-MFF		77			ea.	1.60E-02	2.00E-02		1.20E-03	9.30E-04		6.00E-06	0.000616	0.00077	0	4.62E-05	3.58E-05	0	2.31E-07
		5"/62 HECVT	100 in water; 768 on land	860			ea.	1.60E-02	2.00E-02		1.20E-03	9.30E-04		6.00E-06	0.00688	0.0086	0	0.000516	0.0004	0	2.58E-06
		5"/62 HEET		4			ea.	1.60E-02	2.00E-02		1.20E-03	9.30E-04		6.00E-06	0.000032	0.00004	0	2.4E-06	1.86E-06	0	1.2E-08
		5"/62 KEET		21			ea.	1.60E-02	2.00E-02		1.20E-03	9.30E-04		6.00E-06	0.000168	0.00021	0	1.26E-05	9.77E-06	0	6.3E-08
60mm	AP-42	60MM		285			ea.	2.90E-01	3.00E-02	4.20E-03	3.20E-02	1.70E-02		2.30E-04	0.041325	0.004275	0.0005985	0.00456	0.002423	0	3.28E-05
		60MM WP					ea.	2.90E-01	3.00E-02	4.20E-03	3.20E-02	1.70E-02		2.30E-04	0	0	0	0	0	0	0
76mm		76MM BLP	INERT	1,881			ea.	1.44E-02	1.80E-02		1.08E-03	8.37E-04		5.40E-06	0.013543	0.016929	0	0.001016	0.000787	0	5.08E-06
	AP-42	81MM HE		489			ea.	1.60E-02	2.00E-02		1.20E-03	9.30E-04		6.00E-06	0.003912	0.00489	0	0.000293	0.000227	0	1.47E-06
	AP-42	81MM ILL		22			ea.	1.50E-02	1.40E-02	3.60E-04	9.20E-04	7.60E-04		1.30E-06	0.000165	0.000154	0.00000396	1.01E-05	8.36E-06	0	1.43E-08
		122MM Main Tank Gun		160																	
CAS	No data	GAU-17 30mm					ea.														
		Total:		16,068																	
GUNFIRE (small)	AMW 114,1125	20MM	Fired by aircraft at low alt.	1,909,274			ea.														
		25MM	Fired by ship	61,553			ea.														
	No Data	30MM EFV Main Gun	Fired on land or sea	3,681			ea.														
	AP-42	40MM	NSW on land	7,380			ea.	2.60E-04	3.50E-04	3.60E-05	2.60E-05	2.30E-05		6.70E-04	0.000959	0.001292	0.00013284	9.59E-05	8.49E-05	0	0.002472
	AP-42	40MM HE	NSW on land	901			ea.	6.60E-02	7.00E-03	1.60E-03	1.30E-02	6.60E-03		7.30E-05	0.029733	0.003154	0.0007208	0.005857	0.002973	0	3.29E-05
	No Data	40MM ILL	NSW on land	422			ea.	2.60E-04	3.50E-04	3.60E-05	2.60E-05	2.30E-05		6.70E-04	5.49E-05	7.39E-05	0.000007596	5.49E-06	4.85E-06	0	0.000141
	AP-42	40MM PRACTICE	NSW on land	3,090			ea.	2.60E-04	3.50E-04	3.60E-05	2.60E-05	2.30E-05		6.70E-04	0.000402	0.000541	0.00005562	4.02E-05	3.55E-05	0	0.001035
	AP-42	.45 CAL	NSW and USMC	6,869			ea.	2.20E-04	2.60E-04	8.10E-06	3.70E-05	3.10E-05		1.20E-05	0.000756	0.000893	2.78195E-05	0.000127	0.000106	0	4.12E-05
	AP-42	5.56	NSW and USMC	3,391,607			ea.	8.70E-04	1.60E-03	8.50E-05	3.90E-05	2.80E-05		5.10E-06	1.475349	2.713286	0.144143298	0.066136	0.047482	0	0.008649
	AP-42	5.56 BLANK	NSW and USMC	4,814			ea.	2.30E-04	2.80E-04	2.00E-05	6.90E-06	2.00E-06		9.70E-07	0.000554	0.000674	0.00004814	1.66E-05	4.81E-06	0	2.33E-06
	AP-42	.50CAL	NSW and USMC	334,687			ea.	5.10E-03	1.10E-02	1.20E-03	3.10E-04	1.90E-04		1.30E-05	0.853452	1.840779	0.2008122	0.051876	0.031795	0	0.002175
		.50CAL	USCG	19,647			ea.	5.10E-03	1.10E-02	1.20E-03	3.10E-04	1.90E-04		1.30E-05	0.0501	0.108059	0.0117882	0.003045	0.001866	0	0.000128
	AP-42	.50CAL BLANK	NSW and USMC	10,000			ea.	2.10E-03	1.80E-03	2.80E-05	9.80E-05	8.80E-05		1.20E-05	0.0105	0.009	0.00014	0.00049	0.00044	0	0.00006
	AP-42	7.62	NSW and USMC	261,202			ea.	1.20E-03	2.30E-03	9.70E-05	5.10E-05	3.80E-05		4.90E-06	0.156721	0.300382	0.012668297	0.006661	0.004963	0	0.00064
		7.62	USCG	21,000			ea.	1.20E-03	2.30E-03	9.70E-05	5.10E-05	3.80E-05		4.90E-06	0.0126	0.02415	0.0010185	0.000536	0.000399	0	5.15E-05
	AP-42	9MM	NSW and USMC	2,515,859			ea.	2.00E-04	3.10E-04	1.50E-05	2.40E-05	2.00E-05		6.80E-06	0.251586	0.389958	0.018868943	0.03019	0.025159	0	0.008554
	No Data	.300 WIN MAG	Environmental Contractors				ea.	2.00E-04	3.10E-04	1.50E-05	2.40E-05	2.00E-05		6.80E-06	0	0	0	0	0	0	0
	No Data	.223 Rifle Rounds	Environmental Contractors				ea.	6.80E-05	7.20E-05	3.10E-06	2.60E-06	1.90E-06		1.80E-06	0	0	0	0	0	0	0
	No Data	.22 Magnum	Environmental Contractors				ea.	7.50E-05	8.00E-05	5.00E-06	3.40E-06	2.60E-06		1.90E-06	0	0	0	0	0	0	0
	AP-42	.22 Long Rifle	Environmental Contractors				ea.	6.80E-05	7.20E-05	3.10E-06	2.60E-06	1.90E-06		1.80E-06	0	0	0	0	0	0	0
		12 Guage Shotgun	Environmental Contractors				ea.	5.10E-03	1.10E-02	1.20E-03	3.10E-04	1.90E-04		1.30E-05	0	0	0	0	0	0	0
		Total:		8,551,986																	
MINE SHAPE	AP-42	M18A1		164			ea.	1.6	2.00E-02	1.80E-02	4.90E-02	2.60E-02		5.70E-05	0.1312	0.00164	0.001476	0.004018	0.002132	0	4.67E-06
		MK76		68			ea.														
		MK62		13			ea.	No emissions													
		Total:		245																	
MISSILE		AGM-114B	Fired at low altitude	16			ea.														
		AGM-65 Maverick		6																	
		AGM-84		10																	
		AIM-120	Fired well above 3,000 ft	4			ea.														
		AIM-7	Fired well above 3,000 ft	7			ea.														
		AIM-9	Fired well above 3,000 ft	5			ea.														
		BGM-71E TOW-A	Fired at ground level	1			ea.														
		GBU-9		9																	
		HARM		4																	
		NSM	Fired at ocean surface	1			ea.														
AW 25		JSOW	No emissions	10			ea.														
		Japanese Missile Tests		10			ea.														
		Tactical Tomahawk		2			ea.														
		Seasparrow Missile		12																	
		SLAM ER		2																	
		Stinger		68																	
		SM2 or equivalent	Fired from ship-to-air	7			ea.														
		Total:		174																	

Ordnance Group	AQ Data	Ordnance Type	Fate	Quantity Fired	Consolidated Nos.	NEW ea.	UOM/ Cum NEW	CO2	CO	Nox	PM10	PM2.5	SO2	Lead	CO2	CO	Nox	PM10	PM2.5	SO2	Lead
ROCKET		2.75" RKT		488			ea.	4.50E-01	5.60E-02	7.10E-03	6.10E-02	3.80E-02		1.20E-03	0.1098	0.013664	0.0017324	0.014884	0.009272	0	0.000293
		2.75" RKT HE					ea.	4.50E-01	5.60E-02	7.10E-03	6.10E-02	3.80E-02		1.20E-03	0	0	0	0	0	0	0
		2.75" RKT I	INERT Warhead				ea.	4.50E-01	5.60E-02	7.10E-03	6.10E-02	3.80E-02		1.20E-03	0	0	0	0	0	0	0
		Total:		**488**																	
FLARES		**FLARES****		**1,135**			**ea.**														
SMOKE		MK58 Marine Location Marker		10			ea.	1	1.30E-02	1.20E-02	3.20E-02	1.70E-02	6.10E-05	3.80E-05	0.005	0.000065	0.00006	0.00016	0.000085	0.000000305	1.9E-07
		SMOKE GRENADE		120			ea.	1	1.30E-02	1.20E-02	3.20E-02	1.70E-02	6.10E-05	3.80E-05	0.06	0.00078	0.00072	0.00192	0.00102	0.00000366	2.28E-06
		Total:		**130**																	
TORPEDO	NA	MK30	No emissions	602			ea.														
	NA	MK39	No emissions	1,409			ea.														
	NA	MK46	No emissions	8			ea.														
	NA	MK46-HOVER	No emissions				ea.														
	NA	MK46-LAMPS	No emissions				ea.														
	NA	MK-46-REX-FLYIN	No emissions				ea.														
	NA	MK46-REX-HOVER	No emissions				ea.														
	NA	MK46-REX-LAMPS	No emissions				ea.														
	NA	MK46-EXTORP	No emissions	85			ea.														
	NA	MK50-REX-FLYIN	No emissions	12			ea.														
	NA	MK50-REX-LAMPS	No emissions				ea.														
	NA	REXTORP-46	No emissions	126			ea.														
	NA	REXTORP-50	No emissions	20			ea.														
	NA	MK46-REX-SVTT	No emissions	14			ea.														
	NA	MK46-SVTT	No emissions				ea.														
	NA	MK46-VLA	No emissions				ea.														
	NA	REXTORP	No emissions				ea.														
	NA	MK48-ADCAP	No emissions	84			ea.														
	NA	MK48-ER	No emissions				ea.														
	NA	MK48-STD	No emissions				ea.														
	NA	MK54	No emissions	2			ea.														
		SSN	No emissions	89			ea.														
		Total:		**2,451**																	
		GRAND TOTAL ROUNDS		**8,758,296**																	
		GRAND TOTAL POUNDS NEW					**380,969**														
													SOCAL/SCI		120.8916	48.26435	2.585025836	4.437102	3.111851	0.021450327	0.050923
													SOCAL/SD		0.0627	0.132209	0.0128067	0.003581	0.002265	0	0.000179

Date: 13-May-2007

Table C-13. Ground Vehicle Operations - No Action Alternative

Scenario	Type Training	Days	Ground Vehicles	Number	Engine Load	Hours per day	Emissions Factors (lb/hr)					Emissions (lbs)				
Training Exercises							CO	NOx	HC	SOx	PM10	CO	Nox	HC	Sox	PM
1	Air Combat Maneuvers		None													
2	Air Defense Exercise		None													
3	S-A Missiles		None													
4	S-A Gunnery Exercise		None													
5	A-A Missiles		None													
6	Helicopter ASW TRACKEX		None													
7	MPA ASW TRACKEX		None													
8	Helicopter ASW TORPEX		None													
9	MPA ASW TORPEX		None													
10	Surface Ship ASW TRACKEX		None													
11	Surface Ship ASW TORPEX		None													
12	Surface Ship Integrated ASW		None													
13	Sub ASW Trackex		None													
14	Sub ASW TORPEX		None													
15	VBSS		None													
16	A-S MISSILEX		None													
17	A-S BOMBEX		None													
18	A-S GUNEX		None													
19	S-S GUNEX		None													
20	SINKEX		None													
21	NSFS		None													
22	EFEX	3	5-ton Truck	12	80%	8	0.04	0.06	0.01	0.00	0.01	12.71	18.65	2.46	0.05	1.75
		3	HMMWV	2	65%	8	0.04	0.06	0.01	0.00	0.01	2.12	3.11	0.41	0.01	0.29
23	Battalion Landing	0	LAV	20		8	0.04	0.06	0.01	0.00	0.01	0.00	0.00	0.00	0.00	0.00
		0	FAV	12		8	0.04	0.06	0.01	0.00	0.01	0.00	0.00	0.00	0.00	0.00
		0	HMMWV	2		8	0.04	0.06	0.01	0.00	0.01	0.00	0.00	0.00	0.00	0.00
		0	7-ton Truck	8		8	0.12	0.44	0.01	0.00	0.02	0.00	0.00	0.00	0.00	0.00
		0	M-1 Tank	4		8	0.12	0.44	0.01	0.00	0.02	0.00	0.00	0.00	0.00	0.00
24	USMC Stinger	0	LAV	0		5	0.04	0.06	0.01	0.00	0.01	0.00	0.00	0.00	0.00	0.00
25	Amphibious Landings & Raids															
25A	Recon Mission		None													

Scenario	Type Training	Days	Ground Vehicles	Number	Engine Load	Hours per day	Emissions Factors (lb/hr)					Emissions (lbs)				
Training Exercises							CO	NOx	HC	SOx	PM10	CO	Nox	HC	Sox	PM
25B	Helicopter Assault	0	FAV	0	Idle	1										
					65%	4	0.04	0.06	0.01	0.00	0.01	0.00	0.00	0.00	0.00	0.00
25C	Armored Operations	0	HMMWV	0	Idle	2	0.06	0.17	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00
					65%	3	0.04	0.06	0.01	0.00	0.01	0.00	0.00	0.00	0.00	0.00
			M1	0	Idle	1	0.06	0.17	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00
					60%	2	0.12	0.44	0.01	0.00	0.02	0.00	0.00	0.00	0.00	0.00
25D	Amphibious Landings & Raids	1	HMMWV	2	Idle	2	0.06	0.17	0.01	0.00	0.00	0.23	0.66	0.03	0.00	0.01
					65%	3	0.04	0.06	0.01	0.00	0.01	0.26	0.39	0.05	0.00	0.04
			5-ton Trucks		Idle	1	0.06	0.17	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00
					80%	1	0.04	0.06	0.01	0.00	0.01	0.00	0.00	0.00	0.00	0.00
25E	Amphibious Assault		None													
25F	Combat Engineer Ops	1	HMMWV	0	Idle	2	0.06	0.17	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00
					65%	3	0.04	0.06	0.01	0.00	0.01	0.00	0.00	0.00	0.00	0.00
			5-ton Trucks	2	Idle	1	0.06	0.17	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00
					80%	1	0.04	0.06	0.01	0.00	0.01	0.00	0.00	0.00	0.00	0.00
25G	Amphibious Assault Vehicle Ops															
25H	EFV	1	HMMWV	0	Idle	2	0.06	0.17	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00
					65%	3	0.04	0.06	0.01	0.00	0.01	0.00	0.00	0.00	0.00	0.00
			5-ton Trucks	0	Idle	1	0.06	0.17	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00
					80%	1	0.04	0.06	0.01	0.00	0.01	0.00	0.00	0.00	0.00	0.00
			Refueler			1	0.12	0.44	0.01	0.00	0.02	0.00	0.00	0.00	0.00	0.00
25I	Assault Amphibian School	5	7-ton Truck	0	Idle	1	0.06	0.17	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00
					80%	1	0.12	0.44	0.01	0.00	0.02	0.00	0.00	0.00	0.00	0.00
			HMMWV	0	Idle	2	0.06	0.17	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00
					65%	3	0.04	0.06	0.01	0.00	0.01	0.00	0.00	0.00	0.00	0.00
26	Ambphibious Operations CPAAA															
26A	Amphibious Operations		None													
26B	Amphibious Ops		None													
26C	Amphibious Ops		None													
26D	Amphibious Ops		None													
26E	Amphibious Ops		None													
26F	Amphibious Warfare		None													
26G	Amphibious Ops		None													
27	Elec Combat		None													
28A	Sm Obj Avoidance		None													
29	Mine Neutralization		None													
30	Mining Exercise		None													
31	NSWC Land Demolition		None													

Scenario	Type Training	Days	Ground Vehicles	Number	Engine Load	Hours per day	Emissions Factors (lb/hr)					Emissions (lbs)				
Training Exercises							CO	NOx	HC	SOx	PM10	CO	Nox	HC	Sox	PM
32	NSWC UW Demo		None													
33	Mat Weave		None													
34	NSWC Small Arms		None													
35	NSWC Land Nav	1	Pickup Truck	99		6	0.30	0.03	0.02	0.00	0.00	180.82	15.14	9.47	0.17	0.54
36	NSW UAV Operationa		None													
37	Insertion/Extraction		None													
38	NSW Boat Operations		None													
39	NSWG-1 Platoon Ops		None													
40	Direct Action		None													
41	Bombing Exercise - Land		None													
42	CSAR		None													
43	EOD Outside SHOBA		None													
44	USCG Ops		None													
45	NALF Airfield		None													
46	Ship Torpedo Test		None													
47	UUV		None													
48	Sonobuoy QA/QC		None													
49	Ocean Engineering		None													
50	MM Mine Location		None													
51	Missile Flight Test		None													
52	NUWC UW Acoustic		None													
53	Other Tests		None													
	Total						**Total Ground Vehicle Emissions, tons**					0.09807741	0.0189756	0.006208	0.000112	0.001312

Table C-14. Ground Vehicle Operations - Alternative 1

Scenario	Type Training	Days	Ground Vehicles	Number	Engine Load	Hours per day	Emissions Factors (lb/hr) CO	NOx	HC	SOx	PM10	Emissions (lbs) CO	Nox	HC	Sox	PM
Training Exercises																
1	Air Combat Maneuvers		None													
2	Air Defense Exercise		None													
3	S-A Missiles		None													
4	S-A Gunnery Exercise		None													
5	A-A Missiles		None													
6	Helicopter ASW TRACKEX		None													
7	MPA ASW TRACKEX		None													
8	Helicopter ASW TORPEX		None													
9	MPA ASW TORPEX		None													
10	Surface Ship ASW TRACKEX		None													
11	Surface Ship ASW TORPEX		None													
12	Surface Ship Integrated ASW		None													
13	Sub ASW Trackex		None													
14	Sub ASW TORPEX		None													
15	VBSS		None													
16	A-S MISSILEX		None													
17	A-S BOMBEX		None													
18	A-S GUNEX		None													
19	S-S GUNEX		None													
20	SINKEX		None													
21	NSFS		None													
22	EFEX	3	5-ton Truck	14	80%	8	0.04	0.06	0.01	0.00	0.01	14.83	21.76	2.87	0.06	2.04
		3	HMMWV	2	65%	8	0.04	0.06	0.01	0.00	0.01	2.12	3.11	0.41	0.01	0.29
23	Battalion Landing	4	LAV	20		8	0.04	0.06	0.01	0.00	0.01	28.25	41.45	5.47	0.11	3.88
		4	FAV	12		8	0.04	0.06	0.01	0.00	0.01	16.95	24.87	3.28	0.06	2.33
		4	HMMWV	2		8	0.04	0.06	0.01	0.00	0.01	2.83	4.14	0.55	0.01	0.39
		4	7-ton Truck	8		8	0.12	0.44	0.01	0.00	0.02	31.46	111.78	3.72	0.20	4.61
		4	M-1 Tank	4		8	0.12	0.44	0.01	0.00	0.02	15.73	55.89	1.86	0.10	2.31
24	USMC Stinger	1	LAV	3		5	0.04	0.06	0.01	0.00	0.01	0.66	0.97	0.13	0.00	0.09
25	Amphibious Landings & Raids															
25A	Recon Mission		None													

Scenario	Type Training	Days	Ground Vehicles	Number	Engine Load	Hours per day	Emissions Factors (lb/hr)					Emissions (lbs)				
Training Exercises							CO	NOx	HC	SOx	PM10	CO	Nox	HC	Sox	PM
25B	Helicopter Assault	1	FAV	32	Idle	1	0.06	0.17	0.01	0.00	0.00	1.86	5.29	0.22	0.00	0.07
					65%	4	0.04	0.06	0.01	0.00	0.01	5.65	8.29	1.09	0.02	0.78
25C	Armored Operations	1	HMMWV	12	Idle	2	0.06	0.17	0.01	0.00	0.00	1.39	3.97	0.17	0.00	0.05
					65%	3	0.04	0.06	0.01	0.00	0.01	1.59	2.33	0.31	0.01	0.22
			M1	12	Idle	1	0.06	0.17	0.01	0.00	0.00	0.70	1.99	0.08	0.00	0.03
					60%	2	0.12	0.44	0.01	0.00	0.02	2.95	10.48	0.35	0.02	0.43
25D	Amphibious Landings & Raids	1	HMMWV	18	Idle	2	0.06	0.17	0.01	0.00	0.00	2.09	5.96	0.25	0.00	0.08
					65%	3	0.04	0.06	0.01	0.00	0.01	2.38	3.50	0.46	0.01	0.33
			5-ton Trucks	36	Idle	1	0.06	0.17	0.01	0.00	0.00	2.09	5.96	0.25	0.00	0.08
					80%	1	0.04	0.06	0.01	0.00	0.01	1.59	2.33	0.31	0.01	0.22
25E	Amphibious Assault		None													
25F	Combat Engineer Ops	1	HMMWV	3	Idle	2	0.06	0.17	0.01	0.00	0.00	0.35	0.99	0.04	0.00	0.01
					65%	3	0.04	0.06	0.01	0.00	0.01	0.40	0.58	0.08	0.00	0.05
			5-ton Trucks	1	Idle	1	0.06	0.17	0.01	0.00	0.00	0.06	0.17	0.01	0.00	0.00
					80%	1	0.04	0.06	0.01	0.00	0.01	0.04	0.06	0.01	0.00	0.01
25G	Amphibious Assault Vehicle Ops															
25H	EFV	1	HMMWV	4	Idle	2	0.06	0.17	0.01	0.00	0.00	0.46	1.32	0.06	0.00	0.02
					65%	3	0.04	0.06	0.01	0.00	0.01	0.53	0.78	0.10	0.00	0.07
			5-ton Trucks	2	Idle	1	0.06	0.17	0.01	0.00	0.00	0.12	0.33	0.01	0.00	0.00
					80%	1	0.04	0.06	0.01	0.00	0.01	0.09	0.13	0.02	0.00	0.01
			Refueler	1		1	0.12	0.44	0.01	0.00	0.02	0.12	0.44	0.01	0.00	0.02
25I	Assault Amphibian School	5	7-ton Truck	10	Idle	1	0.06	0.17	0.01	0.00	0.00	2.90	8.27	0.35	0.00	0.11
					80%	1	0.12	0.44	0.01	0.00	0.02	6.15	21.83	0.73	0.04	0.90
			HMMWV	10	Idle	2	0.06	0.17	0.01	0.00	0.00	5.80	16.55	0.70	0.01	0.22
					65%	3	0.04	0.06	0.01	0.00	0.01	6.62	9.71	1.28	0.02	0.91
			Refueler	10		1	0.12	0.44	0.01	0.00	0.02	6.15	21.83	0.73	0.04	0.90
26	Ambphibious Operations CPAAA															
26A	Amphibious Operations		None													
26B	Amphibious Ops		None													
26C	Amphibious Ops		None													
26D	Amphibious Ops		None													
26E	Amphibious Ops		None													
26F	Amphibious Warfare		None													
26G	Amphibious Ops		None													
27	Elec Combat		None													
28A	Sm Obj Avoidance		None													
29	Mine Neutralization		None													
30	Mining Exercise		None													

Scenario	Type Training	Days	Ground Vehicles	Number	Engine Load	Hours per day	Emissions Factors (lb/hr)					Emissions (lbs)				
Training Exercises							CO	NOx	HC	SOx	PM10	CO	Nox	HC	Sox	PM
31	NSWC Land Demolition		None													
32	NSWC UW Demo		None													
33	Mat Weave		None													
34	NSWC Small Arms		None													
35	NSWC Land Nav	1	Pickup Truck	118		6	0.30	0.03	0.02	0.00	0.00	215.53	18.05	11.28	0.20	0.64
36	NSW UAV Operationa		None													
37	Insertion/Extraction		None													
38	NSW Boat Operations		None													
39	NSWG-1 Platoon Ops		None													
40	Direct Action		None													
41	Bombing Exercise - Land		None													
42	CSAR		None													
43	EOD Outside SHOBA		None													
44	USCG Ops		None													
45	NALF Airfield		None													
46	Ship Torpedo Test		None													
47	UUV		None													
48	Sonobuoy QA/QC		None													
49	Ocean Engineering		None													
50	MM Mine Location		None													
51	Missile Flight Test		None													
52	NUWC UW Acoustic		None													
53	Other Tests		None													
	Total						**Total Ground Vehicle Emissions, tons**					0.19021591	0.2075521	0.018598	0.000467	0.01105

Table C-15. Ground Vehicle Operations - Alternative 2

Scenario	Type Training	Days	Ground Vehicles	Number	Engine Load	Hours per day	Emissions Factors (lb/hr)					Emissions (lbs)				
Training Exercises							**CO**	**NOx**	**HC**	**SOx**	**PM10**	**CO**	**Nox**	**HC**	**Sox**	**PM**
1	Air Combat Maneuvers		None													
2	Air Defense Exercise		None													
3	S-A Missiles		None													
4	S-A Gunnery Exercise		None													
5	A-A Missiles		None													
6	Helicopter ASW TRACKEX		None													
7	MPA ASW TRACKEX		None													
8	Helicopter ASW TORPEX		None													
9	MPA ASW TORPEX		None													
10	Surface Ship ASW TRACKEX		None													
11	Surface Ship ASW TORPEX		None													
12	Surface Ship Integrated ASW		None													
13	Sub ASW Trackex		None													
14	Sub ASW TORPEX		None													
15	VBSS		None													
16	A-S MISSILEX		None													
17	A-S BOMBEX		None													
18	A-S GUNEX		None													
19	S-S GUNEX		None													
20	SINKEX		None													
21	NSFS		None													
22	EFEX	3	5-ton Truck	16	80%	8	0.04	0.06	0.01	0.00	0.01	16.95	24.87	3.28	0.06	2.33
		3	HMMWV	3	65%	8	0.04	0.06	0.01	0.00	0.01	3.18	4.66	0.62	0.01	0.44
23	Battalion Landing	4	LAV	40		8	0.04	0.06	0.01	0.00	0.01	56.51	82.89	10.93	0.21	7.76
		4	FAV	24		8	0.04	0.06	0.01	0.00	0.01	33.91	49.74	6.56	0.13	4.66
		4	HMMWV	4		8	0.04	0.06	0.01	0.00	0.01	5.65	8.29	1.09	0.02	0.78
		4	7-ton Truck	16		8	0.12	0.44	0.01	0.00	0.02	62.93	223.55	7.45	0.40	9.23
		4	M-1 Tank	8		8	0.12	0.44	0.01	0.00	0.02	31.46	111.78	3.72	0.20	4.61
24	USMC Stinger	1	LAV	4		5	0.04	0.06	0.01	0.00	0.01	0.88	1.30	0.17	0.00	0.12
25	Amphibious Landings & Raids															
25A	Recon Mission		None													

Scenario	Type Training	Days	Ground Vehicles	Number	Engine Load	Hours per day	Emissions Factors (lb/hr)					Emissions (lbs)				
Training Exercises							**CO**	**NOx**	**HC**	**SOx**	**PM10**	**CO**	**Nox**	**HC**	**Sox**	**PM**
25B	Helicopter Assault	1	FAV	48	Idle	1	0.06	0.17	0.01	0.00	0.00	2.78	7.94	0.34	0.00	0.10
					65%	4	0.04	0.06	0.01	0.00	0.01	8.48	12.43	1.64	0.03	1.16
25C	Armored Operations	1	HMMWV	16	Idle	2	0.06	0.17	0.01	0.00	0.00	1.86	5.29	0.22	0.00	0.07
					65%	3	0.04	0.06	0.01	0.00	0.01	2.12	3.11	0.41	0.01	0.29
			M1	16	Idle	1	0.06	0.17	0.01	0.00	0.00	0.93	2.65	0.11	0.00	0.03
					60%	2	0.12	0.44	0.01	0.00	0.02	3.93	13.97	0.47	0.02	0.58
25D	Amphibious Landings & Raids	1	HMMWV	24	Idle	2	0.06	0.17	0.01	0.00	0.00	2.78	7.94	0.34	0.00	0.10
					65%	3	0.04	0.06	0.01	0.00	0.01	3.18	4.66	0.62	0.01	0.44
			5-ton Trucks	48	Idle	1	0.06	0.17	0.01	0.00	0.00	2.78	7.94	0.34	0.00	0.10
					80%	1	0.04	0.06	0.01	0.00	0.01	2.12	3.11	0.41	0.01	0.29
25E	Amphibious Assault		None													
25F	Combat Engineer Ops	1	HMMWV	6	Idle	2	0.06	0.17	0.01	0.00	0.00	0.70	1.99	0.08	0.00	0.03
					65%	3	0.04	0.06	0.01	0.00	0.01	0.79	1.17	0.15	0.00	0.11
			5-ton Trucks	2	Idle	1	0.06	0.17	0.01	0.00	0.00	0.12	0.33	0.01	0.00	0.00
					80%	1	0.04	0.06	0.01	0.00	0.01	0.09	0.13	0.02	0.00	0.01
25G	Amphibious Assault Vehicle Ops															
25H	EFV	1	HMMWV	8	Idle	2	0.06	0.17	0.01	0.00	0.00	0.93	2.65	0.11	0.00	0.03
					65%	3	0.04	0.06	0.01	0.00	0.01	1.06	1.55	0.21	0.00	0.15
			5-ton Trucks	4	Idle	1	0.06	0.17	0.01	0.00	0.00	0.23	0.66	0.03	0.00	0.01
					80%	1	0.04	0.06	0.01	0.00	0.01	0.18	0.26	0.03	0.00	0.02
			Refueler	2		1	0.12	0.44	0.01	0.00	0.02	0.25	0.87	0.03	0.00	0.04
25I	Assault Amphibian School	5	7-ton Truck	15	Idle	1	0.06	0.17	0.01	0.00	0.00	4.35	12.41	0.52	0.01	0.16
					80%	1	0.12	0.44	0.01	0.00	0.02	9.22	32.75	1.09	0.06	1.35
			HMMWV	15	Idle	2	0.06	0.17	0.01	0.00	0.00	8.70	24.82	1.05	0.01	0.33
					65%	3	0.04	0.06	0.01	0.00	0.01	9.93	14.57	1.92	0.04	1.36
			Refueler	15		1	0.12	0.44	0.01	0.00	0.02	9.22	32.75	1.09	0.06	1.35
26	Ambphibious Operations CPAAA															
26A	Amphibious Operations		None													
26B	Amphibious Ops		None													
26C	Amphibious Ops		None													
26D	Amphibious Ops		None													
26E	Amphibious Ops		None													
26F	Amphibious Warfare		None													
26G	Amphibious Ops		None													
27	Elec Combat		None													
28A	Sm Obj Avoidance		None													
29	Mine Neutralization		None													
30	Mining Exercise		None													

Scenario	Type Training	Days	Ground Vehicles	Number	Engine Load	Hours per day	Emissions Factors (lb/hr)					Emissions (lbs)				
Training Exercises							CO	NOx	HC	SOx	PM10	CO	Nox	HC	Sox	PM
31	NSWC Land Demolition		None													
32	NSWC UW Demo		None													
33	Mat Weave		None													
34	NSWC Small Arms		None													
35	NSWC Land Nav	1	Pickup Truck	118		6	0.30	0.03	0.02	0.00	0.00	215.53	18.05	11.28	0.20	0.64
36	NSW UAV Operationa		None													
37	Insertion/Extraction		None													
38	NSW Boat Operations		None													
39	NSWG-1 Platoon Ops		None													
40	Direct Action		None													
41	Bombing Exercise - Land		None													
42	CSAR		None													
43	EOD Outside SHOBA		None													
44	USCG Ops		None													
45	NALF Airfield		None													
46	Ship Torpedo Test		None													
47	UUV		None													
48	Sonobuoy QA/QC		None													
49	Ocean Engineering		None													
50	MM Mine Location		None													
51	Missile Flight Test		None													
52	NUWC UW Acoustic		None													
53	Other Tests		None													
	Total						**Total Ground Vehicle Emissions, tons**					0.25185605	0.3605397	0.028176	0.000757	0.019352

Table C-16. Total Emissions within 3 nm - SOCAL OPAREA (conformity)

No Action Alternative	CO	NOx	HC	SOx	PM10	PM2.5
Aircraft–Operations	1.13	1.76	0.12	0.10	1.14	1.13
Surface Ships	8.69	12.84	3.22	7.22	1.16	3.61
NALF	132.86	37.97	33.63	1.89	28.11	27.83
Ordnance	25.12	1.15	0.00	0.01	2.66	1.89
Total	**167.80**	**53.72**	**36.97**	**9.23**	**33.08**	**34.46**
Alternative 1						
Aircraft–Operations	9.11	9.73	0.85	0.57	5.61	5.55
Surface Ships	10.90	17.35	4.88	10.34	4.13	4.09
NALF	153.67	47.18	35.98	2.30	29.14	28.85
Ordnance	39.66	1.97	0.00	0.02	3.37	2.36
Total	**213.34**	**76.23**	**41.72**	**13.22**	**42.24**	**40.85**
Alternative 2						
Aircraft–Operations	11.10	11.63	1.06	0.68	6.50	6.43
Surface Ships	12.09	19.82	5.99	12.03	5.51	7.34
NALF	165.78	54.63	37.75	2.65	31.72	31.40
Ordnance	48.26	2.59	0.00	0.02	4.44	3.11
Total	**237.23**	**88.67**	**44.80**	**15.37**	**48.17**	**48.29**
Increases over Baseline						
Alternative 1	45.54	22.51	4.74	3.99	9.17	6.39
Alternative 2	69.43	34.94	7.82	6.14	15.09	13.83
De Minimus Limits	**100.00**	**10.00**	**10.00**	**100.00**	**70.00**	**100.00**
Alternative 1 Above De Minimis?	NO	YES	NO	NO	NO	NO
Alternative 2 Above De Minimis?	NO	YES	NO	NO	NO	NO

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Aircraft - Operations	4.57	5.66	0.48	0.31	3.39
Surface Ships	17.94	29.05	10.66	6.13	1.16
Ordnance	21.2	0.07	0.01	0	0.26
NALF Aircraft	333.15	55.71	106.43	3.66	61.35
Total	**376.66**	**90.49**	**117.58**	**10.10**	**66.16**
Alt 1 Above 2006 Emissions Budget?	NO	NO	NO	YES	NO
Alt 2 Above 2006 Emissions Budget?	NO	NO	NO	YES	NO

Appendix D

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LIST OF TABLES

TABLE D-1. AMOUNT OF VEGETATION AND WILDLIFE HABITAT WITHIN INDIVIDUAL OPERATIONS AREAS ON SCI, DESCRIPTION OF POTENTIAL IMPACTS OF EXISTING AND PROPOSED OPERATIONS, APPLICABLE MITIGATION MEASURES, AND IMPACT SIGNIFICANCE. EVALUATION OF IMPACT SIGNIFICANCE FOR THE NO ACTION ALTERNATIVE IS BASED ON COMPARISON WITH THE BASELINE. 1
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Table D-1. Amount of Vegetation and Wildlife Habitat within Individual Operations Areas on SCI, Description of Potential Impacts of Existing and Proposed Operations, Applicable Mitigation Measures, and Impact Significance. Evaluation of Impact Significance for the No Action Alternative is Based on Comparison with the Baseline.

Operations Area[1]	Amount of Resource[1]	Description of Impacts	Applicable Mitigation Measures and Impact Significance[2,3]
IMPACT AREA I 2,346.4 ac	Vegetation Types (acreage) Coastal Strand: None Coastal Salt Marsh: 19.3 ac Delineated wetland 0.5 ac Island Woodland: 43.5 ac Disturbed: 440.5 ac Grassland: 1.0 ac MDS Cholla Phase: 932.3 ac MDS Lycium Phase: 511.6 ac MDS Prickly Pear-Cholla Phase: 397.7 ac	Existing patterns of disturbance from ordnance impacts and fire would be expected to continue under the no-action alternative, given the long history of similar use as a range for incoming heavy ordnance including naval bombardment, aerial bombardment, conventional artillery and mortars, and live-fire involving small arms. Under no action, Impact Area I receives about 6% of the large caliber ordnance used in SHOBA including about 199 bombs (mostly inert practice bombs), 244 large caliber artillery rounds and 138 2.75-inch rockets fired from helicopters at low altitude. Currently portions of the Impact Area where targets have most frequently been placed are highly disturbed by ordnance and frequent fires. The disturbance level decreases with distance from the target areas as exposure to incoming ordnance and fires decreases. This applies to all the habitats listed at left. Island Woodland, a sensitive community, is additionally protected from frequent fire or ordnance impact by distance from targets and topography. Targets are not placed in the area mapped as Coastal Salt Marsh, including the delineated wetland. Continued use as an impact area would not be expected to substantially change the condition of vegetation and wildlife habitat given the existing condition and long history of disturbance. The increases in ordnance associated with Alternatives 1 and 2 (11% and 21% increase in bombs, 31% and 47% increase in large caliber artillery rounds, and 28% and 57% increase in rockets, respectively) would not be expected to substantially change the existing intensity and patterns of disturbance within Impact Area I because the majority of this ordnance would fall into areas already highly disturbed by incoming ordnance. Moreover, improvements in weapons systems would be expected to lead to a higher percentage of ordnance hitting the intended target and fewer stray rounds. Impact Area I: Baseline / Alt 1 / Alt 2 Bombs: 199 / 221 / 241 Artillery: 244 / 319 / 359 Rockets: 138 / 176 / 217 Total: 581 / 716 / 817	Implementation of the SCI Wildland Fire Management Plan is part of the No Action Alternative, Alternative 1 and Alternative 2. G-M-1* G-M-3* G-M-4 G-M-5 G-M-6* G-M-7 G-M-9 *CRNSW policy prohibiting access for natural resource surveys or management means that some applicable mitigation measures (e.g., G-M-1, G-M-3, G-M-6) would be conducted around the periphery of impact areas but not within them. No Action: Impacts are less than significant. Alternative 1: Impacts would be less than significant with mitigation. Alternative 2: Impacts would be less than significant with mitigation

Table D-1 (continued). Amount of Vegetation and Wildlife Habitat Within Individual Operations Areas on SCI

Operations Area[1]	Amount of Resource[1]	Description of Impacts	Applicable Mitigation Measures and Impact Significance[2,3]
IMPACT AREA II 1,112.9 ac	Vegetation Types (acreage) Coastal Strand: 7.1 ac Island Woodland: 10.1 ac MDS Cholla Phase: 448.5 ac MDS Lycium Phase: 572.2 ac MDS Prickly Pear Phase: 28.0 ac Stabilized sand Dunes: 46.9 ac	Existing patterns of disturbance from ordnance impacts and fire would be expected to continue, given the long history of similar use as a range for incoming heavy ordnance including naval bombardment, aerial bombardment, conventional artillery and mortars, and live-fire involving small arms. Impact Area II includes Impact Area IIA, the "bomb box", where the use of large live bombs (500-2,000 lb) is permitted. Under No Action, Impact Area II (including IIA) receives ~94% of the large caliber ordnance used in SHOBA, including 2,453 bombs, 7,572 artillery rounds, 168 rockets, and 174 mortar rounds. Most of the bombs and nearly all of the rockets go into Impact Area IIA, which is very highly disturbed by ordnance impacts and frequent fires as are adjacent portions of Impact Area II where targets have most frequently been placed. The disturbance level decreases with increasing distance from the target areas as exposure to incoming ordnance and fires decreases. This applies to all the habitats listed at left. Island Woodland, a sensitive community, is additionally protected from frequent fire or ordnance impact by distance from targets and topography. Continued use as an impact area would not be expected to substantially change the condition of vegetation and wildlife habitat given the existing condition of the site and long history of disturbance. The increases in ordnance associated with Alternatives 1 and 2 (11% and 21% increase in bombs, 31% and 47% increase in large caliber artillery rounds, and 28% and 57% increase in rockets, respectively) would not be expected to substantially change the existing intensity and patterns of disturbance within Impact Area II because the majority of this ordnance would fall into areas already highly disturbed by incoming ordnance. Moreover, improvements in weapons systems would be expected to lead to a higher percentage of ordnance hitting the intended target and fewer stray rounds. Impact Area II (incl IIA) Baseline / Alt 1 / Alt 2 Bombs: 2,453 / 2,715 / 2,968 Artillery: 7,572 / 9,926 / 11,141 Rockets: 168 / 215 / 264 Totals: 10,193 / 12,856 / 14,373	Applicable mitigation measures and Impact significance are as described for Impact Area I above.
NALF AVMA 264.8ac	Vegetation Types (acreage) Coastal Strand: 5.1 ac Disturbed: 240.1 ac MDS Lycium Phase: 26.1 ac	Surface disturbance of the AVMA by tracked vehicles in Alternatives 1 and 2 would lead to reduction of vegetation in general; replacement of native shrubs such as boxthorn (*Lycium californicum)* by non-native annual grasses and weeds; and disturbance of soils, leading to an increase in wind and water erosion and opportunities for establishment of invasive species. Native vegetation includes MDS Lycium (along the southern boundary) and Coastal strand (at the egress from West Cove) vegetation types. Some further degradation of existing coastal strand and disturbed habitat is likely to result from USMC amphibious landings involving LCACs (if they run	Implementation of the SCI Wildland Fire Management Plan is part of the No Action Alternative, Alternative 1 and Alternative 2. G-M-1 G-M-3

Table D-1 (continued). Amount of Vegetation and Wildlife Habitat Within Individual Operations Areas on SCI

Operations Area[1]	Amount of Resource[1]	Description of Impacts	Applicable Mitigation Measures and Impact Significance[2,3]
		up into existing vegetation) and heavy tracked and wheeled vehicles including AAVs, EFVs, tanks and wheeled vehicles (if they run over vegetated areas while egressing from the beach).The majority of the AVMA has been disturbed by past grading and these portions would be less substantially affected by tracked vehicle use, except that the movements of tracked vehicles in this AVMA are likely to spread an infestation of veldt grass (*Ehrharta calycina*) that has been noted in this area southward on the Island if the current aggressive treatment of veldt grass is not effective. Designation of this AVMA is part of Alternatives 1 and 2. Alternative 1. The AVMA could be used by tracked vehicles during approximately 43 (42 USMC Amphibious plus 1 USMC Battalion Landing) operations per year. Alternative 2. The AVMA could be used by tracked vehicles during approximately 63 (61 USMC Amphibious plus 2 USMC Battalion Landing) operations per year. Greater impacts than for Alternative 1 due to the 47% increase in operations using the AVMA, compared to Alternative 1.	G-M-4 AVMC-M-1 AVMC-M-2 AVMC-M-3 AVMC-M-4 AVMC-M-5 AVMC-M-6 AVMC-M-7 AVMC-M-9 No Action: No Impact. Alternative 1: Impacts would be less than significant with mitigation. Alternative 2: Impacts would be less than significant with mitigation.
Old Rifle Range AVMA 200.3 ac	Vegetation Types (acreage) Disturbed: 62.6 ac Grassland: 0.5 ac MDS Lycium Phase: 137.2 ac	Surface disturbance of the AVMA by tracked vehicles in Alternatives 1 and 2 would inhibit ecosystem recovery and lead to reduction of vegetation in general; replacement of native shrubs such as boxthorn (*Lycium californicum)* by non-native annual grasses and weeds; and disturbance of soils, leading to an increase in wind and water erosion. The western boundary of the AVMA contains steep slopes prone to erosion. Drainages previously determined to be under Corps of Engineers jurisdiction cross the AVMA and would be affected by vehicular activity and may require grading to enable vehicular passage. Native vegetation is MDS Lycium (along the southern boundary). Portions of the AVMA have been disturbed by past grading and other activities (development and use as a firing range) and these portions would be less substantially affected by tracked vehicle use. Designation of this AVMA is part of Alternatives 1 and 2. Alternatives 1 and 2: Operations would be as described above for NALF AVMA.	Implementation of the SCI Wildland Fire Management Plan is part of the No Action Alternative, Alternative 1 and Alternative 2. G-M-1 G-M-3 G-M-4 AVMC-M-1 AVMC-M-2 AVMC-M-3 AVMC-M-4 AVMC-M-5 AVMC-M-6 AVMC-M-7 No Action: No Impact Alternatives 1 and 2: As described above for NALF AVMA, impacts would be less than significant with mitigation.

Table D-1 (continued). Amount of Vegetation and Wildlife Habitat Within Individual Operations Areas on SCI

Operations Area[1]	Amount of Resource[1]	Description of Impacts	Applicable Mitigation Measures and Impact Significance[2,3]
VC-3 AVMA 587.8 ac	Vegetation Types (acreage) Disturbed: 309.8 ac Grassland: 275.5 ac MDS Prickly Pear-Cholla Phase: 2.5 ac Vernal pool wetland: 0.3 ac	Surface disturbance of the AVMA by tracked vehicles in Alternatives 1 and 2 would inhibit ecosystem recovery and lead to reduction of vegetation in general and disturbance of soils, leading to an increase in wind and water erosion and susceptibility to invasive species. Over half of the AVMA has been disturbed by past grading and other uses, including aerial bombardment in the 1930s or 1940s, and would be less substantially affected by tracked vehicle use. The tiny vernal pool wetlands in the southern portion of the AVMA are probably artifacts of the former use of the area for bombing; tracked vehicle activity could adversely affect these pools by crushing or uprooting plants and increasing turbidity. Under some conditions, tracked vechicles may expand the pools by compacting soils and creating new ruts. The movements of tracked vehicles after departing from this AVMA are likely to spread localized infestations of invasive species including salsify (*Tragopogon porrifolius*) and smilo grass (*Piptatherum miliaceum*) to other parts of the island . Designation of this AVMA is part of Alternatives 1 and 2. Alternatives 1 and 2: Operations would be as described above for NALF AVMA	Applicable Mitigation Measures as listed for Old Rifle Range AVMA (above) No Action: No Impact Alternatives 1 and 2: Impacts would be less than significant with mitigation.
AVMC in SHOBA 72.2 ac	Vegetation Types (acreage) Disturbed: 0.9 ac Grassland: 9.1 ac MDS Cholla Phase: 6.7 ac MDS Prickly Pear-Cholla Phase: 9.6 ac	Operation of the AVMC in SHOBA in Alternatives 1 and 2 would have localized impacts on roadside vegetation and habitat including erosion, deposition of dust on vegetation, and spread of invasive plant species. The impacts would be localized along the sides of the AVMC, where invasive species would be detectable and treatable. Frequency of use would be up to approximately 43 times per year in Alternative 1 and up to 63 times per year in Alternative 2. (Construction of the route would be addressed in a separate environmental document and permitted separately).	Applicable Mitigation Measures as listed for Old Rifle Range AVMA (above) No Action: No Impact Alternative 1: Impacts from use of the route during operations would be less than significant with mitigation. Alternative 2: Impacts from use of the route during operations would be less than significant with mitigation.
Island Airfield AMP (AMP-A) 20.2 ac	Vegetation Types (acreage) Disturbed: 20.2 ac	Maneuvering of tracked and wheeled vehicles and howitzers for simulated attacks would inhibit ecosystem recovery, maintain soil and vegetation in disturbed condition, maintain conditions favorable to establishment or spread of invasive plant species, including veldt grass. Existing condition of site is disturbed. Designation of the AMP is part of Alternatives 1 and 2. Alternative 1: Artillery maneuvering during 3-day exercises up to 6 times per year plus 1 USMC Battalion Landing. Alternative 2. Artillery maneuvering during 3-day exercises up to 8 times per year plus 2 USMC Battalion Landings.	Implementation of the SCI Wildland Fire Management Plan is part of the No Action Alternative, Alternative 1 and Alternative 2. G-M-1 G-M-3 G-M-4 AVMC-M-1 AVMC-M-2 AVMC-M-3 AVMC-M-4 AVMC-M-5

Table D-1 (continued). Amount of Vegetation and Wildlife Habitat Within Individual Operations Areas on SCI

Operations Area[1]	Amount of Resource[1]	Description of Impacts	Applicable Mitigation Measures and Impact Significance[2,3]
			AVMC-M-6 AVMC-M-7 AVMC-M-8 No Action: No Impact. Alternative 1: Impacts would be less than significant with mitigation. Alternative 2: Impacts would be less than significant with mitigation.
Old Rifle Range (ORR) AMP (AMP-B) 25.4 ac	Vegetation Types (acreage) Disturbed: 20.6 ac MDS Lycium Phase: 4.7 ac	Maneuvering of wheeled and tracked vehicles and placement of howitzers for simulated attack coupled with use of the overlapping AVMA in Alternatives 1 and 2 is expected to inhibit ecosystem recovery and cause reduction of vegetation in general; replacement of native shrubs such as boxthorn (*Lycium californicum*) by non-native annual grasses and weeds; and disturbance of soils, leading to an increase in wind and water erosion. Designation of the AMP is part of Alternatives 1 and 2. Frequency of use is as described for Island Airfield AMP (AMP A) above.	Applicable conservation measures and Impact significance are as described for Island Airfield AMP (AMP A) above.
Self Help AMP (AMP-C) 5.5 ac	Vegetation Types (acreage) Disturbed: 2.1 ac Grassland: 3.4 ac	Maneuvering of wheeled and tracked vehicles and placement of howitzers for simulated attack in Alternatives 1 and 2 is expected to cause reduction of vegetative cover in general and disturbance of soils, leading to an increase in wind and water erosion especially near an existing drainage head on the east side of the AMP. This small site is previously disturbed and lacks perennial vegetation. Periodic use of the AMP by vehicles would inhibit ecosystem recovery by causing soil and vegetation to remain in disturbed condition and maintaining conditions favorable to establishment or spread of invasive plant species. Designation of the AMP is part of Alternatives 1 and 2. Frequency of use is as described for Island Airfield AMP (AMP A) above.	Applicable conservation measures and Impact significance are as described for Island Airfield AMP (AMP A) above.
Old Airfield AMP (AMP-D) 6.2 ac	Vegetation Types (acreage) Disturbed: 3.9 ac Grassland: 2.3 ac	Maneuvering of wheeled and tracked vehicles and placement of howitzers for simulated attack in Alternatives 1 and 2 is expected to cause reduction of vegetative cover in general and disturbance of soils, leading to an increase in wind and water erosion. This small site is previously disturbed owing to its location on one arm of the historic VC-3 runway and lacks native perennial vegetation. Periodic use of the AMP by vehicles would cause soil and vegetation to remain in disturbed condition and maintain conditions favorable to establishment or spread invasive plant species including salsify (*Tragopogon porrifolius*) and smilo grass (*Piptatherum miliaceum*), which are established onsite and have the potential to be carried to other parts of the island through vehicle and foot traffic. Designation of the AMP is part of Alternatives 1 and 2. Frequency of use is as described for Island Airfield AMP (AMP A) above.	Applicable conservation measures and Impact significance are as described for Island Airfield AMP (AMP A) above.
AFP-1 SHOBA 34.1 ac	Vegetation Types (acreage) AFP-1: MDS -Cholla Phase: 34.1 ac	Maneuvering of heavy wheeled and tracked vehicles, including tanks, and digging in of recoil spades on howitzers is expected to cause a reduction in vegetation cover in general, a reduction	Implementation of the SCI Wildland Fire Management Plan is

Table D-1 (continued). Amount of Vegetation and Wildlife Habitat Within Individual Operations Areas on SCI

Operations Area[1]	Amount of Resource[1]	Description of Impacts	Applicable Mitigation Measures and Impact Significance[2,3]
		in native shrub cover and biomass, replacement of native shrubs with non-native grasses and weeds, and to maintain the vegetation and soils on site in disturbed condition, subject to wind and water erosion, and establishment of invasive plant species. Portions of the 34-acre site have been previously affected by vehicles and equipment. Less than significant impacts for No Action due to small size and existing condition of site. No Action: 5 operations per year from this general area. Designation of this AFP is included in Alternatives 1 and 2. Alternative 1. Artillery maneuvering during 3-day USMC artillery exercises up to 6 times per year plus 1 USMC Battalion Landing. Alternative 2. Artillery maneuvering during 3-day USMC artillery exercises up to 8 times per year plus 2 USMC Battalion Landings.	part of the No Action Alternative, Alternative 1 and Alternative 2. G-M-1 G-M-3 G-M-4 G-M-9 AVMC-M-1 AVMC-M-2 AVMC-M-3 AVMC-M-4 AVMC-M-5 AVMC-M-6 AVMC-M-7 AVMC-M-8 No Action: Impacts are less than significant. Alternative 1. Impacts would be less than significant with mitigation. Alternative 2. Impacts would be less than significant with mitigation.
AFP-6 SHOBA 124.2 ac	Vegetation Types (acreage) Grassland 123.3 ac; MDS -Cholla Phase: 1 ac Vernal pool wetland: 0.4 ac	Maneuvering of heavy wheeled and tracked vehicles, including tanks, and maneuvering and digging in of recoil spades on howitzers in Alternatives 1 and 2 is expected to cause a reduction in vegetation cover in general, a reduction in grass cover and biomass, and to maintain the vegetation and soils on site in disturbed condition, subject to wind and water erosion and establishment of invasive plant species. Vehicle activity in the AFP could adversely affect the small vernal pools by crushing or uprooting plants and increasing turbidity. Under some conditions, tracked or wheeled vehicle use may expand the pools somewhat by compacting soils and creating new ruts that could retain water. Impacts would be less than significant with mitigation. No action: Designation of this AFP is included in Alternatives 1 and 2. Alternative 1. Artillery maneuvering during 3-day USMC artillery exercises up to 6 times per year plus 1 USMC Battalion Landing. Alternative 2. Artillery maneuvering during 3-day USMC artillery exercises up to 8 times per year plus 2 USMC Battalion Landings.	Implementation of the SCI Wildland Fire Management Plan is part of the No Action Alternative, Alternative 1 and Alternative 2. G-M-1 G-M-3 G-M-4, G-M-9 AVMC-M-1 AVMC-M-2 AVMC-M-3 AVMC-M-4 AVMC-M-5 AVMC-M-6

Table D-1 (continued). Amount of Vegetation and Wildlife Habitat Within Individual Operations Areas on SCI

Operations Area[1]	Amount of Resource[1]	Description of Impacts	Applicable Mitigation Measures and Impact Significance[2,3]
			AVMC-M-7 AVMC-M-8 No Action: No impact. This site was not included in the No Action Alternative. Alternative 1. Impacts would be less than significant with mitigation. Alternative 2. Impacts would be less than significant with mitigation.
TAR 1—Demolition Range Northeast Point 1.8 ac	Vegetation Types (acreage) Disturbed: 1.4 ac Stabilized sand dunes: 0.4 ac	Light disturbance of vegetation and soils by small groups on foot except for a small area (<0.25 ac) used for demolitions and safety bunker. Sandy soils, gently sloping terrain, and small disturbance area have low potential for erosion. Invasive species may establish around the margins of the disturbed are where they would be localized, detectable, and treatable. Less than significant impacts given light disturbance outside demolitions area, small size and existing condition of the site for No Action. No Action: 23 ops/yr. This TAR has been previously established. Alternative 1: 28 ops/yr. Alternative 2: 30 ops/yr. For Alternatives 1 and 2, with application of mitigation measures, the potential for disturbance of vegetation and soils but impacts would remain low for the reasons stated above despite the increased tempo of operations.	Implementation of the SCI Wildland Fire Management Plan is part of the No Action Alternative, Alternative 1 and Alternative 2. G-M-1 G-M-3 G-M-4 TAR-M-1 No Action: 23 operations/yr. Impacts are less than significant. Alternative 1: Impacts would be less than significant with mitigation. Alternative 2: Impacts would be less than significant with mitigation.

Table D-1 (continued). Amount of Vegetation and Wildlife Habitat Within Individual Operations Areas on SCI

Operations Area[1]	Amount of Resource[1]	Description of Impacts	Applicable Mitigation Measures and Impact Significance[2,3]
TAR 2—Graduation Beach Underwater Demolition Range 13.8 ac	Vegetation Types (acreage) Disturbed: 13.2 ac	Disturbance of onshore vegetation and soils would be from small groups on foot similar to historical use. Most of the activity at this TAR would occur on the beach and in the water. Impacts of No Action are less than significant. Baseline use = 5 ops/yr. Designation of this TAR is part of Alternatives 1 and 2. Alternative 1: 24 ops/yr. Alternative 2: 30 ops/yr.	Implementation of the SCI Wildland Fire Management Plan is part of the No Action Alternative, Alternative 1 and Alternative 2. G-M-1 G-M-3 G-M-4 TAR-M-1 No Action: Impacts are less than significant. Alternative 1: Impacts would be less than significant with mitigation. Alternative 2: Impacts would be less than significant with mitigation.
TAR 3—BUD/S Beach Underwater Demolition Range 4.1 ac	Vegetation Types (acreage) Disturbed with coastal strand and possibly some coastal dune. Quantitative data not available for this site.	This site has a long history of frequent high level NSW training activity and is adjacent to two permanent manned NSW facilities that use it for training. Native vegetation is somewhat disturbed. There would be additional disturbance by small groups on foot plus site improvements in Alternatives 1 and 2, which include erosion control on the access road and the demolition area, communication line telephone, maintenance of a demolition preparation area, and a demolition staging area. Some potential for establishment of invasive species but should be readily detectable and treatable given small size, accessibility, and frequent use of site. Most of the activity at this TAR would occur on the beach and in the water. Baseline use = 82 ops/yr. Designation of this TAR is part of Alternatives 1 and 2. Alternative 1: 82 ops/yr. Alternative 2: 95 NSW and 4 USMC Amphibious ops/yr.	Implementation of the SCI Wildland Fire Management Plan is part of the No Action Alternative, Alternative 1 and Alternative 2. G-M-1 G-M-3 G-M-4 TAR-M-1 No Action: Impacts are less than significant. Alternative 1: Impacts would be less than significant with mitigation. Alternative 2: Impacts would be less than significant with mitigation.

Table D-1 (continued). Amount of Vegetation and Wildlife Habitat Within Individual Operations Areas on SCI

Operations Area[1]	Amount of Resource[1]	Description of Impacts	Applicable Mitigation Measures and Impact Significance[2,3]
TAR 4—Whale Point/Castle Rock 27.1 ac	Vegetation Types (acreage) Disturbed: 15.4 ac MDS Lycium Phase: 11.7 ac	Ongoing and proposed operations would be expected to gradually degrade the MDS Lycium Phase habitat due to direct impacts resulting from frequent use by small groups on foot coupled with use of demolitions, flares, pyrotechnics, and small arms (including tracers). Indirect impacts associated with spread of invasive species that increase in response to disturbance of vegetation and soils and frequent small fires would also expected to adversely affect the MDS Lycium Phase habitat, because the dominant species regenerates slowly after fire or other disturbance and short fire return intervals are likely to cause long-term loss (DoN 2005, Draft FMP BA). Implementation of the SCI Wildland Fire Management Plan as described herein would be expected to reduce impacts of future operations under Alternatives 1 and 2. No Action: Baseline use = 222 ops/yr. This TAR has been previously established. Alternative 1: 240 ops/yr. Alternative 2: 300 ops/yr.	Implementation of the SCI Wildland Fire Management Plan is part of the No Action Alternative, Alternative 1 and Alternative 2. G-M-1 G-M-3 G-M-4 TAR-M-1 No Action: Impacts on vegetation are significant. Alternative 1: Impacts would be less than significant with mitigation. Alternative 2: Impacts would be less than significant with mitigation.
TAR 5— West Cove Amphibious Assault Training Area 2.1 ac	Vegetation Types (acreage) Coastal strand: 2.1 ac[1]	NSW activities would have minimal impact due to their infrequent occurrence and low intensity nature. Some further degradation of existing coastal strand and disturbed habitat is likely to result from USMC amphibious landings involving LCACs (if they run up into existing vegetation) and heavy tracked and wheeled vehicles including AAVs, EFVs, tanks and wheeled vehicles (if they run over vegetated areas while egressing from the beach). Existing use is for amphibious landings and extractions and access to NALF AVMA, which overlaps West Cove. Movements of vehicles and personnel from this TAR to other parts of the Island are likely to spread an infestation of veldt grass (*Ehrharta calycina*) that has been noted in this area and has been the target of weed treatments for several years. Baseline use = 10 ops/yr incl. 10 USMC Amphibious. Designation of this TAR is part of Alternatives 1 and 2. Alternative 1: 25ops/yr (incl. 17 USMC Amphibious). Alternative 2: 55 ops/yr (incl. 44 USMC Amphibious).	Implementation of the SCI Wildland Fire Management Plan is part of the No Action Alternative, Alternative 1 and Alternative 2. G-M-1 G-M-3 G-M-4 TAR-M-1 AVMC-M-9 For amphibious landings measures listed above for NALF AVMA are also applicable. No Action: Impacts are less than significant. Alternative 1: Impacts would be less than significant with mitigation. Alternative 2: Impacts would be less than significant with mitigation.

Table D-1 (continued). Amount of Vegetation and Wildlife Habitat Within Individual Operations Areas on SCI

Operations Area[1]	Amount of Resource[1]	Description of Impacts	Applicable Mitigation Measures and Impact Significance[2,3]
TAR 6—White House Training Area 3.3 ac	Vegetation Types (acreage) MDS *Lycium* Phase: 3.3 ac	Minimal disturbance to native vegetation and soils is anticipated in Alternatives 1 and 2. Site has existing developed features and access road. Some amount of disturbed vegetation is present and not reflected in the vegetation types data. Baseline use = 0 ops/yr. Designation of this TAR is part of Alternatives 1 and 2. Alternative 1: 8 ops/yr. Alternative 2: 10 ops/yr.	Implementation of the SCI Wildland Fire Management Plan is part of the No Action Alternative, Alternative 1 and Alternative 2. G-M-1 G-M-3 G-M-4 TAR-M-1 No Action: Impacts are less than significant Alternative 1: Impacts would be less than significant with mitigation. Alternative 2: Impacts would be less than significant with mitigation.
TAR 9—Photo Lab Training Area 26.3 ac	Vegetation Types (acreage) Disturbed: 23.5 ac Grassland: 2.8 ac	Physical disturbance to vegetation and habitat from continuing operations in the No-Action Alternative would be minimal (small groups on foot). Constructed roads and paths already exist between buildings. Use of breaching charges would be confined to designated currently disturbed areas. Baseline use = 23 ops/yr. Designation of this TAR is part of Alternatives 1 and 2. Alternative 1: 32 ops/yr. Alternative 2: 44 ops/yr.	Implementation of the SCI Wildland Fire Management Plan is part of the No Action Alternative, Alternative 1 and Alternative 2. G-M-1 G-M-3 G-M-4 TAR-M-1 No Action: Impacts are less than significant. Alternative 1: Impacts would be less than significant with mitigation. Alternative 2: Impacts would be less than significant with mitigation.

Table D-1 (continued). Amount of Vegetation and Wildlife Habitat Within Individual Operations Areas on SCI

Operations Area[1]	Amount of Resource[1]	Description of Impacts	Applicable Mitigation Measures and Impact Significance[2,3]
TAR 10—Demolition Range West 54.9 ac	Vegetation Types (acreage) Disturbed 29.6 ac MDS Lycium Phase: 25.3 ac Stabilized sand dune: 0.1 ac Salt marsh wetland: 0.14 ac	Development and use of the TAR would be concentrated in previously disturbed parts of the site, some of which have partially revegetated with native species. The proposed facility at this TAR would include a 200 ft^2 (19 m^2) personnel safety bunker and a 1,000 ft^2 (93 m^2) range building. The area of disturbance including demolitions area would be limited to a 10,000 ft^2 (930 m^2) area. Outside of the demolition areas operations would be by small groups on foot. Some potential for invasive species to establish on the site and along the access road and to spread into undisturbed MDS-Lycium and stabilized dune vegetation. Potential for wildland fires originating onsite, spreading into contiguous MDS-Lycium habitat to the north and south of TAR 10 has been addressed in the SCI Wildland Fire Management Plan and BA, with effective measures designed to minimize spread of fire beyond the TAR and avoid type conversion of habitat (see above). Assuming implementation of the Wildland Fire Management Plan as described herein and confining construction and concentrated human activities to existing disturbed areas, impacts on vegetation would be less than significant in Alternatives 1 and 2. Baseline use = 3 ops/yr. (Designation of this TAR is part of Alternatives 1 and 2). Alternative 1: 20 ops/yr. Alternative 2: 20 ops/yr.	Implementation of the SCI Wildland Fire Management Plan is part of the No Action Alternative, Alternative 1 and Alternative 2. G-M-1 G-M-3 G-M-4 TAR-M-1 No Action: Impacts are less than significant. Alternative 1: Impacts would be less than significant with mitigation. Alternative 2: Impacts would be less than significant with mitigation.
TAR 11—Surveillance Training Area 8.8 ac	Vegetation Types (acreage) Maritime sage scrub: 8.8 ac	Low disturbance of vegetation based on infrequent use by small groups on foot only, with helicopter insertion. Moderate potential for wildland fire ignition associated with use of flares and ordnance. Low potential for introduction and spread of invasive species due to small groups and relatively infrequent use, however sensitive plant communities and T/E plant populations are present on site and in surrounding area and could be adversely affected by an introduction of invasive species. Less than significant impacts for Alternatives 1 and 2 assuming implementation of the Wildland Fire Management Plan as described herein. Baseline use = 4 ops/yr. (Designation of this TAR is part of Alternatives 1 and 2). Alternative 1: 17 ops/yr. Alternative 2: 22 ops/yr.	Implementation of the SCI Wildland Fire Management Plan is part of the No Action Alternative, Alternative 1 and Alternative 2. G-M-1 G-M-3 G-M-4 TAR-M-1 No Action: Impacts are less than significant. Alternative 1: Impacts would be less than significant with mitigation. Alternative 2: Impacts would be less than significant with mitigation.

Table D-1 (continued). Amount of Vegetation and Wildlife Habitat Within Individual Operations Areas on SCI

Operations Area[1]	Amount of Resource[1]	Description of Impacts	Applicable Mitigation Measures and Impact Significance[2,3]
TAR 12—Radar Site Training Area 5.1 ac	Vegetation Types (acreage) Grassland: 4.9 ac Maritime sage scrub: 0.2 ac	Low impacts on vegetation and soils caused by infrequent foot traffic by small groups in Alternatives 1 and 2. Low to moderate potential for introduction and spread of invasive species. Low risk of wildland fire ignition. Baseline use = 11 ops/yr. (Designation of this TAR is part of Alternatives 1 and 2). Alternative 1: 12 ops/yr. Alternative 2: 17 ops/yr.	Implementation of the SCI Wildland Fire Management Plan is part of the No Action Alternative, Alternative 1 and Alternative 2. G-M-1 G-M-3 G-M-4 TAR-M-1 No Action: Impacts are less than significant. Alternative 1: Impacts would be less than significant with mitigation. Alternative 2: Impacts would be less than significant with mitigation.
TAR 13—Randall Radar Site Training Area 17.1 ac	Vegetation Types (acreage) Disturbed: 6.4 ac Grassland: 7.4 ac MDS Prickly Pear: 0.1 ac Maritime sage scrub: 3.6 ac	Low impacts on vegetation and soils caused by infrequent foot traffic by small groups. Use of flares, illumination rounds, and pyrotechnics creates a moderate risk of igniting a wildland fire. Live-fire would be indoors only. Less than significant impacts for Alternatives 1 and 2 assuming implementation of the Wildland Fire Management Plan as described herein. Baseline use = 29 ops/yr. (Designation of this TAR is part of Alternatives 1 and 2). Alternative 1: 31 ops/yr. Alternative 2: 52 ops/yr.	Implementation of the SCI Wildland Fire Management Plan is part of the No Action Alternative, Alternative 1 and Alternative 2. G-M-1 G-M-3 G-M-4 TAR-M-1 No Action: Impacts are less than significant. Alternative 1: Impacts would be less than significant with mitigation. Alternative 2: Impacts would be less than significant with mitigation.

Table D-1 (continued). Amount of Vegetation and Wildlife Habitat Within Individual Operations Areas on SCI

Operations Area[1]	Amount of Resource[1]	Description of Impacts	Applicable Mitigation Measures and Impact Significance[2,3]
TAR 14— VC-3 Onshore Parachute Drop Zone "Twinky" 338.7 ac	Vegetation Types (acreage) Disturbed: 5.2 ac Grassland: 324.9 ac MDS Prickly Pear: 8.6 ac	Low disturbance of vegetation caused by NSW activities based on use by small groups on foot only, some with helicopter insertion. Existing vegetation reflects substantial disturbance from past activities. Moderate potential for wildland fire ignition associated with use of flares and ordnance. Low potential for introduction and spread of invasive species due to small groups and relatively infrequent use. No sensitive species or vegetation types known from the site. Less than significant impacts for Alternatives 1 and 2 assuming implementation of the Fire Plan. Baseline use = 20 ops/yr. (Designation of this TAR is part of Alternatives 1 and 2). Alternative 1: 30 ops/yr. Alternative 2: 68 ops/yr.	Implementation of the SCI Wildland Fire Management Plan is part of the No Action Alternative, Alternative 1 and Alternative 2. G-M-1 G-M-3 G-M-4 TAR-M-1 No Action: Impacts are less than significant. Alternative 1: Impacts would be less than significant with mitigation. Alternative 2: Impacts would be less than significant with mitigation.
TAR 15— VC-3 Airfield Training Area 770.8 ac	Vegetation Types (acreage) Disturbed: 368.7 ac Grassland: 397.1 ac MDS Prickly Pear: 5.1 ac Vernal pool wetland: 0.3 ac	Low disturbance of vegetation caused by NSW activities based on use by small groups on foot only, with helicopter or land insertion. Existing vegetation reflects substantial disturbance from past activities. Moderate potential for wildland fire ignition associated with use of flares and ordnance high potential for spread under high and extreme FDRS. Low potential for introduction and spread of invasive species due to small groups and relatively infrequent use. Except for a small area of vernal pool wetlands in the southern tip of the TAR and overlying VC-3 AVMA (see above), no sensitive species or sensitive vegetation types are known from the site. The vernal pools would not be adversely affected (see text). Less than significant impacts for Alternatives 1 and 2 assuming implementation of the Wildland Fire Management Plan as described herein. Baseline use = 20 ops/yr. (Designation of this TAR is part of Alternatives 1 and 2). Alternative 1: 25 ops/yr. Alternative 2: 94 ops/yr.	Implementation of the SCI Wildland Fire Management Plan is part of the No Action Alternative, Alternative 1 and Alternative 2. G-M-1 G-M-3 G-M-4 TAR-M-1 No Action: Impacts are less than significant. Alternative 1: Impacts would be less than significant with mitigation. Alternative 2: Impacts would be less than significant with mitigation.

Table D-1 (continued). Amount of Vegetation and Wildlife Habitat Within Individual Operations Areas on SCI

Operations Area[1]	Amount of Resource[1]	Description of Impacts	Applicable Mitigation Measures and Impact Significance[2,3]
TAR 16—South VC-3 (Missile Impact Range) 54.2 ac	Vegetation Types (acreage) Grassland: 54.0 ac	Existing condition of grassland habitat is disturbed as a result of use as a missile target area, including grading and the construction and rearrangement of very large scale targets. Additional proposed activities, including vehicle traffic, use as a missile target, and use during Battalion Landings would be expected to have little additional impact on the habitat at this site. Less than significant impacts for Alternatives 1 and 2 assuming implementation of the Wildland Fire Management Plan as described herein. Baseline use = 25 ops/yr. This TAR has been previously established. Alternative 1: 41 ops/yr. Alternative 2: 52 ops/yr.	Implementation of the SCI Wildland Fire Management Plan is part of the No Action Alternative, Alternative 1 and Alternative 2. G-M-1 G-M-3 G-M-4 TAR-M-1 No Action: Impacts are less than significant. Alternative 1: Impacts would be less than significant with mitigation. Alternative 2: Impacts would be less than significant with mitigation.
TAR 17— Eel Point Tactical Training Range 11.9 ac	Vegetation Types (acreage) Disturbed: 4.7 ac MDS Lycium Phase: 7.2 ac	Outside of existing disturbed areas where demolitions would occur, disturbance of vegetation and soils would be limited to small groups on foot using tactical environmental movement. Low disturbance of vegetation, soils, and crusts would result from the foot traffic. There is a moderate potential for invasive species to spread following the foot traffic and into the surrounding undisturbed MDS Lycium vegetation. Potential for wildland fires originating onsite to spread into contiguous MDS-Lycium habitat to the north or to the south of TAR 17 has been addressed in the SCI Fire Management Plan and BA, with effective measures designed to minimize spread of fire beyond the TAR and avoid type conversion of habitat. Assuming implementation of the Wildland Fire Management Plan as described herein and confining most activities including demolitions and flare use to existing disturbed areas, impacts on vegetation would be less than significant in Alternatives 1 and 2. Baseline use = 15 ops/yr. (Designation of this TAR is part of Alternatives 1 and 2). Alternative 1: 31 ops/yr. Alternative 2: 40 ops/yr.	Implementation of the SCI Wildland Fire Management Plan is part of the No Action Alternative, Alternative 1 and Alternative 2. G-M-1 G-M-3 G-M-4 TAR-M-1 No Action: Impacts are less than significant. Alternative 1: Impacts would be less than significant with mitigation. Alternative 2: Impacts would be less than significant with mitigation.

Table D-1 (continued). Amount of Vegetation and Wildlife Habitat Within Individual Operations Areas on SCI

Operations Area[1]	Amount of Resource[1]	Description of Impacts	Applicable Mitigation Measures and Impact Significance[2,3]
TAR 18—Close Quarter Battle Training Complex 0.64 ac	Vegetation Types (acreage) Disturbed: 0.6 ac	Development and use of site in Alternatives 1 and 2 would impact disturbed vegetation and habitat only. Baseline use = 0 ops/yr. (Designation of this TAR is part of Alternatives 1 and 2). Alternative 1: 25 ops/yr. Alternative 2: 30 ops/yr.	Implementation of the SCI Wildland Fire Management Plan is part of the No Action Alternative, Alternative 1 and Alternative 2. G-M-1 G-M-3 G-M-4 TAR-M-1 No Action: Impacts are less than significant. Alternative 1: Impacts would be less than significant with mitigation. Alternative 2: Impacts would be less than significant with mitigation.
TAR 19—Simulated POW Camp and SAM Site 2.4 ac	Vegetation Types (acreage) Disturbed: 2.4 ac	Development and use of site in Alternatives 1 and 2 would impact disturbed vegetation and habitat only. Baseline use = 0 ops/yr. (Designation of this TAR is part of Alternatives 1 and 2). Alternative 1: 10 ops/yr. Alternative 2: 10 ops/yr.	Implementation of the SCI Wildland Fire Management Plan is part of the No Action Alternative, Alternative 1 and Alternative 2. G-M-1 G-M-3 G-M-4 TAR-M-1 No Action: Impacts are less than significant. Alternative 1: Impacts would be less than significant with mitigation. Alternative 2: Impacts would be less than significant with mitigation.

Table D-1 (continued). Amount of Vegetation and Wildlife Habitat Within Individual Operations Areas on SCI

Operations Area[1]	Amount of Resource[1]	Description of Impacts	Applicable Mitigation Measures and Impact Significance[2,3]
TAR 20—Pyramid Cove Training Area 167.2 ac	Vegetation Types (acreage) Coastal salt marsh: 11.6 ac Disturbed: 155.6 ac The coastal marsh is evidently mapped on the basis of vegetation and appears to be very infrequently flooded and lacking surface water. It is dominated by native salt marsh plant species due to the presence of saturated saline soils.	Impacts would be less than significant for No Action given the levels of existing disturbance in Impact Area I, including the portion designated as TAR 20. Ship to shore live-fire from small boats and other live-fire from people on foot would be expected to increase and vegetation and habitat would be expected to remain in similar condition or experience an incremental increase in disturbance as a result of ordnance use, fire, and foot traffic in Alternatives 1 and 2. Minimal impacts on the salt marsh habitat, which is low-lying and set back from the beach, would be expected from ordnance and fire. Vehicle traffic, including mounted patrol operations, would be confined to existing roads. Baseline use = 44 ops/yr. (This TAR is located in SHOBA Impact Area I where ongoing live-fire and bombardment are included in the No Action Alternative. Designation of this TAR is part of Alternatives 1 and 2). Alternative 1: 50 ops/yr. Alternative 2: 60 ops/yr.	Implementation of the SCI Wildland Fire Management Plan is part of the No Action Alternative, Alternative 1 and Alternative 2. G-M-1* G-M-3* G-M-4, G-M-9 TAR-M-1* *CRNSW policy prohibiting access for natural resource surveys or management means that some applicable mitigation measures (e.g., G-M-1, G-M-3, G-M-6) would be conducted around the periphery of impact areas but not within them. No Action: Impacts are less than significant. Alternative 1: Impacts would be less than significant with mitigation. Alternative 2: Impacts would be less than significant with mitigation.
TAR 21—Horse Beach Cove Training Area and Horse Beach Cove Amphibious Landing and Embarkation Area. 88.1 ac	Vegetation Types (acreage) Coastal salt marsh: 7.6 ac Island Woodland: 0.2 ac MDS Lycium Phase: 80.3 ac The coastal salt marsh in TAR 21 is the second largest mapped on SCI	TAR 21. Frequent use by small groups on foot with live firing has caused localized disturbance to vegetation in frequently used areas and routes. There is a moderate potential to introduce and spread invasive species related to the types and frequency of operations conducted in and proposed for TAR 21. Increased fire frequency resulting from the intensification of uses may lead to changes in vegetation (possibly leading to type conversion) under No Action and in Alternatives 1 and 2. The Wildland Fire Management Plan does not provide for ground based fire suppression within SHOBA. Amphibious Landing and Embarkation: Direct impacts of vehicular traffic on vegetation would be localized between the beach and the egress road, but vehicle traffic could significantly affect coastal salt marsh and coastal strand/foredune vegetation while maneuvering between beach and egress road in Alternatives 1 and 2. No amphibious landings are conducted under No Action. Baseline use = 79 ops/yr. (This TAR is located in SHOBA Impact Area I where ongoing live-fire and bombardment are included in the No Action Alternative. Designation of this TAR is part of Alternatives 1 and 2.) Alternative 1: 91 ops/yr. including 81 NSW, 10 USMC Amphibious and 1 USMC Battalion Landing.	Implementation of the SCI Wildland Fire Management Plan is part of the No Action Alternative, Alternative 1 and Alternative 2. G-M-1* G-M-3* G-M-4, G-M-7, G-M-9 TAR-M-1* AVMC-M-3 AVMC-M-4 AVMC-M-5 AVMC-M-7 AVMC-M-10 *CRNSW policy prohibiting access for natural resource surveys or

Table D-1 (continued). Amount of Vegetation and Wildlife Habitat Within Individual Operations Areas on SCI

Operations Area[1]	Amount of Resource[1]	Description of Impacts	Applicable Mitigation Measures and Impact Significance[2,3]
		Alternative 2: 102 ops/yr. including 90 NSW, 10 USMC Amphibious and 2 USMC Battalion Landing.	management means that some applicable mitigation measures (e.g., G-M-1, G-M-3, G-M-6) would be conducted around the periphery of impact areas but not within them. No Action: Impacts on vegetation are significant. Alternative 1: Impacts would be less than significant with mitigation. Alternative 2: 102 ops/yr. including 90 NSW, 10 USMC Amphibious and 2 USMC Battalion Landing. Impacts would be less than significant with mitigation.
TAR 22—China Cove Training Area 289 ac	Vegetation Types (acreage) Island Woodland: 0.1 ac MDS Cholla Phase: 22.3 ac MDS Lycium Phase: 229.6 ac Stabilized sand dunes: 37.0 ac	Most of the land area of TAR 22 is disturbed, a result of a long history of Naval artillery and aerial bombardment and other live-fire training. Proposed uses in Alternatives 1 and 2 would incrementally add to the existing disturbance, primarily as a result of ordnance use, demolition activities, fire, and foot traffic by platoon-sized groups (12-15). Entry to the site by swimming for many of the operations minimizes the potential for introducing or spreading invasive species. Stabilized sand dunes above beach are in relatively good condition despite evidence of ordnance and training impacts. Baseline use = 96 ops/yr including 33 NSW ops/yr. and 63 Non-NSW Naval ops/yr. (This TAR is located in SHOBA Impact Area II and contains Impact Area IIA, where ongoing live-fire and bombardment are included in the No Action Alternative. Designation of this TAR is part of Alternatives 1 and 2.) Alternative 1: 200 ops/yr. including 33 NSW, 6 USMC Amphibious, 1 USMC Battalion Landing and 160 other naval operations. Alternative 2: 220 ops/yr. including 40 NSW, 16 USMC Amphibious, 2 USMC Battalion Landing and 162 other naval operations. (Other naval operations include naval artillery and air-to-ground ordnance delivery into overlapping Impact Area II and IIA (which are included above under Impact Area II).	Implementation of the SCI Wildland Fire Management Plan is part of the No Action Alternative, Alternative 1 and Alternative 2. G-M-1*, G-M-3* G-M-4, G-M-7, G-M-9 TAR-M-1* *CRNSW policy prohibiting access for natural resource surveys or management means that some applicable mitigation measures (e.g., G-M-1, G-M-3, G-M-6) would be conducted around the periphery of impact areas but not within them. No Action: Impacts on vegetation are less than significant. Alternative 1: Impacts would be less than significant with mitigation. Alternative 2: Impacts would be less than significant with mitigation.
Infantry	Vegetation Types (acreage)	Foot traffic has a moderate potential for localized physical disturbance of the vegetation and soils over an	Implementation of the SCI

Table D-1 (continued). Amount of Vegetation and Wildlife Habitat Within Individual Operations Areas on SCI

Operations Area[1]	Amount of Resource[1]	Description of Impacts	Applicable Mitigation Measures and Impact Significance[2,3]
Operations Area 8,815.3 ac	Coastal strand: 4.5 ac Coastal salt marsh: 4.0 ac Island woodland: 3.2 ac Disturbed: 974.5 ac Grassland: 6351.4 ac MDS-Cholla Phase: 550.6 ac MDS Lycium Phase: 311.1 ac MDS Prickly Pear/Cholla phase: 435.6 ac MDS Prickly Pear Phase: 179.6 ac Vernal pool wetland 2.1 ac	extensive area, especially on sloping surfaces and when soils are wet. Grassland habitat, which constitutes the majority (~72%) of the Infantry Operations Area, has comparatively low botanical sensitivity. Habitat classified as disturbed constitutes another 11% of the Infantry Operations Area, however much of this disturbed habitat is incorporated into overlapping operations areas such as TARs and AVMAs addressed above. Because of the infrequency and dispersed nature of the foot traffic, direct impacts on vegetation and soils are expected to be temporary and less than significant. Island woodland, coastal strand and coastal salt marsh communities have high botanical sensitivity. The coastal strand and coastal salt marsh communities are in overlapping portions of Impact Area I and TAR 21. The Island woodland occurs in canyons mostly around the periphery of the IOA particularly on the edge of the eastern escarpment where the community is unlikely to be affected by foot traffic because of the terrain. Foot traffic spread over a large area has the potential to introduce or spread invasive plant species, an indirect impact. The large size and remoteness of parts of the Infantry Operations Area will make beginning infestations of invasive species difficult to detect when they are localized and most treatable. The large number of personnel and equipment involved in the Battalion Landing Operations and their dispersal over the island make introductions and spreading of invasive species almost unavoidable. The consequences of a particular introduction are not entirely predictable, however there are many documented cases of landscape transformations with serious ecological impacts resulting from introductions, most notably on islands. Baseline use = 0 ops/yr, Battalion-sized landings have occurred on SCI in the past, but not during the baseline year. Foot traffic by individuals and groups is permitted within the IOA and elsewhere on the Island under the No Action Alternative. Alternative 1: 1 USMC Battalion-sized landing per year with troops on foot using the IOA and mechanized vehicles using the AVMC or Ridge Road. 2 USMC Battalion-sized landings per year with troops on foot using the IOA and mechanized vehicles using the AVMC or Ridge Road. Alternative 2: 2 USMC Battalion-sized landings per year with troops on foot using the IOA and mechanized vehicles using the AVMC or Ridge Road.:	Wildland Fire Management Plan is part of the No Action Alternative, Alternative 1 and Alternative 2. G-M-1 G-M-3 G-M-4 G-M-9 AVMC-M-1 AVMC-M-2 AVMC-M-4 AVMC-M-7 No Action: Impacts are less than significant. Alternative 1: Impacts would be less than significant with mitigation. Alternative 2: Impacts would be less than significant with mitigation.

Note:

1. Vegetation acreage based on the classification and mapping by Sward and Cohen (1980). Resource acreage totals are approximate and may not agree with operations area total due to rounding and other factors associated with the GIS data layers.
2. Impact significance conclusion is based on discussion in "Description of Impacts" column and is assessed assuming application of mitigation measures identified in this document. Impact significance of No Action is based on condition of the resource existing in 2004 and continuance of operations at baseline levels.
3. Impact significance assessment assumes mitigation for Alternatives 1 and 2.

Table D-2. Occurrence of San Clemente Island Indian Paintbrush Within Individual Operations Areas on SCI, Description of Potential Impacts of Existing and Proposed Operations, and Impact Significance. Evaluation of Impact Significance for the No Action Alternative is Based on Comparison with the Baseline

Operations Area	Amount of Resource[1]	Description of Impacts	Applicable Mitigation Measures and Impact Significance[2,3]
IMPACT AREA I	SCI Indian paintbrush: 52 of 335 occurrences on SCI (15.5% of SCI total occurrences), 2034 of 14,064 individuals on SCI (14.5% of SCI total individuals). Nearly all of Impact Area I occurrences are in Horse Beach Canyon	Impact Area I contains about 15% of the known SCI Indian paintbrush on SCI. The occurrences of these plants are mainly in Horse Beach Canyon and are generally away from target locations and somewhat shielded by topography, minimizing potential for ordnance hits. Since removal of non-native herbivores from the Island, SCI Indian paintbrush has been increasing in abundance in this area despite ongoing use of live ordnance. Effect of fire on SCI Indian paintbrush is unknown but indications are that it might benefit from occasional fire. Under No Action, Impact Area I receives about 6% of the large caliber ordnance used in SHOBA, and the increases with Alternatives 1 and 2 are as described in Table D-1. Increased use of large ordnance in Alternatives 1 and 2 would have minimal effects on this species based on the increase of the plants during ongoing operations, adaptation to fire, distance from frequently used targets and topographic shielding. Implementation of the Navy Access Policy applying to Impact Areas I and II and TARS 20, 21, and 22 will preclude future direct monitoring of this endangered plant species and its habitat in these locations.	Implementation of the SCI Wildland Fire Management Plan is part of the No Action Alternative, Alternative 1 and Alternative 2. G-M-1* G-M-3* G-M-4 G-M-5 G-M-6* G-M-7 G-M-9 *CRNSW policy prohibiting access for natural resource surveys or management means that some applicable mitigation measures (e.g., G-M-1, G-M-3, G-M-6) would be conducted around the periphery of impact areas but not within them. No Action: Impacts are less than significant. Alternative 1: Impacts would be less than significant. Alternative 2: Impacts would be less than significant.
IMPACT AREA II	SCI Indian paintbrush: 3 of 335 SCI occurrences (0.9% of SCI total occurrences) with 43 individuals (0.3% of 14,064 SCI total individuals). These are located in China Canyon.	Existing patterns of disturbance from ordnance impacts and fire would be expected to continue, given the long history of similar use. This species is located in China Canyon where there is some topographic shielding, and it is not near targets, reducing the likelihood of a direct hit or near miss by ordnance. This species is increasing in abundance in SHOBA. As described in Table D-1, Impact Area II (including IIA) would receive about 94 % of the incoming large caliber ordnance in SHOBA and the increases with Alternatives 1 and 2 are as described in Table D-1. Heavy use of Impact Area II would have no adverse effects on this species based on the likelihood that the existing occurrences would persist or expand.	Applicable conservation measures and Impact significance are as described for Impact Area I above.

Table D-2 (continued). Occurrence of San Clemente Island Indian Paintbrush Within Individual Operations Areas on SCI

Operations Area	Amount of Resource[1]	Description of Impacts	Applicable Mitigation Measures and Impact Significance[2,3]
NALF AVMA	SCI Indian paintbrush: 6 of 335 SCI occurrences (1.8% of SCI total occurrences) with a total of 6 individuals (0.04% of 14,064 SCI total individuals) are clustered a short distance inland of the TAR 5 boundary. The location of each individual was recorded as a separate occurrence in this survey rather than as a single location with six individuals at one location as has been the more common practice.	The six Indian paintbrush plants in this AVMA are newly discovered and are located in a cluster with 3 other sensitive species (discussed in Table D-10) a short distance inland of the egress from TAR 5. At this location, surface disturbance of the AVMA by tracked vehicles in Alternatives 1 and 2 could lead to damage to or elimination of these plants from this area. Protection of the localized area containing the paintbrush can be addressed through development of the erosion control plan (AVMC-M-3), briefing of maneuver area boundaries prior to conducting operations in these areas (AVMC-M-4), and continuing to use the existing route for ingress and egress from the beach at West Cove (AVMC-M-9), as appropriate. Tracked vehicle use in this AVMA is likely to spread an infestation of veldt grass (*Ehrharta calycina*) within the AVMA and southward on the Island if the current aggressive treatment of veldt grass is not effective. Designation of this AVMA is part of Alternatives 1 and 2. Alternative 1. The AVMA could be used by tracked vehicles during approximately 43 (42 USMC Amphibious plus 1 USMC Battalion Landing) operations per year. Alternative 2. The AVMA could be used by tracked vehicles during approximately 63 (61 USMC Amphibious plus 2 USMC Battalion Landing) operations per year.	Implementation of the SCI Wildland Fire Management Plan is part of the No Action Alternative, Alternative 1 and Alternative 2. G-M-1 G-M-3 G-M-4 AVMC-M-1 AVMC-M-2 AVMC-M-3 AVMC-M-4 AVMC-M-5 AVMC-M-6 AVMC-M-7 AVMC-M-9 No Action: No Impact. Alternative 1: Impacts would be less than significant with mitigation. Alternative 2: Impacts would be less than significant with mitigation.
AFP-1 SHOBA	SCI Indian paintbrush: 1 of 335 SCI occurrences (0.3% of SCI total occurrences) with 28 individuals (0.2% of 14,064 SCI total individuals). These are located in the central portion of the AFP near the Ridge road.	Maneuvering of heavy wheeled and tracked vehicles, including tanks, and digging in of recoil spades on howitzers are likely to adversely affect individuals in this population through the physical effects of vehicle activity and possibly by spread of invasive species facilitated by the activity. Portions of this 34-acre site had been disturbed previously by grading and off-road tracked vehicle and artillery activity. The paintbrush occurrences appear to be in operationally accessible portions of the site but outside of the previously used portions of the site. Depending on the specifics of the site, protection of the localized area containing the paintbrush could potentially be addressed as part of development of the erosion control plan (AVMC-M-3) and/or briefing of maneuver area boundaries prior to conducting operations in these areas (AVMC-M-4). Less than significant impacts for No Action due to small size and previous disturbance of site and the small proportion of the SCI Indian Paintbrush population represented on site (<<1 percent). No Action: 5 operations per year from this general area. Designation of this AFP is included in Alternatives 1 and 2. Alternative 1. Artillery maneuvering during 3-day USMC artillery exercises up to 6 times per	Implementation of the SCI Wildland Fire Management Plan is part of the No Action Alternative, Alternative 1 and Alternative 2. G-M-1 G-M-3 G-M-4 G-M-9 AVMC-M-1 AVMC-M-2 AVMC-M-3 AVMC-M-4 AVMC-M-5

Table D-2 (continued). Occurrence of San Clemente Island Indian Paintbrush Within Individual Operations Areas on SCI

Operations Area	Amount of Resource[1]	Description of Impacts	Applicable Mitigation Measures and Impact Significance[2,3]
		year plus 1 USMC Battalion Landing. Alternative 2. Artillery maneuvering during 3-day USMC artillery exercises up to 8 times per year plus 2 USMC Battalion Landings.	AVMC-M-6 AVMC-M-7 AVMC-M-8 No Action: Impacts are less than significant. Alternative 1. Impacts would be less than significant with mitigation. Alternative 2. Impacts would be less than significant with mitigation.
TAR 21—Horse Beach Cove Training Area and Horse Beach Cove Amphibious Landing and Embarkation Area.	SCI Indian paintbrush: 1 of 335 occurrences on SCI (0.3% of SCI total occurrences), 3 of 14,064 individuals on SCI (0.02% of SCI total individuals). About 15% of SCI total individuals/occurrences of SCI Indian paintbrush are located in Horse Beach Canyon, in Impact Area I upstream from this TAR.	TAR 21. Occurrences of this species are primarily inland of the TAR boundary and are associated with the floodplain, hill slopes, or canyon walls of Horse Beach Canyon. Frequent foot traffic by small groups, ordnance use, and demolitions could directly affect this species. These effects would be localized to the specific activity areas. There is a moderate potential to introduce and spread invasive species related to the frequency of operations in TAR 21. Ship to shore live firing, tracers, use of flares and other devices have the potential to ignite fires that could spread north of the TAR boundary into areas occupied by this species, which appears able to survive periodic fire by reproduction from seed. Repeated fires at a short interval could adversely affect this species by killing plants before its seed bank has been replenished. Horse Beach Canyon upstream from the TAR 21 boundary supports about 15% of the SCI total occurrences of the SCI Indian paintbrush. The Wildland Fire Management Plan does not provide for ground-based fire suppression within SHOBA. Fires would be unlikely to spread far beyond the TAR boundary in an up-canyon direction due to the gentle elevational gradient of the lower canyon coupled with the direction of prevailing NW or NE winds under high and very high FDRS (DoN 2006), which would be opposed to spreading of fire in an up-canyon direction. Increased use in Alternatives 1 and 2 would increase the potential for adverse effects on this species. Amphibious Landing and Embarkation: Direct impacts of vehicular traffic on vegetation would be localized between the beach and the egress road where the SCI Indian paintbrush is not known to occur, so vehicular traffic associated with amphibious exercises would have less than significant impact on the species. Associated activity is as described above for TAR 21. Baseline use = 79 ops/yr. This TAR is located in SHOBA where ongoing live-fire and bombardment are included in the No Action Alternative. Designation of this TAR is part of Alternatives 1 and 2. Alternative 1: 91 ops/yr. including 81 NSW, 10 USMC Amphibious and 1 USMC Battalion Landing. Alternative 2: 102 ops/yr. including 90 NSW, 10 USMC Amphibious and 2 USMC Battalion Landing.	Implementation of the SCI Wildland Fire Management Plan is part of the No Action Alternative, Alternative 1 and Alternative 2. G-M-1* G-M-3* G-M-4 G-M-5 G-M-6* G-M-7 G-M-9 AVMC-M-1 AVMC-M-2* AVMC-M-3* AVMC-M-4 AVMC-M-5 AVMC-M-7 AVMC-M-10 TAR-M-1* *CRNSW policy prohibiting access for natural resource surveys or management means that some applicable mitigation measures (e.g., G-M-1, G-M-3, G-M-6) would be conducted around the periphery of impact areas but not within them.

Table D-2 (continued). Occurrence of San Clemente Island Indian Paintbrush Within Individual Operations Areas on SCI

Operations Area	Amount of Resource[1]	Description of Impacts	Applicable Mitigation Measures and Impact Significance[2,3]
			No Action: Impacts are less than significant. Alternative 1: Impacts would be less than significant with mitigation. Alternative 2: Impacts would be less than significant with mitigation.

Table D-2 (continued). Occurrence of San Clemente Island Indian Paintbrush Within Individual Operations Areas on SCI

Operations Area	Amount of Resource[1]	Description of Impacts	Applicable Mitigation Measures and Impact Significance[2,3]
TAR 22—China Cove Training Area	SCI Indian paintbrush: 1 of 335 occurrences on SCI (0.3% of SCI total occurrences), 23 of 14,064 individuals on SCI (0.16% of SCI total individuals).	The single location within TAR 22 is within Impact Area II at the eastern boundary of the TAR, where it is unlikely to be affected by activities. The plants are located in China Canyon near the TAR boundary where they are afforded some topographic shielding and are not in proximity with target areas, reducing the likelihood of a direct hit or near miss by ordnance. This species is increasing in abundance in SHOBA despite historic and ongoing bombardment, ordnance use and wildland fire. Effect of fire on SCI Indian paintbrush would be as described above. Activities within the TAR under No Action apparently have not adversely affected this species due to the distance of the plants from the TAR and topographic shielding that makes direct ordnance impacts unlikely, even after the long exposure of these populations to similar activities. Increased use of the TAR 22 in Alternatives 1 and 2 would increase the potential for effects on this species. Baseline use = 96 ops/yr including 33 NSW ops/yr. and 63 Non-NSW Naval ops/yr. (This TAR is located in SHOBA where ongoing live-fire and bombardment are included in the No Action Alternative. Designation of this TAR is part of Alternatives 1 and 2.) Alternative 1: 200 ops/yr. including 33 NSW, 6 USMC Amphibious, 1 USMC Battalion Landing and 160 other naval operations. Alternative 2: 220 ops/yr. including 40 NSW, 16 USMC Amphibious, 2 USMC Battalion Landing and 162 other naval operations (naval artillery and air-to-ground ordnance into overlapping Impact Area II and IIA (covered under Impact Area II).	Implementation of the SCI Wildland Fire Management Plan is part of the No Action Alternative, Alternative 1 and Alternative 2. G-M-1* G-M-3* G-M-4 G-M-5 G-M-6* G-M-7 G-M-9 TAR-M-1* *CRNSW policy prohibiting access for natural resource surveys or management means that some applicable mitigation measures (e.g., G-M-1, G-M-3, G-M-6) would be conducted around the periphery of impact areas but not within them. No Action: Impacts are less than significant. Alternative 1: Impacts would be less than significant with mitigation. Alternative 2: Impacts would be less than significant with mitigation.
Infantry Operations Area	SCI Indian paintbrush: 53 of 335 SCI 1998-2007 occurrences identified (15.8% of SCI total occurrences), 808 of 14,064 individuals on SCI (5.75% of SCI total individuals).	About 16% of the known occurrences of SCI Indian paintbrush on SCI are located in the Infantry Operations Area, where there would be an increase in dispersed foot traffic associated with Battalion Landings under Alternatives 1 and 2. Surveys of the 8,815-ac area have been recently completed with over 50 additional populations of this species located within the boundaries of the IOA. SCI Indian paintbrush is a small shrub and is unlikely to be adversely affected by occasional foot traffic. Any effects of foot traffic on a local occurrence of this species would be dispersed (because the Marines would be spread out), minor (trampled leaves or broken branches), infrequent (up to twice per year, generally less) and temporary. Because of the dispersion of the Marines and the small effect that the foot travel would have on plants, it is not expected that the direct effects of foot travel on this species would be substantial or significant.	Implementation of the SCI Wildland Fire Management Plan is part of the No Action Alternative, Alternative 1 and Alternative 2. G-M-1 G-M-3 G-M-4 G-M-9 AVMC-M-1

Table D-2 (continued). Occurrence of San Clemente Island Indian Paintbrush Within Individual Operations Areas on SCI

Operations Area	Amount of Resource[1]	Description of Impacts	Applicable Mitigation Measures and Impact Significance[2,3]
		However, the potential for introduction or spread of invasive species as a result of dispersed battalion landing foot traffic is not discountable and adverse consequences from such an event on endangered plant species are reasonably foreseeable. Baseline use: Battalion-sized landings have occurred on SCI in the past, but not during the baseline year. Foot traffic by individuals and groups is permitted within the IOA and elsewhere on the Island under the No Action Alternative. Alternative 1: 1 USMC Battalion landing per year with troops on foot using the IOA and mechanized vehicles using the AVMC or Ridge Road. Alternative 2: 2 USMC Battalion-sized landings per year with troops on foot using the IOA and mechanized vehicles using the AVMC or Ridge Road.	AVMC-M-2 AVMC-M-4 AVMC-M-7 No Action: Impacts are less than significant. Alternative 1: Impacts would be less than significant with mitigation. Alternative 2: Impacts would be less than significant with mitigation.

Note:

1. See text for an explanation of the 1998-2007 rare plant data. Under “amount of resource” resources (e.g., occurrences and numbers of individuals) occurring in overlapping operations areas are reported for each of the overlapping areas, enabling the effects of the differing operations in the overlapping areas to be assessed.
2. Impact significance conclusion is based on discussion in “Description of Impacts” column and is assessed assuming application of mitigation measures identified in this document.
3. Impact significance assessment assumes mitigation for Alternatives 1 and 2.

Table D-3. Occurrence of San Clemente Island larkspur within or near individual operations areas on SCI, description of potential impacts of existing and proposed operations, and impact significance. Evaluation of impact significance for the no action alternative is based on comparison with the baseline.

Operations Area[1]	Amount of Resource[1]	Description of Impacts	Applicable Mitigation Measures and Impact Significance[2,3]
TARs 14 & 15	No populations documented in these TARs but substantial populations are located on the eastern side and downslope from TARs 14 and 15.	No direct effect. Modeled fires under moderate Fire Danger Rating System conditions with southwest winds 5 mph (without implementing Wildland Fire Management Plan (DoN 2005) precautions and countermeasures referenced in Section 2-x and summarized below) spread into SCI larkspur habitat during nighttime hours, affecting up to 24 occurrences and 5,000 individuals 12 hours after ignition. This would be unlikely given implementation of the measures specified in the plan, because the fire would originate and burn initially in grassland habitat in moderate, accessible terrain in which fire suppression is most feasible. During the conditions when fire would be most likely, the SCI larkspur exists as dormant underground storage roots that resprout the following rainy season. This species, which is most prevalent in grassland habitats, may benefit from the removal of competing vegetation and thatch caused by periodic fire. The grassland habitat of the larkspur also recovers rapidly after fire. These model results do not take into account precautions and countermeasures specified in the SCI Wildland Fire Management Plan, which incorporates a series of increasing precautions and fire suppression measures related to increasing FDRS ratings, including having a fully equipped and staffed fire truck positioned within line of sight of the TAR and action area and having the ability to be on scene and pumping water within 10 minutes of an ignition report, whenever any type of incendiary ordnance is used and at higher danger ratings imposing restrictions on the use of demolitions or other flame or heat producing ordnance, including flares, tracers, and pyrotechnics, during daytime hours except under specific conditions. Increased operations in TARs 14 and 15 under Alternatives 1 and 2 would increase the potential for fires that could adversely affect the species. Even with the resiliency of the plants and their habitat with regard to fire, implementation of the SCI Fire Management Plan would be necessary to reduce those effects. Designation of TARs 14 and 15 is part of Alternatives 1 and 2 TAR 14: Baseline use = 20 ops/yr. Alternative 1: 30 ops/yr. Alternative 2: 68 ops/yr. TAR 15: Baseline use = 20 ops/yr. Alternative 1: 25 ops/yr. Alternative 2: 94 ops/yr.	Fire Management Plan Implementation G-M-1 G-M-3 G-M-4 TAR-M-1 No Action: Impacts are less than significant. Alternative 1. Impacts would be less than significant with mitigation. Alternative 2. Impacts would be less than significant with mitigation.

Table D-3 (continued). Occurrence of San Clemente Island larkspur within or near individual operations areas on SCI.

Operations Area[1]	Amount of Resource[1]	Description of Impacts	Applicable Mitigation Measures and Impact Significance[2,3]
Infantry Operations Area	SCI larkspur: 7 of 38 1998-2007 occurrences on SCI (18.4% of SCI total 1998-2006 occurrences), 284 of 7,389 individuals on SCI (3.8% of SCI total individuals); 12 of 46 pre-1998 historic SCI occurrences (26.1% SCI total historic occurrences) totaling 13.3 of 87 pre-1998 SCI acres (15.3%).	Less than 20% of known occurrences of this endangered plant species on SCI are within the Infantry Operations Area, where they would be exposed to dispersed foot traffic associated with Battalion Landings up to 2 times per year under Alternatives 1 and 2. Surveys of the 8,815-ac area were recently completed and 5 new occurrences totaling 59 individuals were located within the IOA. Any effects of foot traffic on a local population of this plant species would be dispersed (because the Marines would be spread out), minor (damaged leaves or flower stems), infrequent (up to twice per year, generally less) and temporary. SCI larkspur would be affected only during its winter-spring season of growth when foliage is above ground. The rest of the year they exist as dormant storage roots and dormant seed. Because of the dispersion of the Marines and the small effect that the foot travel would have on individual plants, it is not expected that the direct effects of foot travel on this species would be substantial. However, the potential for introduction or spread of invasive species as a result of dispersed battalion landing foot traffic is not discountable, and adverse consequences from such an event on this species in the Infantry Operations Area are reasonably foreseeable. Baseline use: none. Battalion-sized landings have occurred on SCI in the past, but are not considered part of the baseline. Foot traffic by individuals and groups is permitted within the IOA and elsewhere on the Island under the No Action Alternative. Alternative 1: 1 USMC Battalion-sized landing per year with troops on foot using the IOA and mechanized vehicles using the AVMC or Ridge Road. Alternative 2: 2 USMC Battalion-sized landings per year with troops on foot using the IOA and mechanized vehicles using the AVMC or Ridge Road.	Implementation of the SCI Wildland Fire Management Plan is part of the No Action Alternative, Alternative 1 and Alternative 2. G-M-1 G-M-3 G-M-4 AVMC-M-1 AVMC-M-2 AVMC-M-4 AVMC-M-7 No Action: No Impact. Alternative 1: Impacts would be less than significant with mitigation. Alternative 2: Impacts would be less than significant with mitigation.

Notes:
1. See text for an explanation of the 1998-2007 rare plant data and pre-1998 "historical" data used in the analysis.
2. Impact significance conclusion is based on discussion in "Description of Impacts" column and is assessed assuming application of mitigation measures identified in this document.
3. Impact significance assessment assumes mitigation for Alternatives 1 and 2.

Table D-4. Occurrence of San Clemente Island broom within or near individual operations areas on SCI, description of potential impacts of existing and proposed operations, and impact significance. Evaluation of impact significance for the no action alternative is based on comparison with the baseline.

Operations Area	Amount of Resource[1]	Description of Impacts	Applicable Mitigation Measures and Impact Significance[2,3]
TAR 11: Surveillance Training Area	SCI broom: 9 of 147 occurrences on SCI (6.1% of SCI total occurrences); 878 of 9674 individuals on SCI (9.1% of SCI total individuals) About 12 additional occurrences are in the general vicinity of the TAR.	Operations in No Action likely result in temporary damage to some individuals as a result of trampling and use of flares and pyrotechnics. Some potential exists for spreading of invasive species into habitat associated with the foot traffic. Fire originating as a result of operations could affect 10% or more of the Island population. Seedling establishment of this short-lived subshrub is fire-stimulated and the species also establishes from seed after minor disturbances. Burned plants are generally killed outright by fire. Increasing the number of operations in Alternatives 1 and 2 would increase the potential for effects on this species. Baseline use = 4 ops/yr. (Designation of this TAR is part of Alternatives 1 and 2). Alternative 1: 17 ops/yr. Alternative 2: 22 ops/yr.	Implementation of the SCI Wildland Fire Management Plan is part of the No Action Alternative, Alternative 1 and Alternative 2. G-M-1 G-M-3. G-M-4 TAR-M-1 No Action: Impacts are less than significant. Alternative 1: Impacts would be less than significant with mitigation. Alternative 2: Impacts would be less than significant with mitigation.
Infantry Operations Area	SCI broom: 14 of 147 1998-2007 occurrences on SCI (9.5% of SCI total 1998-2007 occurrences), 241 of 9674 individuals on SCI (2.5% of SCI total individuals).	Less than 10% of known occurrences and 2.5 % of known individuals of SCI broom on SCI are located in the Infantry Operations Area, where they would be exposed to dispersed foot traffic associated with Battalion Landings up to 2 times per year. SCI broom is a small shrub and is unlikely to be affected by occasional foot traffic. Any effects of foot traffic on a local population of this species would be dispersed (because the Marines would be spread out), minor (damaged leaves or broken branches), infrequent (up to twice per year, generally less) and temporary. Because of the dispersion of the Marines and the small effect that the foot travel would have on plants, it is expected that the direct effects of occasional foot travel on this species would be minor. However, as described above, the potential for introduction or spread of invasive species as a result of dispersed battalion landing foot traffic is not discountable and adverse consequences from such an event on this plant species are reasonably foreseeable.	Implementation of the SCI Wildland Fire Management Plan is part of the No Action Alternative, Alternative 1 and Alternative 2. G-M-1 G-M-3 G-M-4 AVMC-M-1 AVMC-M-2 AVMC-M-4 AVMC-M-7 No Action: No Impact. Alternative 1: Impacts would be less than significant with mitigation. Alternative 2: Impacts would be less than significant with mitigation.

Table D-4 (continued). Occurrence of San Clemente Island broom within or near individual operations areas on SCI.

Operations Area	Amount of Resource[1]	Description of Impacts	Applicable Mitigation Measures and Impact Significance[2,3]
		Baseline Use: none. Battalion-sized landings have occurred on SCI in the past, but are not considered part of the baseline. Foot traffic by individuals and groups is permitted within the IOA and elsewhere on the Island under the No Action Alternative. Alternative 1: 1 USMC Battalion-sized landing per year with troops on foot using the IOA and mechanized vehicles using the AVMC or Ridge Road. Alternative 2: 2 USMC Battalion-sized landings per year with troops on foot using the IOA and mechanized vehicles using the AVMC or Ridge Road.	

Note:
1. See text for an explanation of the 1998-2007 rare plant data and pre-1998 "historical" data used in the analysis.
2. Impact significance conclusion is based on discussion in "Description of Impacts" column and is assessed assuming application of mitigation measures identified in this document.
3. Impact significance assessment assumes mitigation for Alternatives 1 and 2.

Table D-5. Occurrence of San Clemente Island Bush Mallow Within or Near Individual Operations Areas on SCI, Description of Potential Impacts of Existing and Proposed Operations, and Impact Significance. Evaluation of Impact Significance for the No Action Alternative is Based on Comparison with the Baseline.

Operations Area	Amount of Resource[1]	Description of Impacts	Applicable Mitigation Measures and Impact Significance[2,3]
IMPACT AREA I	SCI bush mallow: 54 of 80 occurrences on SCI (67.5% of SCI total occurrences), 864 of 1591individuals on SCI (54.3% of SCI total individuals) Nearly all of the Impact Area I occurrences are in Horse Beach Canyon	The occurrences of these plants are mainly in Horse Beach Canyon and are generally away from targets for naval artillery and air-ground ordnance and somewhat shielded by topography, minimizing potential for ordnance hits. SCI bush mallow is increasing in abundance in this area despite ongoing use of live ordnance. Evidence is that occasional fire is beneficial to bush mallow. Under baseline conditions, Impact Area I receives about 6% of the large caliber ordnance used in SHOBA and the increases with Alternatives 1 and 2 are as described in Table D-1. Increased use of large ordnance in Alternatives 1 and 2 would have minimal effects on this species based on the increase of the plants during ongoing operations, adaptation to fire, distance from heavy ordnance targets currently in use, and topographic shielding. Implementation of the Navy Access Policy applying to Impact Areas I and II and TARS 20, 21, and 22 will preclude future direct monitoring of this endangered plant species and its habitat in these locations.	Implementation of the SCI Wildland Fire Management Plan is part of the No Action Alternative, Alternative 1 and Alternative 2. G-M-1* G-M-3* G-M-4 G-M-5 G-M-6* G-M-7 G-M-9 *CRNSW policy prohibiting access for natural resource surveys or management means that some applicable mitigation measures (e.g., G-M-1, G-M-3, G-M-6) would be conducted around the periphery of impact areas but not within them. No Action: Impacts are less than significant. Alternative 1: Impacts would be less than significant with mitigation. Alternative 2: Impacts would be less than significant with mitigation.

Table D-5 (continued). Occurrence of San Clemente Island Bush Mallow Within or Near Individual Operations Areas on SCI.

Operations Area	Amount of Resource[1]	Description of Impacts	Applicable Mitigation Measures and Impact Significance[2,3]
IMPACT AREA II	SCI bush mallow: 2 of 80 SCI occurrences (2.5% of SCI total occurrences) with 78 of 1591 individuals (4.9% of SCI total individuals). These plants are located in China Canyon.	Existing patterns of disturbance from ordnance impacts and fire would be expected to continue, given the long history of similar use. The known occurrences for this species in Impact Area II are in China Canyon where the plants are afforded some topographic shielding and are not in proximity with target areas, reducing the likelihood of a direct hit or near miss by ordnance. This species is increasing in abundance in SHOBA. Impact Area II receives about 94% of the large caliber ordnance used in SHOBA under baseline conditions and the increases with Alternatives 1 and 2 are as described in Table D-1. Increased use of Impact Area II would not be expected to have substantial adverse effects on this species based on the likelihood that the existing occurrences would persist or expand as the area continues to recover from the effects of feral goats. Implementation of the Navy Access Policy applying to Impact Areas I and II and TARS 20, 21, and 22 will preclude future direct monitoring of this endangered plant species and its habitat in these locations.	Applicable conservation measures and Impact significance are as described for Impact Area I above.
TAR 21— Horse Beach Cove Training Area and Horse Beach Cove Amphibious Landing and Embarkation Area	SCI bush mallow: 17 of 80 occurrences on SCI (21.2% of SCI total occurrences), 223 of 1591 individuals on SCI (14.0 % of SCI total individuals). All of these occurrences are also within Impact Area I, which overlaps TAR 21.	TAR 21: Occurrences of SCI bush mallow are inland of the coastal road that parallels the beach and are associated with the floodplain or canyon sides of Horse Beach Canyon. Frequent foot traffic by small groups, ordnance use, and demolitions could directly affect this species where activity is most frequent. These effects would be localized to the specific activity areas. There is a moderate potential to introduce and spread invasive species related to the frequency of operations and disturbances proposed for TAR 21. Ship to shore live firing, tracers, use of flares, etc. have the potential to ignite fires that could spread into areas occupied by this species, which survives periodic fire by resprouting. It has not been observed to reproduce from seed on SCI (WFMP DoN 2005). Repeated fires at a very short return interval could adversely affect SCI bush mallow by killing plants before underground reserves have been replenished. Horse Beach Canyon in Impact Area I (including the overlapping portion of TAR 21) has a substantial proportion (67.5%) of the total documented occurrences of the SCI bush-mallow. Increased fire frequency resulting from the intensification of uses may lead to localized changes in vegetation (type conversion). The Wildland Fire Management Plan does not provide for ground-based fire suppression within SHOBA. However, fires are unlikely to spread far beyond the TAR boundary in an up-canyon direction because of the low elevational gradient of the lower canyon coupled with the direction of prevailing NW or NE winds under high and very high FDRS (DoN 2006) which would be opposed to spreading of fire in an up-canyon direction. Increased use in Alternatives 1 and 2 would increase the potential for adverse effects on this species. Amphibious Landing and Embarkation: Assuming no maneuvering or parking of vehicles inland of the egress road, direct impacts of vehicular traffic on vegetation would be localized between the beach and the egress road where the SCI bush	Implementation of the SCI Wildland Fire Management Plan is part of the No Action Alternative, Alternative 1 and Alternative 2. G-M-1* G-M-3* G-M-4 G-M-5 G-M-6* G-M-7 G-M-9 AVMC-M-1 AVMC-M-2* AVMC-M-3* AVMC-M-4 AVMC-M-5 AVMC-M-7 AVMC-M-10 TAR-M-1* *CRNSW policy prohibiting access for natural resource surveys or management means that some applicable mitigation measures (e.g., G-M-1, G-M-3, G-M-6) would be conducted around the periphery of impact areas but not within them. No Action: Impacts are less than significant.

Table D-5 (continued). Occurrence of San Clemente Island Bush Mallow Within or Near Individual Operations Areas on SCI.

Operations Area	Amount of Resource[1]	Description of Impacts	Applicable Mitigation Measures and Impact Significance[2,3]
		mallow is not known to occur, so vehicular traffic associated with amphibious exercises would have less than significant impact on the species. Associated activity is accounted for above. Implementation of the Navy Access Policy applying to Impact Areas I and II and TARS 20, 21, and 22 will preclude future direct monitoring of this endangered plant species and its habitat in these locations. Baseline use = 79 ops/yr. ((This TAR is located in SHOBA where ongoing live-fire and bombardment are included in the No Action Alternative. Designation of this TAR is part of Alternatives 1 and 2.) Alternative 1: 91 ops/yr. including 81 NSW, 10 USMC Amphibious and 1 USMC Battalion Landing. Alternative 2: 102 ops/yr. including 90 NSW, 10 USMC Amphibious and 2 USMC Battalion Landing.	Alternative 1: Impacts would be less than significant with mitigation. Alternative 2: Impacts would be less than significant with mitigation.
TAR 22—China Cove Training Area	A pre-1998 historic occurrence of SCI bush mallow was not observed during 2005 surveys of this TAR.	Proposed activities at TAR 22 are unlikely to affect the previously documented occurrence of SCI bush mallow, which may no longer exist, given that it was not relocated during 2005 surveys of the TAR. This species is increasing in abundance in SHOBA despite historic and ongoing bombardment, ordnance use, and wildland fire. Evidence is that occasional fire is beneficial to bush mallow and impacts of No Action are less than significant. Increasing the number of operations in Alternatives 1 and 2 would increase the potential for effects on this species. Implementation of the Navy Access Policy applying to Impact Areas I and II and TARS 20, 21, and 22 will preclude future direct monitoring of this endangered plant species and its habitat in these locations. Baseline use = 96 ops/yr including 33 NSW ops/yr. and 63 Non-NSW Naval ops/yr. (This TAR is located in SHOBA where ongoing live-fire and bombardment are included in the No Action Alternative. Designation of this TAR is part of Alternatives 1 and 2.) Alternative 1: 200 ops/yr. including 33 NSW, 6 USMC Amphibious, 1 USMC Battalion Landing and 160 other naval operations. Alternative 2: 220 ops/yr. including 40 NSW, 16 USMC Amphibious, 2 USMC Battalion Landing and 162 other naval operations. (Other naval operations include naval artillery and delivery of air-to-ground ordnance into overlapping Impact Area II and IIA , which are overed under Impact Area II).	Implementation of the SCI Wildland Fire Management Plan is part of the No Action Alternative, Alternative 1 and Alternative 2. G-M-1* G-M-3* G-M-4 G-M-5 G-M-6* G-M-7 G-M-9 TAR-M-1* *CRNSW policy prohibiting access for natural resource surveys or management means that some applicable mitigation measures (e.g., G-M-1, G-M-3, G-M-6) would be conducted around the periphery of impact areas but not within them. No Action: Impacts are less than significant. Alternative 1: Impacts would be less than significant with mitigation. Alternative 2: Impacts would be less than significant with mitigation.
Infantry Operations Area	SCI bush mallow: 0 of 80 SCI 1998-2005 occurrences identified (0.0%); 1 of 28 pre-1998 historic SCI occurrences (3.6% SCI total occurrences) totaling 0.4 of 15.6 pre-1998	Less than 5% of known historic occurrences and individuals of SCI bush mallow are located in the Infantry Operations Area, where they would be exposed to dispersed foot traffic associated with Battalion Landings up to 2 times per year. Surveys of the 8,815-ac area have been recently completed and no additional occurrences of SCI bush mallow were located within the boundaries of the IOA. SCI bush mallow is a small to medium sized shrub and is unlikely to be affected by occasional foot traffic.	Implementation of the SCI Wildland Fire Management Plan is part of the No Action Alternative, Alternative 1 and Alternative 2. G-M-1 G-M-3

Table D-5 (continued). Occurrence of San Clemente Island Bush Mallow Within or Near Individual Operations Areas on SCI.

Operations Area	Amount of Resource[1]	Description of Impacts	Applicable Mitigation Measures and Impact Significance[2,3]
	SCI acres (2.6%).	Any effects of foot traffic on a local occurrence of this species would be dispersed (because the Marines would be spread out), minor (damage to leaves or possible broken branches), infrequent (up to twice per year, generally less) and temporary. Because of the dispersion of the Marines and the small effect that the foot travel would have on plants, it is not expected that the direct effects of occasional foot travel on this species would be substantial. However, the potential for introduction or spread of invasive species as a result of dispersed battalion landing foot traffic is not discountable and adverse consequences from such an event on endangered plant species are reasonably foreseeable. Baseline use: Battalion-sized landings have occurred on SCI in the past, but are not considered part of the baseline. Foot traffic by individuals and groups is permitted within the IOA and elsewhere on the island. Proposed Action: Two USMC Battalion-sized landings per year with troops on foot using the IOA and mechanized vehicles using the AVMC or Ridge Road.	G-M-4 AVMC-M-1 AVMC-M-2 AVMC-M-4 AVMC-M-7 No Action: No Impact. Alternative 1: Impacts would be less than significant with mitigation. Alternative 2: Impacts would be less than significant with mitigation.

Note:

1. See text for an explanation of the 1998-2007 rare plant data and pre-1998 "historical" data used in the analysis. Under "amount of resource", resources (e.g., occurrences and numbers of individuals) occurring in overlapping operations areas are reported for each of the overlapping areas (e.g., Impact Area I and TAR 21), enabling the effects of the differing operations in the overlapping areas to be assessed.
2. Impact significance conclusion is based on discussion in "Description of Impacts" column and is assessed assuming application of mitigation measures identified in this document.
3. Impact significance assessment assumes mitigation for Alternatives 1 and 2.

Table D-6. Occurrence of Island Night Lizard (INL) Within or Near Individual Operations Areas on SCI, Description of Potential Impacts of Existing and Proposed Operations, and Impact Significance. Evaluation of Impact Significance for the No Action Alternative is Based on Comparison with the Baseline.

Operations Area	Amount of Resource[1]	Description of Impacts	Applicable Mitigation Measures and Impact Significance[2,3]
IMPACT AREA I	INL Medium density habitat: 511.6 (8.7% of SCI total) Low density habitat: 397.8 (26% of SCI total) Lowest density habitat: 1.0 (<1% of SCI total) Estimated population in 511.6 ac of MDS Lycium is 400,583 individuals, based on average density of 783 individuals/acre for MDS Lycium habitat (DoN 2005, based on data from Mautz 2000). 397.9 ac of low density habitat would be expected to support about 229,190 individuals; 1.0 ac of lowest density would support 462 individuals.	Exposure to direct ordnance impacts, noise, and habitat degradation. Existing patterns of habitat disturbance from ordnance impacts and fire would be expected to continue, given the long history of similar use. Many individuals survive and populations are observed to persist in areas exposed to repeated fires and artillery bombardment, probably because of the high proportion of time spent by INL under cover (e.g., in rock crevices). Some take may occur from direct hits but would not be measurable at the population level. Table D-1 provides a summary of ordnance use for No Action, Alternative 1 and Alternative 2. Implementation of the Navy Access Policy applying to Impact Areas I and II and TARS 20, 21, and 22 will preclude future direct monitoring of this species and its habitat in these locations.	Implementation of the SCI Wildland Fire Management Plan is part of the No Action Alternative, Alternative 1 and Alternative 2. G-M-1* G-M-2* G-M-3* G-M-4 G-M-5 G-M-6* G-M-7 G-M-8 G-M-9 INL-M-1* *CRNSW policy prohibiting access for natural resource surveys or management means that some applicable mitigation measures (e.g., G-M-1, G-M-2, G-M-3, G-M-6, INL-M-1) would be conducted around the periphery of impact areas but not within them. No Action: Impacts are less than significant. Alternative 1: Impacts would be less than significant with mitigation. Alternative 2: Impacts would be less than significant with mitigation.

Table D-6 (continued). Occurrence of Island Night Lizard (INL) Within or Near Individual Operations Areas on SCI.

Operations Area	Amount of Resource[1]	Description of Impacts	Applicable Mitigation Measures and Impact Significance[2,3]
IMPACT AREA II	INL High density habitat: 28.0 ac (0.4% of SCI total) Medium density habitat: 572.0 ac (9.8% of SCI total) Low density habitat: 0.0 ac Lowest density habitat: 0.0 ac Estimated population in 28.0 ac of high density habitat is 29,008 individuals, based on average density of 1,036 individuals/ac for MDS Prickly Pear habitat (DoN 2005, based on data from Mautz 2000). 572.0 ac of medium density habitat would be expected to support about 447,876 individuals	Existing patterns of habitat disturbance from ordnance impacts and fire would be expected to continue, given the long history of similar use. No observable effect on the population would be expected. Impacts on the species are less than significant, given the demonstrated continuance of the population despite historic and ongoing use and the low proportion of the SCI total habitat exposed in Impact Area II. Table D-1 provides a summary of ordnance use for No Action, Alternative 1 and Alternative 2. Implementation of the Navy Access Policy applying to Impact Areas I and II and TARS 20, 21, and 22 will preclude future direct monitoring of this species and its habitat in these locations.	Applicable conservation measures and Impact significance are as described for Impact Area I above.
NALF AVMA	INL Medium density habitat: 26.1 ac (4% of SCI total) Estimated population in 26.1 ac of MDS Lycium is 20,436 individuals, based on average density of 783 individuals/acre (DoN 2005, based on data from Mautz 2000).	Tracked vehicles, including M-1 tanks, AAVs, and EFVs would degrade coastal strand and MDS Lycium habitat by causing a reduction in shrub (especially boxthorn) cover with a concomitant reduction of thermal cover and suitability for INL. Some mortality of individuals is likely but probably would not be observable. Degradation of 26.1 ac of habitat would lead to reduced reproduction of breeding adults and reduced survivorship of non-breeding individuals in that habitat. This would be a long term effect but less than significant because of the small effect on the overall population (< 0.5% of the medium density habitat on SCI). Designation of the AVMA is part of Alternatives 1 and 2. Alternative 1. The AVMA could be used by tracked vehicles during approximately 43 (42 USMC Amphibious plus 1 USMC Battalion Landing) operations per year. Alternative 2. The AVMA could be used by tracked vehicles during approximately 63 (61 USMC Amphibious plus 2 USMC Battalion Landing) operations per year.	Implementation of the SCI Wildland Fire Management Plan is part of the No Action Alternative, Alternative 1 and Alternative 2. G-M-1 G-M-2 G-M-3 G-M-4 AVMC-M-2 AVMC-M-3 AVMC-M-5 AVMC-M-6 AVMC-M-7 AVMC-M-8 INL-M-1 No Action: No Impact. Alternative 1: Impacts would be less than significant with mitigation. Alternative 2: Impacts would be less than significant with mitigation.

Table D-6 (continued). Occurrence of Island Night Lizard (INL) Within or Near Individual Operations Areas on SCI.

Operations Area	Amount of Resource[1]	Description of Impacts	Applicable Mitigation Measures and Impact Significance[2,3]
Old Rifle Range AVMA	INL Medium density habitat: 137.2 ac (2.3% of SCI total) Lowest density habitat: 0.5 ac (<1% of SCI total) Estimated population in 137.2 ac of MDS Lycium is 107,428 individuals, based on average density of 783 individuals/acre (DoN 2005, based on data from Mautz 2000). 0.5 ac of lowest density habitat would be expected to support about 231 additional individuals.	Tracked vehicles would degrade MDS Lycium habitat and grassland by causing a reduction in shrub (boxthorn) cover with a concomitant reduction of thermal cover and suitability for INL. Some mortality of individuals is likely but probably not observable. Take would include degradation of 143 ac of habitat expected to lead to reduced reproduction of breeding adults and reduced survivorship of non-breeding individuals in that habitat. This would be a long term effect but less than significant impact because of the small effect on the overall population (< 2.5% of the medium density and lowest density habitat on SCI). Designation of the AVMA is part of Alternatives 1 and 2. Alternative 1. The AVMA could be used by tracked vehicles during approximately 43 (42 USMC Amphibious plus 1 USMC Battalion Landing) operations per year. Alternative 2. The AVMA could be used by tracked vehicles during approximately 63 (61 USMC Amphibious plus 2 USMC Battalion Landing) operations per year.	Applicable Mitigation Measures as listed for NALF AVMA (above). No Action: No Impact Alternative 1: Impacts would be less than significant with mitigation. Alternative 2: Impacts would be less than significant with mitigation.
VC-3 AVMA	INL Low density habitat: 2.6 ac (0.2% of SCI total) Lowest density habitat: 275.5 ac (2.3% of SCI total) Estimated population in 275.5 ac of grassland habitat is 127,281 individuals, based on average density of 462 individuals/acre; 2.6 ac of MDS Cholla-Prickly Pear habitat would be expected to support about 1,498 additional individuals based on an average estimated density of 576 individuals/acre (DoN 2005, based on data from Mautz 2000).	Tracked vehicles would degrade MDS Cholla-Prickly Pear and grassland habitat by causing a reduction in vegetation cover with a concomitant reduction of thermal cover and suitability for INL. Some mortality of individuals is likely but probably not observable. Take would include degradation of 278 ac of habitat leading to reduced reproduction of breeding adults and reduced survivorship of non-breeding individuals in that habitat. This would be a long term effect but less than significant impact because of the small effect on the overall population (< 2.5% of the medium and lowest density habitat on SCI). Designation of the AVMA is part of Alternatives 1 and 2. Alternative 1. The AVMA could be used by tracked vehicles during approximately 43 (42 USMC Amphibious plus 1 USMC Battalion Landing) operations per year. Alternative 2. The AVMA could be used by tracked vehicles during approximately 63 (61 USMC Amphibious plus 2 USMC Battalion Landing) operations per year.	Applicable Mitigation Measures as listed for NALF AVMA (above). No Action: No Impact Alternative 1: Impacts would be less than significant with mitigation. Alternative 2: Impacts would be less than significant with mitigation.
Old Rifle Range (ORR) AMP	INL Medium density habitat: 4.7 ac (<0.08% of SCI total). Estimated population in 4.7 ac of MDS Lycium is 3,680 individuals, based on average density of 783 individuals/acre (DoN 2005, based on data from Mautz 2000).	Vehicular activity would probably result in degradation of habitat, including reduction of thermal cover, possibly leading to a measurable reduction in population size in the affected area due to habitat degradation. Mortality of individual INLs may also result from vehicular activity. Take would include degradation of 4.7 ac of medium density INL habitat and reduction of carrying capacity for INL. Designation of the AMP is part of Alternatives 1 and 2. Alternative 1: Artillery maneuvering during 3-day exercises up to 6 times per year plus 1 USMC Battalion Landing. Alternative 2. Artillery maneuvering during 3-day exercises up to 8 times per year plus 2 USMC Battalion Landings.	Implementation of the SCI Wildland Fire Management Plan is part of the No Action Alternative, Alternative 1 and Alternative 2. G-M-1 G-M-2 G-M-3 G-M-4 AVMC-M-2 AVMC-M-3

Table D-6 (continued). Occurrence of Island Night Lizard (INL) Within or Near Individual Operations Areas on SCI.

Operations Area	Amount of Resource[1]	Description of Impacts	Applicable Mitigation Measures and Impact Significance[2,3]
			AVMC-M-5 AVMC-M-6 AVMC-M-7 AVMC-M-8 INL-M-1 No Action: No Impact. Alternative 1: Impacts would be less than significant with mitigation. Alternative 2: Impacts would be less than significant with mitigation.
Self Help AMP	INL Lowest density habitat: 3.4 ac (<0.01% of Island total). Estimated population in 3.4 ac of grassland is 1,571 individuals, based on average density of 462 individuals/acre for grassland habitat (DoN 2005, based on data from Mautz 2000).	Vehicular activity would probably result in degradation of habitat, including reduction of thermal cover, possibly leading to a measurable reduction in population size in the affected area due to habitat degradation. Mortality of individual INLs may also result from vehicular activity. Take includes degradation of 3.4 ac of lowest density INL habitat and reduction of carrying capacity for INL. Grassland, because it is dominated by weedy annual species, would be expected to recover rapidly after cessation of disturbance, compared to habitats dominated by native shrubs such as boxthorn. Designation of the AMP is part of Alternatives 1 and 2. Alternative 1: Artillery maneuvering during 3-day exercises up to 6 times per year plus 1 USMC Battalion Landing. Alternative 2. Artillery maneuvering during 3-day exercises up to 8 times per year plus 2 USMC Battalion Landings.	Applicable Mitigation Measures as listed for Old Rifle Range (ORR) AMP (above). No Action: No Impact. Alternative 1: Impacts would be less than significant with mitigation. Alternative 2: Impacts would be less than significant with mitigation.
Old Airfield AMP	INL Lowest density habitat: 2.3 ac (<0.02% of SCI total). Estimated population in 2.3 ac of grassland habitat is 1,063 individuals, based on average density of 462 individuals/acre (DoN 2005, based on data from Mautz 2000).	Vehicular activity would probably result in degradation of habitat, including reduction of thermal cover, possibly leading to a measurable reduction in population size in the affected area due to habitat degradation. Mortality of individual INLs may also result from vehicular activity. Take includes degradation of 2.3 ac of lowest density INL habitat and reduction of carrying capacity for INL. Grassland, because it is dominated by weedy annual species, would be expected to recover rapidly after cessation of disturbance, compared to habitats dominated by native shrubs such as boxthorn. Designation of the AMP is part of Alternatives 1 and 2. Alternative 1: Artillery maneuvering during 3-day exercises up to 6 times per year plus 1 USMC Battalion Landing. Alternative 2. Artillery maneuvering during 3-day exercises up to 8 times per year plus 2 USMC Battalion Landings.	Applicable Mitigation Measures as listed for Old Rifle Range (ORR) AMP (above). No Action: No Impact. Alternative 1: Impacts would be less than significant with mitigation. Alternative 2: Impacts would be less than significant with mitigation.

Table D-6 (continued). Occurrence of Island Night Lizard (INL) Within or Near Individual Operations Areas on SCI.

Operations Area	Amount of Resource[1]	Description of Impacts	Applicable Mitigation Measures and Impact Significance[2,3]
AFP-1	INL Low density habitat: 34.1 ac (2.2% of Island total). Estimated population in 34.1 ac of MDS Prickly Pear-Cholla is 19,642 individuals, based on an average density of 576 individuals/acre for MDS Prickly Pear-Cholla habitat (DoN 2005, based on data from Mautz 2000).	Vehicular activity would result in degradation of habitat, including reduction of thermal cover, possibly leading to a measurable reduction in population size in the affected area due to habitat degradation. Mortality of individual INLs may also result from vehicular activity. Take would include degradation of about 34 ac of low density INL habitat leading to reduced reproduction of breeding adults and reduced survivorship of non-breeding individuals in that habitat and a probable reduction in carrying capacity of the habitat. This is a long term effect but less than significant impact because of the small effect on the overall population (~2.2% of the low density habitat on SCI). INL would be expected to survive on the site but at lower population level. 5 operations per year from this general area. .Designation of this AFP is included in Alternatives 1 and 2. Alternative 1. Artillery maneuvering during 3-day USMC artillery exercises up to 6 times per year plus 1 USMC Battalion Landing. Alternative 2. Artillery maneuvering during 3-day USMC artillery exercises up to 8 times per year plus 2 USMC Battalion Landings.	Implementation of the SCI Wildland Fire Management Plan is part of the No Action Alternative, Alternative 1 and Alternative 2. G-M-1 G-M-2 G-M-3, G-M-4 G-M-8, G-M-9 AVMC-M-2 AVMC-M-3 AVMC-M-5 AVMC-M-7 AVMC-M-8 INL-M-1 No Action: Impacts are less than significant. Alternative 1: Impacts would be less than significant with mitigation. Alternative 2. Impacts would be less than significant with mitigation.
AFP-6	INL Lowest density habitat: 123.3 ac (1.0% of Island total) Estimated population in 3.6 ac of MDS Prickly Pear-Cholla is 56,978 individuals, based on average density of 462 individuals/acre for grassland habitat (DoN 2005, based on data from Mautz 2000).	Vehicular activity would probably result in degradation of the grassland habitat, including reduction of thermal cover, possibly leading to a measurable reduction in population size in the affected area due to habitat degradation. Mortality of individual INLs may also result from vehicular activity. Take would include degradation of 123.3 ac of lowest density INL habitat leading to reduced reproduction of breeding adults and reduced survivorship of non-breeding individuals in that habitat and a probable reduction in carrying capacity of the habitat. This would be a long term effect but less than significant impact because of the small effect on the overall population (~1% of the lowest density habitat on SCI). INL would be expected to survive on the site but at lower population level. This site was not included in the No Action Alternative. Designation of this AFP is included in Alternatives 1 and 2. Alternative 1. Artillery maneuvering during 3-day USMC artillery exercises up to 6 times per year plus 1 USMC Battalion Landing. Alternative 2. Artillery maneuvering during 3-day USMC artillery exercises up to 8 times per year plus 2 USMC Battalion Landings.	Applicable Mitigation Measures as listed for AFP-1 (above). No Action: No impact. Alternative 1: Impacts would be less than significant with mitigation. Alternative 2: Impacts would be less than significant with mitigation.
TAR 4—Whale	INL	Continued operations, including ordnance use, fire, and foot traffic, outside of developed	Implementation of the SCI Wildland Fire

Table D-6 (continued). Occurrence of Island Night Lizard (INL) Within or Near Individual Operations Areas on SCI.

Operations Area	Amount of Resource[1]	Description of Impacts	Applicable Mitigation Measures and Impact Significance[2,3]
Point/Castle Rock	Medium density habitat: 11.7 ac (0.20% of SCI total). An additional 119.1 acres of medium density habitat are in the action area. Estimated population in 11.7 ac of MDS Lycium is 9,161 individuals, based on average density of 783 individuals/acre for MDS Lycium habitat (DoN 2005, based on data from Mautz 2000), with an additional 93,255 individuals in the action area.	facilities in this established TAR would be expected to lead to some reduced reproduction of breeding adults and reduced survivorship of non-breeding individuals as well as some direct mortality in heavily used portions of the habitat. Effect on population levels may not be detectable. The anticipated effects of operations on INL at this TAR would be long-term but less than significant because of the small effect on the overall population (~0.1% of the medium density INL habitat on SCI). This TAR was previously established. Baseline use = 222 ops/yr. Alternative 1: 240 ops/yr. Alternative 2: 300 ops/yr.	Management Plan is part of the No Action Alternative, Alternative 1 and Alternative 2. G-M-1 G-M-2 G-M-3 G-M-4 INL-M-1 No Action: Impacts are less than significant. Alternative 1: Impacts would be less than significant with mitigation. Alternative 2: Impacts would be less than significant with mitigation.
TAR 10—Demolition Range West	INL Medium density habitat: 25.3 ac (0.43% of SCI total) An additional 9.0, 156.2 and 7.2 ac of lowest, medium, and high density habitat, respectively, are within the action area. Estimated population in 25.3 ac of MDS Lycium is 19,810 individuals, based on average density of 783 individuals/acre for MDS Lycium habitat (DoN 2005, based on data from Mautz 2000). 9.0, 156.2 and 7.2 ac of lowest, medium, and high density habitat would respectively be expected to support 4,158; 122,305; and 7,459 individuals.	Approximately 0.25 acres of habitat would be affected by construction, demolitions, or concentrated foot traffic. Take would include loss or degradation of 1.5 acres of habitat affected by construction, demolitions, or concentrated foot traffic, which would be expected to lead to reduced reproduction of breeding adults and reduced survivorship of non-breeding individuals in that habitat. Effect on population levels may not be detectable. The loss or degradation of habitat at this TAR would be a long term effect but less than significant (NEPA) because of the small effect on the overall population (< 0.5% of the medium density INL habitat on SCI). Baseline use = 3 ops/yr. (Designation of this TAR is part of Alternatives 1 and 2). Alternative 1: 20ops/yr. Alternative 2: 20 ops/yr.	Implementation of the SCI Wildland Fire Management Plan is part of the No Action Alternative, Alternative 1 and Alternative 2. G-M-1 G-M-2 G-M-3 G-M-4 INL-M-1 No Action: Impacts are less than significant. Alternative 1: Impacts would be less than significant with mitigation. Alternative 2: Impacts would be less than significant with mitigation.

Table D-6 (continued). Occurrence of Island Night Lizard (INL) Within or Near Individual Operations Areas on SCI.

Operations Area	Amount of Resource[1]	Description of Impacts	Applicable Mitigation Measures and Impact Significance[2,3]
TAR 17— Eel Point Tactical Training Range	INL Medium density habitat 7.2 ac (0.1% of SCI total); action area contains an additional 53.6 ac of medium density habitat and 35.8 ac of high density habitat. Estimated population in 7.2 ac of MDS Lycium is 5638 individuals, based on average density of 783 individuals/acre for MDS Lycium habitat (DoN 2005, based on data from Mautz 2000). Additional 53.6 ac of medium density habitat and 35.8 ac of high density habitat would respectively be expected to support 41,969 and 37,088 individuals.	Assuming that approximately 0.5 ac of habitat outside of existing disturbed areas would be affected by training operations, especially concentrated foot traffic, take would include loss or degradation of 0.5 ac of habitat expected to lead to reduced reproduction of breeding adults and reduced survivorship of non-breeding individuals in that habitat. Effect on population levels may not be detectable. The loss or degradation of habitat at this TAR would be a long term effect but less than significant (NEPA) because of the small effect on the overall population (~ 0.1% of the medium density INL habitat on SCI). Baseline use = 15 ops/yr. (Designation of this TAR is part of Alternatives 1 and 2). Alternative 1: 31 ops/yr. Alternative 2: 40 ops/yr.	Applicable Mitigation Measures as listed for TAR--10 (above). No Action: Impacts are less than significant. Alternative 1: Impacts would be less than significant with mitigation. Alternative 2: Impacts would be less than significant with mitigation.

Table D-6 (continued). Occurrence of Island Night Lizard (INL) Within or Near Individual Operations Areas on SCI.

Operations Area	Amount of Resource[1]	Description of Impacts	Applicable Mitigation Measures and Impact Significance[2,3]
TAR 21—Horse Beach Cove Training Area	INL Medium density habitat: 80.3 ac (1.4% of SCI total medium density habitat). Action area contains an additional 172.6 ac (~3% of SCI total). Estimated population in 80.3 ac of MDS Lycium is 62,875 individuals, based on average density of 783 individuals/acre for MDS Lycium habitat (DoN 2005, based on data from Mautz 2000). Additional 172.6 ac of medium density habitat in action area would be expected to support 135,146 individuals.	Assuming that approximately 1 ac of habitat outside of existing disturbed areas would be directly affected by training operations, especially concentrated foot traffic, take would include loss or degradation of 1 ac of habitat expected to lead to reduced reproduction of breeding adults and reduced survivorship of non-breeding individuals in that habitat. Additionally fire would be expected to affect habitat and thermal cover. INL have been demonstrated to survive fire, even repeated fires. Effect on population levels may not be detectable unless sampling effort is intensive. The loss or degradation of habitat at this TAR would be a long term effect but less than significant (NEPA) because of the small effect on the overall population (~ 1.4% of the medium density INL habitat on SCI). Baseline use = 79 ops/yr. ((This TAR is located in SHOBA where ongoing live-fire and bombardment are included in the No Action Alternative. Designation of this TAR is part of Alternatives 1 and 2.). Alternative 1: 91 ops/yr. including 81 NSW, 10 USMC Amphibious and 1 USMC Battalion Landing. Alternative 2: 102 ops/yr. including 90 NSW, 10 USMC Amphibious and 2 USMC Battalion Landing.	Implementation of the SCI Wildland Fire Management Plan is part of the No Action Alternative, Alternative 1 and Alternative 2. G-M-1* G-M-2* G-M-3* G-M-4 G-M-6* G-M-7 G-M-8 G-M-9 AVMC-M-2* AVMC-M-3* AVMC-M-4 AVMC-M-5 AVMC-M-6* AVMC-M-7 AVMC-M-10 INL-M-1* *CRNSW policy prohibiting access for natural resource surveys or management means that some applicable mitigation measures (e.g., G-M-1, G-M-3, G-M-6) would be conducted around the periphery of impact areas but not within them. No Action: Impacts are less than significant. Alternative 1: Impacts would be less than significant with mitigation. Alternative 2: Impacts would be less than significant with mitigation.

Table D-6 (continued). Occurrence of Island Night Lizard (INL) Within or Near Individual Operations Areas on SCI.

Operations Area	Amount of Resource[1]	Description of Impacts	Applicable Mitigation Measures and Impact Significance[2,3]
TAR 22—China Cove Training Area	INL Medium density habitat: 229.6 ac (3.9% of SCI total medium density habitat). Action area contains an additional 218 ac (3.7% of SCI total). Estimated population in 229.6 ac of MDS Lycium is 179,777 individuals, based on average density of 783 individuals/acre for MDS Lycium habitat (DoN 2005, based on data from Mautz 2000). Additional 218 ac of medium density habitat in action area would be expected to support an additional 170,694 individuals.	Existing patterns of habitat disturbance from activities of small groups on foot, demolitions, small arms use, and fire would be expected to continue, given the long history of similar use and impact of heavy ordnance in overlapping Impact Area II. No observable effect on the population would be expected from continued uses and impacts on the species are less than significant, given the demonstrated continuance of the population despite historic and ongoing use and the low proportion of the SCI total habitat exposed in TAR 22. Baseline use = 96 ops/yr including 33 NSW ops/yr. and 63 Non-NSW Naval ops/yr. (This TAR is located in SHOBA where ongoing live-fire and bombardment are included in the No Action Alternative. Designation of this TAR is part of Alternatives 1 and 2.) Alternative 1: 200 ops/yr. including 33 NSW, 6 USMC Amphibious, 1 USMC Battalion Landing and 160 other naval operations. Alternative 2: 220 ops/yr. including 40 NSW, 16 USMC Amphibious, 2 USMC Battalion Landing and 162 other naval operations. (Other naval operations include naval artillery and delivery of air-to-ground ordnance into overlapping Impact Area II and IIA , which are covered under Impact Area II).	Implementation of the SCI Wildland Fire Management Plan is part of the No Action Alternative, Alternative 1 and Alternative 2. G-M-1* G-M-2 G-M-3* G-M-4, G-M-7, G-M-8, G-M-9 INL-M-1* *CRNSW policy prohibiting access for natural resource surveys or management means that some applicable mitigation measures (e.g., G-M-1, G-M-3, G-M-6) would be conducted around the periphery of impact areas but not within them. No Action: Impacts are less than significant. Alternative 1: Impacts would be less than significant with mitigation. Alternative 2: Impacts would be less than significant with mitigation.
Infantry Operations Area	INL High density habitat: 179.6 ac (2.4% of SCI total high density habitat) Medium density habitat: 311.1 ac (5.4% of SCI total medium density habitat) Low density habitat: 435.6 ac (29.6% of SCI total low density habitat) Lowest density habitat: 6,351.6 ac (53.7% of SCI total lowest density habitat) Estimated population in 179.6 ac of MDS prickly pear is 186,066 individuals, based on average density of 1036 individuals/acre for MDS prickly pear habitat (DoN 2005, based on data from	Although it is possible that individual lizards under cover could be injured by foot traffic this would be an infrequent event and there would be no observable effect on the population. Establishment and spread of invasive species in the IOA from foot traffic may occur but effects on INL would depend on the characteristics of the species that establish, their growth habitats and growth forms, and their effect on the habitat including other plant species. No Action: Battalion-sized landings have occurred on SCI in the past, but are not considered part of the baseline. Foot traffic by individuals and groups is permitted within the IOA and elsewhere on the Island under the No Action Alternative. Alternative 1: 1 USMC Battalion-sized landing per year with troops on foot using the IOA and mechanized vehicles using the AVMC or Ridge Road. Alternative 2: 2 USMC Battalion-sized landings per year with troops on foot using the IOA and mechanized vehicles using the AVMC or Ridge Road.	Implementation of the SCI Wildland Fire Management Plan is part of the No Action Alternative, Alternative 1 and Alternative 2. G-M-1 G-M-2 G-M-3 G-M-4 G-M-8 G-M-9 INL-M-1 No Action: Impacts are less than significant. Alternative 1: Impacts would be less

Table D-6 (continued). Occurrence of Island Night Lizard (INL) Within or Near Individual Operations Areas on SCI.

Operations Area	Amount of Resource[1]	Description of Impacts	Applicable Mitigation Measures and Impact Significance[2,3]
	Mautz 2000). Estimated populations for 314.5 areas of medium density, 447.8 areas of low density, and 6,351.6 areas of lowest density would, respectively, be expected to support 246,254; 257,933; and 2,934,439 individuals.		than significant with mitigation. Alternative 2: Impacts would be less than significant with mitigation.

Notes:

1. Population density categorizations (high density, medium density, low density, and lowest density) are based on population density figures in DoN (2005) based on data of Mautz (2000) and relate to vegetation classification and mapping by Sward and Cohen (1980). Under "amount of resource", resources (e.g., acres of habitat) occurring in overlapping operations areas are reported for each of the overlapping areas (e.g., Impact Area I and TAR 21), enabling the effects of the differing operations in the overlapping areas to be assessed.
2. Impact significance conclusion is based on discussion in "Description of Impacts" column and is assessed assuming application of mitigation measures identified in this document.
3. Impact significance assessment assumes mitigation for Alternatives 1 and 2.

Table D-7. Occurrence of San Clemente Loggerhead Shrike Within or Near Individual Operations Areas on SCI, Description of Potential Impacts of Existing and Proposed Operations, and Impact Significance. Evaluation of Impact Significance for the No Action Alternative is Based on Comparison with the Baseline.

Operations Area	Amount of Resource[1]	Description of Impacts	Applicable Mitigation Measures and Impact Significance[2,3]
IMPACT AREA I	2007: Two of 66 nest sites on SCI (3.0% of SCI total) 2001-2007: Nine of 375 nesting records on SCI (2.4% of SCI total) Five additional nest sites used between 2001 and 2007 are located outside but within 500 ft of the Impact Area I boundary (on the western boundary). Wintering birds also present. Nest locations used during 2001-2007 are present in upper and lower Horse Beach Canyon. The three nest sites used between 2001 to 2005 within Impact Area I represent <5% of Island total during same period and have typical records of reproductive success for shrikes on SCI. Nest site HB2 (used in 2005) successfully fledged young. HB4 (used in 2003) was unsuccessful. HB1, near the northwestern corner of Impact Area I successfully fledged young in 3 of 4 seasons between 2001 and 2005.	Nest sites used since 2000 are located in Horse Beach Canyon along the western boundary of Impact Area I, away from targets and 1 km or more up canyon from the beach. The next sites used during 2007 are in upper Horse Beach Canyon at the northern boundary of Impact Area I. Potential for direct hits by ordnance is very low due to distance from targets and topographic shielding. Impact Area I receives about 6 % of the large ordnance incoming to SHOBA (the remainder goes to Impact Area II including Impact Area IIA). Existing large ordnance use and increases associated with Alternatives 1 and 2 are summarized under Vegetation in Table D-1. There is some exposure to impact noise, flares, and potential fires. Potential for injury or death resulting from direct hit or near miss is so unlikely as to be discountable. There is some potential for take of individuals or damage to essential habitat elements due to possible adverse effects from fire on nest trees or possible adverse response by individual shrikes to visual and noise effects associated with NSFS and CAS in the vicinity. Any reasonably foreseeable take under No Action and both alternatives would affect <<5% of the population, would average less than one individual per year, and would not likely be measurable. Implementation of the Navy Access Policy applying to Impact Areas I and II and TARS 20, 21, and 22 will preclude future direct monitoring of this endangered plant species and its habitat in these locations. Effects of existing and proposed operations are less than significant due to the unlikelihood of direct hit or near miss, infrequency of direct effect on habitat or individuals (e.g., by fire), the reproductive success of nearby pairs exposed to existing uses of the Impact Area, and the very small proportion of the population in proximity to the Impact Area.	Implementation of the SCI Wildland Fire Management Plan is part of the No Action Alternative, Alternative 1 and Alternative 2. G-M-1* G-M-2* G-M-3* G-M-4 G-M-5 G-M-6* G-M-7 G-M-8 G-M-9 SCLS-M-1* *CRNSW policy prohibiting access for natural resource surveys or management means that some applicable mitigation measures (e.g., G-M-1, G-M-3, G-M-6) would be conducted around the periphery of impact areas but not within them. No Action: Impacts are less than significant. Alternative 1: Impacts would be less than significant with mitigation. Alternative 2: Impacts would be less than significant with mitigation.

Table D-7 (continued). Occurrence of San Clemente Loggerhead Shrike Within or Near Individual Operations Areas on SCI.

Operations Area	Amount of Resource[1]	Description of Impacts	Applicable Mitigation Measures and Impact Significance[2,3]
IMPACT AREA II	2007: One of 66 nest sites (1.5% of SCI total) 2001-2007: Ten of 375 nest sites (2.7% of SCI total) Two additional nest sites used between 2001 and 2007 are located outside but within 500 ft of the Impact Area II boundary. Wintering birds also present including males that remain around their breeding territories. Nest sites used during 2001-2007 are located in China Canyon, with one site used in 2005 at the NW edge of TAR 22 in Red Canyon. The Red Canyon site was not monitored because of its location adjacent to a target in the middle of the Impact Area (and < 200 m from the NW corner of Impact Area IIA). Other nesting territories in Impact Area II used in one or more years between 2001 and 2005 have had success in years when nesting occurred. These are China 11 (2/2), China 8 (3/3), China 3 (2/2). Nests at China 8 in 1999 and at China 3 in 1997 and 1998 were unsuccessful. Years 1997 and 1998 had generally poor nesting success throughout the San Clemente loggerhead strike population.	Nest sites used since 2001 in Impact Area II are located in Red Canyon, near the center of Impact Area II, and in China Canyon along the eastern boundary of Impact Area II. The nest site in Red Canyon was discovered in 2005 and is in very close proximity to two targets (approximately 175 m from the location of the nearer of the two targets). The nearest target to a China Canyon nest site is about 750 m to the southwest. Potential for direct hits or near misses by ordnance at the Red Canyon site is relatively high due to the proximity of targets but is low at the China Canyon sites due to distance from targets and a certain amount of topographic shielding. There would be some exposure to impact noise, flares, and potential fires. Potential for injury or death resulting from direct hit or near miss is discountable except at Red Canyon, given proximity of that site to targets. At Red Canyon, should that nest site be reoccupied in the future, the potential for take is higher, ranging from behavioral response leading to harm, to injury or death of an individual or loss of a clutch or nestlings. Existing large ordnance use and increases associated with Alternatives 1 and 2 are summarized under Vegetation in Table D-1. There is some additional potential for take of individuals or damage to essential habitat elements due to possible adverse effects from fire on nest trees or adverse response to visual and noise effects associated with NSFS and air-to-ground bombardment in the vicinity. Any reasonably foreseeable take under No Action and both alternatives would affect <<5% of the population, would probably average less than one individual per year, and would not likely be measurable in most years. Implementation of the Navy Access Policy applying to Impact Areas I and II and TARS 20, 21, and 22 will preclude future direct monitoring of this endangered plant species and its habitat in these locations. Effects of existing and proposed operations are less than significant due to the unlikelihood of direct hit or near miss, infrequency of direct effect on habitat or individuals (e.g., by fire), the reproductive success of nearby pairs, and the very small proportion of the population in proximity to the Impact Area.	Applicable conservation measures and Impact significance are as described for Impact Area I above.
VC-3 AVMA	2007: No nesting documented. 2001-2007: One of 375 nests documented during the period (0.3% of the SCI total). The one documented nest in this area was constructed in a building at VC-3 near Ridge Road at the southern edge of the AVMA during 2006. The first nesting attempt was depredated by a raven and the second is also believed to have been depredated.	Tracked vehicles would degrade habitat in the AVMA by causing a reduction in vegetation cover. Some of this habitat may be used by foraging shrikes from this one-time nest location. The likelihood of shrikes nesting here in the future is not known. The nest location at the edge of the AVMA would provide access to habitat outside the AVMA as well as within it. A nest at this location would be exposed to noise and activity of vehicles and personnel on Ridge Road and the AVMR. These disturbances would continue to affect this site in the future, which has also been used by wintering shrikes. Whatever the future use, this site represents a small fraction of the sites that have been used by shrikes for nesting in recent years. Designation of the AVMA is part of Alternatives 1 and 2. Alternative 1. The AVMA could be used by tracked vehicles during approximately 43 (42	Implementation of the SCI Wildland Fire Management Plan is part of the No Action Alternative, Alternative 1 and Alternative 2. G-M-1 G-M-2 G-M-3 G-M-4 AVMC-M-2 AVMC-M-3

Table D-7 (continued). Occurrence of San Clemente Loggerhead Shrike Within or Near Individual Operations Areas on SCI.

Operations Area	Amount of Resource[1]	Description of Impacts	Applicable Mitigation Measures and Impact Significance[2,3]
		USMC Amphibious plus 1 USMC Battalion Landing) operations per year. Alternative 2. The AVMA could be used by tracked vehicles during approximately 63 (61 USMC Amphibious plus 2 USMC Battalion Landing) operations per year.	AVMC-M-5 AVMC-M-6 AVMC-M-7 AVMC-M-8 SCLS-M-1 No Action: No Impact. Alternative 1: Impacts would be less than significant with mitigation. Alternative 2: Impacts would be less than significant with mitigation.
AFP-1	Wintering only, nearest San Clemente loggerhead strike nest sites are about 4,000 m to the west in Horse Beach Canyon.	In the unlikely event that a shrike would be at the AFP during an operation in Alternative 1 or 2, it would be expected to be unaffected or to avoid the activity (Insignificant effect not reaching the level of "take"). There is a very low potential that artillery fired from this location could land in Horse Beach Canyon or China Canyon and directly affect San Clemente loggerhead strike or other listed species (potential so low as to be discountable). Nesting shrikes in Horse Beach and China Canyon are unlikely to be adversely affected by noise caused by live artillery and other weapons firing from this position and would be out of the line of sight of this AFP and impact areas due to their typical location in canyon bottoms (insignificant effect not reaching the level of take). Designation of this AFP is included in Alternatives 1 and 2. Artillery has been historically fired from this general area into SHOBA. Alternative 1. Artillery maneuvering during 3-day USMC artillery exercises up to 6 times per year plus 1 USMC Battalion Landing. Alternative 2. Artillery maneuvering during 3-day USMC artillery exercises up to 8 times per year plus 2 USMC Battalion Landings.	Implementation of the SCI Wildland Fire Management Plan is part of the No Action Alternative, Alternative 1 and Alternative 2. G-M-1 G-M-2 G-M-3 G-M-4 G-M-5 G-M-6, G-M-8, G-M-9 AVMC-M-2 AVMC-M-3 AVMC-M-4 AVMC-M-5 AVMC-M-9 SCLS-M-1 No Action: Impacts are less than significant. Alternative 1: Impacts would be less than significant with mitigation. Alternative 2: Impacts would be less than significant with mitigation.
AFP-6	Wintering only, nearest San Clemente loggerhead strike nest sites are approximately 400 m to the north in Eagle	In the unlikely event that a shrike would be at the AFP during an operation in Alternative 1 or 2, it would be expected to be unaffected or to avoid the activity (Insignificant effect not reaching the level of "take"). There is a very low potential that artillery fired from this location	Implementation of the SCI Wildland Fire Management Plan is part of the No Action Alternative, Alternative 1

Table D-7 (continued). Occurrence of San Clemente Loggerhead Shrike Within or Near Individual Operations Areas on SCI.

Operations Area	Amount of Resource[1]	Description of Impacts	Applicable Mitigation Measures and Impact Significance[2,3]
	Canyon and 700 m to the west in Cave Canyon. Firing would be toward Impact Area II (south-southeast of the AFP).	toward Impact Area IIA could directly affect San Clemente loggerhead strike or other listed species (potential so low as to be discountable). Nesting shrikes in Cave and Eagle Canyons are within 400 to 800 m of the AFP, but are at lower elevation and topographically shielded from the AFP site. They would be exposed to noise from the artillery firing but would be out of the line of sight from the AFP and out of the line of fire, as well. The noise levels at these sites would be difficult to predict, given the topographic factors, but there would be no visual or other accompaniments to the firing and some habituation to artillery noise would be expected as a result of regular exposure to more distant naval artillery without any accompanying threat. Exposure to the artillery noise would happen up to 7 to 10 times per year, with Alternatives 1 and 2, respectively. Baseline use: Designation of this AFP is included in Alternatives 1 and 2. Alternative 1. Artillery maneuvering and firing during 3-day USMC artillery exercises up to 6 times per year plus 1 USMC Battalion Landing. Alternative 2. Artillery maneuvering and firing during 3-day USMC artillery exercises up to 8 times per year plus 2 USMC Battalion Landings.	and Alternative 2. G-M-1 G-M-2 G-M-3 G-M-4 G-M-5 G-M-6, G-M-8, G-M-9 AVMC-M-2 AVMC-M-3 AVMC-M-4 AVMC-M-5 AVMC-M-9 SCLS-M-1 SCLS-M-2 No Action: No Impact. Alternative 1: Impacts would be less than significant with mitigation. Alternative 2: Impacts would be less than significant with mitigation.
TAR 15	2007: No nesting documented. 2001-2007: One of 375 nests documented during the period (0.3% of the SCI total). The one documented nest in this area was constructed in a building at VC-3 near Ridge Road at the southern edge of the AVMA during 2006. The first nesting attempt was depredated by a raven and the second is also believed to have been depredated. This is the same nest discussed above under the VC-3 AVMA, which overlaps TAR -15 at this location.	Low effects on habitat associated with infrequent foot traffic by small groups near this one-time nesting location. There is some likelihood of disturbance of nesting shrikes at this location by noise of simulated weapons and human activity if a nearby location is chosen as an objective for NSW training. The likelihood of future nesting at this location is unknown. Likelihood of direct effects on a bird or nest is so low as to be discountable given the fact that all live fire on TAR 15 would be directed toward the east (away from the buildings on site and away from the SCLS nest site. Fire effects would be less than significant in the annual grassland foraging habitat. The increase in operations with Alternatives 1 and 2 would incrementally increase the potential for fire or disturbance around a nest but impacts would be less than significant with mitigation. Baseline use = 20 ops/yr. (Designation of this TAR is part of Alternatives 1 and 2). Alternative 1: 25 ops/yr. Alternative 2: 94 ops/yr.	Implementation of the SCI Wildland Fire Management Plan is part of the No Action Alternative, Alternative 1 and Alternative 2. G-M-1 G-M-2 G-M-3 G-M-4 G-M-5 G-M-6 TAR-M-1 SCLS-M-1 No Action: Impacts are less than significant.

Table D-7 (continued). Occurrence of San Clemente Loggerhead Shrike Within or Near Individual Operations Areas on SCI.

Operations Area	Amount of Resource[1]	Description of Impacts	Applicable Mitigation Measures and Impact Significance[2,3]
			Alternative 1: Impacts would be less than significant with mitigation. Alternative 2: Impacts would be less than significant with mitigation.
TAR 21—Horse Beach Cove Training Area and Horse Beach Cove Amphibious Landing and Embarkation Area	Wintering only (documented); a breeding site used unsuccessfully in 2003 (HB4) is located about 500 m up the canyon from the TAR boundary; a breeding site used successfully in 2005 (HB2) is located over 800 m from the TAR boundary. These two nest sites represent < 1% of the nest sites used by San Clemente loggerhead strike on SCI between 2001 and 2005.	TAR 21-In the event that a wintering or foraging shrike would be at TAR 21 during an operation, it would be expected to be unaffected or to avoid the activity (Insignificant effect not reaching the level of "take"). Nesting locations used in 2003 and 2005 would be visually and topographically screened from TAR 21, minimizing disturbance of San Clemente loggerhead strike from activities within the TAR. A fire originating from activities within the TAR, including ship to shore weapons fire, could burn up canyon affecting shrike breeding habitat and, depending on the timing, could affect breeding shrikes. The general areas up canyon from TAR 21 have burned 1-3 times between 1979 and about 2000 (SCI INRMP, DoN 2002). Fires would be unlikely to spread far beyond the TAR boundary in an up-canyon direction because of the low elevational gradient of the lower canyon coupled with the direction of prevailing NW or NE winds under high and very high FDRS (DoN 2006), which would be opposed to spreading of fire in an up-canyon direction. The two San Clemente loggerhead strike territories in lower Horse Beach Canyon that have been occupied between 2001 and 2005 (HB2 and HB4-see additional information in column to left) represent <1% of the nesting sites occupied by San Clemente loggerhead strike during that period. Horse Beach Cove Amphibious Landing and Embarkation Area- A wintering or foraging shrike present at Horse Beach Cove during an amphibious landing or embarkation would be expected to be unaffected or to avoid the activity (Insignificant effect not reaching the level of "take"). Nesting locations used in 2003 and 2005 would be visually and topographically screened from the landing/embarkation site, minimizing disturbance of San Clemente loggerhead strike from activities at the landing site (Insignificant effect not reaching the level of "take"). The potential for fire to burn upcanyon from the landing site to areas where shrikes have nested in the past 5 years is very low as discussed above under TAR 21 and supported by analysis in the FMP BA (DoN 2006). Baseline use = 79 ops/yr. ((This TAR is located in SHOBA where ongoing live-fire and bombardment are included in the No Action Alternative. Designation of this TAR is part of Alternatives 1 and 2.) Alternative 1: 91 ops/yr. including 81 NSW, 10 USMC Amphibious and 1 USMC Battalion Landing. Alternative 2: 102 ops/yr. including 90 NSW, 10 USMC Amphibious and 2 USMC Battalion Landing.	Implementation of the SCI Wildland Fire Management Plan is part of the No Action Alternative, Alternative 1 and Alternative 2. G-M-1* G-M-2* G-M-3* G-M-4 G-M-5 G-M-6*, G-M-7, G-M-8, G-M--9 SCLS-M-1* Horse Beach Cove Amphibious Landing and Embarkation Area Same as TAR 21 plus AVMC-M-2* AVMC-M-3* AVMC-M-4 AVMC-M-5 AVMC-M-6* AVMC-M-7 AVMC-M-10 *CRNSW policy prohibiting access for natural resource surveys or management means that some applicable mitigation measures (e.g., G-M-1, G-M-3, G-M-6) would be conducted around the periphery of impact areas but not within them. No Action: Impacts are less than significant. Alternative 1: Impacts would be less

Table D-7 (continued). Occurrence of San Clemente Loggerhead Shrike Within or Near Individual Operations Areas on SCI.

Operations Area	Amount of Resource[1]	Description of Impacts	Applicable Mitigation Measures and Impact Significance[2,3]
			than significant with mitigation. Alternative 2: Impacts would be less than significant with mitigation.
TAR 22—China Cove Training Area	One nest on NW boundary of the TAR in Red Canyon was active in 2005 but success not known. TAR 22 and vicinity is a documented wintering location. The next nearest nest site (CH 11) is located in China Canyon about 500 m north of the TAR 22 boundary. It was used twice since 2001 and was successful in both years (2004 and 2005) The next nearest nest site (CH 8) was successful in 3 of 4 years with nesting attempts since 2001.	See Discussion above under Impact Area II which overlaps TAR 22. NSW activities in TAR 22 are not expected to be concentrated near the nest site in Red Canyon that was active in 2005 but not known to be active during 2006. This is the only nesting documented within or near TAR 22 in recent years (see discussion above under Impact Area II). In the event that a wintering shrike would be at TAR 22 during an operation, it would be expected to be unaffected or to avoid the activity (Insignificant effect not reaching the level of "take"). Effects of existing operations are less than significant due to the unlikelihood of direct hit or near miss, infrequency of direct effect on habitat or individuals (e.g., by fire), the reproductive success of nearby pairs, and the very small proportion of the population in proximity to the TAR. The near doubling of activity in the TAR associated with Alternatives 1 and 2 including increases in heavy ordnance use in overlapping Impact Areas II and IIA would make some level of take increasingly likely compared to under the No Action Alternative, but impacts would be less than significant because of the low percentage of the shrike population exposed to operations in this area. Baseline use = 96 ops/yr including 33 NSW ops/yr. and 63 Non-NSW Naval ops/yr. (This TAR is located in SHOBA where ongoing live-fire and bombardment are included in the No Action Alternative. Designation of this TAR is part of Alternatives 1 and 2.) Alternative 1: 200 ops/yr. including 33 NSW, 6 USMC Amphibious, 1 USMC Battalion Landing and 160 other naval operations. Alternative 2: 220 ops/yr. including 40 NSW, 16 USMC Amphibious, 2 USMC Battalion Landing and 162 other naval operations. (Other naval operations include naval artillery and delivery of air-to-ground ordnance into overlapping Impact Area II and IIA, which are covered under Impact Area II).	Implementation of the SCI Wildland Fire Management Plan is part of the No Action Alternative, Alternative 1 and Alternative 2. G-M-1* G-M-2* G-M-3* G-M-4 G-M-5 G-M-6*, G-M-7, G-M-8, G-M-9 SCLS-M-1* *CRNSW policy prohibiting access for natural resource surveys or management means that some applicable mitigation measures (e.g., G-M-1, G-M-3, G-M-6) would be conducted around the periphery of impact areas but not within them. No Action: Impacts are less than significant. Alternative 1: Impacts would be less than significant with mitigation. Alternative 2: Impacts would be less than significant with mitigation.
Infantry Operations Area	Nesting and wintering. 2007: 0 of 66 documented nest locations on SCI (0% of SCI total locations) were in the Infantry Operations Area. Between 2001 and 2007: 16 of 375 documented nest site locations were within the Infantry Operations Area (4.3% SCI total locations).	In the event that a wintering shrike would be in the vicinity of advancing Marines in the IOA during an operation, it would be expected to be unaffected or to avoid the activity (Insignificant effect not reaching the level of "take"). During the breeding season, approaching Marines could cause nesting adults to temporarily fly away from the nest, returning momentarily after the personnel have passed. This would be a brief exposure because the Marines would normally be spaced apart in formation perpendicular to the direction of travel. Many variables come into play in determining whether this would represent an adverse effect. Direct injury or harassment of adults is so unlikely as to be discountable. Some potential for injury or mortality to nestlings is possible, but unlikely given the brief duration of the proximity to the nest of a human walking by and the low likelihood of	Implementation of the SCI Wildland Fire Management Plan is part of the No Action Alternative, Alternative 1 and Alternative 2. G-M-1 G-M-2 G-M-3 G-M-4

Table D-7 (continued). Occurrence of San Clemente Loggerhead Shrike Within or Near Individual Operations Areas on SCI.

Operations Area	Amount of Resource[1]	Description of Impacts	Applicable Mitigation Measures and Impact Significance[2,3]
		a very close approach of a human to a nest. Under current levels of shrike nesting activity, about one nest (about 1.5% of the nesting population) per breeding season could be exposed to close approaching foot traffic within the Infantry Operations Area. Assuming that a reaction reaching the level of take happened in about 1 of 5 encounters, then take would represent 1 nesting attempt affected every 5 years or so. This would be a short-term effect on less than 5% of the breeding pairs and would not be expected to affect renesting of the pair. Impacts would be less than significant due to infrequency of the effect, small portion of the population affected, and temporary nature of the effect. Baseline use: Battalion-sized landings have occurred on SCI in the past, but are not considered part of the baseline. Foot traffic by individuals and groups is permitted within the IOA and elsewhere on the Island under the No Action Alternative. Alternative 1: 1 USMC Battalion-sized landing per year with troops on foot using the IOA and mechanized vehicles using the AVMC or Ridge Road. Alternative 2: 2 USMC Battalion-sized landings per year with troops on foot using the IOA and mechanized vehicles using the AVMC or Ridge Road.	G-M-5 G-M-6 G-M-8 G-M-9 AVMC-M-1 AVMC-M-2 AVMC-M-4 AVMC-M-6 AVMC-M-7 SCLS-M-1 No Action: No Impact. Alternative 1: Impacts would be less than significant with mitigation. Alternative 2: Impacts would be less than significant with mitigation.

Note:

1. Documented nest locations and totals 2001-2005 from the SCI GIS, based on annual monitoring studies. Under "amount of resource", resources (e.g., nest sites used during different years) occurring in overlapping operations areas are reported for each of the overlapping areas (e.g., Impact Area I and TAR 21), enabling the effects of the differing operations in the overlapping areas to be assessed.
2. Impact significance conclusion is based on discussion in "Description of Impacts" column and is assessed assuming application of mitigation measures identified in this document.
3. Impact significance assessment assumes mitigation for Alternatives 1 and 2.

Table D-8. Impacts on San Clemente Sage Sparrow Within Individual Operations Areas on SCI, Description of Potential Impacts of Existing and Proposed Operations, and Impact Significance. Evaluation of Impact Significance for the No Action Alternative is Based on Comparison with the Baseline.

Operations Area	Amount of Resource[1]	Description of Impacts	Applicable Mitigation Measures and Impact Significance[2,3]
IMPACT AREA II	Low density habitat: 176.9 ac along lower terraces in the western part of the Impact Area. This is about 6.8% of the low density habitat mapped on SCI. Based on 1999-2007 average SCSS density for low density habitat (0.11 adults/ac), 177 ac would be expected to support about 19 adults (roughly 2% of the population); however, according to Turner et al. (2006), sightings have been very infrequent in this area, which is near the southern limit of the species range on SCI, and so the population is probably lower.	Any disturbance from ordnance impacts would be expected to continue as a result of continuing Naval Surface Fire Support, air strikes and close air support. This includes exposure to impact noise, flares, and potential fires. There is some potential for take of individuals or damage to essential habitat elements due to possible adverse effects from fire on MDS-Lycium habitat, which does not recover rapidly after fire, or from adverse behavioral response by individuals to visual and noise effects associated with NSFS and CAS in the vicinity. Some habituation to these exposures would be expected, reducing the chance of adverse behavioral response. Any reasonably foreseeable take under No Action, Alternative 1, or Alternative 2 would affect <<5% of the SCSS population and would probably average less than one individual per year. Impacts are expected to be less than significant (NEPA) because of the extended history of use of this site as an impact area for live ordnance, the small proportion of individuals and habitat potentially exposed to the effects. Existing levels of large ordnance associated with No Action, and projected increases associated in Alternatives 1 and 2 are presented in Table D-1.	Implementation of the SCI Wildland Fire Management Plan is part of the No Action Alternative, Alternative 1 and Alternative 2. G-M-1* G-M-2* G-M-3* G-M-4 G-M-5 G-M-6*, G-M-8, G-M-9 SCSS-M-1* SCSS-M-2* *CRNSW policy prohibiting access for natural resource surveys or management means that some applicable mitigation measures (e.g., G-M-1, G-M-3, G-M-6) would be conducted around the periphery of impact areas but not within them. No Action: Impacts are less than significant. Alternative 1: Impacts would be less than significant with mitigation. Alternative 2: Impacts would be less than significant with mitigation.

Table D-8 (continued). Impacts on San Clemente Sage Sparrow Within Individual Operations Areas on SCI.

Operations Area	Amount of Resource[1]	Description of Impacts	Applicable Mitigation Measures and Impact Significance[2,3]
Old Rifle Range AVMA	Low density habitat: 142.5 ac (5% of SCI total low density habitat) contiguous with low and medium density habitat along the western and northern edges of the AVMA. The ORR AVMA is contiguous with large blocks of low and medium density habitat along its western boundary. Based on 1999-2007 average for low density habitat (0.11 adults/acre), about 16 adults would be expected in the 142 ac of low density habitat on the ORR AVMA.	Tracked vehicle activity associated with Alternatives 1 and 2 is expected result in take through a reduction in shrub cover and other long-term changes in the habitat reducing or eliminating its suitability to SCSS. In addition to gradual loss of habitat value, low levels of additional take (up to 2 individuals or nests per year) in the form of possible loss of eggs or nestlings, nest failure, unintentional harassment, injury, or death of adults are anticipated from the activities of tracked vehicles in this area. Because of sloping terrain on the western side of the AVMA associated with drainage heads and between-terrace slopes there is the potential for off site effects on SCSS habitat caused by increased runoff from the AVMA. Designation of the AVMA is part of Alternatives 1 and 2. Alternative 1. The AVMA could be used by tracked vehicles during approximately 43 (42 USMC Amphibious plus 1 USMC Battalion Landing) operations per year.	Implementation of the SCI Wildland Fire Management Plan is part of the No Action Alternative, Alternative 1 and Alternative 2. G-M-1 G-M-2 G-M-3, G-M-4 G-M-5, G-M-6 AVMC-M-2 AVMC-M-3 AVMC-M-4; AVMC-M-5
		Alternative 2. The AVMA could be used by tracked vehicles during approximately 63 (61 USMC Amphibious plus 2 USMC Battalion Landing) operations per year.	AVMC-M-7 AVMC-M-7 AVMC-M-9 AVMC-M-10 SCSS-M-1 SCSS-M-2 No Action: No Impact. Alternative 1: Impacts would be less than significant with mitigation. Alternative 2: Impacts would be less than significant with mitigation.
Old Rifle Range (ORR) AMP	Low density habitat: 15.05 ac (<0.6% of SCI total low density habitat). Contiguous with low density habitat in adjacent portions of the overlapping AVMA and along the western edge of the AMP.	Degradation of vegetation and soils from vehicular activity associated with Alternatives 1 and 2 leading to loss of shrub cover, especially boxthorn, expected to make the habitat on the site unsuitable for this species. Habitat on site is estimated to be capable of supporting about 1-2 adults. Take would include degradation of 15.05 ac of SCSS habitat and reduction in carrying capacity for SCSS. Designation of the AMP is part of Alternatives 1 and 2. Alternative 1. Artillery maneuvering during 3-day exercises up to 6 times per year plus 1 USMC Battalion Landing. Alternative 2. Artillery maneuvering during 3-day exercises up to 8 times per year plus 2 USMC Battalion Landings.	Applicable mitigation measures as identified above under Old Rifle Range AVMA. No Action: No Impact. Alternative 1: Impacts would be less than significant with mitigation. Alternative 2: Impacts would be less than significant with mitigation.

Table D-8 (continued). Impacts on San Clemente Sage Sparrow Within Individual Operations Areas on SCI.

Operations Area	Amount of Resource[1]	Description of Impacts	Applicable Mitigation Measures and Impact Significance[2,3]
TAR 4--Whale Point/Castle Rock	Medium density habitat: 27.1 ac (1.6% of SCI total medium density habitat). TAR 4 is surrounded by medium density habitat with 110 additional acres of medium density habitat and 29.9 ac of low density habitat within 1,000 feet of the TAR. Based on 1999-2007 average for medium density habitat (0.21 adults/ac), about 6 adults would be expected in the 27.1 ac medium density habitat and about 26 additional adults expected in the medium and low density habitat within 1,000 feet of the TAR. The mean SCSS population size on the Island is 808 adults (1999-2007). TAR 4 plus the area within 1,000 feet includes 8.3% of the medium density habitat and 1.1% of the low density habitat on the island.	In the TAR 4 area, most of the area occupied by sage sparrows (>75%) is infrequently used for military training (Turner et al. 2005, page 50). Construction activities, accidental fires, demolitions, and other disturbances have been documented during 2003 and 2004, which have affected sage sparrow habitat and which, based on timing and location, may have a causal association with the disappearance of a marked adult and a nest failure (Turner et al. 2005). However, a comparison of population dynamics from a study plot at TAR 4 with other plots established on the island conducted by Beaudry et al. (2004) indicated that the study plot encompassing TAR 4 generally fell within the range of other plots with regard to most parameters measured, including percent of nest success (high), number of fledglings per nest (high), and percent of birds resighted on plot from 2002 (high) despite ongoing construction and military use since its establishment. Based on continued reproductive success of the sage sparrow population at TAR 4, impacts of baseline use at TAR 4 are less than significant under No Action. Impacts associated with Alternative 1 would be less than significant with mitigation, including implementation of the Wildland Fire Management Plan. Alternative 2 would have a substantial increase in operations at TAR 4 compared to No Action and Alternative 1; however, a large proportion of these operations would be at developed facilities in the TAR (e.g., the MOUT, the village site, and the rifle ranges) and would involve minimal exposure of sage sparrows or sage sparrow habitat to the activities. Baseline use = 212 ops/yr. This TAR has been previously established. Alternative 1: 230 ops/yr. Alternative 2: 300 ops/yr.	Implementation of the SCI Wildland Fire Management Plan is part of the No Action Alternative, Alternative 1 and Alternative 2. G-M-1 G-M-2 G-M-3 G-M-4 G-M-5 G-M-6 TAR-M-1 SCSS-M-1 SCSS-M-2 No Action: Impacts are less than significant. Alternative 1: Impacts would be less than significant with mitigation. Alternative 2: Impacts would be less than significant with mitigation.
TAR 10—Demolition Range West	High density habitat 43.6 ac (4.7% of SCI total). Medium density habitat: 11.3 ac (0.7% of SCI total). TAR 10 is surrounded by medium and high density SCSS habitat with 101.3, 119.3, and 25.0 additional acres of high, medium and low density habitat, respectively, within 1,000 feet of the TAR. TAR 10 plus the area within 1,000 feet of the TAR contain 15.7%, 7.9% and <1% of SCI totals of high density, medium density, and low density habitat, respectively.	Noise from weapons and demolition, human activity, and helicopters could disturb SCSS especially when bonding and establishing nests (late January through March), early in the breeding season. Fire and invasive species spread could affect habitat. Development of two small range buildings on this site would occupy about 0.25 ac, assumed to be in previously disturbed habitat. The potential for fire carrying from this TAR into adjacent contiguous areas of high and medium density SCSS habitat has been identified as a key issue. The SCI Draft Wildland Fire Management Plan (DoN 2006) has a series of increasing precautions and fire suppression measures related to increasing fire danger ratings, including a fully equipped and staffed fire truck in the vicinity of the TAR within line of sight visibility of the TAR and action area and ability to be on scene and pumping water within 10 minutes of an ignition report whenever any type of incendiary ordnance is used (See Section 2.X). The Fire Plan notes the slow growth and recovery of boxthorn and places a priority on preventing short-interval recurrences of fire that might result in replacement of shrub-dominated native vegetation by grasses or weeds (type conversion). Impacts on habitat are less than significant as described in Table D-1. Monitoring of SCSS in the vicinity of TAR 4 during a period of training operations coupled with construction of the MOUT and related facilities has shown that the SCSS population there is healthy and comparable to other SCSS populations on the Island (as described above under TAR 4). Most of the	Applicable mitigation measures are as identified for TAR 4. No Action: Impacts are less than significant. Alternative 1: Impacts would be less than significant with mitigation. Alternative 2: Impacts would be less than significant with mitigation.

Table D-8 (continued). Impacts on San Clemente Sage Sparrow Within Individual Operations Areas on SCI.

Operations Area	Amount of Resource[1]	Description of Impacts	Applicable Mitigation Measures and Impact Significance[2,3]
		training activity and all of the demolition within TAR 10 would be in previously disturbed areas, so that effects on habitat would be less than significant. Based on the results of monitoring sage sparrow response to NSW training at TAR 4, it is assumed that low levels of take (up to 2 individuals per year) in the form of unintentional harassment of birds nesting in the area would occur but this would not likely be measurable because it is expected that population levels and reproductive parameters would remain with the range of other sage sparrows on SCI. Baseline use = 3 ops/yr. (Designation of this TAR is part of Alternatives 1 and 2). Alternative 1: 25 ops/yr. Alternative 2: 40 ops/yr.	
TAR 14—VC-3 Onshore Parachute Drop Zone "Twinky"	No SCSS habitat mapped within the TAR. TAR 14 lies approximately 1,500 feet or more to the east of SCSS low density habitat.	The nearest SCSS habitat lies about 1,500 feet from the western boundary of TAR 14 and effects on the SCSS population or habitat from activities in TAR 14 would be insignificant (effects on habitat) or so unlikely as to be discountable (injury, death, or harassment of an SCSS). All live-fire on TAR 14 is directed toward the east (away from the SCSS habitat). Modeling in the Fire Plan BA shows considerable spread of fire into SCSS habitat off site during NE winds and very high to extreme FDRS (Fire Danger Rating System) conditions (DoN 2006). A variety of precautions have been defined to be in effect under these conditions, including a standby fully-equipped wildland fire truck staffed with 3 wildland fire certified personnel whenever incendiary ordnance (e.g., flares) is to be used (SCI Wildland Fire Management Plan DoN 2005). Modeling in the Fire Management Plan BA indicates take of SCSS ranging from <1 to 4 individuals under different fire scenarios associated with fire originating on TAR 14. Impacts are less than significant because of the distance from the site to the habitat, the small fraction of the population and habitat that would be affected, the ability of the population to recover rapidly, and the likelihood that with implementation of the Fire Management Plan (FMP), fires would become smaller in extent, less frequent, and less likely to result in habitat type conversion. The increase in operations with Alternatives 1 and 2 would incrementally increase the potential for fire but impacts would be less than significant with mitigation. Baseline use = 20 ops/yr. (Designation of this TAR is part of Alternatives 1 and 2). Alternative 1: 30 ops/yr. Alternative 2: 68 ops/yr.	Applicable mitigation measures are as identified for TAR 4. No Action: Impacts are less than significant. Alternative 1: Impacts would be less than significant with mitigation. Alternative 2: Impacts would be less than significant with mitigation.

Table D-8 (continued). Impacts on San Clemente Sage Sparrow Within Individual Operations Areas on SCI.

Operations Area	Amount of Resource[1]	Description of Impacts	Applicable Mitigation Measures and Impact Significance[2,3]
TAR 15—VC-3 Airfield Training Area	Low density habitat: 5.0 ac in the SW corner of the TAR (<0.2% of SCI total low density habitat). An additional 92.3 ac of low density habitat (3.5% of SCI total) extends from the SW corner of the TAR within 1,000 feet of the TAR.	Low effects on habitat by infrequent foot traffic by small groups. Likelihood of direct effects on a bird or nest is so low as to be discountable given the fact that all live-fire on TAR 15 is directed toward the east (away from the SCSS habitat); the out of the way location of the SCSS habitat in the extreme southwestern corner of the TAR; and the very small area of the habitat. Fire effects are possible under very high and extreme FDRS and NE winds only. Take in the event of a fire would be generally as described under TAR 14 and impacts would be less than significant as described under TAR 14. The increase in operations with Alternatives 1 and 2 would incrementally increase the potential for fire but impacts would be less than significant with mitigation. Baseline use = 20 ops/yr. (Designation of this TAR is part of Alternatives 1 and 2). Alternative 1: 25 ops/yr. Alternative 2: 94 ops/yr.	Applicable mitigation measures are as identified for TAR 4. No Action: Impacts are less than significant. Alternative 1: Impacts would be less than significant with mitigation. Alternative 2: Impacts would be less than significant with mitigation.

Table D-8 (continued). Impacts on San Clemente Sage Sparrow Within Individual Operations Areas on SCI.

Operations Area	Amount of Resource[1]	Description of Impacts	Applicable Mitigation Measures and Impact Significance[2,3]
TAR 17— Eel Point Tactical Training Range	High density habitat: 11.9 ac within TAR 17 (1.3% of SCI total high density habitat). TAR 17 is surrounded by high and medium density SCSS habitat with 43.6 and 40.3 additional acres of high and medium density habitat, respectively, within 1,000 feet of the TAR. TAR 17 plus the area within 1,000 feet of the TAR contain 6.0% and 2.4% of SCI totals of high density and medium density habitat, respectively.	Noise from weapons and demolition, human activity, and helicopters could disturb SCSS especially when bonding and establishing nests (late January through March), early in the breeding season. Fire and invasive species spread could affect habitat. Small groups on foot traveling across country between TAR 17 and another location (e.g., TAR 14) have the potential to damage low boxthorn shrubs in areas of dense shrubs, vines, and cactus, despite stealthy foot travel using Tactical Environmental Movement. Contact or very close approach to a nest shrub could cause abandonment, although this would be statistically unlikely given the small number of people in an operation (12-15), use of Tactical Environmental Movement, the low density and dispersion of nests (ranging from 1 nest per 8, 14, or 27 ac, in high, medium, and low density habitat, respectively, based on densities of males between 1999-2005 and assuming 1 nest per male), and small number of operations conducted annually during the nesting season (< 5 expected mid-March through June for No Action, ~ 10 for Alternative 1, ~12 for Alternative 2). Proposed measures in the SCI Fire Plan to reduce frequency and extent of wildland fire discussed under TAR 10 would apply to TAR 17, reducing the chance of repeated fires that could lead to habitat type conversion. Monitoring of SCSS in the vicinity of TAR 4 during a period of training operations coupled with construction of the MOUT and related facilities has shown that the SCSS population there is healthy and comparable to other SCSS populations on the Island (as described above under TAR 4). Although much of the training activity and all of the demolition within TAR 17 would be in previously disturbed areas, it is assumed that take in the form of 0.5 ac of habitat loss or degradation is likely and a low level of additional take (up to 2 individuals per year) in the form of possible loss of eggs or nestlings, nest failure, unintentional harassment, injury, or death of adult individuals is anticipated. Baseline use = 15 ops/yr. (Designation of this TAR is part of Alternatives 1 and 2). Alternative 1: 31 ops/yr. Alternative 2: 40 ops/yr.	Applicable mitigation measures are as identified for TAR 4. No Action: Impacts are less than significant. Alternative 1: Impacts would be less than significant with mitigation. Alternative 2: Impacts would be less than significant with mitigation.
TAR 22—China Cove Training Area	Low density habitat: 18.2 ac (~0.7% of SCI total), all of which is accounted for in Impact Area II. The area within 1,000 feet of the TAR contains 28.9 additional acres of low density habitat (1.1% of SCI total). Based on average densities for low density habitat between 1999 and 2006, 18.2 ac would be expected to support two adult SCSS and the area within 1,000 feet of	Based on the amount of habitat present, the exposed population of SCSS would be very low in TAR 22 (~ 2 individuals or less) with 3 individuals or less in nearby habitat. Noise from weapons and demolition, human activity, and overflight by helicopters, fixed wing attack aircraft, and small UAVs could disturb SCSS especially when bonding and establishing nests (from late January through March), early in the breeding season. The sparseness of the vegetation in TAR 22 minimizes the potential for damage to low boxthorn shrubs from platoon-sized movements on foot through SCSS habitat in TAR 22. Contact or very close approach to a nest shrub would be very unlikely given the improbability of there being a nest in the TAR, the small number of people in an operation (12-15), sparseness of the MDS-Lycium at this locality, and use of stealthy Tactical Environmental Movement. Fire and	Implementation of the SCI Wildland Fire Management Plan is part of the No Action Alternative, Alternative 1 and Alternative 2. G-M-1* G-M-2* G-M-3* G-M-4 G-M-5

Table D-8 (continued). Impacts on San Clemente Sage Sparrow Within Individual Operations Areas on SCI.

Operations Area	Amount of Resource[1]	Description of Impacts	Applicable Mitigation Measures and Impact Significance[2,3]
	the TAR would be expected to support about 3 adults. However, actual densities at this location near the southern limit of the species on SCI are probably lower. According to Turner et al. (2006), SCSS are sighted infrequently in the area south of Kinkipar Canyon (near the western boundary of Impact Area II) including Impact Area II and TAR 22.	invasive species spread could affect habitat. However, spread of wildland fire through the MDS-Lycium habitat in the TAR and adjacent impact area would be expected to occur slowly because of the sparseness of the vegetation and infrequency of conditions that would cause fire to spread up the coast in the direction of additional habitat. Insertion of SEALS would be primarily by boat or by swimming (vs. overland) minimizing the potential for introduction/spread of invasive species. Monitoring of SCSS in the vicinity of TAR 4 during a period of training operations coupled with construction of the MOUT and related facilities has shown that the SCSS population there is healthy and comparable to other SCSS populations on the Island (as described above under TAR 4). Because the training activity, including demolition within TAR 22, would be in previously disturbed areas, take of SCSS in the form of habitat loss or degradation is not anticipated with No Action, Alternative 1, or Alternative 2. Given the low size of the exposed population (~ 2 individuals or less in the TAR with an additional 3 individuals or less within1,000 feet of the TAR), additional take in the form of possible loss of eggs or nestlings, nest failure, unintentional harassment, injury, or death of adult individuals is expected to be very low (<1/year) and probably not observable for No Action and also for Alternative 1 and Alternative 2 due to the very low probability of impact. Impacts are less than significant. Baseline use = 96 ops/yr including 33 NSW ops/yr. and 63 Non-NSW Naval ops/yr. (This TAR is located in SHOBA where ongoing live-fire and bombardment are included in the No Action Alternative. Designation of this TAR is part of Alternatives 1 and 2.) Alternative 1: 200 ops/yr. including 33 NSW, 6 USMC Amphibious, 1 USMC Battalion Landing and 160 other naval operations. Alternative 2: 220 ops/yr. including 40 NSW, 16 USMC Amphibious, 2 USMC Battalion Landing and 162 other naval operations. (Other naval operations include naval artillery and delivery of air-to-ground ordnance into overlapping Impact Area II and IIA, which are covered under Impact Area II).	G-M-6* G-M-8 G-M-9 TAR-M-1* SCSS-M-1* SCSS-M-2 *CRNSW policy prohibiting access for natural resource surveys or management means that some applicable mitigation measures (e.g., G-M-1, G-M-3, G-M-6) would be conducted around the periphery of impact areas but not within them. No Action: Impacts are less than significant. Alternative 1: Impacts would be less than significant with mitigation. Alternative 2: Impacts would be less than significant with mitigation.

Table D-8 (continued). Impacts on San Clemente Sage Sparrow Within Individual Operations Areas on SCI.

Operations Area	Amount of Resource[1]	Description of Impacts	Applicable Mitigation Measures and Impact Significance[2,3]
Infantry Operations Area	Low density habitat: 153.5 ac, about 6% of the SCI total low density habitat. Most (130.4 ac) of the SCSS habitat within the IOA is addressed above under the overlapping NALF AVMA, Old Rifle Range AVMA, the associated AMPs, and TAR 15.	Foot traffic in the IOA would occur during the USMC Battalion Landings which could occur once to twice per year in Alternatives 1 and 2, respectively. Marines walking through the area would normally be spread out more or less perpendicular to the direction of travel with about 5-m spacing between individuals. Where not overlapped by an AVMA or AMP, direct impacts on the shrub-dominated habitat in the IOA would be short term and minor given the infrequency of the operation. The peripheral location of the SCSS habitat to the IOA would probably reduce the chances that it would be walked through in any given operation. Individual SCSS, if present in the vicinity of advancing personnel during the operation, would be expected to be unaffected or to avoid the activity (insignificant effect not reaching the level of "take"). During the breeding season, approaching Marines could cause nesting adults to temporarily fly away from the nest, returning momentarily after the line of personnel has passed. Direct injury or harassment of adults is so unlikely as to be discountable. Some potential for injury or mortality to nestlings is possible, but unlikely given the brief duration that a human walking by would be in proximity of the nest and the low likelihood of a very close approach of a human to a nest. Under current levels of sage sparrow nesting activity, about one nest (less than 0.1% of the nesting population) per breeding season could be exposed to close approaching foot traffic within the Infantry Operations Area. [This is based on the low density and dispersion of nests (ranging from 1 nest per 8, 14, or 27 ac, in high, medium, and low density habitat, respectively, assuming observed densities of males between 1999-2005 and assuming 1 nest per male)]. Impact on SCSS from use of the IOA under Alternatives 1 and 2 would be less than significant because of the minimal nature of the potential exposure to foot traffic, the temporary and likely insignificant nature of any response, and the small portion of the population and habitat exposed. Baseline use: Battalion-sized landings have occurred on SCI in the past, but are not considered part of the baseline . Foot traffic by individuals and groups is permitted within the IOA and elsewhere on the Island under the No Action Alternative. Alternative 1: 1 USMC Battalion-sized landing per year with troops on foot using the IOA and mechanized vehicles using the AVMC or Ridge Road. Alternative 2: 2 USMC Battalion-sized landings per year with troops on foot using the IOA and mechanized vehicles using the AVMC or Ridge Road.	Implementation of the SCI Wildland Fire Management Plan is part of the No Action Alternative, Alternative 1 and Alternative 2. G-M-1 G-M-2 G-M-3 G-M-4 G-M-8 G-M-9 AVMC-M-2 AVMC-M-5 AVMC-M-7 SCSS-M-1 SCSS-M-2 No Action: No Impact. Alternative 1: Impacts would be less than significant with mitigation. Alternative 2: Impacts would be less than significant with mitigation.

Note:

1. Population density figures by habitat density category are averages of density estimates in annual reports for 1999 through 2007. Under “amount of resource”, resources (e.g., acres of medium density habitat) occurring in overlapping operations areas are reported for each of the overlapping areas (e.g., Old Rifle Range AVMA, AMP B, Infantry Operations Area), enabling the effects of the differing operations in the overlapping areas to be assessed.
2. Impact significance conclusion is based on discussion in “Description of Impacts” column and is assessed assuming application of mitigation measures identified in this document.
3. Impact significance assessment assumes mitigation for Alternatives 1 and 2.

Table D-9. Occurrence of Western Snowy Plover Within or Near Individual Operations Areas on SCI, Description of Potential Impacts of Existing and Proposed Operations, and Impact Significance. Evaluation of Impact Significance for the No Action Alternative is Based on Comparison with the Baseline.

Operations Area	Amount of Resource[1]	Description of Impacts	Applicable Mitigation Measures and Impact Significance[2,3]
IMPACT AREA I	21.1 ac (mostly where it overlaps TARs 20 and 21). SCI INRMP (DoN 2002) reported breeding attempts at Horse Beach Cove in 1997 (nest depredated) and 1998 ("probably hatched"). These are the most recent breeding attempts reported on SCI. Compared to elsewhere on SCI, Pyramid Cove consistently has had the highest numbers of wintering birds (15-25 individuals) on SCI while being used for NSFS, CAS and other training activities that are part of the baseline.	The beaches within Impact Area I are used by the western snowy plover primarily for winter foraging and roosting; plovers are generally absent during the breeding season months. Plovers may temporarily leave the affected area in response to noise or visual effects from ordnance use including flares during exercises such as FIREX or EFEX. See Table D-1 for a breakdown of heavy ordnance associated with No Action, Alternative 1 and Alternative 2. Likelihood of injury or mortality from ordnance hit in plover habitat is discountable. Effects of amphibious landings are addressed under Horse Beach Cove Amphibious Landing and Embarkation Area. Impact Area I receives < 6% of incoming large-caliber ordnance. Implementation of the Navy Access Policy applying to Impact Areas I and II and TARS 20, 21, and 22 will preclude future direct monitoring of this endangered plant species and its habitat in these locations.	G-M-1* G-M-2* G-M-3* G-M-4 G-M-5 G-M-7 G-M-8 *CRNSW policy prohibiting access for natural resource surveys or management means that some applicable mitigation measures (e.g., G-M-1, G-M-3, G-M-6) would be conducted around the periphery of impact areas but not within them. No Action: Impacts are less than significant. Alternative 1: Impacts would be less than significant with mitigation. Alternative 2: Impacts would be less than significant.
IMPACT AREA II	9.1 ac (mostly where it overlaps TAR 22). Used by wintering birds only.	The beaches within Impact Area II are used by the western snowy plover primarily for winter foraging and roosting; plovers are generally absent during the breeding season months. Bombardment is generally inland from the beach. Plovers may temporarily leave the affected area during NSFS exercises in response to noise or visual effects of ordnance use, including flares. The proposed increases in heavy ordnance associated with Alternatives I and 2 (see Table D-1) would not increase the likelihood of injury or mortality from an ordnance hit in plover habitat to a level above discountable or result in adverse behavioral response above that for ongoing activities. Implementation of the Navy Access Policy applying to Impact Areas I and II and TARS 20, 21, and 22 will preclude future direct monitoring of this endangered plant species and its habitat in these locations.	Applicable conservation measures and Impact significance are as described for Impact Area I above.

Table D-9 (continued). Occurrence of Western Snowy Plover Within or Near Individual Operations Areas on SCI.

Operations Area	Amount of Resource[1]	Description of Impacts	Applicable Mitigation Measures and Impact Significance[2,3]
NALF AVMA	See TAR 5 below.	See discussion of amphibious landings and embarkation under TAR 5 which is overlapped by the NALF AVMA.	See TAR 5 and West Cove Landing and Embarkation Area (below).
TAR 3--BUD/S Beach Underwater Demolition Range	4.8 ac mapped within the TAR with an additional 7.9 ac within action area. Beach is used by small numbers of wintering plovers. No breeding has been documented at this site.	Plovers would be expected to be unaffected by the NSW activity or, if approached closely by a boat or personnel coming ashore, would be expected to move to another part of the beach and continue their activities (insignificant effect not reaching the level of "take"). Impacts are less than significant in No Action. Alternatives 1 and 2 would increase the number of operations and, therefore, the potential for impacts to plovers. Baseline use = 82 ops/yr. (Designation of this TAR is part of Alternatives 1 and 2) Alternative 1: 82 ops/yr. Alternative 2: 95 NSW and 4 USMC Amphibious ops/yr.	G-M-1 G-M-2 G-M-3 G-M-4 G-M-5 G-M-6 WSP-M-1 No Action: Impacts are less than significant. Alternative 1: Impacts would be less than significant with mitigation. Alternative 2: Impacts would be less than significant with mitigation.
TAR 5--West Cove Amphibious Assault Training Area and West Cove Landing and Embarkation area for NALF AVMA	0.8 ac mapped plus 3.4 ac where TAR 5 is overlapped by NALF AVMA. One nesting attempt with 1 chick documented in 1989, it is not known whether it fledged (SCI INRMP, DoN 2002). No other nesting attempts documented despite periodic monitoring in subsequent years. Used by small numbers (typically 5-10) of plovers during winter.	<u>TAR 5.</u> Most potential snowy plover nesting habitat at this site is subject to periodic inundation during high tides and frequented by predators such as domestic cat, island fox, and ravens making it largely unsuitable for nesting. Plovers would be expected to be unaffected by the increased NSW activity in Alternatives 1 and 2, or, if approached closely by a boat or personnel coming ashore, would be expected to move to another part of the beach and continue their activities (insignificant effect not reaching the level of "take"). <u>West Cove Landing and Embarkation Area.</u> Wintering snowy plovers would be expected to move to other parts of the beach or to another site during frequent landings and unloadings of LCACs and LCUs on the beach, as well as landings and transit of AAVs (and ultimately EFVs) across the beach. This is considered an insignificant effect and is not expected to reach the level of take. Baseline use = 10 ops/yr incl. 10 USMC Amphibious. (Designation of this TAR is part of Alternatives 1 and 2). Alternative 1: 25 ops/yr (incl. 17 USMC Amphibious). Alternative 2: 55 ops/yr (incl. 44 USMC Amphibious).	G-M-1 G-M-2 G-M-3 G-M-4 G-M-5 G-M-6 AVMC-M-9 WSP-M-1 No Action: Impacts are less than significant. Alternative 1: Impacts would be less than significant with mitigation. Alternative 2: Impacts would be less than significant with mitigation.

Table D-9 (continued). Occurrence of Western Snowy Plover Within or Near Individual Operations Areas on SCI.

Operations Area	Amount of Resource[1]	Description of Impacts	Applicable Mitigation Measures and Impact Significance[2,3]
TAR 20—Pyramid Cove Training Area	9.1 ac, all of which are accounted for under Impact Area I. Pyramid Cove Beach has generally had the largest number of wintering plovers on SCI (ranging from 10 to 20 during peak months) but was not monitored in 2004 or subsequently because of safety concerns related to unexploded ordnance (Lynn et al. 2005).	The beach at Pyramid Cove within and adjacent to Impact Area I is used by WSP primarily for winter foraging and roosting; plovers are generally absent during the breeding season months. Plovers may temporarily move from the affected area in response to noise or visual effects from daytime or nighttime operations during NSW exercises such as GUNEX or EFEX, in which landings by CRRC and ship to shore firing are involved. Impacts would be less than significant; likelihood of injury or mortality from ship to shore weapons fire in plover habitat is low, but possible, if it is not preceded by some type of stimulus to cause them to move from the area. Baseline use = 44 ops/yr. (This TAR is located in SHOBA where ongoing live-fire and bombardment are included in the No Action Alternative. Designation of this TAR is part of Alternatives 1 and 2.). Alternative 1: 50 ops/yr. Alternative 2: 60 ops/yr.	G-M-1* G-M-2* G-M-3* G-M-4 G-M-5 G-M-7 G-M-8 *CRNSW policy prohibiting access for natural resource surveys or management means that some applicable mitigation measures (e.g., G-M-1, G-M-3, G-M-6) would be conducted around the periphery of impact areas but not within them. No Action: Impacts are less than significant. Alternative 1: Impacts would be less than significant with mitigation. Alternative 2: Impacts would be less than significant with mitigation.
TAR 21—Horse Beach Cove Training Area and Horse Beach Cove Amphibious Landing and Embarkation Area	12.0 ac, all of which are previously accounted for under Impact Area I. The beach at Horse Beach Cove is used by small numbers of WSP (typically 0-5) primarily for winter foraging and roosting; plovers are generally absent during the breeding season months. However, SCI INRMP (DoN 2002) reported breeding attempts at Horse Beach Cove in 1997 (nest depredated) and 1998 ("probably hatched"). These are the most recent breeding attempts reported on SCI.	TAR 21: Roosting or foraging plovers may temporarily move away from the human activity, noise or visual effects of daytime or nighttime operations during live-fire exercises such as GUNEX or EFEX, which may include landings by CRRC, weapons firing from support craft to shore, demolitions, and overflights by helicopters, fixed-wing attack aircraft, and small UAVs. Observations suggest that the plovers would rapidly resume normal behavior after moving away from the activity. The scope of some of the operations and multiple sources of disturbance may result in take in the form of unintentional harassment of a small number of birds. Likelihood of injury or mortality to an individual plover from ship to shore weapons fire or other project-related activity in plover habitat is very low, but possible. Impacts (NEPA) for No Action, Alternative 1, and Alternative 2 would be less than significant due to the low likelihood of harm to individuals and the small number of individuals potentially exposed to the activity. Horse Beach Cove Amphibious Landing and Embarkation Area. Roosting or foraging plovers may temporarily move away from the human and vehicular activity, noise or visual effects of daytime or nighttime amphibious landings. Observations suggest that the plovers would rapidly resume normal behavior after moving away from the activity. The scope of some of the operations and multiple sources of disturbance may result in take in the form of unintentional harassment of a small number of birds. Likelihood of injury or mortality to an individual plover from project-related activity in plover habitat is very low, but possible. It is estimated that take in the form of	G-M-1* G-M-2* G-M-3* G-M-4 G-M-5 G-M-7 G-M-8 *CRNSW policy prohibiting access for natural resource surveys or management means that some applicable mitigation measures (e.g., G-M-1, G-M-3, G-M-6) would be conducted around the periphery of impact areas but not within them. No Action: Impacts are less than significant. Alternative 1: Impacts would be less than

Table D-9 (continued). Occurrence of Western Snowy Plover Within or Near Individual Operations Areas on SCI.

Operations Area	Amount of Resource[1]	Description of Impacts	Applicable Mitigation Measures and Impact Significance[2,3]
		unintentional harassment would not exceed 4 individuals per year. Take in the form of injury or mortality to individuals is so improbable as to be discountable. Impacts (NEPA) for No Action, Alternative 1, and Alternative 2 would be less than significant because of the low likelihood of harm to individuals and the small number of individuals potentially exposed to the activity. Baseline use = 79 ops/yr. ((This TAR is located in SHOBA where ongoing live-fire and bombardment are included in the No Action Alternative. Designation of this TAR is part of Alternatives 1 and 2.). Alternative 1: 91 ops/yr. including 81 NSW, 10 USMC Amphibious and 1 USMC Battalion Landing. Alternative 2: 102 ops/yr. including 90 NSW, 10 USMC Amphibious and 2 USMC Battalion Landing.	significant with mitigation. Alternative 2: Impacts would be less than significant with mitigation.
TAR 22—China Cove Training Area	9.2 ac, all of which is accounted for under Impact Area II. This is the narrowest and most exposed of the SHOBA beaches. There have been no records of plovers breeding or attempting to breed on this beach. The beach at China Cove within Impact Area II is used by small numbers of WSP primarily for winter foraging and roosting; plovers are generally absent during the breeding season months. During 2004, a median number of 8 birds was observed at this location when birds were present (range 1-19).	Roosting or foraging plovers may temporarily move away from the human activity, noise or visual effects of daytime or nighttime operations during live-fire exercises such as GUNEX or EFEX, which may include landings by CRRC, weapons firing from support craft to shore, demolitions, and overflights by helicopters, fixed-wing attack aircraft, and small UAVs. Observations suggest that the plovers would rapidly resume normal behavior after moving away from the activity. The scope of some of the operations and multiple sources of disturbance may result in take in the form of unintentional harassment of a small number of birds. There would be no effects on breeding WSP. Likelihood of injury or mortality to an individual plover from ship to shore weapons fire or other project-related activity in plover habitat is very low, but possible. Impacts (NEPA) would be less than significant because of the low likelihood of harm to individuals and the small number of individuals potentially exposed to the activity. Baseline use = 96 ops/yr including 33 NSW ops/yr. and 63 Non-NSW Naval ops/yr. (This TAR is located in SHOBA where ongoing live-fire and bombardment are included in the No Action Alternative. Designation of this TAR is part of Alternatives 1 and 2.) Alternative 1: 200 ops/yr. including 33 NSW, 6 USMC Amphibious, 1 USMC Battalion Landing and 160 other naval operations. Alternative 2: 220 ops/yr. including 40 NSW, 16 USMC Amphibious, 2 USMC Battalion Landing and 162 other naval operations. (Other naval operations include naval artillery and delivery of air-to-ground ordnance into overlapping Impact Area II and IIA, which are covered under Impact Area II).	G-M-1* G-M-2* G-M-3* G-M-4 G-M-5 G-M-7 G-M-8 *CRNSW policy prohibiting access for natural resource surveys or management means that some applicable mitigation measures (e.g., G-M-1, G-M-3, G-M-6) would be conducted around the periphery of impact areas but not within them. No Action: Impacts are less than significant. Alternative 1: Impacts would be less than significant with mitigation. Alternative 2: Impacts would be less than significant with mitigation.

Note:

1. Habitat acreage calculated from the SCI GIS. Acreages are approximate and should be used only for comparative purposes for several reasons including seasonal and year to year changes in the narrow strips of beach habitat.
2. Impact significance conclusion is based on discussion in “Description of Impacts” column and is assessed assuming application of mitigation measures identified in this document.
3. Impact significance assessment assumes mitigation for Alternatives I and 2.

Table D-10. State-listed and California Native Plant Society (CNPS)-List 1B Plant Species (Rare and Endangered in California and Elsewhere) Within Individual Operations Areas on SCI, Description Of Potential Impacts Of Existing and Proposed Operations, and Impact Significance. Evaluation of Impact Significance for the No Action Alternative is Based on Comparison With the Baseline.

Operations Area	Amount of Resource[1]	Description of Impacts	Applicable Mitigation Measures and Impact Significance[2,3]
IMPACT AREA I	State Listed and Sensitive Plant Species SCI bedstraw (*Galium catalinense* ssp. *acrispum*): 2 of 224 (0.9% of SCI total occurrences) with 48 individuals (1.8% of 2,647 SCI total individuals). SCI silvery hosackia (*Lotus argophyllus* subsp. *adsurgens*): 25 of 207 occurrences on SCI (12.1% of SCI total occurrences); 330 of 5,505 individuals on SCI (6% of total SCI individuals). Aphanisma *(Aphanisma blitoides)* : 46 of 175 occurrences on SCI (26.3% of SCI total occurrences). SCI milkvetch (*Astragalus nevinii*) : 21 of 205 occurrences on SCI (10.2% of SCI total occurrences). South Coast saltscale (*Atriplex pacifica*): 9 of 67 occurrences on SCI (13.4% of SCI total occurrences). SCI evening primrose (suncup) (*Camissonia guadalupensis clementina*): 6 of 89 occurrences on SCI (6.7% of SCI total occurrences). Island apple-blossom *(Crossosoma californicum)*: 4 of 60 occurrences on SCI (6.7% of SCI total occurrences). Island green dudleya (*Dudleya virens* ssp. *virens*) : 7 of 324 occurrences on SCI (2.2% of SCI total occurrences). SCI buckwheat (*Eriogonum giganteum var. formosum*): 1 of 270 occurrences on SCI (0.4% of SCI total occurrences). SCI hazardia (*Hazardia cana*): 2 of 153 occurrences on SCI (1.3% of SCI total occurrences).	Existing patterns of disturbance from ordnance impacts and fire would be expected to continue, given the long history of similar use. Much of the distribution of SCI silvery hosackia (*Lotus argophyllus adsurgens*) is within SHOBA, and 12% of the populations documented since 1998 are within Impact Area I, where this state-listed endangered species is relatively abundant on south facing slopes and ridgetops. These habitats are largely away from target areas and many of the occurrences are very sparsely vegetated and unlikely to carry fire. This species regenerates from seed after fire. Under no action, Impact Area I receives about 6 % of the large caliber ordnance used in SHOBA. Because of its distribution is in up-canyon locations away from target areas, and the long history of ordnance use in Impact Area I, continued use of Impact Area I would have less than significant impacts on this species. Other sensitive species in Impact Area I have smaller proportions of their Island distribution in Impact Area I and would also be expected to experience less than significant impacts from continued use of the Impact Area. Increases in ordnance use associated with Alternatives 1 and 2 are as described in Table D-1. The patterns of disturbance from the increased use associated with these alternatives would be expected to be similar to existing patterns. Compared to baseline conditions, substantial changes in distribution and abundance of state-listed and sensitive plant species, including the SCI silvery hosackia, would not be expected. Implementation of the Navy Access Policy applying to Impact Areas I and II will preclude future monitoring of these state-listed and sensitive plants species and their habitat.	Implementation of the SCI Wildland Fire Management Plan is part of the No Action Alternative, Alternative 1 and Alternative 2. G-M-1* G-M-3* G-M-4 G-M-5 G-M-6* G-M-7 G-M-9 *CRNSW policy prohibiting access for natural resource surveys or management means that some applicable mitigation measures (e.g., G-M-1, G-M-3, G-M-6) would be conducted around the periphery of impact areas but not within them. No Action: Impacts are less than significant. Alternative 1: Impacts would be less than significant with mitigation. Alternative 2: Impacts would be less than significant with mitigation.

	Guadalupe Island lupine (*Lupinus guadalupensis*): 5 of 356 occurrences on SCI (1.4% of SCI total occurrences). SCI phacelia (*Phacelia floribunda*): 3 of 52 occurrences on SCI (5.8% of SCI total occurrences).		

Table D-10 (continued). State-Listed and CNPS-Listed Sensitive Plant Species Within Individual Operations Areas on SCI.

Operations Area	Amount of Resource[1]	Description of Impacts	Applicable Mitigation Measures and Impact Significance[2,3]
IMPACT AREA II	State Listed and Sensitive Plant Species SCI bedstraw (*Galium catalinense* ssp. *acrispum*): 2 of 224 (0.9% of SCI total occurrences) with 3 individuals (0.1% of 2,647 SCI total individuals). SCI silvery hosackia (*Lotus argophyllus* subsp. *adsurgens*): 2 of 207 occurrences on SCI (1.0% of SCI total occurrences) with 70 individuals (1.3% of 5,505 SCI total individuals). Aphanisma *(Aphanisma blitoides)* : 1 of 175 occurrences on SCI (0.6% of SCI total occurrences). SCI evening primrose (suncup) (*Camissonia guadalupensis clementina*): 6 of 89 occurrences on SCI (6.7% of SCI total occurrences). Trask's cryptantha (Cryptantha traskiae): 1 of 25 occurrences on SCI (4.0% of SCI total occurrences). Island green dudleya (*Dudleya virens* ssp. *virens*): 5 of 324 occurrences on SCI (1.5% of SCI total occurrences). SCI buckwheat (*Eriogonum giganteum var. formosum*): 5 of 270 occurrences on SCI (1.85% of SCI total occurrences). SCI hazardia (*Hazardia cana*): 1 of 153 occurrences on SCI (0.6% of SCI total occurrences). Guadalupe Island lupine (*Lupinus guadalupensis*): 7 of 356 occurrences on SCI (2.0% of SCI total occurrences). SCI tritelia: 1 of 88 occurrences on SCI (1.1% of SCI total occurrences).	Existing patterns of disturbance from ordnance impacts and fire would be expected to continue, given the long history of similar use. Continued use of Impact area II would have less than significant impacts on these species based on the historic and ongoing pattern of the disturbance, the ability of these species to survive or escape (through habitat association) fire or other disturbance, and the low proportions of their Island occurrences in Impact Area II. Increases in ordnance use associated with Alternatives 1 and 2 are as described in Table D-1. Impacts of the alternatives on these species would be less than significant despite the increased ordnance use because the patterns of disturbance are expected to be similar to existing and historic patterns. Implementation of the Navy Access Policy applying to Impact Areas I and II will preclude future monitoring of these state-listed and sensitive plants species and their habitat.	Applicable conservation measures and Impact significance are as described for Impact Area I above.
NALF AVMA	State Listed and Sensitive Plant Species SCI silvery hosackia *Lotus argophyllus* subsp. *adsurgens*): 2 of 207 occurrences on SCI (1.0% of SCI total occurrences) with 2 individuals (0.04% of 5,505 SCI total	Physical disturbance to vegetation and soils caused by tracked vehicle activity coupled with indirect impacts associated with introduction or spread of invasive species may lead to a reduction in these local populations of sensitive species. Newly discovered occurrences of southern Island tree mallow, SCI silvery hosackia (state-listed as endangered, SCI Indian paintbrush (federally listed as endangered Table D-2), and SCI milkvetch are clustered near	Implementation of the SCI Wildland Fire Management Plan is part of the No Action Alternative, Alternative 1 and Alternative 2.

Table D-10 (continued). State-Listed and CNPS-Listed Sensitive Plant Species Within Individual Operations Areas on SCI.

Operations Area	Amount of Resource[1]	Description of Impacts	Applicable Mitigation Measures and Impact Significance[2,3]
	individuals). SCI milkvetch (*Astragalus nevinii*) : 5 of 205 occurrences on SCI (2.4% of SCI total occurrences). SCI evening primrose (suncup) *(Camissonia guadalupensis clementina*): 4 of 89 occurrences on SCI (4.5% of SCI total occurrences). Southern Island Tree Mallow (*Lavatera assurgentifolia* subsp. *glabra*): 5 of 32 occurrences on SCI (15.6% of the total SCI occurrences) with 5 individuals (1.8% of 276 SCI total individuals). The southern island tree mallow has also been noted in the SCI INRMP (DoN 2002) to occur on sandy soils south of the airfield immediately adjacent to the AVMA and AMP. This plant, which is CNPS 1B status, is noted in the INRMP (page D-17) as being in danger of extirpation on SCI because it is known from only 32 occurrences comprising less than 300 individuals total.	the egress from TAR 5, where their localized habitat may be susceptible to impacts from vehicle traffic. Protection of this localized area can be addressed through development of the erosion control plan (AVMC-M-3), briefing of maneuver area boundaries prior to conducting operations in these areas (AVMC-M-4), and continuing to use the existing route for ingress and egress from the beach at West Cove (AVMC-M-9), as appropriate. The occurrences of SCI evening primrose and SCI milkvetch at the northwestern and northeastern boundaries of the overlapping TAR 5 and along the southern boundary of the AVMA would probably not be affected during most operations because their peripheral locations would not receive frequent tracked vehicle activity. There would not be a substantial impact given the existing level of disturbance, the infrequency of activity at the sites, and the low proportion of the occurrences on SCI represented on this site. The southern island tree mallow population is inside the boundary of this AVMA and upwind from most of the activity and is therefore unlikely to be directly or indirectly affected by tracked vehicle activity within the AVMA. Designation of this AVMA is part of Alternatives 1 and 2. Alternative 1. The AVMA could be used by tracked vehicles during approximately 43 (42 USMC Amphibious plus 1 USMC Battalion Landing) operations per year. Alternative 2. The AVMA could be used by tracked vehicles during approximately 63 (61 USMC Amphibious plus 2 USMC Battalion Landing) operations per year.	G-M-1, G-M-3, G-M-4 AVMC-M-1 AVMC-M-2 AVMC-M-3 AVMC-M-4 AVMC-M-5 AVMC-M-6 AVMC-M-7, AVMC-M-9 No Action: No Impact. Alternative 1: Impacts would be less than significant with mitigation. Alternative 2: Impacts would be less than significant with mitigation.
Old Rifle Range AVMA	State Listed and Sensitive Plant Species Aphanisma *(Aphanisma blitoides)*: 1 of 175 occurrences on SCI (0.6% of SCI total occurrences). SCI milkvetch (*Astragalus nevinii*) : 5 of 205 occurrences on SCI (2.4% of SCI total occurrences). Island appleblossom (*Crossosoma californicum*): 1 of 60 occurrences on SCI (1.7% of total SCI occurrences).	Physical disturbance to vegetation and soils caused by tracked vehicle activity coupled with indirect impacts associated with introduction or spread of invasive species may lead to a reduction in this local population. It might be able to persist on site given its annual habitat and association with sparsely vegetated habitats. Low proportions of the occurrences of aphanisma, SCI milkvetch, and island appleblossom on SCI are represented on this site (0.6%, 2.4%, and 1.7 %, respectively). Designation of this AVMA is part of Alternatives 1 and 2. Alternative 1. The AVMA could be used by tracked vehicles during approximately 43 (42 USMC Amphibious plus 1 USMC Battalion Landing) operations per year. Alternative 2. The AVMA could be used by tracked vehicles during approximately 63 (61 USMC Amphibious plus 2 USMC Battalion Landing) operations per year.	Implementation of the SCI Wildland Fire Management Plan is part of the No Action Alternative, Alternative 1 and Alternative 2. G-M-1 G-M-3 G-M-4 AVMC-M-1 AVMC-M-2 AVMC-M-3 AVMC-M-4 AVMC-M-5 AVMC-M-6 AVMC-M-7 No Action: No Impact

Table D-10 (continued). State-Listed and CNPS-Listed Sensitive Plant Species Within Individual Operations Areas on SCI.

Operations Area	Amount of Resource[1]	Description of Impacts	Applicable Mitigation Measures and Impact Significance[2,3]
			Alternatives 1 and 2: As described above for NALF AVMA, impacts would be less than significant with mitigation.
VC-3 AVMA	State Listed and Sensitive Plant Species Guadalupe Island lupine (*Lupinus guadalupensis*): 5 of 356 occurrences on SCI (1.4% of SCI total occurrences).	Physical disturbance to vegetation and soils caused by tracked vehicle activity coupled with indirect impacts associated with introduction or spread of invasive species may lead to a reduction in the local population of this species. A low proportion (< 3%) of the occurrences on SCI represented on this site. It might be able to persist on site given its annual habitat and association with sparsely vegetated habitats. Designation of this AVMA is part of Alternatives 1 and 2. Alternative 1. The AVMA could be used by tracked vehicles during approximately 43 (42 USMC Amphibious plus 1 USMC Battalion Landing) operations per year. Alternative 2. The AVMA could be used by tracked vehicles during approximately 63 (61 USMC Amphibious plus 2 USMC Battalion Landing) operations per year.	Applicable mitigation measures as identified above for Old Rifle Range AVMA. No Action: No Impact No Action: No Impact Alternatives 1 and 2: As described above for NALF AVMA, impacts would be less than significant with mitigation.
AVMC in SHOBA	Thorne's royal larkspur (*Delphinium variegatum* subsp. *Thornei*): 3 of 78 SCI occurrences (3.8 percent of SCI total occurrences) with 51 of 10,026 individuals (0.5% of SCI total individuals). Guadalupe Island lupine (*Lupinus guadalupensis*): 1 of 356 occurrences on SCI (0.3% of SCI total occurrences).	Construction of the AVMC in SHOBA would require engineering and would be addressed in a separate environmental document and permitted separately. The occurrences of Thorne's royal larkspur and Guadalupe Island lupine in the 26.3-acre conceptual alignment represent a low proportion of the SCI totals for these plants. Operation of the AVMC in SHOBA in Alternatives 1 and 2 would have localized impacts including erosion, deposition of dust on vegetation, and spread of invasive plant species. The impacts would be localized along the sides of the AVMC, where beginning populations of invasive species would be detectable and treatable. Frequency of use would be up to approximately 43 times per year in Alternative 1 and up to 63 times per year in Alternative 2. (Construction of the route would be addressed in a separate environmental document and permitted separately).	Applicable Mitigation Measures as listed for Old Rifle Range AVMA (above) No Action: No Impact Alternative 1: Impacts from use of the route during operations would be less than significant with mitigation. Alternative 2: Impacts from use of the route during operations would be less than significant with mitigation.
AFP-1 SHOBA	SCI silvery hosackia (*Lotus argophyllus* subsp *adsurgens*): 4 of 207 SCI occurrences (1.9% of SCI total occurrences) with 289 individuals (5.2% of 5,505 SCI total individuals).	Maneuvering of heavy wheeled and tracked vehicles, including tanks, and digging in of recoil spades on howitzers may adversely affect individuals in this population through the physical effects of vehicle activity and possibly by spread of invasive species facilitated by the activity. Portions of this 34-acre site had been disturbed previously by grading and off-road tracked vehicle and artillery activity. The newly discovered silvery hosackia occurrences appear to be outside of the previously disturbed portions of the site and at least some appear to be in operationally inaccessible portions of the site due to topographic constraints. Depending on the specifics of the site, protection of some or all of the silvery hosackia occurrences could potentially be addressed through development of the erosion control plan (AVMC-M-3) and/or briefing of maneuver area boundaries prior to conducting operations in these areas (AVMC-M-4).Less than significant impacts for No Action due to small size and previous disturbance of site, the likely inaccessibility of some or all of the occurrences, and the small	Implementation of the SCI Wildland Fire Management Plan is part of the No Action Alternative, Alternative 1 and Alternative 2. G-M-1 G-M-3 G-M-4 G-M-9 AVMC-M-1 AVMC-M-2

Table D-10 (continued). State-Listed and CNPS-Listed Sensitive Plant Species Within Individual Operations Areas on SCI.

Operations Area	Amount of Resource[1]	Description of Impacts	Applicable Mitigation Measures and Impact Significance[2,3]
		proportion of the SCI silvery hosackia population represented on site (5.2 percent). No Action: 5 operations per year from this general area, which had been disturbed by past activities. Future disturbance under no action would be confined to the previously used portions of AFP-1. Designation of this AFP is included in Alternatives 1 and 2. Alternative 1. Artillery maneuvering during 3-day USMC artillery exercises up to 6 times per year plus 1 USMC Battalion Landing. Alternative 2. Artillery maneuvering during 3-day USMC artillery exercises up to 8 times per year plus 2 USMC Battalion Landings.	AVMC-M-3 AVMC-M-4 AVMC-M-5 AVMC-M-6 AVMC-M-7 AVMC-M-8 No Action: Impacts are less than significant. Alternative 1. Impacts would be less than significant with mitigation. Alternative 2. Impacts would be less than significant with mitigation.
TAR 1-Demolition Range Northeast Point	State Listed and Sensitive Plant Species Trask's cryptantha: 1 of 10 occurrences reported by Junak and Wilken (1998) is located outside this TAR and was estimated to contain 10,000 individuals of this annual plant species, comprising 50% of the individuals located by Junak and Wilken (1998).	This population was considered in the EA authorizing development and use of this TAR, which was originally proposed to be about 65 ac, much larger than its current 1.8 ac extent. The plants reported in 1998 and addressed in the EA are outside the boundary of this TAR. This species, an annual plant that exists as dormant seed during conditions unfavorable for growth, was not found during 2005 surveys of the TAR. No Action: 23 ops/yr. This TAR has been previously established. Alternative 1: 28 ops/yr. Alternative 2: 30 ops/yr.	Implementation of the SCI Wildland Fire Management Plan is part of the No Action Alternative, Alternative 1 and Alternative 2. G-M-1 G-M-3 G-M-4 TAR-M-1 No Action: Impacts are less than significant. Alternative 1: Impacts would be less than significant with mitigation. Alternative 2: Impacts would be less than significant with mitigation.
TAR 4--Whale Point/Castle Rock	State Listed and Sensitive Plant Species Guadalupe Island lupine (*Lupinus guadalupensis*): 1 of 356 occurrences on SCI (0.3% of SCI total occurrences).	A single occurrences of this annual species is documented on this site. The seedbank of this species would be expected to survive fire and the species has been observed to reappear abundantly after fire where a seedbank is present. This species would probably tolerate disturbance from foot traffic and germinate and establish in areas where there has been light disturbance to perennial shrub cover and would be expected to persist on site. Impacts are less than significant given the expected persistence of the species on site and the small	Applicable mitigation measures as identified above for TAR 1. No Action: Impacts are less than significant. Alternative 1: Impacts would be less than significant with

Table D-10 (continued). State-Listed and CNPS-Listed Sensitive Plant Species Within Individual Operations Areas on SCI.

Operations Area	Amount of Resource[1]	Description of Impacts	Applicable Mitigation Measures and Impact Significance[2,3]
		portions of their SCI populations represented on site. Baseline use = 212 ops/yr. This TAR has been previously established. Alternative 1: 230 ops/yr. Alternative 2: 300 ops/yr.	mitigation. Alternative 2: Impacts would be less than significant with mitigation.
TAR 5--West Cove Amphibious Assault Training Area	State Listed and Sensitive Plant Species SCI milkvetch (*Astragalus nevinii*): 1 of 205 occurrences on SCI (0.5% of SCI total occurrences). SCI evening primrose (suncup) (*Camissonia guadalupensis clementina*): 1 of 89 occurrences on SCI (1.1% of SCI total occurrences).	NSW activities are unlikely to affect these species due to their infrequent, low intensity nature. Species are located at the northwestern and northeastern boundaries of the TAR where frequent activity of NSW forces or amphibious vehicles are not expected. See also discussion above under NALF AVMA, which overlaps this site. Existing use is for amphibious landings and extractions and access to NALF AVMA, which overlaps West Cove. Impacts are less than significant due to out of the way location of the sensitive species and the small proportion of the SCI population represented on site. Baseline use = 10 ops/yr incl. 10 USMC Amphibious. Designation of this TAR is part of Alternatives 1 and 2. Alternative 1: 22 ops/yr (incl. 17 USMC Amphibious). Alternative 2: 52 ops/yr (incl. 44 USMC Amphibious).	Implementation of the SCI Wildland Fire Management Plan is part of the No Action Alternative, Alternative 1 and Alternative 2. G-M-1 G-M-3 G-M-4 TAR-M-1 AVMC-M-9 For amphibious landings measures listed above for NALF AVMA are also applicable. No Action: Impacts are less than significant. Alternative 1: Impacts would be less than significant with mitigation. Alternative 2: Impacts would be less than significant with mitigation.
TAR 10—Demolition Range West	State Listed and Sensitive Plant Species Aphanisma (*Aphanisma blitoides*): 2 of 175 occurrences on SCI (1.1% of SCI total occurrences). SCI milkvetch (*Astragalus nevinii*): 15 of 205 occurrences on SCI (7.3% of SCI total occurrences). SCI evening primrose (suncup) *Camissonia guadalupensis clementina*: 1 of 89 occurrences on SCI (1.1% of SCI total occurrences). Southern island tree mallow (*Lavatera assurgentifolia* ssp. *glabra*): 1 of 32	Sensitive species occurrences are concentrated in a sandy area along the northeastern part of the access road and in relatively undisturbed habitat east and south of the previously disturbed demolitions area. At these locations, direct impacts would be primarily from foot traffic by small groups and are expected to be less than significant. Development of range facilities associated with Alternatives 1 and 2 is assumed to be in existing disturbed habitat lacking these species. Implementation of the Wildland Fire Management Plan is assumed to contain fires and prevent spread of fires at short intervals and possible type conversion of habitat. Establishment and spread of invasive species as a result of training operations could adversely affect these sensitive species within the TAR and in adjacent undisturbed habitat. These species regenerate from fire by seed and possibly by resprouting. Implementation of the Wildland Fire Management Plan is assumed to contain fires and prevent spread of fires at short intervals and possible type conversion of habitat. Impacts are less than significant due to infrequency of operations and small number of individuals involved coupled with	Applicable mitigation measures as identified above for TAR 1. No Action: Impacts are less than significant. Alternative 1: Impacts would be less than significant with mitigation. Alternative 2: Impacts would be less than significant with mitigation.

Table D-10 (continued). State-Listed and CNPS-Listed Sensitive Plant Species Within Individual Operations Areas on SCI.

Operations Area	Amount of Resource[1]	Description of Impacts	Applicable Mitigation Measures and Impact Significance[2,3]
	occurrences on SCI (3.1% of SCI total occurrences). Guadalupe Island lupine (*Lupinus guadalupensis*): 13 of 356 occurrences on SCI (3.6% of SCI total occurrences).	demolitions in existing disturbed area. Baseline use = 3 ops/yr. (Designation of this TAR is part of Alternatives 1 and 2). Alternative 1: 25 ops/yr. Alternative 2: 40 ops/yr.	
TAR 13—Randall Radar Site Training Area	State Listed and Sensitive Plant Species SCI bedstraw (*Galium catalinense* ssp. *acrispum*): 1 of 224 occurrences on SCI (0.4% of SCI total occurrences) with 1 individual (0.04% of 2,647 total SCI individuals).	Low effects on these species would be caused by infrequent foot traffic by small groups. Some potential for spreading of invasive species into habitat associated with the foot traffic. This species is able to regenerate following fire. Baseline use = 10 ops/yr. (Designation of this TAR is part of Alternatives 1 and 2). Alternative 1: 16 ops/yr. Alternative 2: 22 ops/yr.	Applicable mitigation measures as identified above for TAR 1. No Action: Impacts are less than significant. Alternative 1: Impacts would be less than significant with mitigation. Alternative 2: Impacts would be less than significant with mitigation.
TAR 14—VC-3 Onshore Parachute Drop Zone "Twinky"	State Listed and Sensitive Plant Species Guadalupe Island lupine *Lupinus guadalupensis*): 1 of 356 occurrences on SCI (0.3% of SCI total occurrences).	Infrequent use by small groups on foot are unlikely to adversely affect this annual species, which is also unlikely to be adversely affected by fire because fire would generally not be expected to burn through its grassland habitat until after the plant has produced its seed. Some potential for spreading of invasive species into habitat associated with the foot traffic. Baseline use = 20 ops/yr. (Designation of this TAR is part of Alternatives 1 and 2). Alternative 1: 30 ops/yr. Alternative 2: 68 ops/yr.	Applicable mitigation measures as identified above for TAR 1. No Action: Impacts are less than significant. Alternative 1: Impacts would be less than significant with mitigation. Alternative 2: Impacts would be less than significant with mitigation.

Table D-10 (continued). State-Listed and CNPS-Listed Sensitive Plant Species Within Individual Operations Areas on SCI.

Operations Area	Amount of Resource[1]	Description of Impacts	Applicable Mitigation Measures and Impact Significance[2,3]
TAR 15—VC-3 Airfield Training Area	State Listed and Sensitive Plant Species Guadalupe Island lupine *Lupinus guadalupensis*): 8 of 356 occurrences on SCI (2.2% of SCI total occurrences).	Infrequent use by small groups on foot are unlikely to adversely affect this annual species, which is also unlikely to be adversely affected by fire because fire would generally not be expected to burn through its grassland habitat until after the plant has produced its seed. Some potential for spreading of invasive species into habitat associated with the foot traffic. Baseline use = 43 ops/yr. (Designation of this TAR is part of Alternatives 1 and 2). Alternative 1: 80 ops/yr. Alternative 2: 94 ops/yr.	Applicable mitigation measures as identified above for TAR 1. No Action: Impacts are less than significant. Alternative 1: Impacts would be less than significant with mitigation. Alternative 2: Impacts would be less than significant with mitigation.
TAR 16—South VC-3 (Missile Impact Range)	State Listed and Sensitive Plant Species SCI brodiaea: 2 of 142 occurrences on SCI (1.4% of SCI total occurrences).	These plants are located on the periphery of the TAR where direct effects on the plants or the soils from trampling or vehicle traffic are unlikely. These exist as dormant underground corms (bulbs) during most of the summer after they set seed and do not sprout leaves until after seasonal rains start. Because of the dormancy they are resistant to impact much of the year. Unlikely to be adversely affected by fire for the same reason. Many related species increase after fire from dormant underground corms. Some potential for spreading of invasive species into habitat associated with actions at the TAR. Baseline use = 25 ops/yr. This TAR has been previously established. Alternative 1: 41 ops/yr. Alternative 2: 52 ops/yr.	Applicable mitigation measures as identified above for TAR 1. No Action: Impacts are less than significant. Alternative 1: Impacts would be less than significant with mitigation. Alternative 2: Impacts would be less than significant with mitigation.
TAR 17— Eel Point Tactical Training Range	State Listed and Sensitive Plant Species Aphanisma (*Aphanisma blitoides*): 1 of 175 occurrences on SCI (0.6% of SCI total occurrences). SCI milkvetch: 1 of 205 occurrences on SCI (0.5% of SCI total occurrences). South coast allscale (*Atriplex pacifica*): 3 of 67 SCI occurrences (4.5% of SCI total occurrences). Guadalupe Island lupine (*Lupinus guadalupensis*): 5 of 356 occurrences on SCI (1.4% of SCI total occurrences).	Less than significant impacts expected due to the low physical disturbance outside the demolition areas and the small proportion of SCI's populations present at TAR 17. Spread of invasive species could adversely affect these occurrences. Fire is unlikely to adversely affect these annual or short-lived perennial species. Baseline use = 15 ops/yr. (Designation of this TAR is part of Alternatives 1 and 2). Alternative 1: 31 ops/yr. Alternative 2: 40 ops/yr.	Applicable mitigation measures as identified above for TAR 1. No Action: Impacts are less than significant. Alternative 1: Impacts would be less than significant with mitigation. Alternative 2: Impacts would be less than significant with mitigation.

Table D-10 (continued). State-Listed and CNPS-Listed Sensitive Plant Species Within Individual Operations Areas on SCI.

Operations Area	Amount of Resource[1]	Description of Impacts	Applicable Mitigation Measures and Impact Significance[2,3]
TAR 21—Horse Beach Cove Training Area and Horse Beach Cove Amphibious Landing and Embarkation Area	State Listed and Sensitive Plant Species Aphanisma (*Aphanisma blitoides*): 9 of 175 occurrences on SCI (5.1% of SCI total occurrences). SCI milkvetch (*Astragalus nevinii*): 8 of 205 occurrences on SCI (3.9% of SCI total occurrences). SCI evening primrose (suncup) (*Camissonia guadalupensis clementina*): 6 of 89 occurrences on SCI (6.7% of SCI total occurrences) Island green dudleya (*Dudleya virens virens*): 2 of 280 occurrences on SCI (0.71% of SCI total occurrences). Guadalupe Island lupine (*Lupinus guadalupensis*): 2 of 356 occurrences on SCI (0.6% of SCI total occurrences). Most of these occurrences are located in Horse Beach Canyon, including the associated hillslopes and canyon walls. Additional occurrences are located upstream of the TAR 21 boundary.	TAR 21: Frequent use by small groups on foot with live firing is likely to cause localized disturbance to individual plants when they are located in or near frequently used areas and routes. There is a moderate potential to introduce and spread invasive species related to the frequency of operations proposed for TAR 21. Increased fire frequency resulting from the intensification of uses is likely to lead to localized changes in vegetation in the most frequently used areas, possibly affecting sensitive species. The Wildland Fire Management Plan does not provide for ground based fire suppression within SHOBA. All of these species are able to survive or regenerate after fire. Most of the sensitive species occurrences in the TAR are located east of the landing beach or north of it where they would be exposed to effects from individuals on foot and live-fire but not vehicular traffic. With the exception of Island green dudleya (a succulent perennial) these species are annual or perennial herbs and would be sensitive to foot traffic only when actively growing, existing during the dry months as seed or as seed and dormant stems or roots. Impacts are less than significant because most if not all of the occurrences on the TAR would be expected to persist given the nature of the training activities and the resilience of the plants and because of the relatively small proportion of their numbers located within the TAR. Horse Beach Cove Amphibious Landing and Embarkation Area: None of the sensitive species is known from the area between the beach and the coast road that would be used during amphibious landings and embarkations, therefore none of these species is expected to be directly affected by amphibious operations. Impacts are less than significant. Baseline use = 79 ops/yr. (This TAR is located in SHOBA where ongoing live-fire and bombardment are included in the No Action Alternative. Designation of this TAR is part of Alternatives 1 and 2.) Alternative 1: 91 ops/yr. including 81 NSW, 10 USMC Amphibious and 1 USMC Battalion Landing. Alternative 2: 102 ops/yr. including 90 NSW, 10 USMC Amphibious and 2 USMC Battalion Landing.	Implementation of the SCI Wildland Fire Management Plan is part of the No Action Alternative, Alternative 1 and Alternative 2. G-M-1* G-M-3* G-M-4 G-M-5 G-M-6* G-M-7 G-M-9 AVMC-M-1 AVMC-M-2* AVMC-M-3* AVMC-M-4 AVMC-M-5 AVMC-M-7 AVMC-M-10 *CRNSW policy prohibiting access for natural resource surveys or management means that some applicable mitigation measures (e.g., G-M-1, G-M-3, G-M-6) would be conducted around the periphery of impact areas but not within them. No Action: Impacts are less than significant. Alternative 1: Impacts would be less than significant with mitigation. Alternative 2: Impacts would be less than significant with mitigation.

Table D-10 (continued). State-Listed and CNPS-Listed Sensitive Plant Species Within Individual Operations Areas on SCI.

Operations Area	Amount of Resource[1]	Description of Impacts	Applicable Mitigation Measures and Impact Significance[2,3]
TAR 22—China Cove Training Area	State Listed and Sensitive Plant Species SCI bedstraw (*Galium catalinense* ssp. *acrispum*): 1 of 224 occurrences on SCI (0.4% of SCI total occurrences) with 2 individuals (0.08% of 2,647 SCI total individuals). SCI evening primrose (suncup) (*Camissonia guadalupensis clementina*): 5 of 89 occurrences on SCI (5.6% of SCI total occurrences). Island green dudleya (*Dudleya virens* ssp. *virens*):: 1 of 324 occurrences on SCI (0.3% of SCI total occurrences). SCI buckwheat (*Eriogonum giganteum var. formosum*): 3 of 270 occurrences on SCI (1.1% of SCI total occurrences). SCI hazardia (*Hazardia cana*): 1 of 153 occurrences on SCI (0.6% of SCI total occurrences). Guadalupe Island lupine (*Lupinus guadalupensis*): 7 of 356 occurrences on SCI (2.0% of SCI total occurrences). SCI tritelia: 1 of 88 occurrences on SCI (1.1% of SCI total occurrences).	Existing patterns of disturbance from ordnance impacts and fire would be expected to continue and the sensitive plant populations would be expected to persist, given their presence despite a long history of similar use. Use of TAR 22 by NSW as proposed would have less than significant impacts on these species based on the historic and ongoing pattern of disturbance in this area and the low proportions of their Island occurrences in TAR 22. Baseline use = 96 ops/yr including 33 NSW ops/yr. and 63 Non-NSW Naval ops/yr. (This TAR is located in SHOBA where ongoing live-fire and bombardment are included in the No Action Alternative. Designation of this TAR is part of Alternatives 1 and 2.) Alternative 1: 200 ops/yr. including 33 NSW, 6 USMC Amphibious, 1 USMC Battalion Landing and 160 other naval operations. Alternative 2: 220 ops/yr. including 40 NSW, 16 USMC Amphibious, 2 USMC Battalion Landing and 162 other naval operations.	Implementation of the SCI Wildland Fire Management Plan is part of the No Action Alternative, Alternative 1 and Alternative 2. G-M-1* G-M-3* G-M-4 G-M-5 G-M-6* G-M-7 G-M-9 *CRNSW policy prohibiting access for natural resource surveys or management means that some applicable mitigation measures (e.g., G-M-1, G-M-3, G-M-6) would be conducted around the periphery of impact areas but not within them. No Action: Impacts are less than significant. Alternative 1: Impacts would be less than significant with mitigation. Alternative 2: Impacts would be less than significant with mitigation.
Infantry Operations Area	State Listed and Sensitive Plant Species SCI bedstraw (*Galium catalinense* ssp. *acrispum*): 3 of 224 occurrences on SCI (1.3% of SCI total occurrences) with 5 individuals (0.2% of 2,647 SCI total individuals). SCI silvery hosackia (*Lotus argophyllus* subsp. *adsurgens*): 92 of 207 occurrences on SCI (44% of SCI total occurrences) with 1,662 individuals (30.2% of 5,505 SCI total	During the dry season on SCI when many of the sensitive species are dormant, direct effects of foot travel would be minimal and dispersed. Direct effects of trampling are possible, especially when soils are wet and seasonal plants such as geophytes and annuals are actively growing. Geophytes, such as Thorne's royal larkspur, SCI brodiaea, and SCI tritelia, go dormant after producing seed and survive unfavorable periods as underground bulbs, corms, rhizomes, or similar underground structures. Annuals, such as Guadalupe Island lupine, complete their life cycles from seed to seed within a few months and exist as seed during the dry season. Generally, the majority of the affected plants would be expected to survive the foot traffic even during the growing season and would complete their life cycle. During the dry months there would be little effect of foot traffic on seasonal species. Because	Implementation of the SCI Wildland Fire Management Plan is part of the No Action Alternative, Alternative 1 and Alternative 2. G-M-1 G-M-3 G-M-4 G-M-8 AVMC-M-1 AVMC-M-2

Table D-10 (continued). State-Listed and CNPS-Listed Sensitive Plant Species Within Individual Operations Areas on SCI.

Operations Area	Amount of Resource[1]	Description of Impacts	Applicable Mitigation Measures and Impact Significance[2,3]
	individuals). Aphanisma (*Aphanisma blitoides*): 2 of 175 occurrences on SCI (1.1% of SCI total occurrences). SCI milkvetch (*Astragalus nevinii*): 98 of 205 occurrences on SCI (47.8% of SCI total occurrences). South coast allscale (Atriplex pacifica): 2 of 67 SCI occurrences (3.0 % of SCI total occurrences). SCI brodiaea: 59 of 142 occurrences on SCI (41.6% of SCI total occurrences). San Clemente SCI evening primrose (suncup) (*Camissonia guadalupensis clementina*): 3 of 89 occurrences on SCI (3.4% of SCI total occurrences). Island apple-blossom (*Crossosoma californicum*): 6 of 60 occurrences on SCI (10.0% of SCI total occurrences). Thorne's royal larkspur (*Delphinium variegatum subsp. thornei*): 40 of 78 occurrences on SCI (51.3% of SCI total occurrences). Island green dudleya (*Dudleya virens* ssp. *virens*): 27 of 324 occurrences on SCI (8.3% of SCI total occurrences). SCI buckwheat (*Eriogonum giganteum var. formosum*): 75 of 270 occurrences on SCI (27.8% of SCI total occurrences). SCI hazardia (*Hazardia cana*): 28 of 153 occurrences on SCI (18.3% of SCI total occurrences). Southern island tree mallow (*Lavatera assurgentifolia* ssp. *glabra*): 19 of 32 occurrences on SCI (59.4% of SCI total occurrences). Guadalupe Island lupine Guadalupe Island lupine (*Lupinus guadalupensis*): 197 of 356 occurrences on SCI (55.3% of SCI total occurrences).	infantry would be spread across the landscape with approximately 5 m spacing between individual Marines, impacts on any individual population would be very dispersed. Shrubs and trees would be minimally affected by foot traffic. There is a potential for foot traffic to introduce or spread invasive plant species. Because the Marines would be spread over a large area when advancing, the large size and remoteness of parts of the Infantry Operations Area will make beginning infestations of invasive species difficult to detect when they are localized and most treatable. The outcome of an invasive plant species introduction is not always predictable, however it is very well documented, especially on islands, that plant invasions can result in dramatic ecological changes affecting the survival of plant and wildlife species. As described above, introduction or spread of invasive plant species as a result of use of the IOA by large numbers of personnel associated with the Battalion Landing is a reasonably foreseeable indirect impact with the potential for serious adverse consequences on sensitive plant species. Baseline use = 0 ops/yr, Battalion-sized landings have occurred on SCI in the past, but not during the baseline year. Foot traffic by individuals and groups is permitted within the IOA and elsewhere on the Island under the No Action Alternative. Alternative 1: 1 USMC Battalion-sized landing per year with troops on foot using the IOA and mechanized vehicles using the AVMC or Ridge Road. Alternative 2: 2 USMC Battalion-sized landings per year with troops on foot using the IOA and mechanized vehicles using the AVMC or Ridge Road.:	AVMC-M-4 AVMC-M-7 No Action: Impacts are less than significant. Alternative 1: Impacts would be less than significant with mitigation. Alternative 2: Impacts would be less than significant with mitigation.

Table D-10 (continued). State-Listed and CNPS-Listed Sensitive Plant Species Within Individual Operations Areas on SCI.

Operations Area	Amount of Resource[1]	Description of Impacts	Applicable Mitigation Measures and Impact Significance[2,3]
	Santa Cruz ironwood: 4 of 153 occurrences on SCI (2.6% of SCI total occurrences). Blair's stephanomeria: 20 of 296 occurrences on SCI (6.8% of SCI total occurrences).		

Note:

1. Sensitive plant occurrence and abundance is based on information in the SCI GIS developed from information in Junak and Wilken (1998), the SCI INRMP (DoN 2002), Junak (2006), and Tierra Data, Inc (2007). The data reported by Junak also includes occurrences documented by the Soil Ecology and Restoration Group (SERG), who operate the on-island nursery and conduct restoration projects on behalf of the Navy. The surveys by Junak and Wilken (1998), Junak (2006) were botanically driven and not focused on operations areas and covered large portions of the Island including TARs. The Tierra Data Inc surveys were conducted in 2005-2007 and were focused on operations areas including the AVMAs, AMPs, AFPs, and IOA. Three CNPS List 1B species [*Eriophyllum* (=*Constancea*) *nevinii*, *Galvezia speciosa*, and *Linanthus* (=*Leptosiphon*) *pygmaeus* ssp. *pygmaeus)*] were found to be so widespread and abundant that they were not included in the island-wide datasets of Junak and Wilken (1998) and Junak (2006) . Table 3.11-8 provides additional information about distribution, status, and population size as well as scientific and common names for these species. These species are listed alphabetically by genus, starting with the two state-listed endangered species *Galium* and *Lotus*. Under "amount of resource" resources (e.g., occurrences) occurring in overlapping operations areas are reported for each of the overlapping areas, enabling the effects of the differing operations in the overlapping areas to be assessed.
2. Impact significance conclusion is based on discussion in "Description of Impacts" column and is assessed assuming application of mitigation measures identified in this document.
3. Impact significance assessment assumes mitigation for Alternatives I and 2.

Appendix E

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DRAFT

ESSENTIAL FISH HABITAT ASSESSMENT

Prepared for:
Department of the Navy
Commander, U.S. Pacific Fleet

APRIL 2008

EXECUTIVE SUMMARY

This assessment of the impact of United States Navy training in the Southern California (SOCAL) Range Complex on Essential Fish Habitat (EFH) covers regulatory issues, Fishery Management Plans and Managed Species, the project area, proposed actions, impacts, and mitigation measures. The SOCAL Range Complex encompasses 120,000 square nautical miles (nm^2) of ocean between Dana Point and San Diego, California, and extends more than 600 miles (mi) southwest into the Pacific Ocean. It includes land areas, water areas, and airspace used to conduct operations, training, research, development, testing, and evaluation of military hardware, personnel, tactics, munitions, explosives, and electronic combat systems.

The Magnuson-Stevens Fisheries Conservation and Management Act (16 United States Code [U.S.C.] § 1801 *et seq.*), mandates identification and protection of EFH. A second habitat type is also protected: Habitat Areas of Particular Concern (HAPC). These subsets of EFH are rare, sensitive, ecologically important, or located in an area that is already stressed. Federal agencies are required to consult with the NOAA Fisheries Service and to prepare an EFH Assessment describing potential adverse affects of their activities on EFH.

The SOCAL Range Complex contains EFH for 109 species covered under Fishery Management Plans. These 109 Managed Species include 83 species of groundfish that live on or near the bottom (e.g., rockfish and flatfish), six pelagic species that live in the water column (e.g., anchovies, mackerel, and squid), and 13 highly migratory species including tuna, billfish, and sharks. Three federal Fisheries Management Plans, for Groundfish, Coastal Pelagic Species, and Highly Migratory Species, include areas within the SOCAL Range Complex.

All marine waters in the SOCAL Range Complex offshore to depths of 3,500 meters (m) (1,914 fathoms (fm)) are designated as EFH for Groundfish Managed Species (seamounts out to 200 nautical miles (nm) offshore are also included). EFH for Coastal Pelagic Species includes all marine and estuarine waters above the thermocline from the shoreline to 200 nm offshore. Highly Migratory Species EFH includes all marine waters from the shoreline to 200 nm offshore. Estuaries, sea grass beds, canopy kelp, rocky reefs, and other “areas of interest” (e.g., seamounts, offshore banks, canyons) are designated Groundfish HAPCs. No HAPCs have been adopted for Coastal Pelagic or Highly Migratory Species in the SOCAL Range Complex.

Navy operations in the SOCAL Range Complex involve a wide variety of activities including: tactical reconnaissance and surveillance; attacking surface and subsurface targets; intercepting and engaging aircraft and missiles; suppressing air defenses; conducting electronic attack; interdicting enemy forces and targets; conducting fire support; mine and mine countermeasures exercises; performing search and rescue; and, research, development, testing and evaluation. These exercises utilize fixed-winged aircraft, helicopters, unmanned aerial vehicles, boats and ships, submarines, unmanned surface and underwater vehicles, divers, and amphibious vehicles. Radar, sonar, and lasers are used in the course of these training activities.

The following factors were considered in the analysis of potential impacts: the duration, frequency, intensity, and spatial extent of the impact; the sensitivity/vulnerability of the habitat; habitat functions that might be altered by the impact; and the timing of the impact relative to when Managed Species may use or need the habitat. Adverse effects are defined in EFH guidelines as being more than minimal, not temporary, causing significant change in ecological function, and not allowing the environment to recover without measurable impact.

Impacts to EFH and Managed Species could be associated with vessel movement, aircraft over-flight, expended materials, hazardous chemicals, detonation of explosive ordnance, weapons training, sensor testing, and sonar use. Navy operations could have direct and indirect impacts on individual species, modify their habitat, or alter water quality. The EFH assessment focuses on activities and impacts common to most offshore operations, but also discusses specific types of operations such as Expeditionary Assault, TORPEX, and SINKEX that may have the unique aspects relevant to the EFH Assessment.

Vessel movement and aircraft over-flights would cause brief, reversible disruptions in fish distribution. Fuel spills are unlikely, with any occurrence mitigated through standard spill control responses and wildlife rescue procedures. Discharge from ships would comply with international conventions and have minimal impact.

Potential impacts from expended material (e.g., flares, chaff, dye, torpedo accessories, sunken targets and vessels) could result from exposure to toxic chemicals, through contact with or ingestion of debris, and from entanglement. The small quantity of material expended, the rapid dilution of dissolved constituents, the relatively non-toxic nature of the debris, and its eventual encrustation and incorporation into the sediments would minimize adverse affects on resident marine communities. Bioaccumulation of toxic metals and organic compounds to higher-order food chain species is not expected. Expended material would not significantly disturb the sea floor or compromise habitat components that support feeding, resting, sheltering, reproduction, or migration of Managed Species.

Underwater detonations and weapons training could disrupt habitats, release hazardous chemical by-products, kill or injure marine life, affect hearing organs, modify behavior, mask biologically-relevant sounds, induce stress, and have indirect effects on prey species and other components of the food web. Underwater detonation will not take place within 1,000 m (3,281 ft) of live, hard-bottom habitats, artificial reefs, or shipwrecks. Initial concentrations of explosion by-products are not hazardous to marine life and would not accumulate because training exercises are widely dispersed over time and space. A small number of fish would be killed by shockwaves from explosions or would be injured and could subsequently die or suffer greater rates of predation. Beyond the range of direct, lethal or sub-lethal impacts to fish, minor, short-term behavioral reactions would not be ecologically significant or substantially impact their ability to survive, grow, and reproduce. No lasting adverse effect of underwater detonations or weapons training on prey availability or on the food web is expected.

Most bombs and missiles used in SOCAL Range Complex exercises would not have explosive warheads. The shock force from dummy bombs and missiles hitting the sea surface could result in a limited number of fish kills or injuries, and minor acoustic displacement, but would not substantially affect local species or habitats. Although few fish would be directly struck by naval gun fire, explosive 5-inch gunnery rounds could kill or injure a small proportion of the nearby assemblage. Behavioral reactions of fish would extend over a larger area. However, adverse regional consequences are not anticipated.

Training torpedoes used in the SOCAL EIS/OEIS Range Complex would not have exploding warheads. The physical force marine organisms would be exposed to would be limited to torpedo launch and movement. Due to the small size of torpedo transit areas, the probability of fish strikes would be low. Similar, minimal effects would be expected from training exercises employing Expendable Mobile Acoustic Torpedo Targets and Acoustic Device Countermeasures.

Some fish species may be able to detect mid frequency sonar at the lower end of its range. Short-term behavioral responses such as startle and avoidance may occur, but are not likely to adversely affect indigenous fish communities. Auditory damage from sonar signals is not expected and there is no indication that non-impulsive acoustic sources result in significant fish mortality at the population level.

This assessment concludes that based on the limited extent, duration, and magnitude of potential impacts from SOCAL Range Complex training and testing, and with the mitigation proposed; there would not be adverse effects on EFH or Managed Species. Range operations would not significantly contribute to cumulative impacts on present or future uses of the area.

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Acronyms and Abbreviations

A-A	Air-to-Air
AAMEX	Air-to-Air Missile Exercise
AASBn	Assault Amphibian School Battalion
AAV	Amphibious Assault Vehicle
AAW	Anti-Air Warfare
ACM	Air Combat Maneuvering
ADC	Acoustic Device Countermeasures
ADEX	Air Defense Exercise
ALMDS	Airborne Laser Mine Detection System
AMCM	Airborne Mine Countermeasures
AMNS	Airborne Mine Neutralization System
AMW	Amphibious Warfare
AS	At-Sea
ASROC	Rocket-Assisted Anti-Submarine Torpedo
ASUW	Anti-Surface Warfare
ASW	Anti-Submarine Warfare
ATC	Air Traffic Control
BA	Biological Assessment
BFM	Basic Fighter Maneuvers
BO	Biological Opinion
°C	Degrees Celsius
C3F	Commander, Third Fleet
CAS	Commercial Air Services
CCC	Command Control and Communications
CEQ	Council on Environmental Quality
CFFC	Commander, United States Navy Fleet
CFR	Code of Federal Regulations
CIWS	Close-In Weapon System
CJTFEX	Combined Joint Task Force Exercise
cm	Centimeter
CMLMA	California Marine Life Management Act
CNO	Chief of Naval Operations
COMPACFLT	Commander, Pacific Fleet
COMPTUEX	Composite Training Unit Exercise
CPAAA	Camp Pendleton Amphibious Assault Area
CPAVA	Camp Pendleton Amphibious Vehicle
CPF	Commander, Pacific Fleet
CPS	Coastal Pelagic Species
CRRC	Combat Rubber Raiding Craft
CSAR	Combat Search and Rescue
CSG	Carrier Strike Group
DoD	Department of Defense
DON	Department of the Navy
DoN	Department of the Navy
e.g.	For Example
EA	Environmental Assessment
EC	Electronic Combat
EEZ	Exclusive Economic Zone
EFH	Essential Fish Habitat
EHF	Extremely High Frequency
EIS	Environmental Impact Statement
EMW	Expeditionary Maneuver Warfare
ENETA	Encinitas Naval Electronic Test Area
EO	Executive Order
EOD	Explosive Ordnance Disposal
EPA	Environmental Protection Agency
ESA	Endangered Species Act
ESG	Expeditionary Strike Group
ESGEX	Expeditionary Strike Group Exercise
EW	Electronic Warfare
EX	Exercise
FAA	Federal Aviation Administration
FEIS	Final Environmental Impact Statement
FL	Flight Level
FLEETEX	Fleet Exercise
FLETA	Fleet Training Area
fm	Fathom
FMC	Fisheries Management Council
FMP	Fishery Management Plan
FPT	Fleet Project Team
FRP	Fleet Response Plan
FRTP	Fleet Readiness Training Plan
ft	Foot/Feet
FTS	Fleet Training Strategy
GHz	Gigahertz
GPS	Global Positioning System
GUNEX	Gun Exercise
HAPC	Habitat Areas of Particular Concern
HCOTA	Helicopter Offshore Training Area
HF	High Frequency
HMS	Highly Migratory Species
Hz	Hertz
IEER	Improved Extended Echo Ranging
Sonobuoy	
I MEF	First Marine Expeditionary Force
i.e.	That Is
IPHC	International Pacific Halibut Commission
IOC	Initial Operational Capability
IR	Infra Red
ISE	Independent Steaming Exercise
ISR	Intelligence, Surveillance and Reconnaissance
JFCOM	Joint Forces Command
JNTC	Joint National Training Capability
JSF	Joint Strike Fighter
JTFEX	Joint Task Force Exercise
KB(X)	Kernel Blitz Experimental
kg	Kilogram
KHz	Kilohertz
km	Kilometer
km^2	Square Kilometers
kt	Knot
lb	Pound
LCAC	Landing Craft Air Cushion
LCS	Littoral Combat Ship
LMRS	Long-Term Mine Reconnaissance System
m	Meter
m^2	Square Meter
MARFORPAC	Marine Forces Pacific
MCM	Mine Countermeasures
MCT	Marine Corps Training
MCTL	Marine Corps Task List
MEU	Marine Expeditionary Unit
mi	Mile
min	Minute
MINEX	Mine Warfare Exercise
MISR	Missile Range
MISSILEX	Missile Exercise
MIW	Mine Warfare

mm	Millimeter
MMPA	Marine Mammal Protection Act
MOA	Military Operating Area
Mph	Mile Per Hour
MPRSA	Marine Protection Research & Sanctuaries Act
MSFCMA	Magnuson-Stevens Fishery Conservation and Management Act
msl	Mean Sea Level
N	North
N.E.W.	Net Explosive Weight
NAOPA	Northern Air Operating Area
NAS	Naval Air Station
NBC	Naval Base Coronado
NEPA	National Environmental Policy Act
nm	Nautical Mile
nm	Nautical Miles
nm^2	Square Nautical Miles
NMFS	National Marine Fisheries Service
NMSA	National Marine Sanctuaries Act
NOAA	National Oceanic & Atmospheric Administration
NSFS	Naval Surface Fire Support
NSW	Naval Special Warfare
NTTL	Navy Tactical Task List
OAMCM	Organic Airborne Mine Countermeasures
OCS	Outer Continental Shelf
OEA	Overseas Environmental Assessment
OEIS	Overseas Environmental Impact Statement
^{o}F	Degrees Fahrenheit
OMCM	Organic Mine Countermeasures
OPAREA	Operating Area
OPFOR	Opposition Force
Ops	Operations
PFMC	Pacific Fisheries Management Council
PACFIRE	Pre-Action Calibration Firing Planning
PTS	Permanent Threshold Shift
R&D	Research and Development
RAMICS	Rapid Airborne Mine Clearance System
RCMP	Range Complex Management Plan
RDT&E	Research, Development, Test and Evaluation
RF	Radio Frequency
RHIB	Rigid Hull Inflatable Boat
RTE	Routine Training Exercise
RTS	Remote Training Site
S-A	Surface-to-Air
SBTA	San Diego Bay Training Area
SCB	Southern California Bight
SCI	San Clemente Island
SFA	Sustainable Fisheries Act
SHOBA	Shore Bombardment Area
SINKEX	Sinking Exercise
SMCM	Surface Mine Countermeasures
SMZ	Special Management Zone
SOA	Sustained Operations Ashore
SOCAL	Southern California
SPCOA	San Pedro Channel Operating Area
S-S	Surface-to-Surface
STW	Strike Warfare
SUA	Special Use Airspace
SUW	Surface Warfare
T&E	Testing & Evaluation
TAP	Tactical Training Theater Assessment and Planning
TLAM	Tomahawk Land Attack Missile
TNT	Trinitrotoluene
TORPEX	Torpedo Exercise
TRACKEX	Tracking Exercise
TTS	Temporary Threshold Shift
UNDET	Underwater Detonation
U.S.	United States of America
U.S.C.	U.S. Code
UHF	Ultra High Frequency
UNDET	Underwater Detonation
USC	United States Code
USEPA	U.S. Environmental Protection Agency
USFWS	U.S. Fish and Wildlife Service
USS	United States Ship
USW	Undersea Warfare
UUV	Unmanned undersea vehicle
VAST/IMPASS	Virtual At-Sea Training/Integrated
VHF	Very High Frequency
W	West
WSCOA	Western San Clemente Island
	Planning

1 INTRODUCTION

This assessment of the impact of United States (U.S.) Navy activities in the Southern California (SOCAL) Range Complex on "Essential Fish Habitat" (EFH) covers the regulatory background, project area, environmental setting, Fishery Management Plans and Managed Species, designated EFH in the SOCAL Range Complex, proposed actions, project impacts, mitigation measures, and cumulative impacts. The Environmental Impact Statement (EIS)/Overseas Environmental Impact Statement (OEIS) to which this EFH Assessment is appended details Navy operations in the SOCAL Range Complex, describes the existing environment for marine biology and fish, and discusses potential environmental effects associated with ongoing and proposed naval activities. The Marine Resources Assessment prepared for the Southern California Operating Area (DON 2005a) also contains comprehensive descriptions of the ocean environment including: climate; marine geology; physical, chemical, and biological oceanography; marine biology; marine habitats; and protected species in the project area.

This assessment uses the term "fish" to include both cartilaginous species - sharks, skates, and rays - and bony species. Cartilaginous fish, as the name implies, have a skeleton of cartilage, which is partially calcified, but is not true bone. Bony fish also have cartilage, but their skeletons consist of calcified bone.

1.2 REGULATORY SETTING

1.2.1 The Magnuson-Stevens Fishery Conservation and Management Act

The Magnuson-Stevens Fishery Conservation and Management Act (MSFCMA) of 1976 (16 United States Code [U.S.C.] § 1801 *et seq.*) established jurisdiction over marine fishery resources in the 200-nautical mile (nm) (370-kilometer (km)) U.S. Exclusive Economic Zone (EEZ). The MSFCMA was reauthorized and amended by the Sustainable Fisheries Act (SFA) of 1996 (Public Law 104-297) which provided a new habitat conservation tool: the Essential Fish Habitat mandate. The SFA requires that regional Fishery Management Councils (FMCs) prepare Fishery Management Plans (FMPs) identifying EFH for federally "Managed Species". Managed Species are species covered under FMPs.

Congress defined EFH as "those waters and substrate necessary to fish for spawning, breeding, feeding, or growth to maturity" (16 U.S.C. § 1802(10)). The term "fish" is defined in the SFA as "finfish, mollusks, crustaceans, and all other forms of marine animals and plant life other than marine mammals and birds". The National Marine Fisheries Service (NMFS) in 2002 further clarified EFH with the following definitions (50 Code of Federal Regulations [C.F.R.] §§ 600.05–600.930):

- "Waters" include all aquatic areas and their associated biological, chemical, and physical properties that are used by fish and may include aquatic areas historically used by fish where appropriate.
- "Substrate" includes sediment, hard bottom, structures underlying the waters, and associated biological communities.
- "Necessary" means the habitat required to support a sustainable fishery and the Managed Species' contribution to a healthy ecosystem; and "Spawning, breeding, feeding, or growth to maturity" covers a species' full life cycle" (NMFS 2002a).

The SFA requires that EFH be identified and mapped for each federally Managed Species (NMFS 2007a). The NMFS and regional FMCs determine the species distributions by life stage and characterize associated habitats, including Habitat Areas of Particular Concern (HAPC). HAPCs are discrete areas within EFH that either play especially important ecological roles in the life cycles of Managed Species or are especially vulnerable to degradation from human-induced activities (50 CFR 600.815[a][8]). The SFA requires federal agencies to consult with the NMFS on activities that may adversely affect EFH. For actions that affect a threatened or endangered species, or its critical habitat, and its EFH, federal agencies must integrate Endangered Species Act (ESA) and EFH consultations.

An Essential Fish Habitat Assessment is a critical review of the proposed project and its potential impacts to EFH (NMFS 2004a,b). As set forth in the rules (50 C.F.R. § 600.920(e)(3)), EFH Assessments must include: (1) a description of the proposed action; (2) an analysis of the effects, including cumulative effects, of the action on EFH, and Managed Species; (3) the federal agency's views regarding the effects of the action on EFH; and (4) proposed mitigation, if applicable. Once the NMFS learns of a federal or state activity that may have adverse effects on designated EFH, the NMFS is required to develop EFH consultation recommendations for the activity. These recommendations may include measures to avoid, minimize, mitigate, or otherwise offset adverse effects on EFH (NMFS 2002a).

1.3 PROJECT AREA

1.3.1 SOCAL Range Complex

The SOCAL Range Complex consists of three primary components: ocean operating areas, special use airspace, and San Clemente Island. The SOCAL Range Complex is geographically situated between Dana Point and San Diego, and extends more than 600 nm southwest into the Pacific Ocean (Figures 1-1 and 1-2). The SOCAL Range Complex encompass 120,000 nm^2 of sea space, 113,000 nm^2 of special use airspace (SUA), and over 42 nm^2 of land area (San Clemente Island). The ocean areas of the SOCAL Range Complex include surface and subsurface operating areas extending generally southwest from the coastline of southern California between Dana Point and San Diego for a distance of approximately 600 nm into international waters west of the coast of Baja California, Mexico. The SOCAL Range Complex includes military airspace designated as Warning Area 291, or W-291. W-291 comprises 113,057 nm^2 of SUA that generally overlays the SOCAL ocean operating areas (OPAREAS) and San Clemente Island, extending seaward to the southwest beginning approximately 12 nm off the coast for a distance of approximately 600 nm. W-291 is the largest component of SUA in the Navy range inventory. San Clemente Island includes a Shore Bombardment Area (SHOBA), landing beaches, several live-fire areas and ranges for small arms, maneuvers, and other types of training.

Figure 1-1: SOCAL EIS/ORange Complex

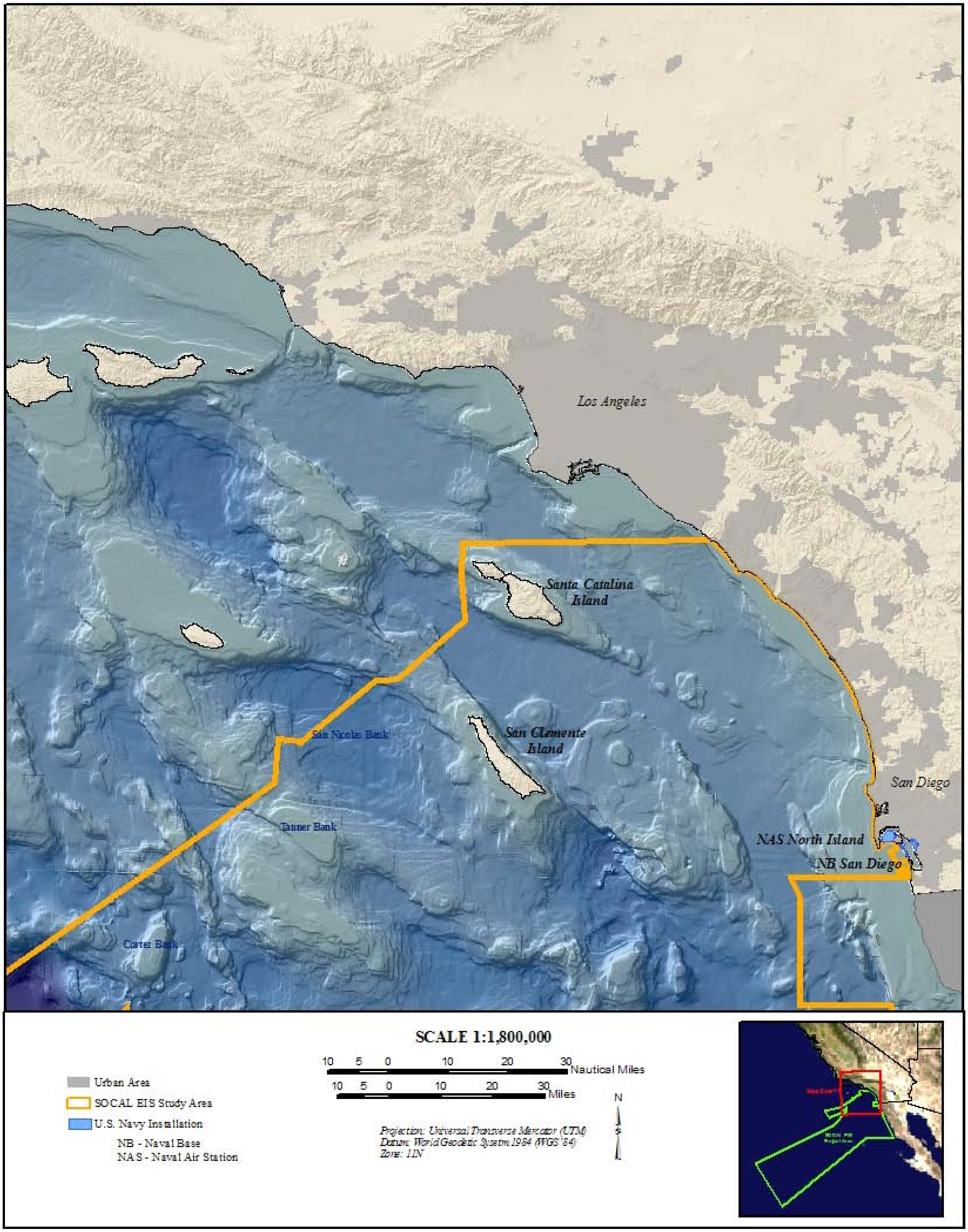

Figure 1-2.: Northern Portion of the SOCAL Range Complex Bathymetry and Topography

1.4 ENVIRONMENTAL SETTING

An indentation of California's coastline south of Point Conception creates a broad ocean embayment known as the Southern California Bight (SCB). The SCB encompasses the area from Point Conception south to Mexico, including the offshore Channel Islands, and is influenced by two major oceanic currents: the southward-flowing, cold-water California Current and the northward-flowing, warm-water California Countercurrent (DON 2005a, Perry 2007). These currents mix in the SCB and strongly influence patterns of ocean water circulation, sea temperatures, and distributional trends of marine flora and fauna assemblages along the southern California coast and Channel Islands (Folley *et al.* 1993).

The SOCAL Range Complex is situated in a region of diverse ichthyofauna. High species richness is a product of the region's complex oceanographic topography and the convergence of multiple, influential water masses (Cross and Allen 1993, DON 2005a). The SCB is home to over 480 species of marine fish and more than 5,000 species of marine invertebrates (Cross and Allen 1993, Schiff *et al.* 2000, Allen *et al.* 2006). The diversity of species, fish and invertebrates, is greatest in southern California and declines as one moves north through the region (Horn and Allen 1978, Horn et al. 2006). The study area is located within a transitional zone between subarctic and subtropical water masses. Specifically, Point Conception, California (34.5ºN) is the distinguished ichthyofaunal boundary between subtropical species (i.e., species with preferences of temperatures above 10º to 20ºC) of the San Diego Province and temperate fish species (*i.e.*, species with temperature preferences below 15ºC) of the Oregon Province (Horn and Allen 1978, Froese and Pauly 2004, Horn *et al.* 2006).

The California Current system is rich in microscopic organisms (i.e., diatoms, tintinnids, and dinoflagellates) which form the base of the food chain in the area (DON 2005a). Small coastal pelagic fish and squid depend on this planktonic food supply and in turn are fed upon by larger species. Groundfish (e.g., flatfish, roundfish, skates/sharks/chimeras, rockfish, etc.) are important recreational and commercial species (Love 2006). The shelf and slope demersal rockfish are the most specious genus of fish off the western coast of North America (Love *et al.* 2000). These fish are typically the dominant species documented in many ichthyological surveys, in terms of abundance and diversity, especially between the 20 to 200 m isobaths (Mearns *et al.* 1980). Highly Migratory Species (HMS) (*e.g.*, tuna, billfish, sharks, dolphinfish, and swordfish) and Coastal Pelagic Species (CPS) (e.g., anchovies, mackerels, sardines, and squids) support extensive fisheries in the area (Allen and Cross 2006).

The diverse habitats of the SCB greatly influence the distribution of fish and invertebrates in the area (Horn *et al.* 2006). Cross and Allen (1993) defined these habitats in three broad categories: the pelagic zone, soft substrate habitats (i.e., bays, estuaries, open coast), and hard substrate and kelp bed habitats (*i.e.*, rocky habitats, reefs). The pelagic zone, relating to open water, is the largest habitat in the area with 40% of the fish species inhabiting this area. This zone is subdivided into three distinct regions: epipelagic (up to 50 m deep), mesopelagic (50 to 500 m deep), and bathypelagic regions (greater than 500 m deep) (Cross and Allen 1993). The epipelagic region is inhabited by small, planktivorous schooling fish (*e.g.*, northern anchovy), predatory schooling fish (*e.g.*, Pacific mackerel), and large solitary predators (*e.g.*, blue shark). Abundance of all epipelagic species changes seasonally with fish moving offshore to spawn. The northern anchovy is the most abundant epipelagic species in the study area. The mesopelagic region is characterized by steep environmental gradients and fish that are small, slow growing, long-lived, and reproduce early and repeatedly (*e.g.*, bigeye lightfish). The bathypelagic zone is a rather uniform system containing large, sluggish, fast growing, short-lived fish, that reproduce late and typically only once (*e.g.*, bigscale and hatchetfish) (Cross and Allen 1993).

Typical fish utilizing soft substrates (sand, silt, and mud) include sharks, skates, rays, smelts, flatfish (flounders), gobies and northern anchovies (Pondella and Allen 2000). Regions with hard substrates and kelp beds (*Macrocystis*) are not as abundant as other benthic habitats in the SCB, but they nevertheless provide important habitats for many species. Shallow reefs (*i.e.*, <30 m depth) are the most common type of hard substrate (*i.e.*, coarse sand, calcareous organic debris, rocks) found in the study area (Cross and

Allen 1993, DON 2005a). These reefs also support kelp beds, which provide nursery areas for various fish species. Rocky intertidal regions are often turbulent, dynamic environments, where organisms must cope with stresses associated with tides (*e.g.*, changes in temperature, salinity, oxygen, and pH). Deep reef fish, found along deep banks and seamounts, are typically large, mobile species (*e.g*., rockfish and spiny dogfish). Kelp beds are regions with a high diversity of fish species. Smaller fish feed on high plankton densities in the area, while larger fish are attracted to these habitats to feed on smaller species. They are especially important habitats for young-of-the-year rockfish species, such as the kelp rockfish, whose densities correlate to the size of the kelp bed (McCain 2003).

Inshore areas (bays and estuaries) provide important nursery habitats and feeding grounds to a variety of species, some of commercial importance (e.g., California halibut) (Allen et al. 2002). San Diego Bay's seagrass beds are used by schooling species, such as anchovies and topsmelt (Cross and Allen 1993) with the highest abundance and biomass of fish occurring in the spring (i.e., April) and summer (i.e., July) (Allen et al. 2002). Juvenile northern anchovy, topsmelt, and slough anchovy comprise up to 79% of the fish in the Bay (Allen et al. 2002).

The influence of the California Current on the physical and biological environment of the SCB undergoes significant year-to-year fluctuations (Horn and Stephens 2006). Its impact is also affected by larger-scale climate variations, such as El Niño-La Niña and the Pacific Decadal Oscillation (PDO) (Hickey 1993). El Niño-La Niña (also called the El Niño Southern Oscillation (ENSO)) is the result of interannual changes in sea level pressures between the eastern and western hemispheres of the tropical Pacific; these events can initiate large shifts in the global climate, atmospheric circulation, and oceanographic processes (NOAA 2007a). ENSO conditions typically last 6 to 18 months although they can persist for longer periods of time. They are the main signs of global change over time scales of months to years (Benjamin and Carlton 1999, Schwing et al. 2002). Under normal conditions, rainfall is low in the eastern Pacific and is high over the warm waters of the western Pacific. El Niño conditions occur when unusually high atmospheric pressure develops over the western tropical Pacific and Indian Oceans and low sea level pressure develop in the southeastern Pacific. During El Niño conditions, the trade winds weaken in the central and west Pacific; thus, the normal east to west surface water transport and upwelling along South America decreases. This results in increased (sometimes extreme) rainfall across the southern U.S. and Peru and drought conditions in the western Pacific (NOAA 2007a). La Niña is the opposite phase of El Niño in the Southern Oscillation cycle. La Niña is characterized by strong trade winds that push the warm surface waters back across to the western Pacific increasing upwelling along the eastern Pacific coastline, causing unusually cold sea surface temperatures. The PDO is a longer-term climatic pattern than ENSO with similar warm and cool phases that may persist for 20 to 30 years (Miller 1996, Benjamin and Carton 1999).

During years experiencing an El Niño event, tropical species (i.e., species with temperature preferences above 20ºC) begin to migrate into the study area, while temperate species, which normally inhabit the area, move north and out of the region (Froese and Pauly 2004). For example, two tropical species, the Mexican barracuda and scalloped hammerhead shark, were recorded off southern California for the first time during the 1997/1998 El Niño event (Moser et al. 2000). Rockfish are particularly sensitive to El Niño, with these events resulting in recruitment failure and adults demonstrating reduced growth, ultimately a decline in biomass is exhibited and poor overall condition in the region becomes evident. Landings of market squid were dramatically decreased during the 1997/1998 El Niño event (Hayward 2000).

Past La Niña events have not had such a dramatic impact on ichthyofauna and marine invertebrate populations as El Niño events. Nevertheless, La Niña years can result in below normal recruitment for many invertebrate species (e.g., rock crabs), and larval rockfish abundance has been reportedly low during years experiencing La Niña events (Lundquist et al. 2000). Cooling trend years (i.e., 1999 La Niña event) can result in increased abundance and commercial landing of herring, anchovies, and squid populations (Hayward 2000; Lluch-Belda et al. 2003).

1.5 FISHERIES MANAGEMENT PLANS

Under the MSFCMA, the federal government has jurisdiction to manage fisheries in the U. S. EEZ which extends from the outer boundary of state waters (3 nm (5.6 km) from shore) to a distance of 200 nm (370 km) from shore. Offshore fisheries in the SOCAL Range Complex are managed by NMFS with assistance from the Pacific Fisheries Management Council (PFMC) (PFMC 2007a), and the Southwest Fisheries Science Center (National Oceanic and Fisheries Administration (NOAA)) (NOAA 2007b,c). Inshore fisheries (less than 3 nm (5.6 km) from shore) are managed by the California Department of Fish and Game (CDFG) (CDFG 2007a). However, in practice, state and federal fisheries agencies manage fisheries cooperatively and FMPs generally cover the area from coastal estuaries out to 200 nm (370 km) offshore.

Fishery Management Plans are extensive documents that are constantly revised and updated. The Pacific Coast Groundfish Fishery Management Plan, for example, originally produced in 1977, has been amended 19 times (PFMC 2006a). FMPs describe the nature, status, and history of the fishery, and, specify management recommendations, yields, quotas, regulations, and harvest guidelines. Associated Environmental Impact Statements (EISs) addresses the biological and socioeconomic consequences of management policies. Fishery Management Councils have web sites that present the various elements of their FMPs, current standards and regulations, committee hearings and decisions, research reports, source documents, and links to related sites (see, for example, PFMC 2007a). Recent coverage of the ecology of marine fish, fisheries and marine environmental issues in California is presented in reviews by Allen 2006, Allen, Pondella and Horn 2006, Allen and Cross 2006, Horn and Stephens 2006, Horn et al. 2006, and Love 2006.

Fishery Management Plans covering the SOCAL Range Complex include; Pacific Groundfish (GF) (83 species), Coastal Pelagic Species (CPS) complex (6 species), and Highly Migratory Species (HMS) (13 species) (Table 1-1, 1-2, 1-3). The Pacific halibut (*Hippoglossus stenolepis*), a flat groundfish, is regulated by the United States and Canada through a bilateral commission, the International Pacific Halibut Commission (IPHC) (IPHC 2007) and is therefore not in a federal FMP. The usual range of Pacific halibut is from Santa Barbara, CA to Nome, Alaska and it would not usually be found in the study area.

Table 1-1. Groundfish Management Plan Species

Groundfish Management Plan Species http://www.pcouncil.org/groundfish/gffmp.html
Flatfish
Arrowtooth flounder *(Atheresthes stomias)*
Butter sole *(Isopsetta isolepis)*
Curlfin sole (*Pleuronichthys decurrens*)
Dover sole (*Microstomus pacificus*)
English sole (*Parophrys vetulus*)
Flathead sole *(Hippoglossoides elassodon)*
Pacific sanddab (*Citharichthys sordidus*)
Petrale sole (*Eopsetta jordani*)
Rex sole (*Glyptocephalus zachirus*)
Rock sole (*Lepidopsetta bilineata*)
Sand sole (*Psettichthys melanostictus*)
Starry flounder (*Platichthys stellatus*)
Rockfish
Aurora rockfish (*Sebastes aurora*)
Bank rockfish (*Sebastes rufus*)
Black rockfish (*Sebastes melanops*)
Black-and-yellow rockfish (*S. chrysomelas*)
Blackgill rockfish (*Sebastes melanostomus*)
Blue rockfish (*Sebastes mystinus*)
Bocaccio (*Sebastes paucispinis*)
Bronzespotted rockfish (*Sebastes gilli*)
Brown rockfish (*Sebastes auriculatus*)
Calico rockfish (*Sebastes dallii*)
Canary rockfish (*Sebastes pinniger*)
Chameleon rockfish (*Sebastes phillipei*)
Chilipepper (*Sebastes goodei*)
China rockfish (*Sebastes nebulosus)*
Copper rockfish (*Sebastes caurinus*)
Cowcod (*Sebastes levis*)
Darkblotched rockfish (*Sebastes crameri*)
Dusky rockfish (*Sebastes ciliatus*)
Dwarf-red rockfish (*Sebastes rufinanus*)
Flag rockfish (*Sebastes rubrivinctus*)
Freckled rockfish (*Sebastes lentiginosus*)
Gopher rockfish (*Sebastes carnatus*)
Grass rockfish (*Sebastes rastrelliger*)

Greenblotched rockfish (*Sebastes rosenblatti*)
Greenspotted rockfish (*Sebastes chlorostictus*)
Squarespot rockfish (*Sebastes hopkinsi*)
Starry rockfish (*Sebastes constellatus*)
Stripetail rockfish (*Sebastes saxicola*)
Swordspine rockfish (*Sebastes ensifer*)
Tiger rockfish (*Sebastes nigrocinctus*)
Treefish (*Sebastes serriceps*)
Vermillion rockfish (*Sebastes miniatus*)
Widow rockfish (*Sebastes entomelas*)
Yelloweye rockfish (*Sebastes ruberrimus*)
Yellowmouth rockfish (*Sebastes reedi*)
Yellowtail rockfish (*Sebastes flavidus*)

Scorpionfish

Ca. scorpionfish (*Scorpaena guttatta*)

Thorneyheads

Longspine thornyhead (*Sebastolobus altivelis*)
Shortspine thornyhead (*S. alascanus*)

Roundfish

Cabezon (*Scorpaenichthvs marmoratus*)
Kelp greenling (*Hexagrammos decagrammus*)
Lingcod (*Opiodon elongatus*)
Pacific cod (*Gadus macrocephalus*)
Pacific hake (*Merluccius productus*)
Sablefish (*Anoplopoma fimbria*)

Skates, Sharks and Chimeras

Big skate (*Raja binoculata*)
California skate (*Raja inornata*)
Finescale codling (*Antimora microlepis)*
Leopard shark (*Triakis semifasciata*)
Longnose skate (*Raja rhina*)
Pacific rattail (*Coryphaenoides acrolepis)*
Soupfin shark (*Galeorhinus zyopterus*)
Spiny dogfish (*Squalus acanthias*)
Spotted ratfish (*Hydrolagus colliei*)

Source: NMFS 2005a, PFMC 2006a.

Table 1-2: Coastal Pelagic Management Plan Species

Coastal Pelagic Management Plan Species http://www.pcouncil.org/cps/cpsfmp.html
Jack mackerel (*Traxchurus symmetricus*) Krill (euphausiids) Pacific mackerel (*Scomber japonicus*) Pacific sardine(*Sardinops sagax*) Market squid (*Loligo opalescens*) Northern anchovy (*Engraulis mordax*)
Source: PFMC 2003, 2005.

Table 1-3: Highly Migratory Management Plan Species

Highly Migratory Management Plan Species http://www.pcouncil.org/hms/hmsfmp.html
Sharks Bigeye thresher shark (*Alopias superciliosus*) Blue shark (*Prionace glauca*) Common thresher shark (*Alopias vulpinus*) Pelagic thresher shark (*Alopias pelagicus*) Shortfin mako shark (*Isurus oxyrinchus*) **Tunas** Albacore tuna (*Thunnus alalunga*) Bigeye tuna (*Thunnus obesus*) Northern bluefin tuna (*Thunnus orientalis*) Skipjack tuna (*Katsuwonus pelamis*) Yellowfin tuna (*Thunnus albacares*) **Billfish** Striped marlin (*Tetrapturus audax*) **Swordfish** Broadbill swordfish (*Xiphias gladius*) **Dolphin-fish** Dorado (mahi mahi) (*Coryphaena hippurus*)
Source: PFMC 2006b

1.6 ESSENTIAL FISH HABITAT DESCRIPTIONS AND IDENTIFICATIONS

The NMFS and the PFMC designate Essential Fish Habitat and develop Fishery Management Plans for all fisheries occurring within the boundary of the EEZ in the SCB from Point Conception to the U.S./Mexico border. The MSFCMA, as amended by the SFA, contains provisions for the identifying and protecting habitat essential to federally Managed Species. The FMPs identify EFH, describe EFH impacts (fishing and non-fishing), and suggest measures to conserve and enhance EFH. The FMPs also designate HAPCs where one or more of the following criteria are demonstrated: (a) important ecological function; (b) sensitivity to human-induced environmental degradation; (c) development activities stressing the habitat type; or (d) rarity of habitat.

With respect to EFH, nearshore areas are considered to be shallower than 120 ft (36 m) with offshore areas beyond that depth. The continental shelf is considered to begin at the 656 ft (200 m) contour (Figure 1-3). EFH/HAPC designations and detailed life histories, habitat preferences, and distribution maps for each Managed Species are included in the Marine Resources Assessment for the Southern California Operating Area (DON 2005a).

Groundfish species are bottom dwelling finfish. More than 80 species of marine fish are included under the Pacific Coast Groundfish FMP that was adopted by the PFMC in 1982 (PFMC, 2006a). In general, the FMP provides for management of bottom dwelling finfish species (including all rockfish and whiting) that are found in U.S. waters off Washington, Oregon, and California. Of these, fewer than 20 of the commercially and recreationally most important have ever been comprehensively assessed. Groundfish management is complicated and demanding because fisheries for many of the species are interrelated, but the various stocks have responded differently to fishing pressure. For example, flat fish populations such as Dover, Petrale, and English soles have been subjected to significant commercial fisheries for decades yet have not shown the magnitude of declines that have occurred in other rockfish populations. The current status of many rockfish and lingcod off the West Coast is poor, and significant changes in the groundfish fishery have been necessary to address this situation. In response to the sharp decline in groundfish landings and the generally poor condition of West Coast groundfish stocks, the Secretary of Commerce formally announced a disaster determination for the fishery in January 2000 (NOAA 2000).

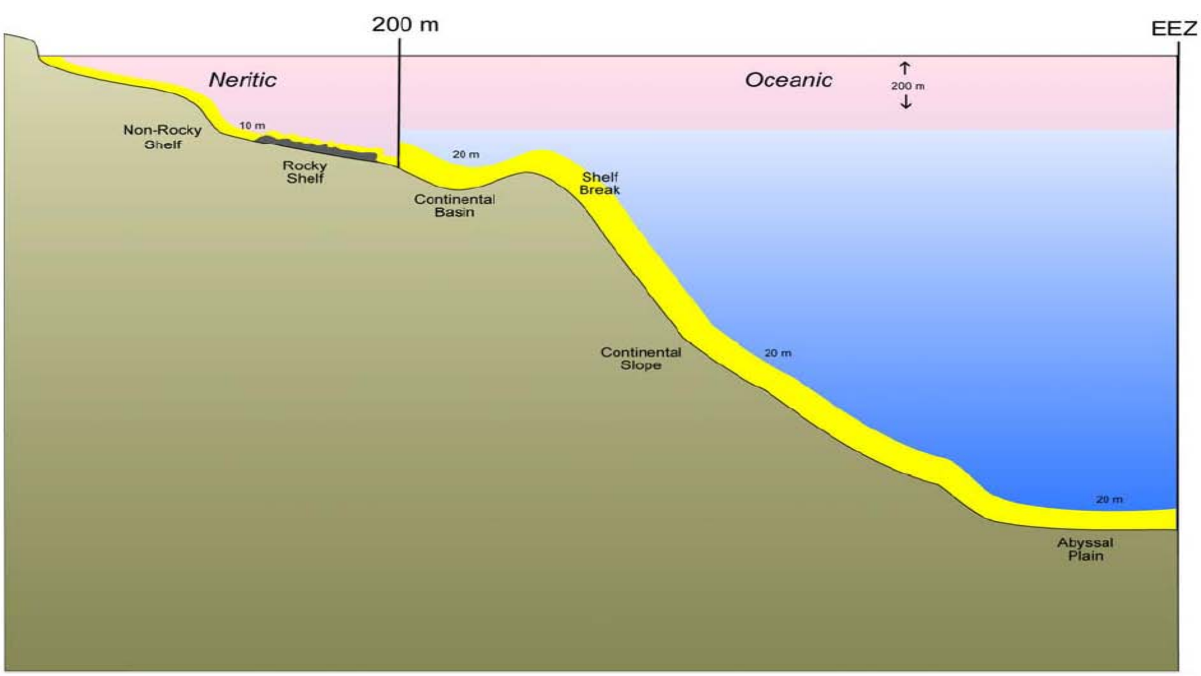

Figure 1-3. Continental Shelf Biological Zones (from SOCAL MRA)

The Pacific Groundfish FMP divides EFH into seven composite habitats including their waters, substrates, and biological communities: 1) estuaries - coastal bays and lagoons, 2) rocky shelf - on or within 10 m (33 ft) of rocky bottom (excluding canyons) from the high tide line to the continental shelf break, 3) nonrocky shelf - on or within 10 m (33 ft) of unconsolidated bottom (excluding the rocky shelf and canyons) from the high tide line to the continental shelf break, 4) canyon - submarine canyons, 5) continental slope/basin - on or within 20 m (66 ft) of the bottom of the continental slope and basin below the shelf break extending to the westward boundary of the EEZ, 6) neritic zone - the water column more than 10 m (33 ft) above the continental shelf, and 7) oceanic zone - the water column more than 20 m (66 ft) above the continental slope and abyssal plain, extending to the westward boundary of the EEZ (PFMC 2006a).

The groundfish species managed by the Pacific Groundfish FMP range throughout the EEZ and occupy diverse habitats at all stages in their life histories (Table 1-4). Some species are broadly dispersed during specific life stages, especially those with pelagic eggs and larvae. The distribution of other species and/or life stages may be relatively limited, as with adults of many nearshore rockfish which show strong affinities to a particular location or substrate type.

Table 1-4: Groundfish Species Essential Fish Habitat

Pacific Groundfish Species EFH and Lifestages Associated With the Seven EFH Designations. A = Adults, SA = Spawning Adults, MA = Mating Adults, LJ = Large Juveniles, SJ = Small Juveniles, J = Juveniles, L = Larvae, E = Eggs, P = Parturition (PFMC 2006a). * =Associated with macrophytes, algae, or seagrass. (from DON 2005a).							
Group/Species	Estuarine	Rocky Shelf	Non-Rocky Shelf	Neritic	Canyon	Continent Slope/ Basin	Ocean
Flatfish							
Curlfin Sole			A, SA	E		A, SA	E
Dover Sole			A, SA, J	L, E		A, SA, J	L, E
English Sole	A*, SA, J*, L*, E	A*, SA, J*	A*,SA, J*	L*, E		A*	
Petrale Sole			A, J	L, E		A, SA	L, E
Rex Sole	A		A, SA	E		A, SA	L, E
Rock Sole		A*, SA*, J*, E*	A*, SA*, J*, E*	L		A*, SA*, J*, E*	
Sand Sole			A, SA, J	L, E			
Pacific Sanddab	J, L, E		A*, SA, J	L, E			L, E
Rockfish							
Aurora Rockfish			A, MA, LJ			A, MA, LJ	L
Bank Rockfish		A, J	A, J		A, J	A, J	
Black Rockfish	A*, SJ*	LJ*	LJ*	A*, SJ*			A*
Black-and-yellow		A*, MA,		L*			

Pacific Groundfish Species EFH and Lifestages Associated With the Seven EFH Designations.

A = Adults, SA = Spawning Adults, MA = Mating Adults, LJ = Large Juveniles, SJ = Small Juveniles, J = Juveniles, L = Larvae, E = Eggs, P = Parturition (PFMC 2006a). * =Associated with macrophytes, algae, or seagrass. (from DON 2005a).

Rockfish		LJ*, SJ*, P					
Blackgill Rockfish		LJ		SJ, L		A, LJ	S, LJ
Blue Rockfish		A*, MA, LJ*	LJ*	SJ*,L			
Bocaccio	SJ*, L	A*, LJ*	A*, LJ*	SJ*, L	LJ*	A*, LJ*	
Bronzespotted Rockfish						A	
Brown Rockfish	A*, MA, J*, P	A*, MA, J*, P					
Calico Rockfish	A, J	A, J	A, J				
Canary Rockfish		A, P		SJ*, L		A, P	SJ*, L
Chilipepper		A, LJ, P	A, LJ, P	SJ*, L		A, LJ, P	
China Rockfish		A, J, P		L			
Copper Rockfish	A*, LJ*, SJ*, P	A*, LJ*		SJ*, P			
Cowcod		A, J	J	L			
Darkblotched Rockfish		A, MA, LJ, P	A, MA, LJ, P			A, MA, P	SJ, L
Flag Rockfish		A, P					
Gopher Rockfish		A*, MA, J*, P	A*, A, J*, P				
Grass Rockfish		A*, J*, P					
Greenblotched Rockfish		A, J, P	A, J, P		A, J, P	A, P	
Greenspotted Rockfish		A, J, P	A, J, P				
Greenstriped Rockfish		A, P	A, P				
Honeycomb Rockfish		A, J, P			J		
Kelp Rockfish	SJ*	A*, LJ*,P		SJ*			
Mexican Rockfish		A	A	L			L
Olive Rockfish		A*, J*, P			A*, P		
Pacific Ocean Perch		A, LJ	A, LJ	SJ	A	A, P	SJ, L
Pink Rockfish		A	A			A	
Redbanded Rockfish			A			A	
Redstripe Rockfish		A, P				A, P	
Rosethorn Rockfish		A, P	A, P			A, P	
Rosy Rockfish		A, J, P					
Rougheye Rockfish		A	A			A	
Sharpchin Rockfish		A, P	A, P			A, P	L

Pacific Groundfish Species EFH and Lifestages Associated With the Seven EFH Designations.

A = Adults, SA = Spawning Adults, MA = Mating Adults, LJ = Large Juveniles, SJ = Small Juveniles, J = Juveniles, L = Larvae, E = Eggs, P = Parturition (PFMC 2006a). * =Associated with macrophytes, algae, or seagrass. (from DON 2005a).

Shortbelly Rockfish		A*, P	A*, P		A*, P	A*, P	
Silverygray Rockfish		A*	A*			A*	
Speckled Rockfish		A, J, P			A, P	A, P	
Splitnose Rockfish			A,J*, P			A, P	
Squarespot Rockfish		A, P			A, P		
Starry Rockfish		A, P				A, P	
Stripetail Rockfish			A, P			A, P	
Tiger Rockfish		A				A	
Treefish		A					
Vermilion Rockfish		A, J*	J*		A	A	
Widow Rockfish		A, MA, LJ,P	A, MA, LJ, P	SJ*, L	A, MA, LJ, P	A, MA, P	SJ*, L
Yelloweye Rockfish		A, P				A, P	
Yellowtail Rockfish		A, MA, LJ, P	A, MA, LJ, P	SJ*		A, MA, P	SJ*
Scorpionfish							
California Scorpionfish	E	A, SA, J	A, SA, J	E			
Thornyheads							
Longspine Thornyhead						A, SA, J	L, E
Shortspine Thornyhead			A			A, SA	L, E
Roundfish							
Cabezon	A, SA, LJ, SJ*, L, E	A, SA, LJ, E		SJ*, L			SJ*, L
Kelp Greenling	A*, SA, LJ*, SJ*, L, E	A*, SA, LJ*, E		SJ*, L			SJ*, L
Lingcod	A*, SA, LJ*, SJ*, L, E	A*, SA, LJ*, E	A*, LJ*	SJ*, L		A*	
Pacific Cod	A, SA, J, L, E		A, SA, J, E	A, SA, J, L		A, SA, E	A, SA, J, L
Pacific Hake (Whiting)	A, SA, J, L, E			A, SA, J, L, E			A, SA, L, E
Pacific Flatnose					A	A	
Pacific Grenadier			A, SA, J			A, SA, J	L

Pacific Groundfish Species EFH and Lifestages Associated With the Seven EFH Designations. A = Adults, SA = Spawning Adults, MA = Mating Adults, LJ = Large Juveniles, SJ = Small Juveniles, J = Juveniles, L = Larvae, E = Eggs, P = Parturition (PFMC 2006a). * =Associated with macrophytes, algae, or seagrass. (from DON 2005a).							
Sablefish	SJ	A	A, LJ	SJ, L	A, LJ	A, SA	SJ, L, E
Skates/Sharks/Chimeras							
Big Skate			A, MA, J, E			A, MA	
California Skate	A, MA, J, E		A, MA, J, E			A, MA, J, E	
Longnose Skate			A, MA, J, E			A, MA, J, E	
Leopard Shark	A, MA, J, P	A, MA, J, P	A, MA, J, P	A, MA, J, P			
Soupfin Shark	A, MA, J, P	A, MA, J	A, MA, J, P	A, MA, J, P	A, MA, J		A, MA, J
Spiny Dogfish	A, LJ, SJ, P	A, MA, LJ	A, LJ, P	A, LJ, SJ	A	A, MA	A
Spotted Ratfish	A, MA, J	A, MA, J, E	A, MA, J, E			A, MA, J, E	
A = Adults, SA = Spawning Adults, MA = Mating Adults, LJ = Large Juveniles, SJ = Small Juveniles, J = Juveniles, L = Larvae, E = Eggs, P = Parturition (PFMC 2006a). * =Associated with macrophytes, algae, or seagrass. (from DON 2005a).							

The Groundfish Management Plan designates EFH for Managed Species (i.e., those covered under FMPS) as: all waters and substrate within the following areas; 1) depths less than or equal to 3,500 m (1,914 fm) to mean higher high water level or the upriver extent of saltwater intrusion, 2) seamounts in depths greater than 3,500 m, and 3) areas designated as HAPCs not already identified by the above criteria (Figure 1-4).

The Pacific Fisheries Management Council has identified six HAPC types. One of these types, certain oil rigs in Southern California waters, was disapproved by NMFS. The current HAPC types are: estuaries, canopy kelp, seagrass, rocky reefs, and “areas of interest” (e.g., submarine features, such as banks, seamounts, and canyons) (Table 1-5, Figure 1-5).

Coastal pelagic species (CPS) include six pelagic species. While “pelagic” designates organisms that live in the water column as opposed to living near the sea floor, some species can be distributed anywhere from the surface to 1,000 m (3,280 ft) depending on species-specific preference. Most pelagic species are typically within 200 m of the surface (PMFC 2003, 2005, Allen and Cross 2006).

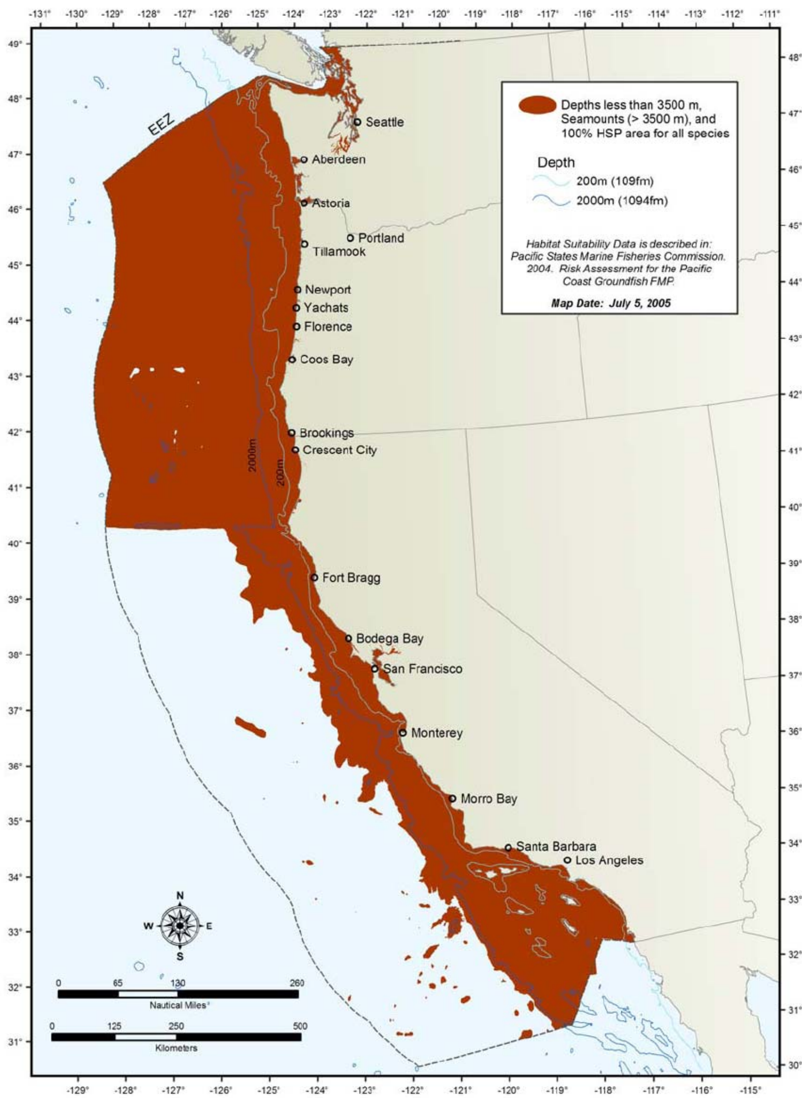

Figure 1-4: Groundfish EFH (from PFMC 2006a)

Table 1-5: EFH and HAPCs in the SOCAL Range Complex

Essential Fish Habitat (EFH) and Habitat Areas of Particular Concern (HAPCs) for the SOCAL Range Complex.		
	EFH	HAPCs
Pacific Groundfish	Marine and esturarine waters less than or equal to 3,500 m (1,914 fm) to mean higher high water level or the upwater extent of seawater intrusion, seamounts in depths greater than 3,500 m, and areas designated as HAPCs not identified by the above criteria.	Estuaries, canopy kelp, sea grass, rocky reefs, and other areas of interest.
Coastal Pelagic Species	All marine and estuarine waters above the thermocline from the shoreline offshore to 200 nm offshore.	No HAPCs designated.
Highly Migratory Species	All marine waters from the shoreline offshore to 200 nm offshore.	No HAPCs designated.
Pacific Coast Salmon	North of project area.	North of project area.
Source: NMFS 2005a, PFMC 2005, 2006a,b		

EFH identified for CPS Managed Species is wide-ranging. It includes the geographical range where they are currently found, have been found in the past, and may be found in the future (PFMC 2005). In the SOCAL Range Complex, the CPS EFH includes all marine waters above the thermocline from the shoreline offshore to the limits of the EEZ with no HAPCs designated (PFMC 2005). The thermocline is an area in the water column where water temperature changes rapidly, usually from colder at the bottom to warmer on top. The CPS live near the surface primarily above the thermocline, and within a few hundred miles of the coast, so their designated EFH is less complex than for groundfish Managed Species (Table 1-6).

Only market squid are significantly associated with benthic environments; the females lay their eggs in sheaths on sandy bottom in 33-165 ft (10-50 m) depths (PFMC 2005). The CPS are found in shallow waters and within bays and even brackish waters, but are not considered dependent upon these habitats. They prefer temperatures in the 10-28 °C range with successful spawning and reproduction occurring from 14 to 16 °C. Larger, older individuals are generally found farther offshore and farther north than younger, smaller individuals. Northern areas tend to be utilized most often when temperatures and abundance is high. All life stages of all CPS species are found in the SOCAL Range Complex.

The term “Highly Migratory Species” (HMS) derives from Article 64 of the United Nations Convention on the Law of the Sea (United Nations 1982). Although the Convention does not provide an operational definition of the term, an annex to it lists species considered highly migratory by parties to the Convention. In general, these species have a wide geographic distribution, both inside and outside countries’ 200-mile zones, and undertake migrations of significant but variable distances across oceans for feeding or reproduction. They are pelagic species, which means they do not live near the sea floor, and mostly live in the open ocean, although they may spend part of their life cycle in near shore waters (DON 2005a, Allen and Cross 2006).

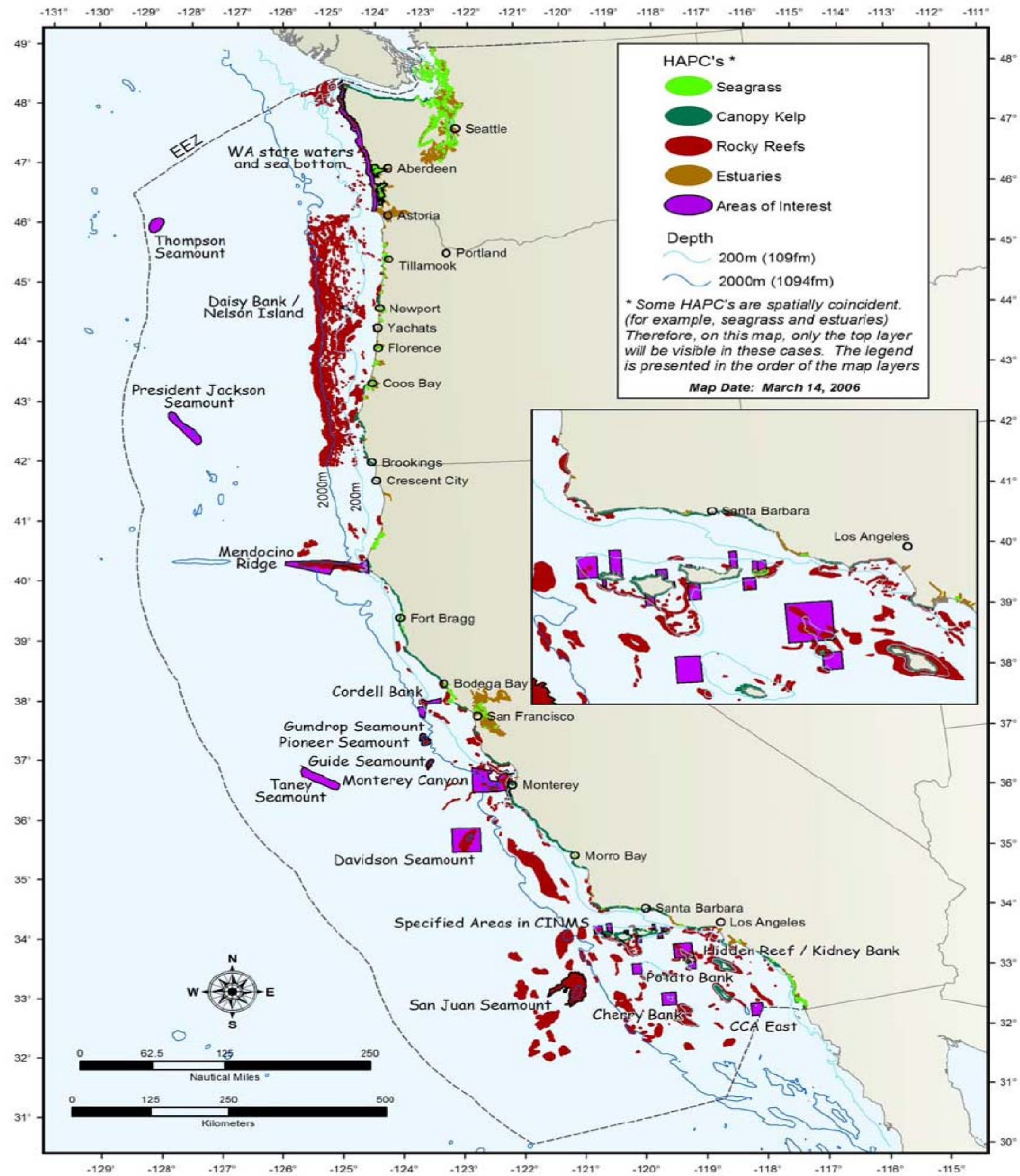

Figure 1-5: Pacific Groundfish HAPCs (from PFMC 2006a)

Table 1-6: Coastal Pelagic Species Essential Fish Habitat

Coastal Pelagic Species and Lifestages Associated with EFH designations.			
Group/Species	Coastal epipelagic	Coastal mesopelagic	Coastal benthic
Krill	E, L, J, A		
Northern anchovy	E, L, J, A		
Mackerels	E, L, J, A		
Sardine	E, L, J, A		
Market Squid	L, J, A		E
A = Adults, J = Juveniles, L = Larvae, E = Eggs. (PFMC 2005).			

HMS species are highly migratory across broad ocean scales, with occurrence in the SCB subject to extreme variability in horizontal and vertical distribution (DON 2005a). Of these pelagic and HMS species, the largest commercial fisheries in Southern California (Los Angeles and San Diego), are for swordfish, albacore tuna, yellowfin tuna, and pacific mackerel based on poundage landed and value reported for the Los Angeles and San Diego areas (see EIS/OEIS Section 3.14, Socioeconomics).

Highly Migratory Species EFH designation for species likely within the Range Complex includes the common thresher shark (all life stages), pelagic thresher shark (late juveniles/sub-adults, adult life stages), bigeye thresher shark (late juveniles/sub-adults, adult life stages), shortfin mako shark (all life stages), blue shark (all life stages), albacore tuna (juvenile and adult life stages), bigeye tuna (juvenile and adult life stages), northern bluefin tuna (juvenile and adult life stages), skipjack tuna (adult life stages), yellowfin tuna (juvenile and adult life stages), striped marlin (adult life stages), broadbill swordfish (juvenile and adult life stages), and dorado (mahi mahi) (juvenile and adult life stages) (DON 2005a).

EFH for Highly Migratory Species such as tuna, sharks, and billfish is even more extensive than for CPS (Table 1-7) (PFMC 2006b, 2007b). HMS travel widely in the ocean, both in terms of area and depth. They are usually not associated with the features typically considered fish habitat (like estuaries, seagrass beds, or rocky bottoms). Their habitat selection appears to be less related to physical features and more to temperature ranges, salinity levels, oxygen levels, and currents. For the U.S. West Coast Fisheries for Highly Migratory Species, EFH occurs throughout the SOCAL Range Complex (PFMC 2006b, 2007b). The PFMC has currently identified no HMS HAPCs . Further, EFH in the Pacific Coast Salmon Plan (PFMC 2003) extends northward from Point Conception and is, thus, out of the Range Complex.

Table 1-7: Highly Migratory Species Essential Fish Habitat

Highly Migratory Species and Lifestages Associated with EFH Designations.				
Group/Species	Coastal epi-pelagic	Coastal meso-pelagic	Oceanic epi-pelagic	Oceanic meso-pelagic
Sharks				
Blue Shark			N, EJ, LJ, SA, A	
Shortfin Mako			N, EJ, LJ, SJ, A	
Thresher Sharks	LJ, SA, A	LJ, SA, A	LJ, SA, A	LJ, SA, A
Tunas				
Albacore			J, A	
Bigeye Tuna			J, A	J, A
Northern Bluefin			J	
Skipjack			A	
Yellowfin			J	
Billfish				
Striped Marlin			A	
Swordfish				
Broadbill Swordfish			J, A	J, A
Dolphinfish				
Dorado			J, SA, A	
A = Adults, SA = Sub-Adults, LJ = Late Juveniles, N= Neonate, EJ = Early Juveniles, J = Juveniles, L = Larvae, E = Eggs. (PFMC 2006b, 2007b).				

1.7 MANAGED SPECIES

Groundfish Managed Species are found throughout the SOCAL Range Complex. As indicated above, EFH for groundfish includes all waters from the high tide line to 3,500 m (1,914 fathoms (fm)) in depth (PFMC 2006a).

The Pacific coast groundfish fishery is the largest, most important fishery managed by the Pacific Fishery Management Council in terms of landings and value (PFMC 2006a). The 83 species managed under the Pacific Groundfish Management Plan are usually found on or near the bottom; rockfish - 63 species including widow, yellowtail, canary, shortbelly, and vermilion rockfish; bocaccio, chilipepper, cowcod, yelloweye, thornyheads, and Pacific Ocean perch; roundfish - six species: lingcod, cabezon, kelp greenling, Pacific cod, Pacific whiting (hake), and sablefish; flatfish - 12 species including various soles, starry flounder, and sanddab; sharks and skates - six species: leopard shark, soupfin shark, spiny dogfish, big skate, California skate, and longnose skate; and three other species: ratfish, finescale codling, and Pacific rattail grenadier (Table 1-1) (PFMC 2006a).

Rockfish can be found from the intertidal zone out to deepest waters of the EEZ (Love 1998, Love et al. 2002, Leet et al. 2001, CDFG 2000). For management purposes, these species are often placed in three groups defined by depth range and distance offshore; nearshore rockfish, shelf rockfish, and slope rockfish (Table 1-8).

Table 1-8: Rockfish Distribution in the SOCAL Range Complex

Shallow Nearshore Rockfish	
black-and-yellow (S. chrysomelas)	grass (S. rastrelliger)
China (S. nebulosus)	kelp (S. atrovirens)
gopher (S. carnatus)	
Deeper Nearshore Rockfish	
black (Sebastes melanops)	copper (S. caurinus)
blue (S. mystinus)	olive (S. serranoides)
brown (S. auriculatus)	quillback (S. maliger)
calico (S. dalli)	treefish (S. serriceps)
Shelf Rockfish	
bocaccio (Sebastes paucispinis)	pinkrose (S. simulator)
bronzespotted (S. gilli)	pygmy (S. wilsoni)
canary (S. pinniger)	redstriped (S. proriger)
chameleon (*S. phillipsi*)	rosethorn (*S. helvomaculatus*)
chilipepper (*S. goodei*)	rosy (*S. rosaceus*)
cowcod (*S. levis*)	silvergrey (*S. brevispinis*)
dwarf-red (*S. rufinanus*)	speckled (*S. ovalis*)
flag (*S. rubrivinctus*)	squarespot (*S. hopkinsi*)
freckled (*S. lentiginosus*)	starry (*S. constellatus*)
greenblotched (*S. rosenblatti*)	stripetail (*S. saxicola*)
greenspotted (*S. chlorostictus*)	swordspine (*S. ensifer*)
greenstriped (*S. elongatus*)	tiger (*S. nigrocinctus*)
halfbanded (*S. semicinctus*)	vermilion (*S. miniatus*)
honeycomb (*S. umbrosus*)	yelloweye (*S. ruberrimus*)
Mexican (*S. macdonaldi*)	yellowtail (*S. flavidus*)
pink (*S. eos*)	
Slope Rockfish	
aurora (*S. aurora*)	rougheye (*S. aleutianus*)
bank (*S. rufus*)	sharpchin (*S. zacentrus*)
blackgill (*S. melanostomus*)	shortraker (*S. borealis*)
darkblotched (*S. crameri*)	splitnose (*S. diploproa*)
Pacific ocean perch (*S. alutus*)	yellowmouth (*S. reedi*)
redbanded (*S. babcocki*)	
Source: CDFG 2007b	

The nearshore rockfish spend most of their lives in relatively shallow water. This group is often subdivided into a shallow component and a deeper component. Shelf rockfish are found along the continental shelf (Figure 1-3). Slope rockfish occur in the deeper waters of the shelf and down the continental slope. The roundfish, flatfish, sharks, and skates covered under the Groundfish FMP are generally concentrated in shallow water while the ratfish, finescale codling, and Pacific rattail are deepsea fish (Eschmeyer et al. 1985, CDFG 2000, Leet et. al. 2001).

A variety of different fishing gear is used to target groundfish including troll, longline, hook and line, pots, gillnets, and other types of gear (Table 1-9 (from NMFS 2005b)). The West Coast groundfish fishery has four components: limited entry - which limits the number of vessels allowed to participate; open access - which allocates a portion of the harvest to fishers without limited entry permits; recreational; and tribal - fishers who have a federally recognized treaty rights (PFMC 2006a).

Table 1-9: Gear Types Used in the West Coast Groundfish Fishery

Fishery	Trawl and Other Net	Longline, Pot, Hook & Line	Other
Limited Entry Fishery (commercial)	Mid-water Trawl, Whiting trawl, Scottish Seine	Pot, Longline	
Open Access Fishery Directed Fishery (commercial)	Set Gillnet Sculpin Trawl	Pot, Longline, Vertical hook/line, Rod/Reel, Troll/dinglebar, Jig, Drifted (fly gear), Stick	
Open Access Fishery Incidental Fishery (commercial)	Exempted Trawl (pink shrimp, spot and ridgeback prawn, CA halibut, sea cucumber), Setnet, Driftnet, Purse Seine (Round Haul Net)	Pot (Dungeness crab, CA sheephead, spot prawn) Longline, Rod/reel Troll	Dive (spear) Dive (with hook and line) Poke Pole
Recreational	Dip Net, Throw Net (within 3 miles)	Hook and Line methods Pots (within 3 miles) from shore, private boat, commercial passenger vessel	Dive (spear)

The Coastal Pelagics FMP includes four finfish (northern anchovy, Pacific sardine, Pacific (chub) mackerel, jack mackerel), and two invertebrates, market squid and krill (Table 1-2). The CPS inhabit the pelagic realm, i.e., live in the water column, not near the sea floor. They are usually found from the surface to 1,000 m (3,281 ft) deep (PFMC 2005).

Northern anchovy (*Engraulis mordax*) are small, short-lived fish that typically school near the surface. They occur from British Columbia to Baja California. Northern anchovies are divided into northern, central, and southern sub-populations. The central sub-population used to be the focus of large commercial fisheries in the U.S. and Mexico. Most of this sub-population is located in the SCB between Point Conception, California and Point Descanso, Mexico. Northern anchovy are an important part of the food chain for other species, including other fish, birds, and marine mammals.

Pacific sardine (*Sardinops sagax*), also small schooling fish, have been the most abundant fish species managed under the Pacific Groundfish FMP. They range from the tip of Baja California to southeastern Alaska and throughout the Gulf of Mexico. Sardines live up to 13 years, but are usually captured in the fishery at less than 5 years old.

Pacific (chub) mackerel (*Scomber japonicus*) are found from Mexico to southeastern Alaska, but are most abundant south of Point Conception, California within 20 miles (mi) (32 km) from shore. The “northeastern Pacific” stock of Pacific mackerel is harvested by fishers in the U.S. and Mexico. Like sardines and anchovies, mackerel are schooling fish, often co-occurring with other pelagic species like jack mackerel and sardines. As with other CPS, they are preyed upon by a variety of fish, mammals, and sea birds.

Jack mackerel (*Trachurus symmetricus*) grow to about 60 centimeters (cm) (2 ft) and can live up to 35 years. They are found throughout the northeastern Pacific, often well outside the EEZ. Small jack mackerel are most abundant in the SCB, near the mainland coast, around islands, and over shallow rocky banks. Older, larger fish range from Cabo San Lucas, Baja California, to the Gulf of Alaska, offshore into deep water and along the coast to the north of Point Conception. Jack mackerel in southern California usually school over rocky banks, artificial reefs, and shallow rocky reefs (PFMC 2005).

Market squid (*Loligo opalescens)* range from the southern tip of Baja California to southeastern Alaska. They are most abundant between Punta Eugenio, Baja California, and Monterey Bay, California. Usually found near the surface, market squid can occur to depths of 800 m (2,625 ft) or more. Squid live less than a year and prefer full-salinity ocean waters. They are important forage foods for fish, birds and marine mammals (PFMC 2005).

In 2006, the PFMC adopted a complete ban on commercial fishing for all species of krill in West Coast federal waters (PFMC 2006c). Krill (euphausiids) are small shrimp-like crustaceans that are an important basis of the marine food chain. They are eaten by many Managed Species, as well as by whales and seabirds. The PFMC is presently considering identifying EFH and possibly HAPCs for two individual krill species, *Euphausia pacifica* and *Thysanoessa spinifera*, and for other species of krill as a separate category.

Coastal pelagic species are harvested directly and incidentally (as bycatch) in other fisheries. Usually targeted with “round-haul” gear including purse seines, drum seines, lampara nets, and dip nets, they are also taken as bycatch in midwater trawls, pelagic trawls, gillnets, trammel nets, trolls, pots, hook-and-line, and jigs. Market squid are fished nocturnally using bright lights to attract the squid to the surface. They are pumped directly from the sea into the hold of the boat, or taken with an encircling net (PFMC 2005).

Most of the CPS commercial fleet is located in California, mainly in Los Angeles, Santa Barbara-Ventura, and, Monterey. About 75 percent of the market squid and Pacific sardine catch are exported, mainly to China, Australia (where they are used to feed farmed tuna), and Japan (where they are used as bait for longline fisheries).

The U.S. West Coast Fisheries for HMS covers 13 free-ranging species; 5 tuna - Pacific albacore, yellowfin, bigeye, skipjack, and northern bluefin; 5 sharks - common thresher, pelagic thresher, bigeye thresher, shortfin mako, and blue shark; 2 billfish - striped marlin and Pacific swordfish; and dorado (also known as dolphinfish and mahi-mahi) (Table 1-3) (PFMC 2006b). HMS have a wide geographic distribution, both inside and outside the EEZ. They are open-ocean, pelagic species, that may spend part of their life cycle in nearshore waters. HMS are harvested by U.S. commercial and recreational fishers and by foreign fishing fleets, with only a fraction of the total harvest taken within U.S. waters (PFMC 2006b). HMS are also an important component of the recreational sport fishery, especially in southern California.

The PFMC has developed stock rebuilding plans for seven overfished, depleted species; Bocaccio, Canary Rockfish, Cowcod, Darkblotched Rockfish, Pacific Ocean Perch, Widow Rockfish, and Yelloweye Rockfish (PFMC 2006d). Conservation Areas, closed to fishing, have also been established to protect sensitive Pacific Coast Groundfish habitat (Figure 1-6, from PMFC 2006a). Though not much bottom trawling is done south of Pt. Conception, bottom trawling and other bottom fishing activities are prohibited in Cowcod Conservation Areas (Figure 1-7, PMFC 2006a).

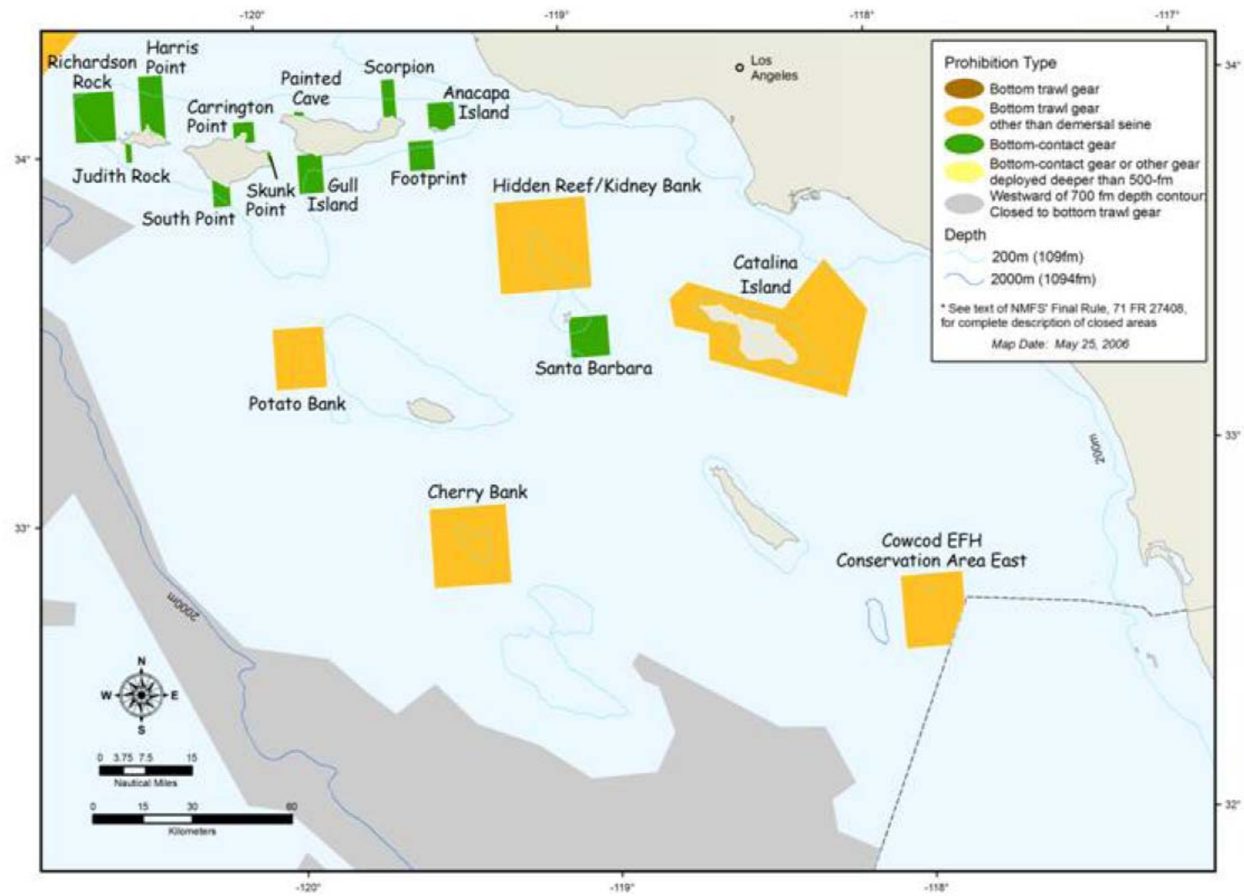

Figure 1-6: Essential Fish Habitat Conservation Areas

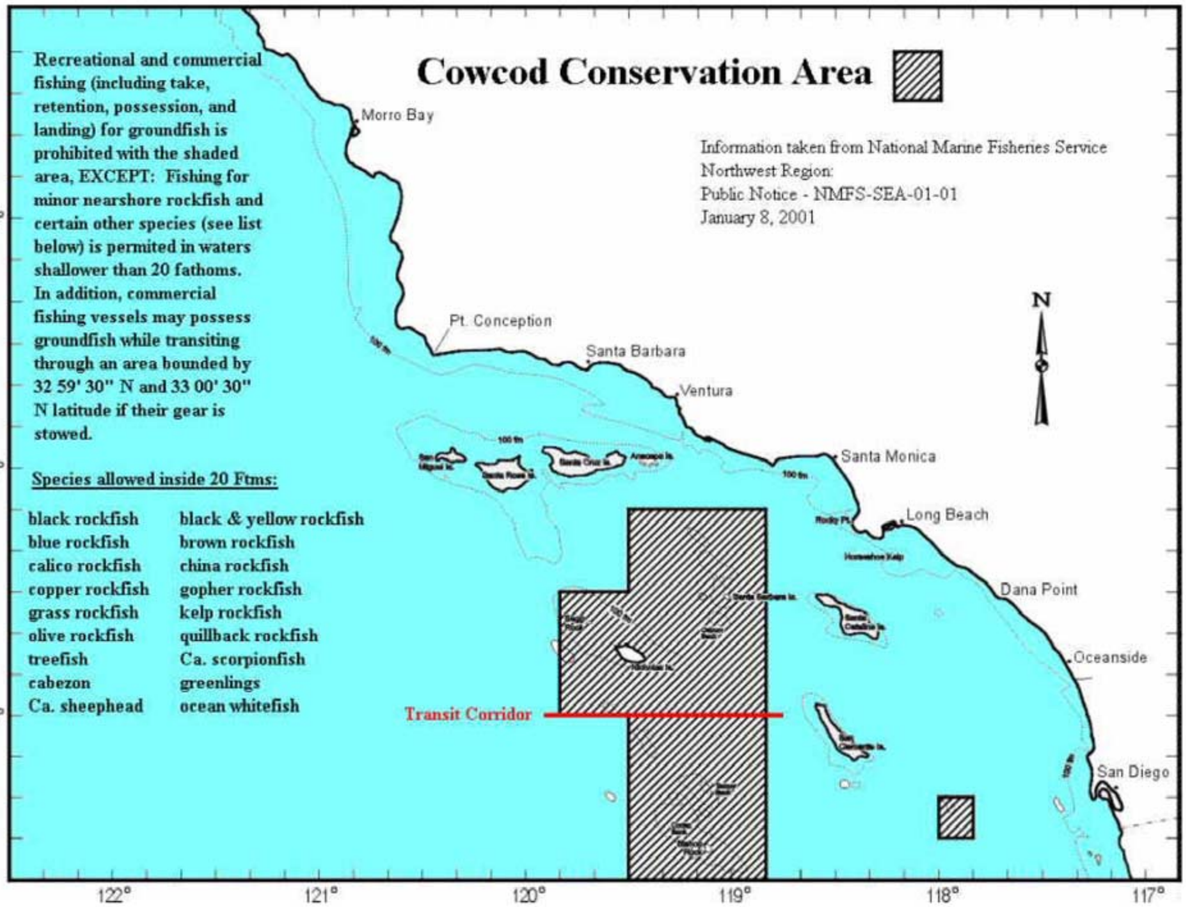

Figure 1-7: Cowcod Conservation Areas

Under the HMS FMP, the PFMC monitors other species for informational purposes. In addition, some species-including great white sharks, megamouth sharks, basking sharks, Pacific halibut, and Pacific salmon - are designated as prohibited catch. If fishers targeting highly migratory species catch these species, they are required to immediately release them (PFMC 2006b). The HMS fishery, with the exception of the swordfish drift gillnet fishery off California, is one of the only remaining open access fishery on the West Coast. However, the PFMC is currently considering a limited entry program to control excess capacity (PFMC 2006b).

Many different gear types are used to catch HMS in California (PFMC 2006b). These include; 1) trolling lines - fishing lines with jigs or live bait deployed from a moving boat, 2) drift gillnets - panels of netting weighted along the bottom and suspended vertically in the water by floats that are anchored to a vessel drifting along with the current, 3) harpoon - a small and diminishing fishery mainly targeting swordfish, 4) pelagic longlines - baited hooks on short lines attached to a horizontal line (the HMS FMP now prohibits West Coast longliners from fishing in the EEZ due to concerns about the take of endangered sea turtles), 5) coastal purse seines - encircling nets closed by synching line threaded through rings on the bottom of the net (usually targeting sardines, anchovies, and, mackerel but also target tuna where available), 6) large purse seines - used in major fisheries in the eastern tropical Pacific and the central and western Pacific (this fishery is monitored by the Inter-American Tropical Tuna Commission, and, in the EEZ by NMFS); and, 7) recreational fisheries - HMS recreational fishers in California include private vessels and charter vessels using hook-and-line to target tunas, sharks, billfish, and dorado (NMFS2006b).

Pacific halibut (*Hippoglossus stenolepis*) is managed by the International Pacific Halibut Commission (IPHC 2007). This large species of halibut is mainly encountered well north of the project area, and, its harvest is prohibited in the SOCAL Range Complex. A smaller relative, the California halibut (*Paralichthys californicus*), is found along the coast of southern California, but is not included in a FMP.

Although EFH mandates are stipulated in federal legislation, EFH habitat defined in FMPs includes state waters. These areas in California (i.e., inshore of 3 nm) are managed under the California Marine Life Management Act (CMLMA) (CDFG 2007c). Four California FMPs have been produced covering market squid, white seabass, nearshore finfish, and abalone (CDFG 2007d,e,f,g).

Market squid (*Loligo opalescens*), discussed previously under the Coastal Pelagics FMP, is the state's largest fishery by tonnage and economic value (CDFG 2007d). Market squid are also important to the recreational fishery as bait and as forage for fish, marine mammals, birds, and other marine life. Squid belong to the class Cephalopoda of the phylum Mollusca. They have large eyes and strong parrot-like beaks. Using their fins for swimming and jets of water from their funnel they are capable of rapid propulsion forward or backward. The squid's capacity for sustained swimming allows it to migrate long distances (CDFG 2007d).

White seabass (*Atractoscion nobilis*), large members of the croaker family, occur in ocean waters off the west coasts of California and Mexico. This highly-prized species is recovering from reduced population levels in late 1900s. The current, California management strategy provides for moderate harvests while protecting young white seabass and spawning adults through seasonal closures, gear provisions, and size and bag limits (CDFG 2007e).

The California Nearshore Fishery Management Plan (CDFG 2007f) covers 28 species that frequent kelp beds and reefs less than 120 ft (36 m) deep off the coast of California and near offshore islands (Table 1-10, from CDFG 2007f).

Table 1-10: Species Managed Under the California Nearshore Fisheries Management Plan

Kelp greenling - *Hexagrammos decagrammus*
Lingcod - *Ophiodon elongatus*
Pacific cod - *Gadus macrocephalus*
Pacific whiting - *Merluccius productus*
Sablefish - *Anoplopoma fimbria*
Black rockfish - *Sebastes melanops*
Black-and-yellow rockfish - *Sebastes chrysomelas*
Blue rockfish - *Sebastes mystinus*
Brown rockfish - *Sebastes auriculatus*
Cabezon - *Scorpaenichthys marmoratus*
Calico rockfish - *Sebastes dallii*
California rockfish - *Scorpena guttatta*
California sheephead – *Semicossyphus pulcher*
China rockfish - *Sebastes nebulosus*
Copper rockfish - *Sebastes caurinus*
Gopher rockfish - *Sebastes carnatus*
Kelp greenling – *Hexagrammos decagrammus*
Kelp rockfish - *Sebastes atrovirens*
Monkeyface prickleback – *Cebidichthys violaceus*
Olive rockfish - *Sebastes serranoides*
Quillback rockfish - *Sebastes maliger*
Rock greenling - *Hexagrammos lagocephalus*
Treefish - *Sebastes serriceps*
Vermilion rockfish - *Sebastes miniatus*
Widow rockfish - *Sebastes entomelas*
Yelloweye rockfish - *Sebastes ruberrimus*
Yellowmouth rockfish - *Sebastes reedi*
Yellowtail rockfish - *Sebastes flavidus*

Thirteen of these species are rockfish - all of which are included in the Pacific Groundfish FMP. Three of the remaining six species are also covered under the Pacific Groundfish FMP. The three species not covered by the Pacific Groundfish FMP are the California sheephead (*Semicossyphus pulcher*), the rock greenling (*Hexagrammos lagocephalus*), and the monkeyface prickleback (*Cebidichthys violaceus*) (CDFG 2007f).

The California sheephead is a large, colorful member of the wrasse family (Love 1996). Male sheephead reach a length of 3 ft (90 cm), a weight of 36 pounds (lb), and have a white chin, black head, and, a pink to red body. Females are smaller, with a brown-colored body (Eschmeyer, Herald, and Hammann 1985). Sheephead populations off southern California have declined because of fishing pressure. Large males are now rare because they are sought by recreational spear fishermen. Sheephead are taken commercially by traps and kept alive for display in restaurant aquaria where patrons select a specific fish for preparation (Leet et al. 2001). The rock greenling is a smaller member of the lingcod family. The monkeyface prickleback, also called the monkeyface eel, is more closely related to rockfish than eels. Its elongate shape is an adaptation to living in cracks, crevices, and under boulders (Love 1996).

The Abalone Recovery and Management Plan (CDFG 2007g) provides a cohesive framework for the recovery of depleted abalone populations in southern California. All of California's abalone species are included in the plan: red abalone, *Haliotis rufescens*; green abalone, *H. fulgens*; pink abalone, *H. corrugata*; white abalone, *H. sorenseni*; pinto abalone, *H. kamtschatkana* (including *H.k. assimilis*); black abalone, *H. cracherodii*; and flat abalone, *H. walallensis*. A recovery and management plan for these species is needed to manage abalone fisheries and prevent further population declines throughout California, and to ensure that current and future populations will be sustainable.

The decline of abalone is due to a variety of factors, primarily commercial and recreational fishing, disease, and natural predation. The recovery of a near-extinct abalone predator, the sea otter, has further eliminated the possibility for an abalone fishery in most of central California. Withering syndrome, a lethal bacterial infection, has caused widespread decline among black abalone in the Channel Islands and along the central California coast. As nearshore abalone populations became depleted, fishermen traveled to more distant locations, until stocks in most areas had collapsed. Advances in diving technology also played a part in stock depletion. The advent of self-contained underwater breathing apparatus (SCUBA) in the mid-1900s gave birth to the recreational fishery in southern California, which placed even more pressure on a limited number of fishing areas.

Following stock collapse, the California Fish and Game Commission closed the southern California pink, green, and white abalone fisheries in 1996, and all abalone fishing south of San Francisco in early 1997. The southern abalone fishery was closed indefinitely with the passage of the Thompson bill (AB 663) in 1997. This bill created a moratorium on taking, possessing, or landing abalone for commercial or recreational purposes in ocean waters south of San Francisco, including all offshore islands.

2 PROPOSED ACTION

2.1 SOCAL RANGE COMPLEX OPERATIONS

The Navy proposes to implement actions within the SOCAL Range Complex to: maintain baseline training and research, development, testing, and evaluation (RDT&E) operations at current levels; increase training and RDT&E operations from current levels as necessary to support fleet readiness; accommodate mission requirements associated with force structure changes and introduction of new weapons and systems to the Fleet; and, implement enhanced range complex capabilities.

These actions potentially include: increased numbers of training operations of the types currently being conducted in the SOCAL Range Complex; expansion of the size and scope of amphibious landing training exercises in the SOCAL Ocean OPAREAS and at San Clemente Island (offshore and on land); conduct of operations on the planned extension of the Shallow Water Training Range (SWTR) in the offshore area of the SCI; development of additional Training Areas and Ranges (TARs) for Naval Special Warfare (NSW) training on the land areas of SCI; increase in Commercial Air Services support for Fleet Opposition Forces (OPFOR) and Electronic Combat (EC) Threat Training; construction and operation of a Shallow Water Mine Field in the offshore and near-shore areas of SCI; and, support of training for Littoral Combat Ship (LCS) warfare missions (including MIW, ASW, and SUW), MH-60R/S helicopter warfare mission areas (including MIW, ASW, SUW, and Combat Search and Rescue (CSAR)), and EA-18G Growler EC aircraft missions throughout the SOCAL Range Complex.

Military activities in SOCAL Range Complex occur (1) on the ocean surface, (2) under the ocean surface, (3) in the air, and (4) on land at SCI. For purposes of scheduling and managing these activities and the ranges, the Range Complex is divided into multiple components.

"W-291" is the Federal Aviation Administration (FAA) designation of the extensive Special Use Airspace (SUA) of the SOCAL Range Complex. This SUA extends from the ocean surface to 80,000 ft. mean sea level (MSL) and encompasses 113,000 nm^3 of airspace. The ocean area underlying the W-291 (i.e., 113,000 nm^3 of sea space) forms the majority of the ocean OPAREA of the SOCAL Range Complex. This OPAREA extends to the sea floor.

Within the area defined by the lateral bounds of W-291, the SOCAL Range Complex encompasses specialize range or training areas in the air, on the surface, or undersea. Depending on the intended use, these specialized range areas may encompass only airspace or may extend from the sea floor to 80,000 ft MSL. A designated air-to-air combat maneuver area is an example of specialized airspace-only range area. Range areas designated for helicopter training in ASW or submarine missile launches, for example, extend from the ocean floor to 80,000 ft. MSL.

The W-291 airspace and associated OPAREAs, including specialized range areas, are described in Table 2-1 and depicted in Figure 2-1. There are several OPAREAS in the SOCAL Range Complex that do not underlay W-291 (Table 2-2). These OPAREAS are used for ocean surface and subsurface training. Military aviation activities also occur in the SOCAL Range Complex outside of W-291. These aviation activities do not include use of live or non-explosive ordnance. For example, amphibious operations involving helicopters and carrier flight operations occur in the SOCAL Range Complex outside W-291.

Table 0-1: W-291 and Associated OPAREAs

Area Designation	Description
Warning Area (W-291)	W-291 is the largest component of SUA in the Navy inventory. It encompasses 113,000 nm^2 (209,276 km^2) located off of the southern California coastline (Figure 2-1), extending from the ocean surface to 80,000 ft above MSL. W-291 supports aviation training and RDT&E conducted by all aircraft in the Navy and Marine Corps inventories. Conventional ordnance use is permitted.
Tactical Maneuvering Areas (TMA) (Papa 1-8)	W-291 airspace includes eight TMAs (designated Papa 1-8) extending from 5,000 to 40,000 ft (1,524 to 12,192 m) MSL. Exercises conducted include Air Combat Maneuvering (ACM), air intercept control aerobatics, and AA gunnery. Conventional ordnance use is permitted.
Air Refueling Areas	W-291 airspace includes three areas which are designated for aerial refueling.
Class “E” airspace (Area Foxtrot)	W-291 airspace includes Class "E" airspace designated as Area Foxtrot, which is activated by the FAA for commercial aviation use as needed (such as during periods of inclement weather or when Lindbergh Field International Airport is utilizing Runway 09).
Fleet Training Area Hot (FLETA HOT)	FLETA HOT is an open ocean area that extends from the ocean bottom to 80,000 ft (24,384 m). The area is used for hazardous operations, primarily surface-to-air and air-to-air ordnance. Types of exercises conducted include AAW, ASW, underway training, and Independent Steaming Exercises (ISE). Conventional ordnance use is permitted.
Over-water parachute drop zones	Three parachute drop zones used by Navy and Marine Corps units are designated within the SOCAL Range Complex. Two of these (Neptune and Saint) lie within the bounds of W-291. One (Leon) lies between W-291 and Naval Base Coronado (NBC).
Missile Range 1 and 2 (MISR-1/MISR-2)	MISR-1 and MISR-2 are located about 60 nm (111 km) south and southwest of NBC, and extend from the ocean bottom up to 80,000 ft MSL. Exercises conducted include rocket and missile firing, ASW, carrier and submarine operations, fleet training, ISE, and surface and air gunnery. Conventional ordnance use is permitted.
Northern Air Operating Area (NAOPA)	The NAOPA is located east of SCI and approximately 90 nm (167 km) west of NBC. It extends from the ocean bottom to 80,000 ft (24,384 m). Exercises in NAOPA include fleet training, multi-unit exercises, and individual unit training. Conventional ordnance is use is permitted.
Electronic Warfare (EW) Range	The EW Range utilizes advanced technology to simulate electronic attacks on naval systems from sites on SCI. The range not is defined as a designated location. Rather it is defined by the electronic nature and extent of the training support it provides. The EW Range supports 50 types of electronic warfare training events for ships and aircraft operating in W-291 airspace and throughout the OPAREAS.
Kingfisher Training Range (KTR)	KTR is a 1-by-2 nm (1.85 x 3.7 km) area in the waters approximately 1 nm (1.85 km) offshore of SCI. The range provides training to surface warfare units in mine detection and avoidance. The range consists of mine-like shapes moored to the ocean bottom by cables.
Laser Training Range (LTR)	LTRs 1 and 2 are offshore water ranges northwest and southwest of SCI, established to conduct over-the-water laser training and testing of the laser-guided Hellfire missile.

Area Designation	Description
Mine Training Range (MTR)	Two MTRs and two mine laying areas are established in the nearshore areas of SCI. MTR-1 is the Castle Rock Mining Range off the northwestern coast of the island. MTR-2 is the Eel Point Mining Range off the midpoint of the southwestern side. In addition, mining training takes place in the China Point area, off the southwestern point of the island, and in the Pyramid Head area, off the island's southeastern tip. These ranges are used for training of aircrews in offensive mine laying by delivery of non-explosive mine shapes (no explosives) from aircraft.
OPAREA 3803	OPAREA 3803 is an area adjacent to SCI extending from the sea floor to 80,000 ft. Operations in OPAREA 3803 include aviation training and submarine training events during JTFEX and COMPTUEX. The SCI Underwater Range lies within OPAREA 3803.
San Clemente Island Underwater Range (SCIUR)	SCIUR is a 5-nm^2 (9.3-km^2) area northeast of SCI. The range is used for ASW training and RDT&E of undersea systems. The range contains six hydrophone arrays mounted on the sea floor that produce acoustic target signals.
Southern California ASW Range (SOAR)	SOAR is located offshore to the west of SCI. The underwater tracking range covers over 670 nm^2 (1,241 km^2), and consists of seven subareas. The range has the capability of providing three-dimensional underwater tracking of submarines, practice weapons, and targets with a set of 84 acoustic sensors (hydrophones) located on the sea floor. Communication with submarines is possible through use of an underwater telephone capability. SOAR supports various ASW training scenarios that involve air, surface, and subsurface units.
SOAR Variable Depth Sonar (VDS) No-Notice Area	The VDS area is used as an unscheduled and no-notice area for training with surface ships' sonar devices. The vertical dimensions are from the surface to a maximum depth of 400 ft (122 m). The VDS overlaps portions of the SOAR and the MINEX training range.
SOCAL Missile Range	SOCAL Missile Range is not a permanently designated area, but is invoked by the designation of portions of the ocean OPAREAS and W-291 airspace, as necessary, to support Fleet live-fire training missile exercises. The areas invoked vary, depending on the nature of the exercise, but generally are extensive areas over water south/southwest of SCI.
Fire Support Areas (FSAs) I and II.	FSAs are designated locations offshore of SCI for the maneuvering of naval surface ships firing guns into impact areas located on SCI. The offshore FSAs and onshore impact areas together are designated as the Shore Bombardment Area (SHOBA).

Table 0-2: Ocean OPAREAs Outside W-291

Ocean Area	Description
Advance Research Projects Agency (ARPA) Training Minefield	The ARPA Training Minefield lies within the Encinitas Naval Electronic Test Area (ENETA), and extends from the ocean bottom to the surface. Exercises conducted are mine detection and avoidance. Ordnance use is not permitted.
Encinitas Naval Electronic Test Area (ENETA)	The ENETA is located about 20 nm (37 km) northwest of NBC. The area extends from the ocean bottom up to 700 ft (213 m) MSL. Exercises conducted include fleet training and ISE. Ordnance use is not permitted.
Helicopter Offshore Training Area (HCOTA)	Located in the ocean area off NBC, the HCOTA is divided into five “dipping areas” (designated A/B/C/D/E), and extends from the ocean bottom to 1,000 ft (305 m) MSL. This area is designed for ASW training for helicopters with dipping sonar. Ordnance use is not permitted.
San Pedro Channel Operating Area (SPCOA)	The SPCOA is an open ocean area about 60 nm (111 km) northwest of the NBC, extending to the vicinity of Santa Catalina Island, from the ocean floor to 1,000 ft (305 m) MSL. Exercises conducted here include fleet training, mining, mine countermeasures, and ISE. Ordnance use is not permitted.
Western San Clemente Operating Area (WSCOA)	The WSCOA is located about 180 nm (333 km) west of NBC. It extends from the ocean floor to 5,000 ft (1,524 m) MSL. Exercises conducted include ISE and various fleet training events. Ordnance use is not permitted.
Camp Pendleton Amphibious Assault Area (CPAAA) and Amphibious Vehicle Training Area (CPAVA)	CPAAA is an open ocean area located approximately 40 nm (74 km) northwest of NBC, used for amphibious operations. No live or non-explosive ordnance is authorized. CPAVA is an ocean area adjacent to the shoreline of Camp Pendleton used for near-shore amphibious vehicle and landing craft training. Ordnance use is not permitted.

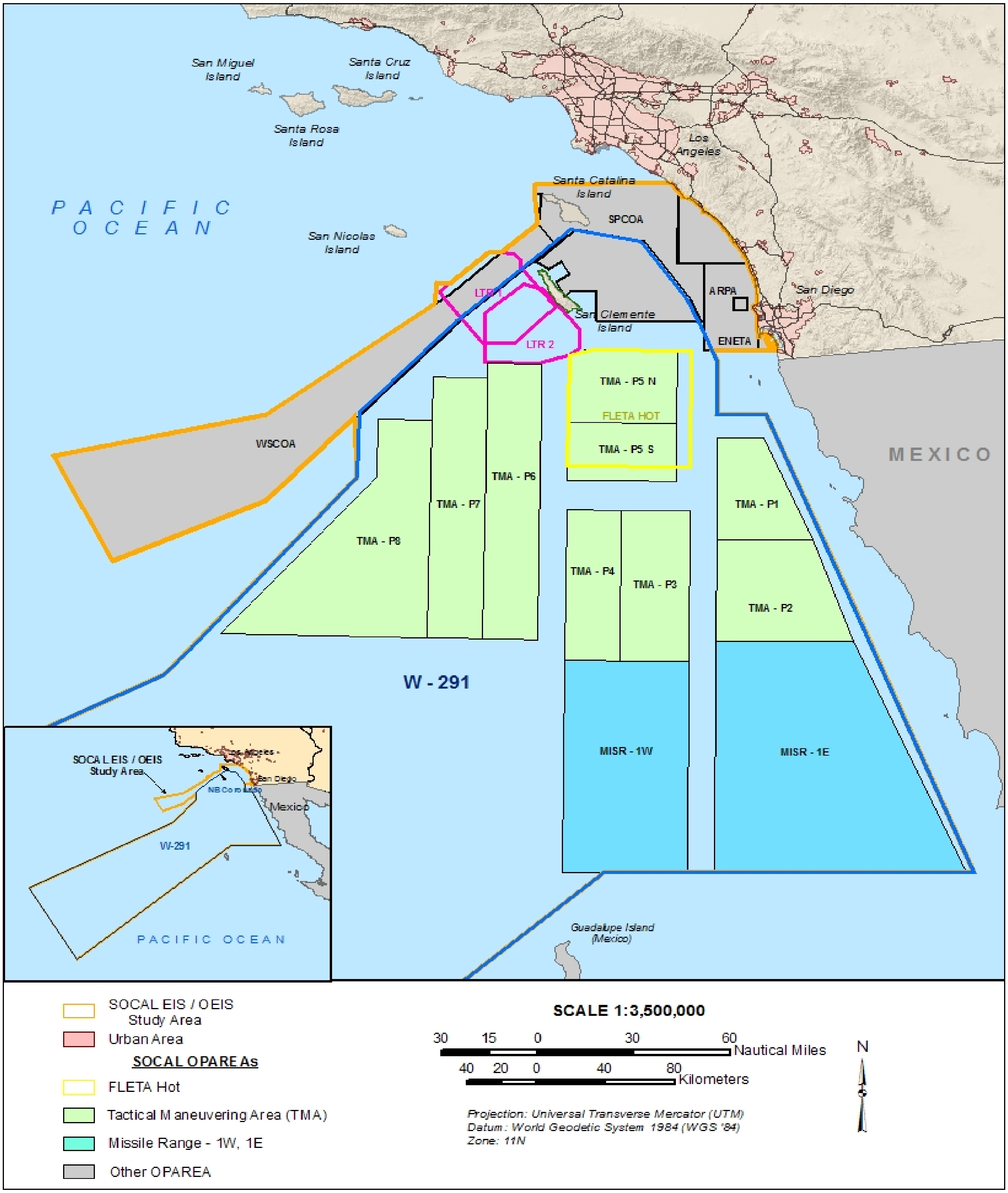

Figure 0-1: SOCAL Range Complex W-291 and Ocean OPAREAs

Table 0-3: San Clemente Island Areas

SCI Ranges	Description
SHOBA Impact Areas	SHOBA is the only range on the western coast of the United States that supports naval surface fire support training using on-the-ground spotters and surveyed targets. The southern one-third of SCI contains Impact Areas I and II, which comprise the onshore portion of SHOBA. (The offshore component provides designated locations [FSAs] for firing ships to maneuver.). The main training activities that occur in SHOBA are naval gun firing, artillery, and air-to-ground bombing. A variety of munitions, both live and non-explosive, are expended in SHOBA. NSW operations also occur in this area.
Naval Special Warfare Training Areas (SWATs)	SCI contains six SWATs. Each includes contiguous land and water areas. The land areas range in size from 100 to 4,400 acres [ac] (.4 to 18 km^2) and are used as ingress and egress to specific Training Areas and Ranges (TARs). Basic and advanced special operations training is conducted within these areas by Navy and Marine Corps units.
NSW Training Areas and Ranges (TARs)	A TAR is an area used for planning and scheduling purposes for specific types of training operations and range activities in the SCI. There are currently 22 TARs, designated as TARS 1-22. All the TARs contain land area, with the exception of two (TAR 7 and 8) which are water drop zones. Three TARs (2, 3, and 5) include beach and nearshore waters, while the rest cover land only. With the exception of the water drop zones, the TARs do not include airspace. TARs are generally small (1-800 ac) and are designed to support NSW training for “actions at the objective.”
Assault Vehicle Maneuver Corridor (AVMC)	The AVMC encompasses three linked areas on SCI: • Assault Vehicle Maneuver Areas (AVMAs), and • Assault Vehicle Maneuver Road (AVMR) plus an AVMR Extension The AVMA accounts for four existing or planned areas for authorized off-road vehicle use. The AVMR is a dirt track that runs the length of the island to allow transit by tactical vehicles through areas that are restricted from off-road use by vehicles.
Artillery Firing Points (AFP) and Artillery Maneuver Points (AMP)	An AFP is a location from which artillery weapons such as the 155mm howitzer are positioned and used in live-fire employment of munitions. Guns are towed by trucks along primary roads, often in convoy with munitions trucks and HMMWVs. Two AFPs are being used at the current time: AFP 1 and AFP 6, both in SHOBA. An AMP is used for non-live fire training in emplacement and displacement of artillery weapons. SCI has four AMPs.
Infantry Operations Area	The Infantry Operations Area, generally located on either side of the AVMC, is on the upland plateau, which is designated for foot traffic by military units. No vehicles are authorized in the off-road areas. Specifically, this area is intended for use by Marine Corps small units during amphibious training events.
Old Airfield (VC-3)	The Old Airfield, called VC-3, located within TAR 15, is approximately 6 nm (11 km) from the northern end of the island. The presence of a number of buildings allows for training of forces in a semi-urban environment. It is suitable for small unit training by NSW and Marine Corps forces.
Missile Impact Range (MIR)	The MIR, located within TAR 16, is in the north-central portion of the island, just south of VC-3. It is situated at the ridge crest of the island’s central plateau. The MIR is 3,200 by 1,000 ft (305 by 975 m) at an elevation of 1,000 ft (305 m) MSL. The MIR contains fixed targets, and is equipped with sophisticated instruments for recording the flight, impacts, and detonations of weapons. Weapons expended on the MIR include the Joint Standoff Weapon (JSOW) and the Tomahawk Land Attack Missile (TLAM).
Naval Auxiliary Landing Field (NALF)	The NALF, located at the northern end of the island, has a single runway of 9,300 ft (2,835 m) equipped with aircraft arresting gear.

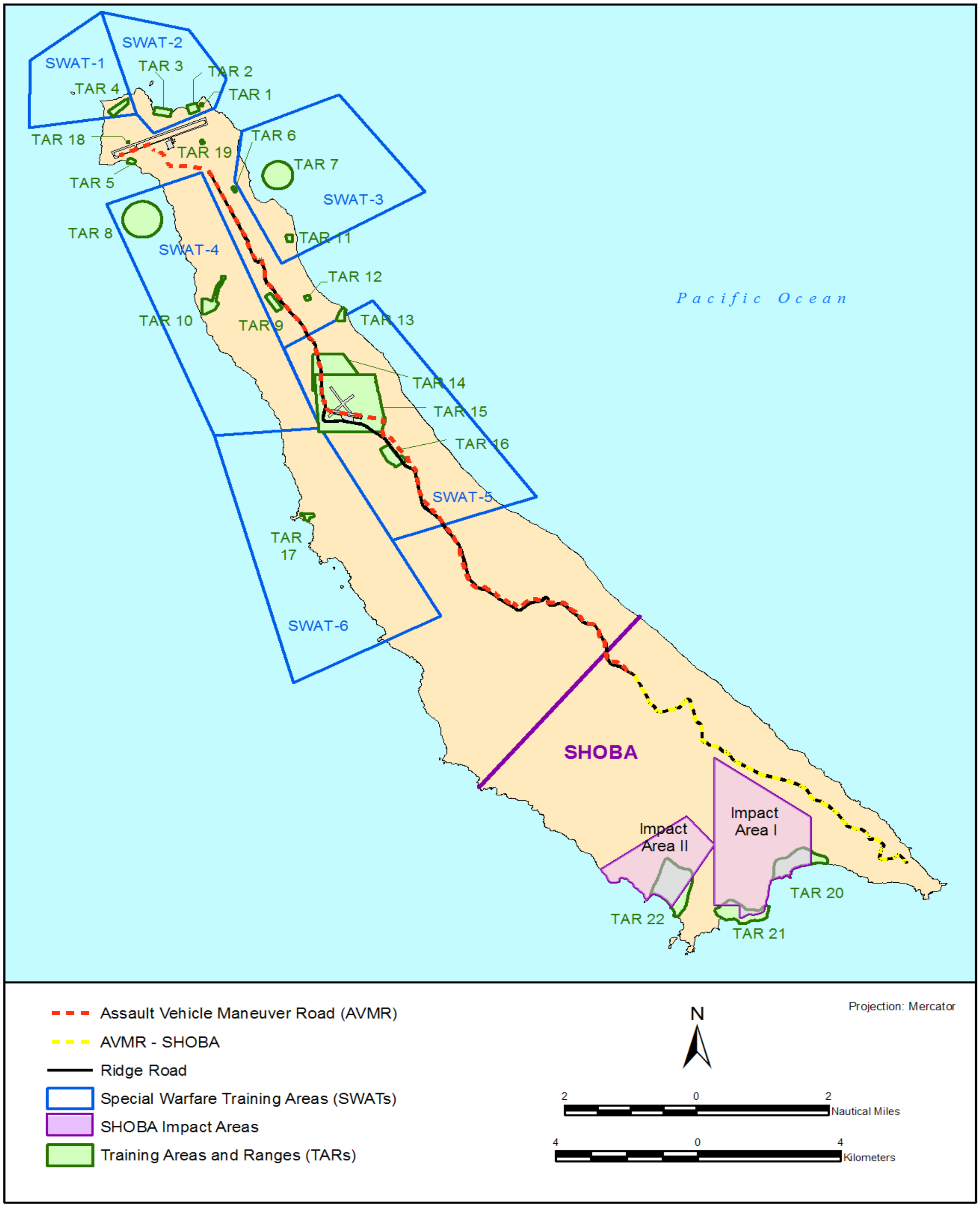

Figure 0-2: SCI Ranges: SWATs, TARs and SHOBA Impact Areas

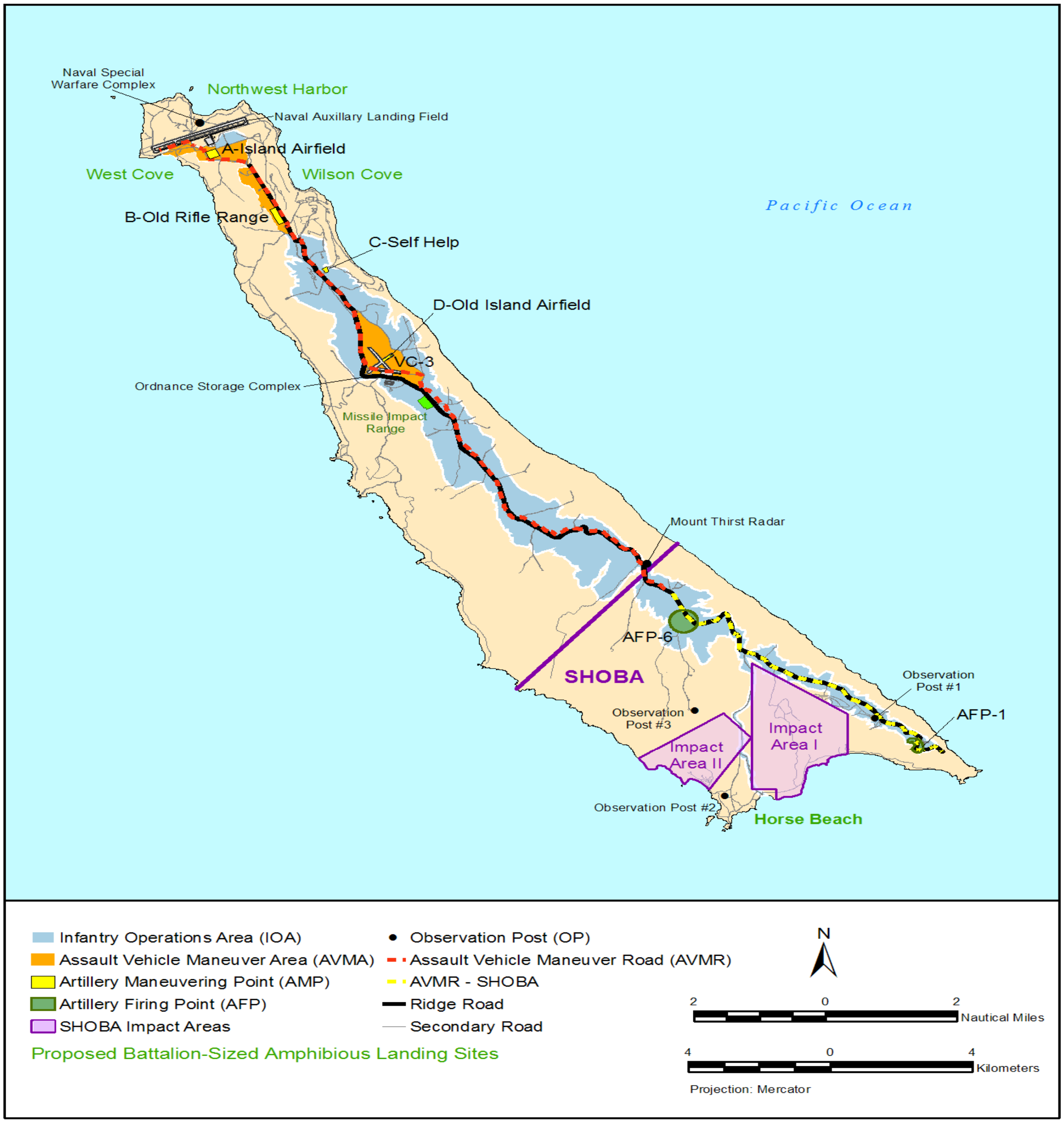

Figure 0-3: San Clemente Island Infantry, Artillery, and Vehicle Range Areas

All of San Clemente Island is dedicated to training and RDT&E activities, utilizing the several distinct ranges at SCI. These land ranges are described above in Table 2-3 and shown in Figures 2-2 and 2-3.

A component part of the SOCAL Range Complex, SCI provides a suite of land ranges and training areas that are integral to training of Pacific Fleet air, surface, and subsurface units; I MEF units; NSW units; and selected formal schools. SCI provides instrumented ranges, operating areas and associated facilities to conduct and evaluate a wide range of exercises within the scope of naval warfare. SCI also provides range areas and services to RDT&E activities. Over 20 Navy and Marine Corps commands conduct training and testing activities at SCI.

2.2 ALTERNATIVES

Three alternatives are analyzed in the SOCAL Range Complex EIS/OEIS: 1) The No Action Alternative – Current Operations; 2) Alternative 1 - Increase Operational Training and Accommodate Force Structure Changes, and 3) Alternative 2 – Increase Operational Training, Accommodate Force Structure Changes, and Implement Range Enhancements.

2.2.1 No-Action Alternative

The Navy has been operating in the SOCAL Range Complex for over 70 years. Under the No Action Alternative, training operations and major range events would continue at current levels. The SOCAL Range Complex would not accommodate an increase in training operations due to the requirements of the FRTP or proposed force structure changes, and it would not implement additional investments associated with the other alternatives. Evaluation of the No-Action Alternative provides a credible baseline for assessing environmental impacts of Alternative 1 and Alternative 2 (Preferred Alternative), as described below.

Operations currently conducted on the SOCAL Range Complex are described below by warfare mission area. Training activities in the SOCAL Range Complex vary from basic individual or unit level events of relatively short duration involving few participants to integrated major range training events such as JTFEX which may involve thousands of participants over several weeks.

Over the years, the tempo and types of operations have fluctuated within the SOCAL Range Complex, due to changing requirements, the dynamic nature of international events, the introduction of advances in warfighting doctrine and procedures, and force structure changes. The factors influencing tempo and types of operations are fluid in nature and will continue to cause fluctuations in training activities within the SOCAL Range Complex.

2.2.1.1 Description of Current Training Operations within the SOCAL Range Complex

2.2.1.1.1 ASW Training

ASW training engages helicopter and sea control aircraft, ships, and submarines operating alone or in combination in training to detect, localize, and attack submarines. ASW training involves sophisticated training and simulation devices including underwater targets and sonobuoys which emit sound through the water. When the object of the exercise is to track the target but not attack it, the exercise is called a Tracking Exercise (TRACKEX). A Torpedo Exercise (TORPEX) takes the operation one step further, culminating in the release of an actual torpedo, which can be either running (EXTORP) or non-running (REXTORP). All torpedoes used in training are have non-explosive warheads. ASW training occurs in W-291 and all ocean operating areas of the SOCAL Range Complex. SOAR is designed specifically for ASW training, with underwater acoustic sensors and communications to allow for the monitoring of training activities and post-mission debriefing feedback to the participants.

2.2.1.1.2 MIW Training

MIW training includes Mine Countermeasures (MCM) Exercises and Mine Laying Exercises (MINEX). MCM training is currently conducted on the Kingfisher Range and offshore areas in the Tanner and Cortez Banks. MCM training engages ships' crews in the use of sonar for mine detection and avoidance, and minefield navigation and reporting. The proposed extension of the SOAR is intended for use in such training. MINEX events involve aircraft dropping non-explosive training shapes, and less frequently submarine mine laying. MINEX events are conducted on the MINEX Training Ranges in the Castle Rock, Eel Point, China Point, and Pyramid Head areas offshore of SCI.

2.2.1.1.3 AAW Training

Surface-to-Air Gunnery Exercise (GUNEX S-A): GUNEX S-A exercises require air services to simulate a threat aircraft or missile towing a target to be fired upon by ship crews utilizing shipboard gun systems.

Air Defense Exercise (ADEX): ADEX is an exercise to train surface and air assets in coordination and tactics for defense of the strike group or other Naval Force from airborne threats.

Simulated Surface-to-Air Missile Exercise (MISSILEX-S): The MISSILEX-S is a non-firing event meeting training requirements for missile engagement of air threats up to the point of actual launch of a missile.

Simulated Air-to-Air Missile Exercise (AAMEX): AAMEXs are non-firing exercises, but may include activities such as air intercept control, where the final objective is to intercept and attack another aircraft.

Air Combat Maneuvers (ACM): ACM includes Basic Fighter Maneuvers (BFM) where aircraft engage in offensive and defensive maneuvering against each other. No ordnance is released during this exercise.

Missile Firing Exercises (MISSILEX): A MISSILEX is an operation in which missiles are fired from either aircraft or ships against aerial targets. Air-to-Air exercises involve a fighter or fighter/attack aircraft firing a missile at an aerial target. Aerial targets are typically launched, controlled, and recovered from SCI while firing operations usually take place in W-291. The preferred launch location for aerial-launched targets is south of SCI, with the hazard pattern extending over portions of the SOAR range.

2.2.1.1.4 ASUW Training

Sinking Exercise (SINKEX): A SINKEX provides an opportunity for ship, submarine, and aircraft crews to deliver live ordnance on a deactivated vessel, which is deliberately sunk using multiple weapons systems. The duration of a SINKEX is unpredictable since it ends when the target sinks, sometimes immediately after the first weapon impact and sometimes only after multiple impacts by a variety of weapons. A SINKEX is conducted only occasionally, typically during a Joint Task Force Exercise (JTFEX), and is conducted under a permit from the U.S. Environmental Protection Agency (EPA).

Surface-to-Surface Gunnery Exercise (GUNEX): A GUNEX takes place in the open ocean to provide gunnery practice for ship crews utilizing shipboard gun systems. Exercises involve a variety of surface targets, both stationary and maneuverable.

Visit Board Search and Seizure (VBSS): These exercises involve the interception of a suspect surface ship by a Navy ship for the purpose of boarding-party inspection or the seizure of suspect ship.

Aircraft Laser Weapons Exercise—Sea: In these training events, helicopters or fighter/attack aircraft expend precision-guided munitions against maneuverable, high-speed, surface targets. Primary operations areas are Laser Training Ranges (LTRs) 1 and 2.

Airborne Surface Attack Exercises: This event involves conducting attacks on surface vessels from naval aircraft. It involves pairs of FA-18, SH-60, or P-3 aircraft delivering ordnance against towed targets.

Surface Firing Exercise: These operations train surface ship crews in high-speed surface engagement procedures against mobile (towed or self-propelled) seaborne targets. Both live and non-explosive training rounds are used against the targets.

2.2.1.1.5 EC Training

Electronic combat operations are conducted in offshore areas and on the Electronic Warfare (EW) Range at the SCIR. Offshore events generally consist of electronic threat simulation and jamming services that are provided to surface ships. Appropriately configured aircraft fly threat profiles against the ships so that crews are trained to detect electronic signatures of various threat aircraft counter jamming of their own electronic equipment by the simulated threat. The EW Range provides air, surface, and subsurface units with operating experience in a dense electronic threat environment similar to what they would face in an actual combat theater. Electronic signals emanate primarily from the Range Electronic Warfare Simulator (REWS), in the north part of SHOBA. Typical EW activities include threat avoidance training, signals analysis, use of airborne and surface electronic jamming devices to defeat tracking radar systems, and the firing of very small simulated surface-to-air missiles (called Smokey SAMs).

2.2.1.1.6 NSW Training

NSW forces (SEALs and Special Boat Units [SBUs]) train to conduct military operations in five Special Operations mission areas: unconventional warfare, direct action, special reconnaissance, foreign internal defense, and counterterrorism. Specific training events include:

Insertion/Extraction: NSW personnel conduct insertion/extraction operations including parachute training of personnel, rubber boats, and equipment, within the Leon Water Drop Zone and in transit to San Clemente Island.

Gunnery Exercises (GUNEX): GUNEX is primarily a ground operation involving an amphibious landing, ground maneuver, live-fire and demolition training by a Marine Corps special operations or NSW units. This category also includes boat-to-shore and boat-to-boat gunnery. Demolition training can be either on land or underwater. A typical GUNEX is a NSW mission conducted against an objective in SHOBA, usually at night, using small arms live-fire and demolitions charges

Basic Training—BUD/S: BUD/S individual training is conducted by the NSW Center. A portion of this training occurs on SCI, including land and underwater demolition, small arms training.

UAV Training: NSW forces train on SCI with UAVs, which provide remotely-piloted aerial reconnaissance.

Other NSW Training Events: NSW training, primarily conducted on SCI, includes: the SEAL Weapons Systems (SWS) course, which provides training in a wide range of underwater and land demolitions; the Special Warfare Combatant Crew (SWCC) course, Seal Qualification Training; and a variety of operational training events for SEAL units and SBUs.

2.2.1.1.7 AMW Training

Amphibious Warfare training includes individual and crew, small unit, large unit, and MAGTF-level events. Individual and crew training includes operation of amphibious vehicles and naval gunfire support training. Small unit training operations include events leading to the certification of a MEU as “Special Operations Capable” (SOC). Such training includes shore assaults, boat raids, airfield or port seizures, and reconnaissance. Larger-scale amphibious exercises are carried out principally by MAGTFs or elements of MAGTFs embarked with ESGs; these include:

Naval Surface Fire Support (FIREX) and Expeditionary Firing Exercise (EFEX): These exercises are required pre-deployment training events, conducted in SHOBA. EFEX is conducted by Marine forces in conjunction with a Fire Support Coordination Center Exercise (FSCEX). The EFEX involves coordination of naval gunfire from surface ships with land-based artillery and CAS. The naval gunfire component trains surface ships in land bombardment, and is known as a FIREX. Amphibious landings operations may be associated with these events. A typical operation involves landing an artillery battery (truck-towed 155mm howitzers) on SCI for live-fire training.

Air Strikes and Close Air Support (CAS): Air strikes are aircraft or missile attacks of ground targets that are located in SHOBA’s Impact Areas I and II. The operations can originate from an aircraft carrier or land bases. CAS operations are air strikes that are integrated with the fire and maneuver of ground forces.

Aircraft Laser Weapons Exercise—Land: These operations train aircrews in the delivery of laser-guided weapons against targets in SHOBA.

Stinger Air-Defense Missile Firing: The Stinger is a small shoulder-fired or vehicle mounted anti-aircraft missile utilized by Marine and NSW forces. Training is conducted from positions on-shore in SHOBA, or by NSW units firing the missiles from boats in the near-shore area.

2.2.1.1.8 Explosive Ordnance Disposal (EOD) Activities

EOD operations are conducted on SCI, primarily in SHOBA and the Missile Impact Range. These operations consist of specially trained personnel conducting sweeps, inspections, and cleanup of Unexploded Ordnance (UXO).

2.2.1.1.9 Combat Search and Rescue (CSAR)

The CSAR operation is usually in conjunction with a larger COMPTUEX or other Fleet exercise. The purpose of the operation is to locate, protect, and evacuate downed aviation crew members from hostile territory. The operation can include reconnaissance aircraft to find the downed aircrew, helicopters to conduct the rescue, and fighter aircraft to perform CAS to protect both the downed aircrews and the rescue helicopters.

2.2.1.1.10 RDT&E

SPAWARSYSCEN conducts RDT&E, engineering, and fleet support for command, control, and communications systems and ocean surveillance. SPAWAR's tests on SCIR include a wide variety of ocean engineering, missile firings, torpedo testing, manned and unmanned submersibles, UAVs, EC, and other Navy weapons systems. Specific events include:

Ship Tracking and Torpedo Tests

Unmanned Underwater Vehicle (UUV) Tests

Sonobuoy Quality Assurance (QA)/Quality Control (QC) Tests

Ocean Engineering Tests

Marine Mammal Mine Shape Location and Research

Radio Frequency (RF) Tests

Unmanned Aerial Vehicles (UAV) Tests

Missile Flight Tests

2.2.1.1.11 Naval Undersea Warfare Center (NUWC) Acoustics Tests:

The San Diego Division of NUWC is a Naval Sea Systems Command (NAVSEA) organization supporting the Pacific Fleet. NUWC operates and maintains the SCI Underwater Range (SCIUR). NUWC conducts tests, analysis, and evaluation of submarine USW exercises and test programs. It also provides engineering and technical support for Undersea Warfare (USW) programs and exercises design cognizance of underwater weapons acoustic and tracking ranges and associated range equipment. It also provides proof testing and evaluation for underwater weapons, weapons systems, and components.

2.2.1.1.12 Naval Auxiliary Landing Field (NALF) SCI Airfield Activities

NALF SCI provides opportunities for aviation training and aircraft access to the island. The airfield is restricted to military aircraft and authorized contract flights. There are no permanently assigned aircraft, and aviation support is limited essentially to refueling. NALF SCI has the primary mission of training Naval Air Force Pacific aircrews in Field Carrier Landing Practice (FCLP). FCLP involves landing on a simulated aircraft carrier deck painted on the surface of the runway near its east end. Other military activities include visual and instrument approaches and departures, aircraft equipment calibration, survey and photo missions, range support, exercise training, RDT&E test support, medical evacuation, and supply and personnel flights.

2.2.1.1.13 Major Range Events

There SOCAL Range Complex hosts “major ranges events.” These generally are “capstone” exercises, conducted as required milestones in the pre-deployment certification of naval strike groups, such as an ESG or CSG. Major range events bring together the elements of a naval strike group (e.g., surface combatant ships, support ships, submarines, fixed-wing and helicopter aviation squadrons, and Marine

Corps forces) to training in complex command and control functions, and in coordination of the operations and activities of these component parts of the task force.

Major range exercises must be understood as part of a training continuum that includes individual and crew training, training of smaller formations, and complex, strike group training. In a major range event, most of the operations and activities being directed and coordinated by the strike group commander are identical in nature to the operations conducted in the course in individual, crew, and smaller-unit training events. In a major range event, however, these disparate training tasks are conducted in concert, rather than in isolation. Aspects of training that are unique to major range events involve the exercise of complex command, control, and logistics functions.

Major range events involve a large number of personnel, air, surface, subsurface, and ground assets in a multi-dimensional exercise. These exercises typically employ an exercise scenario developed to test and train the strike group in required naval tactical tasks. While exercise scenarios for different major range events will be similar, they will not be identical. Exercise scenarios would differ based on the strike group's mission and the operating environment it expects to encounter. Thus, a pre-deployment exercise for a CSG or ESG deploying to the western Pacific Ocean may differ from an exercise conducted by a similar strike group deploying to the Indian Ocean or the Arabian Sea.

Examples of major range events include the Composite Training Unit Exercise (COMPTUEX) and Joint Task Force Exercise (JTFEX). The COMPTUEX is an Integration Phase, at-sea, major range event. For the CSG, this exercise integrates the aircraft carrier and carrier air wing with surface and submarine units in a challenging operational environment. For the ESG, this exercise integrates amphibious ships with their associated air wing, surface ships, submarines, and Marine Expeditionary Unit (MEU). Live fire operations that may take place during COMPTUEX include long-range air strikes, Naval Surface Fire Support (NSFS), and surface-to-air, surface-to-surface, and air-to-surface missile exercises. The MEU also conducts realistic training based on anticipated operational requirements and to further develop the required coordination between Navy and Marine Corps forces. Special Operations training may also be integrated with the exercise scenario. The COMPTUEX is typically 21 days in length. The exercise is conducted in accordance with a schedule of events, which may include two 1-day, scenario-driven, "mini" battle problems, culminating with a scenario-driven 3-day Final Battle Problem.

The JTFEX is a dynamic and complex major range event that is the culminating exercise in the Sustainment Phase training for the CSGs and ESGs. For an ESG, the exercise incorporates an Amphibious Ready Group (ARG) Certification Exercise (ARG CERT) for the amphibious ships and a Special Operations Capable Certification (SOCCERT) for the MEU. When schedules align, the JTFEX may be conducted concurrently for an ESG and CSG. JTFEX emphasizes mission planning and effective execution by all primary and support warfare commanders, including command and control, surveillance, intelligence, logistics support, and the integration of tactical fires. JTFEXs are complex scenario-driven exercises that evaluate a strike group in all warfare areas. JTFEX is normally 10 days long, not including a 3-day in-port Force Protection Exercise, and is the final at-sea exercise for the CSG or ESG prior to deployment.

Table 2-4 identifies typical training operations conducted in the SOCAL Range Complex. This table also groups operations according to the location within the Complex where the operation is generally conducted.

Table 0-4: SOCAL Range Complex: Current Operations by Warfare Area and Location

Navy Warfare Area	No.	Operation Type	Short title	Areas
Anti-Air Warfare	1	Aircraft Combat Maneuvers	ACM	W-291 PAPA Areas
	2	Air Defense Exercise	ADEX	W-291
	3	Surface-to-Air Missile Exercise	A-A MISSILEX	W-291
	4	Surface-to-Air Gunnery Exercise	S-A MISSILEX	W-291
	5	Air-to-Air Missile Exercise	S-A GUNEX	FLETA HOT
Anti-Submarine Warfare	6	Antisubmarine Warfare Tracking Exercise - Helicopter	ASW TRACKEX - Helicopter	W-291/SOAR/USWTRs*
	7	Antisubmarine Warfare Tracking Exercise - Maritime Patrol Aircraft	ASW TRACKEX - MPA	W-291/SOAR/USWTRs*
	8	Antisubmarine Warfare Torpedo Exercise - Helicopter	ASW TORPEX - Helicopter	SOAR/USWTRs*
	9	Antisubmarine Warfare Torpedo Exercise - Maritime Patrol Aircraft	ASW TORPEX - MPA	SOAR/USWTRs*
	10	Antisubmarine Warfare Tracking Exercise - Surface	ASW TRACKEX - Surface	W-291/SOAR/USWTRs*
	11	Antisubmarine Warfare Torpedo Exercise - Surface	ASW TORPEX - Surface	SOAR/USWTRs*
	12	Surface Ship Integrated ASW (IAC II)	IAC II	SOAR/USWTRs
	13	Antisubmarine Warfare Torpedo Exercise - Submarine	ASW TORPEX - Sub	SOAR/USWTRs
Anti-Surface Warfare	14	Visit Board Search and Seizure	VBSS	W-291/3803, SOAR
	15	Air-to-Surface Missile Exercise	MISSILEX (A-S)	SOAR
	16	Air-to-Surface Bombing Exercise	BOMBEX (Sea)	SOAR
	17	Air-to-Surface Gunnery Exercise	GUNEX (A-S)	SOAR
	18	Surface-to-Surface Gunnery Exercise	GUNEX (S-S)	FLETA HOT/SOAR
	19	Sink Exercise	SINKEX	W-291
Amphibious Warfare	20	Naval Surface Fire Support	NSFS	SHOBA/SWTR Nearshore
	21	Expeditionary Fires Exercise	EFEX	SHOBA/SWTR Nearshore
	22	Expeditionary Assault - Battalion Landing	BN Landing	SHOBA/SWTR Nearshore
	23	USMC Stinger Firing Exercise	Stinger	SHOBA
	24	Amphibious Landings and Raids (on SCI)	AMW Landings	West Cove, NW Harbor
	25	Amphibious Operations - CPAAA	AMW Operations	CPAAA
Electronic Warfare	26	Electronic Combat Operations	EC OPS	EW Range

Navy Warfare Area	No.	Operation Type	Short title	Areas
Mine Warfare	27a	Small Object Avoidance	SOA	Kingfisher
	27b	Small Object Avoidance - USWTR	SOA/USWTR	SWTR OS
	28	Mine Neutralization	Mine Neutralization	
	29	Mine Laying	Mine Laying	MTRs/SWTRs
Naval Special Warfare	30	NSW Land Demolition	Land Demo	Demolition Range
	31	Underwater Demolition	Water Demo-sm	NW Harbor
	32	Underwater Mat Weave	Water Demo-lg	NW Harbor
	33	Small Arms Training	Small Arms	Small Arms Range
	34	Land Navigation	LANDNAV	Northern Half of SCI
	35	NSW UAV Operations	UAV	North of SHOBA
	36	Insertion/Extraction	Insert	Leon DZ
	37	NSW Boat Operations	NSW Boat Ops	All north of SHOBA
	38	NSW GRU ONE SEAL Platoon Operations	NSW Platoon Ops	All north of SHOBA
	39	NSW GUNEX Full Mission Profile	GUNEX (S-S)	SHOBA/SWTR Nearshore
Strike	40	Bombing Exercise (Land)	BOMBEX (Land)	SHOBA
	41	Combat Search & Rescue	CSAR	All SCI
Non-Combatant Operations	42	Explosive Ordnance Disposal SCI	EOD	SHOBA/MIR
SPAWAR	43	Ship Torpedo Tests	Torp Tests	SOAR
	44	Unmanned Underwater Vehicles	UUV	NOTS Pier Area
	45	Sonobuoy QA/QC Testing	Sonobuoy	SCIUR
	46	Ocean Engineering	Ocean Engineering	NOTS Pier Area
	47	Marine Mammal Mine Shape Location/Research	Mine Location	Mine Training Ranges/NOTS Pier
	48	RF Emissions	RF	Northern Plateau
	49	UAV Tests	UAV	Cancelled 7/20/05
	50	Missile Flight Tests	Missile Flight Tests	Entire Island
	51	Other Tests	Other	SOAR/SHOBA/Kingfisher
NUWC	52	NUWC Underwater Acoustics Testing	NUWC	SCIUR
* There are two USWTR areas: Offshore (OS) and Nearshore (NS)				
Air Operations	53	NALF Airfield Activities	NALF	NALF San Clemente
Major Range Events	NA	Major Range Events (by reference)		

2.2.2 Alternative 1

Alternative 1 is a proposal designed to meet Navy and DOD current and near-term operational training requirements. If Alternative 1 were to be selected, in addition to accommodating training operations currently conducted, the SOCAL Range Complex would support an increase in training operations including Major Range Events and force structure changes associated with introduction of new weapons systems, vessels, and aircraft into the Fleet. Under Alternative 1, baseline-training operations would be increased. In addition, training and operations associated with force structure changes would be implemented for the LCS, MV-22 Osprey, the EA-18G Growler, and the SH-60R/S Seahawk Multi-Mission Helicopter. Force structure changes associated with new weapons systems would include Offensive Mine Counter Measure (OMCM) systems.

2.2.2.1 Additional Operations

Table 2-5 identifies the baseline and proposed increases in operations in the SOCAL Range Complex if Alternative 1 is implemented.

2.2.2.2 Force Structure Changes

The SOCAL Range Complex is required to accommodate and support training with new ships, aircraft, and vehicles as they become operational in the Fleet. In addition, the SOCAL Range Complex is required to support training with new weapons/sensor systems. Several future platforms and weapons/sensor systems that are in development will likely be incorporated into the Navy and Marine Corps training requirement within the 10-year planning horizon. Several of these new technologies are in early stages of development, and thus specific concepts of operations, operating parameters, or training requirements are not available.

2.2.2.3 New Platforms/Vehicles

Littoral Combat Ship

The Littoral Combat Ship (LCS) is a specialized variant of the DD(X) family. It is designed to be a networked, agile, stealthy surface combatant capable of defeating anti-access and asymmetric threats in the littoral (shallow/nearshore) waters. Primary missions of the LCS include surface warfare (SUW) against hostile small boats; mine countermeasures (MCM); littoral anti-submarine warfare (ASW); intelligence, surveillance, and reconnaissance (ISR); homeland defense; maritime interception operations; special operation forces support; and logistics support for movement of personnel and supplies. The LCS will operate with CSGs and Surface Action Groups, in groups of other similar ships, or independently for diplomatic and presence missions. Additionally, the LCS will have the capability to operate cooperatively with the U.S. Coast Guard and Allies. Designed with the mission to operate in littoral waters, the LCS has unique range and training requirements that must be considered.

MV-22 Osprey

The MV-22 is a tilt rotor vertical/short takeoff and landing (V/STOL), multi-mission aircraft developed to fill multi-service combat operational requirements. It replaces the current Marine Corps assault helicopters in the medium lift category (CH-46E and CH-53D), contributing to the dominant maneuver of the Marine landing force and supporting focused logistics in the days following commencement of an amphibious operation. It is designed for combat, combat support, combat service support, and Special Operations worldwide. The ability to rapidly self-deploy and fly significant distances at high speeds provides rapid response to crisis situations and will extend the operational reach for ship-to-objective-maneuver (STOM) and sustained operations ashore (SOA).

EA-18G Growler

The EA-18G Growler is an electronic combat version of the FA-18 E/F that will replace the EA-6B Prowler. The Growler will have an integrated suite of EC systems that will initially be centered on the ICAP III system, but will also include tactical jamming pods, a radar receivers wingtip pods, an advanced crew station, the Airborne Electronically Scanned Array (AESA) multimode radar, and a communications receiver and jammer. The advanced capabilities of the Growler will require greater standoff ranges and broader frequency spectrum access than current systems.

MH-60R/S Seahawk Multi-Mission Helicopter

The MH-60R Seahawk Multi-Mission Helicopter is a planned conversion of all SH-60B, and eventually all SH-60F helicopters, with IOC expected in 2008. The MH-60S will replace all Navy variants of the H-46D by the end of FY 2004, for use in Vertical Replenishment (VERTREP). These new versions will feature advanced radar, missiles, low-frequency sonar and a host of other improvements including the new Organic Airborne Mine Countermeasures (OAMCM) capability.

2.2.2.4 New Weapons Systems

Under the proposed action, the only weapons system being introduced at this time that warrants evaluation in this EIS/OEIS are the Organic Mine Countermeasures Systems (OMCMs). Five OMCM airborne systems will be deployed by the SH-60R/S which include: AN/AQS-20 Sonar, mine detecting set; AN/AES-1 Airborne Laser Mine Detection System (ALMDS); Airborne Mine Neutralization System (AMNS); AN/ALQ-220 Organic Airborne and Surface Influence Sweep (OASIS); and AN/AWS-2 Rapid Airborne Mine Clearance System (RAMCIS). One OMCM System, the Remote Minehunting System (RMS), will be deployed from a surface ship. Another OMCM system, the Long-term Mine Reconnaissance System (LMRS), will be deployed from submarine.

Table 0-5. Proposed Baseline and Proposed Increases in Operations: Alternative 1

Navy Warfare Area	No.	Operation Type	Short title	Areas	# of Operations	
					No Action (baseline)	Alt 1
Anti-Air Warfare	1	Aircraft Combat Maneuvers	ACM	W-291 PAPA Areas	1,021	1,072
	2	Air Defense Exercise	ADEX	W-291	502	511
	3	Surface-to-Air Missile Exercise	A-A MISSILEX	W-291	1	4
	4	Surface-to-Air Gunnery Exercise	S-A MISSILEX	W-291	262	350
	5	Air-to-Air Missile Exercise	S-A GUNEX	FLETA HOT	13	13
Anti-Submarine Warfare	6	Antisubmarine Warfare Tracking Exercise - Helicopter	ASW TRACKEX - Helicopter	W-291/SOAR/USWTRs*	15	16
	7	Antisubmarine Warfare Tracking Exercise - Maritime Patrol Aircraft	ASW TRACKEX - MPA	W-291/SOAR/USWTRs*	152	160
	8	Antisubmarine Warfare Torpedo Exercise - Helicopter	ASW TORPEX - Helicopter	SOAR/USWTRs*	101	122
	9	Antisubmarine Warfare Torpedo Exercise - Maritime Patrol Aircraft	ASW TORPEX - MPA	SOAR/USWTRs*	15	16
	10	Antisubmarine Warfare Tracking Exercise - Surface	ASW TRACKEX - Surface	W-291/SOAR/USWTRs*	45	48
	11	Antisubmarine Warfare Torpedo Exercise - Surface	ASW TORPEX - Surface	SOAR/USWTRs*	77	81
	12	Surface Ship Integrated ASW (IAC II)	IAC II	SOAR/USWTRs	59	48
	13	Antisubmarine Warfare Torpedo Exercise - Submarine	ASW TORPEX - Sub	SOAR/USWTRs	48	50
Anti-Surface Warfare	14	Visit Board Search and Seizure	VBSS	W-291/3803, SOAR	56	78
	15	Air-to-Surface Missile Exercise	MISSILEX (A-S)	SOAR	94	94
	16	Air-to-Surface Bombing Exercise	BOMBEX (Sea)	SOAR	32	35
	17	Air-to-Surface Gunnery Exercise	GUNEX (A-S)	SOAR	47	50
	18	Surface-to-Surface Gunnery Exercise	GUNEX (S-S)	FLETA HOT/SOAR	315	350
	19	Sink Exercise	SINKEX	W-291	2	2
Amphibious Warfare	20	Naval Surface Fire Support	NSFS	SHOBA/SWTR Nearshore	57	60
	21	Expeditionary Fires Exercise	EFEX	SHOBA/SWTR Nearshore	6	7
	22	Expeditionary Assault - Battalion Landing	BN Landing	SHOBA/SWTR Nearshore	0	1
	23	USMC Stinger Firing Exercise	Stinger	SHOBA	0	3
	24	Amphibious Landings and Raids (on SCI)	AMW Landings	West Cove, NW Harbor	11	42
	25	Amphibious Operations - CPAAA	AMW Operations	CPAAA	~3,000	~3,000
Electronic Warfare	26	Electronic Combat Operations	EC OPS	EW Range	748	755
Mine Warfare	27a	Small Object Avoidance	SOA	Kingfisher	44	46

Navy Warfare Area	No.	Operation Type	Short title	Areas	# of Operations No Action (baseline)	Alt 1
	27b	Small Object Avoidance - USWTR	SOA/USWTR	SWTR OS	44	35
	28	Mine Neutralization	Mine Neutralization			
	29	Mine Laying	Mine Laying	MTRs/SWTRs	17	17
Naval Special Warfare	30	NSW Land Demolition	Land Demo	Demolition Range	90	101
	31	Underwater Demolition	Water Demo-sm	NW Harbor	72	85
	32	Underwater Mat Weave	Water Demo-lg	NW Harbor	14	16
	33	Small Arms Training	Small Arms	Small Arms Range	171	205
	34	Land Navigation	LANDNAV	Northern Half of SCI	108	130
	35	NSW UAV Operations	UAV	North of SHOBA	5	15
	36	Insertion/Extraction	Insert	Leon DZ		
	37	NSW Boat Operations	NSW Boat Ops	All north of SHOBA		
	38	NSW GRU ONE SEAL Platoon Operations	NSW Platoon Ops	All north of SHOBA	340	512
	39	NSW GUNEX Full Mission Profile	GUNEX (S-S)	SHOBA/SWTR Nearshore		
Strike	40	Bombing Exercise (Land)	BOMBEX (Land)	SHOBA	176	197
	41	Combat Search & Rescue	CSAR	All SCI	1	10
Non-Combatant Operations	42	Explosive Ordnance Disposal SCI	EOD	SHOBA/MIR	5	5
SPAWAR	43	Ship Torpedo Tests	Torp Tests	SOAR	22	15
	44	Unmanned Underwater Vehicles	UUV	NOTS Pier Area	10	10
	45	Sonobuoy QA/QC Testing	Sonobuoy	SCIUR	117	117
	46	Ocean Engineering	Ocean Engineering	NOTS Pier Area	242	242
	47	Marine Mammal Mine Shape Location/Research	Mine Location	Mine Training Ranges/NOTS Pier	5	20
	48	RF Emissions	RF	Northern Plateau	15	15
	49	UAV Tests	UAV	Cancelled 7/20/05	12	0
	50	Missile Flight Tests	Missile Flight Tests	Entire Island	10	15
	51	Other Tests	Other	SOAR/SHOBA/Kingfisher	36	15
NUWC	52	NUWC Underwater Acoustics Testing	NUWC	SCIUR	46	83
* There are two USWTR areas: Offshore (OS) and Nearshore (NS)						
Air Operations	53	NALF Airfield Activities	NALF	NALF San Clemente	25,120	23,439
Major Range Events	Major range events such as JTFEX and COMPTUEX are "capstone" exercises, comprised of multiple operations identified in this table, conducted in a coordinated fashion under a single strike group commander (see Section 2.2.1.1.13).					

2.2.3 Alternative 2

Alternative 2, if selected would implement all elements of Alternative 1 (accommodating training operations currently conducted; increase in training operations [including Major Range Events], and force structure changes). In addition, under Alternative 2: training operations of the types currently conducted would be increased over the levels identified in Alternative 1 (see Table 2-6) and, range enhancements would be implemented, to include an increase in Commercial Air Services, establishment of a shallow water minefield; and establishment of the shallow water training range in the SOAR extensions, as described below.

Alternative 2 is the preferred alternative.

2.2.3.1 Additional Operations

Table 2-7 identifies the baseline, and proposed increases in operations in the SOCAL Range Complex under Alternative 2.

Table 0-6: Baseline and Proposed Increases in Operations: Alternative 2

Navy Warfare Area	No.	Operation Type	Short title	Areas	# of Operations	
					No Action (Baseline)	Alt 2
Anti-Air Warfare	1	Aircraft Combat Maneuvers	ACM	W-291 PAPA Areas	1,021	1,072
	2	Air Defense Exercise	ADEX	W-291	502	531
	3	Surface-to-Air Missile Exercise	A-A MISSILEX	W-291	1	6
	4	Surface-to-Air Gunnery Exercise	S-A MISSILEX	W-291	262	350
	5	Air-to-Air Missile Exercise	S-A GUNEX	FLETA HOT	13	13
Anti-Submarine Warfare	6	Antisubmarine Warfare Tracking Exercise - Helicopter	ASW TRACKEX - Helicopter	W-291/SOAR/USWTRs*	15	17
	7	Antisubmarine Warfare Tracking Exercise - Maritime Patrol Aircraft	ASW TRACKEX - MPA	W-291/SOAR/USWTRs*	152	165
	8	Antisubmarine Warfare Torpedo Exercise - Helicopter	ASW TORPEX - Helicopter	SOAR/USWTRs*	101	128
	9	Antisubmarine Warfare Torpedo Exercise - Maritime Patrol Aircraft	ASW TORPEX - MPA	SOAR/USWTRs*	15	17
	10	Antisubmarine Warfare Tracking Exercise - Surface	ASW TRACKEX - Surface	W-291/SOAR/USWTRs*	45	48
	11	Antisubmarine Warfare Torpedo Exercise - Surface	ASW TORPEX - Surface	SOAR/USWTRs*	77	85
	12	Surface Ship Integrated ASW	IAC II	SOAR/USWTRs	59	60

Navy Warfare Area	No.	Operation Type	Short title	Areas	# of Operations No Action (Baseline)	# of Operations Alt 2
		(IAC II)				
	13	Antisubmarine Warfare Torpedo Exercise - Submarine	ASW TORPEX - Sub	SOAR/USWTRs	48	53
Anti-Surface Warfare	14	Visit Board Search and Seizure	VBSS	W-291/3803, SOAR	56	90
	15	Air-to-Surface Missile Exercise	MISSILEX (A-S)	SOAR	94	99
	16	Air-to-Surface Bombing Exercise	BOMBEX (Sea)	SOAR	32	40
	17	Air-to-Surface Gunnery Exercise	GUNEX (A-S)	SOAR	47	60
	18	Surface-to-Surface Gunnery Exercise	GUNEX (S-S)	FLETA HOT/SOAR	315	350
	19	Sink Exercise	SINKEX	W-291	2	3
Amphibious Warfare	20	Naval Surface Fire Support	NSFS	SHOBA/SWTR Nearshore	57	62
	21	Expeditionary Fires Exercise	EFEX	SHOBA/SWTR Nearshore	6	8
	22	Expeditionary Assault - Battalion Landing	BN Landing	SHOBA/SWTR Nearshore	0	2
	23	USMC Stinger Firing Exercise	Stinger	SHOBA	0	4
	24	Amphibious Landings and Raids (on SCI)	AMW Landings	West Cove, NW Harbor	11	61
	25	Amphibious Operations - CPAAA	AMW Operations	CPAAA	~3,000	~3,000
Electronic Warfare	26	Electronic Combat Operations	EC OPS	EW Range	748	775
Mine Warfare	27a	Small Object Avoidance	SOA	Kingfisher	44	48
	27b	Small Object Avoidance - USWTR	SOA/USWTR	SWTR OS	44	36
	28	Mine Neutralization	Mine Neutralization			
	29	Mine Laying	Mine Laying	MTRs/SWTRs	17	18
Naval Special Warfare	30	NSW Land Demolition	Land Demo	Demolition Range	90	101
	31	Underwater Demolition	Water Demo-sm	NW Harbor	72	85
	32	Underwater Mat Weave	Water Demo-lg	NW Harbor	14	18
	33	Small Arms Training	Small Arms	Small Arms Range	171	205

Navy Warfare Area	No.	Operation Type	Short title	Areas	# of Operations No Action (Baseline)	# of Operations Alt 2
	34	Land Navigation	LANDNAV	Northern Half of SCI	108	130
	35	NSW UAV Operations	UAV	North of SHOBA	5	27
	36	Insertion/Extraction	Insert	Leon DZ		
	37	NSW Boat Operations	NSW Boat Ops	All north of SHOBA		
	38	NSW GRU ONE SEAL Platoon Operations	NSW Platoon Ops	All north of SHOBA	340	668
	39	NSW GUNEX Full Mission Profile	GUNEX (S-S)	SHOBA/SWTR Nearshore		
Strike	40	Bombing Exercise (Land)	BOMBEX (Land)	SHOBA	176	215
	41	Combat Search & Rescue	CSAR	All SCI	1	15
Non-Combatant Operations	42	Explosive Ordnance Disposal SCI	EOD	SHOBA/MIR	5	10
SPAWAR	43	Ship Torpedo Tests	Torp Tests	SOAR	22	20
	44	Unmanned Underwater Vehicles	UUV	NOTS Pier Area	10	15
	45	Sonobuoy QA/QC Testing	Sonobuoy	SCIUR	117	120
	46	Ocean Engineering	Ocean Engineering	NOTS Pier Area	242	242
	47	Marine Mammal Mine Shape Location/Research	Mine Location	Mine Training Ranges/NOTS Pier	5	30
	48	RF Emissions	RF	Northern Plateau	15	20
	49	UAV Tests	UAV	Cancelled 7/20/05	12	0
	50	Missile Flight Tests	Missile Flight Tests	Entire Island	10	20
	51	Other Tests	Other	SOAR/SHOBA/Kingfisher	36	20
NUWC	52	NUWC Underwater Acoustics Testing	NUWC	SCIUR	46	139
* There are two USWTR areas: Offshore (OS) and Nearshore (NS)						
Air Operations	53	NALF Airfield Activities	NALF	NALF San Clemente	25,120	24,332
Major Range Events	NA	Major Range Events (by reference)				

2.2.3.2 SOCAL Range Complex Enhancements

Several specific investments and recommendations are required to optimize range capabilities to adequately support training for all missions and roles assigned to the SOCAL Range Complex.

Investment recommendations are based on capability shortfalls (or gaps) and were assessed using the Navy and Marine Corps range required capabilities. Proposed enhancements that pertain to the SOCAL Range Complex are analyzed in the associated EIS/OEIS.

2.2.3.2.1 Commercial Air Services Increase

Under the proposed action, an increase in Commercial Air Services would be implemented. This is a Priority 1 investment because Fleet aircraft are no longer being funded to provide opposition forces (OPFOR) for the CSG and ESG exercises including major range events. In order to provide the required training for CSGs and ESGs, a corresponding increase in Commercial Air Services acting as OPFOR will be required. This would provide for an increase in the number of supersonic and subsonic aircraft within the SOCAL Range Complex. Implementation of the increase is necessary to mitigate for the loss of Fleet aircraft funding and to meet Navy RCD OPFOR requirements.

2.2.3.2.2 Shallow Water Minefield

The Navy plans to construct a shallow water minefield in the SOCAL Range Complex. Multiple site options off Tanner Bank, Cortes Bank, La Jolla and Point Loma have been identified with consideration being given to bathymetry and required capabilities. Of the five areas identified, an area known as Advanced Research Project Agency Training Minefield (ARPA) off La Jolla and historically used for shallow water submarine MCM training is the desired location for expanding MCM training.

Shallow water minefield support of submarine MCM training requires a depth of 250-420 feet, and a sandy bottom and flat contour in an area relatively free from high swells and waves. The size of the area should be a minimum of 2x2-nm and optimally 3x3-nm. Mine shapes would be approximately 500-700 yards apart and 30-35 inches in size, and would consist of a mix of recoverable/replaceable bottom shapes (~10 cylinders weighed down with cement) and moored shapes (~15 shapes, no bottom drilling required for mooring). Shapes would typically need maintenance or cleaning every two years. The MH-60S has similar requirements for shallow water minefield mine training shapes. A fixed shallow water minefield site is not a requirement for Organic Airborne Mine Counter Measures (OAMCM) training however a fixed site would see usage for non-explosive training.

Use of the shallow water minefield would include submarines, surface vessels, and helicopters utilizing a mix of mid to high frequency navigation/mine detecting sonar systems that are either platform based or remotely operated. Airborne laser mine detection systems may also be used to locate surface, moored, and bottom mines. Once located, mine neutralization of permanent shapes by explosive shaped-charge, ordnance, or removal would be by simulation only.

2.2.3.2.3 Shallow Water Training Range (SWTR) Extension

This component of the Proposed Action is to instrument and use two extensions of the current SOAR, one 250-nm^2 area to the west in the area of the Tanner/Cortes Banks, and one 250-nm^2 between SOAR and the southern section of SCI. The instrumentation would be in the form of undersea cables and sensor nodes, which would constitute a SWTR portion of SOAR. The cables and sensors are similar to those that instrument the current deep-water range (SOAR). The combination of deep-water and shallow-water instrumentation provides range uninterrupted coverage of air, surface, and subsurface operations. The instrumented area would be connected to the shore via a single trunk cable.

Phased construction of the SWTR instrumentation array is planned. Construction is scheduled to take place in three increments that would occur over a projected 9-year period (i.e., each phase would take 3 years), beginning with an initial increment of 200 nm2 (370 km2), followed by another 200-nm2 (370-km2) increment, and a final increment of 100 nm2 (185 km2). Because of the size and operational requirements, this section of the range would only be used in a limited manner initially (for the first 3 to 6 years). The analysis conducted in this document addresses full usage of the range once construction has been completed. Before all three phases are complete, range use would be more limited than that described in this document; therefore, effects would be less than those predicted in this analysis.

3 RESOURCE ANALYSIS

Potential effects on EFH and Managed Species from SOCAL operations are described in the following section. The evaluation reflects determinations made in sections of the EIS/OEIS where impacts on the marine environment are quantified, specifically Sections: 3.1 Geology and Soils, 3.3 Hazardous Materials and Wastes, 3.4 Water Quality, 3.5 Acoustic Environment, 3.6 Marine Environment, 3.7 Fish, and 3.14 Socioeconomics (commercial and recreational fishing).

Effects on EFH and Managed Species could be associated with vessel movement, aircraft over-flight, expended materials, hazardous chemicals, detonation of explosive ordnance, weapons training, sensor testing, and sonar use. Navy operations could have direct and indirect effects on individual species, modify their habitats, or alter water quality. The EFH assessment focuses on activities and effects common to offshore operations, but also discusses individual exercises such as Expeditionary Assault, TORPEX, and SINKEX with unique aspects. Mitigation measures and cumulative impacts are described in the final two sections.

3.1 IMPACT DEFINITION

EFH regulations require analysis of potential impacts that could have an adverse effect on EFH and Managed Species (NMFS 2007a). Adverse effect is defined as any impact which reduces the quality and/or quantity of essential fish habitat (NMFS 2004a,b). Adverse effects may include direct or indirect physical, chemical, or biological alterations of the waters or substrate and loss of, or injury to, benthic organisms, prey species and their habitat, and other ecosystem components. Adverse effects to EFH may result from actions occurring within EFH or outside of EFH and may include site-specific or habitat-wide impacts, including individual, cumulative, or synergistic consequences of actions (NMFS 2004a,b).

The EFH regulations in 50 C.F.R. § 600.815(a)(2)(ii) (NMFS 2002a) establish a threshold for determining adverse effects (NMFS 2002b). Adverse effects are more than minimal and not temporary in nature. Temporary effects are those that are limited in duration and allow the particular environment to recover without measurable impact (NMFS 2002b). Minimal effects are those that may result in relatively small changes in the affected environment and insignificant changes in ecological functions. Whether an impact is minimal will depend on a number of factors including: the intensity of the impact at the specific site being affected, the spatial extent of the impact relative to the availability of the habitat type affected, the sensitivity/vulnerability of the habitat to the impact, the habitat functions that may be altered by the impact (e.g., shelter from predators), and the timing of the impact relative to when the species or life stage need the habitat.

Thus, for Essential Fish Habitat and Managed Species an adverse effect is: 1) more than minimal, 2) not temporary, 3) causes significant changes in ecological function, and, 4) does not allow the environment to recover without measurable impact.

3.2 VESSEL MOVEMENT

Vessels performing training exercises in the SOCAL Range Complex are primarily large ocean going ships and submarines operating in waters greater than 328 ft (100 m) and small fast moving vessels. Large ocean going vessels (greater than 100 ft (30.4 m) in length) include a host of tactical military ships performing live firing, electronic monitoring, and avoidance maneuvering. Considering the complexity of the training operations and the required logistical mobilization and demobilization requirements, the majority of all ocean operations involve passive transit of vessels within the SOCAL Range Complex. Of the 4,102 ocean operations currently performed within the SOCAL Range Complex 3,000 are amphibious ocean operations. Other than amphibious operations the primary ocean operation components are surface to surface gunnery exercises (315 exercises), and surface to air gunnery exercises (262 exercises). Large ships operating in offshore waters move at approximately 20 knots at full speed but more often operate at significantly slower speeds while engaged in training activities.

Collisions with commercial and navy ships can injure or kill slow-moving marine animals. Most vulnerable are marine mammals and sea turtles that spend extended periods of time at the surface restoring oxygen levels after deep dives (e.g. Right Whale) (NMFS 2005c). Accordingly, the Navy has adopted protective measures to reduce the potential for collisions with surfaced marine animals. These include the use of lookouts trained to detect all objects on the surface of the water, and, reasonable and prudent actions to avoid the close interaction of Navy assets with marine mammals and sea turtles (DON 2007a,b,c,d). Marine fish are highly mobile and would likely sense approaching vessels and be able to avoid being struck (Chapman and Hawkins 1973, Acoustic Ecology 2007).

The noise from Navy vessels could affect fish behavior. However, Navy vessels are quiet compared to commercial vessels of comparable size. Bubble screens are commonly used to reduce propeller noise and other sound reduction mechanisms may be employed (Richardson et al. 1998).

Studies documenting behavioral responses of fish to vessels show that fish may exhibit avoidance responses to engine noise, sonar, depth finders, and fish finders (Jorgensen et al. 2004, Acoustic Ecology 2007). Avoidance reactions are quite variable depending on the type of fish, its life history stage, behavior, time of day, and the sound propagation characteristics of the water (Schwartz 1985). Misund (1997) found that fish ahead of a ship, that showed avoidance reactions, did so at ranges of 160 to 490 ft (50 to 350 m). When the vessel passed over them, some species of fish responded with sudden escape responses that included lateral avoidance and/or downward compression of the school.

The low-frequency sounds of large vessels or accelerating small vessels caused avoidance responses among herring (Chapman and Hawkins 1973). Avoidance ended within 10 seconds after the vessel departed. Twenty five percent of the fish groups habituated to the sound of the large vessel and 75 percent of the responsive fish groups habituated to the sound small boats.

Fish are capable of active avoidance so ship strikes would be a rare event. Behavioral impacts would be transient with return to normal behavior after a ship passes. SOCAL Range Complex vessel movement would not have an adverse effect on fish populations.

3.3 AIRCRAFT OVER-FLIGHT

Aircraft flyovers will be a routine event during training exercises. Most high-performance would fly at altitudes over 5,000 ft (1,524 m). However, aviation exercises can involve aircraft operating at low altitude (less than 1,500 ft (457 m)), at high speeds, for a brief periods, over relatively small areas in vicinity of practice targets. Otherwise, low-level flights are usually restricted to take-offs and landings, and flights by helicopters and observation aircraft.

Airborne sound from a low-flying airplanes or helicopters may be heard by marine animals at the surface or underwater but the acoustic intensity would not be likely to cause physical damage since sound does not transmit well from air to water (USAF 2002, DON 2007a,d).

The sounds from aircraft flying over the ocean could trigger startle responses and swimming away from the aircraft track in some sensitive species of fish in the upper portion of the water column. The primary factor causing abrupt movements of animals is engine noise, specifically changes in engine noise (Richardson et al.1995, Hain et al. 1999). Responses to aircraft noise would be within the range of normal behavior and highly transitory. Therefore, no significant effects on fish are expected.

Aircraft flown in warfare training areas may fly at supersonic speeds (i.e., speeds greater than the speed of sound). At supersonic speeds, air pressure waves combine and produce shock waves known as sonic booms. The penetration of sound pressure waves including sonic booms through an air/water interface is relatively inefficient (Yagla and Stiegler 2003, DON 2007b). Sonic booms would be infrequent and are not expected to have significant effects on marine life.

3.4 FUEL SPILLS

Fish could be harmed by petroleum hydrocarbons spilled as a result of ship or aircraft accidents and weapons and target use (DON 2007a,b,c,d). Oil and diesel fuel pose less risk than jet fuel which is particularly toxic. However, jet fuel floats on sea water and vaporizes quickly so it would not be likely to contact many fish. Assuming that an aerial target disintegrates on contact with the water, toxic components of the fuel would evaporate within several hours to days and/or be degraded by biogenic organisms (e.g., bacteria, phytoplankton, zooplankton) (NRC 1985). Small petro-chemical releases from weapons and targets would be spatially separated and occur at different times, even in areas of highest use (e.g., FLETA HOT and around San Clemente Island).

If a fuel spill occurs, the effects would be mitigated through compliance with standard spill-control responses and wildlife rescue procedures. Fuel dumping by aircraft rarely occurs. Department of the Navy (DON) aircrews are prohibited from dumping fuel below 6,000 ft (1,829 m), except in an emergency situation. Above 6,000 ft (1,829 m), the fuel has enough time to completely vaporize and dissipate and would therefore have a no effect on the sea below. Fuel spills should not be a significant hazard to EFH and Managed Species.

3.5 DISCHARGES FROM SHIPS

The International Convention for the Prevention of Pollution from Ships (MARPOL 73/78) prohibits certain discharges of oil, garbage, and other substances from vessels. The MARPOL Convention and its Annexes are implemented by national legislation, including the Act to Prevent Pollution from Ships (APPS) (33 USC 1901 to 1915) and the Federal Water Pollution Control Act (FWPCA) (33 USC 1321 to 1322). These statutes are further implemented and amplified by DON and the Office of the Chief of Naval Operations Environmental and Natural Resources Program Manual (OPNAVINST 5090.1 series), which establishes US Navy policy, guidance, and requirements for the operation of US Navy vessels. The vessels operating on the SOCAL Range Complex would comply with the discharge requirements established in OPNAVINST 5090.1 (series), minimizing or eliminating potential impacts from the discharges of ships.

3.6 EXPENDED MATERIAL

Most weapons and devices used during training exercises would be removed at the conclusion of the exercises. However, some weapons and devices are unrecoverable. This equipment includes: lightsticks, flares, chaff, dye, markers, sensing devices such as sonobuoys and expendable bathythermographs, torpedo accessories, targets, and sunken vessels.

3.6.1 Lightsticks

Lightsticks are small, plastic chemiluminescent devices used as portable light sources during training and rescue operations after dark (United States Air Force (USAF) 1997, 2002). Lightsticks are also used by divers and commercial fishers to mark their fishing gear. Lightsticks contain two solutions which, when mixed together by breaking two small glass ampoules within the plastic casing, produce a light with little or no heat. Their chemical contents are not classified as hazardous waste, although hydrogen peroxide, one of the constituents, is an irritant to mammalian skin and mucous membranes at high concentrations. They do, however, contribute to the overall plastics load and could end up on beaches or in kelp beds.

The release of lightstick chemicals into the marine environment is unlikely since the housing is a tough, pliable plastic. If the lightstick casing were broken, either through degradation over time or by physical destruction, the enclosed small quantity of chemicals would disperse and be rapidly neutralized by sea water. There could be some risk of injury to marine animals if a lightstick, or sharp plastic or glass shards from a broken lightstick were ingested, although this would be a rare event given the relatively small number of lightsticks deployed and the low probability of breakage. Therefore, lightstick use would not result in significant adverse effects.

3.6.2 Flares

Flares are chemical candles that burn at high temperatures creating bright light (USAF 1997, 2002). The typical white light is produced by burning magnesium in an aluminum canister. Other colors of light may also be created by including other metals. Flares cast light at ranges of up to 3,000 ft (914 m) with burn times lasting from three to seven minutes. At the brightest point, the flare light is 0.46 foot-candles. For comparison, the sun at mid-day in summer registers 10,000 to 12,000 foot-candles.

A second type of flare provides infrared (IR) illumination. Unlike the magnesium burning flares which produce light in the visible spectrum, these IR lights have very long wavelengths and are used mainly to enhance night vision capabilities. Because the sun shines infrared light onto the Earth as well as visible light and ultraviolet light; infrared illumination would result in an insignificant adverse effect.

Flares are designed to burn completely (including the aluminum casing), thus reducing the amount of waste material that falls into the ocean. Toxicity of flare debris is not a significant concern because the primary material in flares, magnesium, is not highly toxic (Naval Research Laboratory (NRL) 1999). There have been no documented reports of wildlife consuming flare materials (USAF 2002). The probability of injury from falling dud flares and debris would be extremely remote. Only a small area would be affected by the occasional flare that is not extinguished before hitting the sea surface. The primary constituent of flares and illumination rounds is magnesium, which is nontoxic and occurs naturally in soils. Although impulse cartridges and squibs used in some flares contain chromium and lead, a screening health risk assessment concluded that they do not present a significant health risk in the environment in the quantities proposed to be used (NRL 1999).

Contact with marine flare debris would not cause injury to skin or eyes because exposure would be brief and the materials contained in spent flares are biologically non-explosive. Flares at night would be much brighter than natural moonlight but altered behavior of fish in areas illuminated by flares would be unlikely to have significant consequences, considering the limited duration (3-5 minutes) and extent of flare usage (3,000 ft). Thus, the use of flares would have negligible effect on fish populations and their habitat.

3.6.3 Chaff

Chaff is deployed to confuse radar tracking devices (USAF 2002). Chaff canisters burst in the air releasing millions of aluminum coated glass or silicon fibers. Chaff particles are very light and designed to remain airborne as long as possible. Depending on wind speed and direction, chaff particles may be distributed over a wide area. When finally reaching the water, they may remain suspended on the surface for a while before sinking (NRL 1997, DON 2007b).

A fish surfacing in an area where chaff has fallen on the ocean surface could have its skin covered with the particles (NRL 1999). However, it is unlikely that the concentration of chaff particles would be great enough to restrict mobility. As the animal submerges, the particles would either disperse into the water, or remain temporarily attached. Fish are unlikely to suffer physical effects from chaff lodging in their gills or ingesting toxic quantities of chaff (USAF 1997).

Eventually, chaff particles would sink or be carried away by currents. Ocean floor sediments are largely composed of silicates (crystalline solids such as quartz and feldspar make up a large percentage of the earth’s crust). The ocean water is constantly exposed to these silicates. Likewise, aluminum is a natural component of the ocean environment, entering the water from sediments and through hydrothermal vents. So, the addition of small amounts of these chemicals from chaff would be unlikely to have an effect on water or sediment composition (NRL 1999). Effects of chaff on resident populations of fish are likely to be short-term and would not be expected to adversely affect EFH or Managed Species.

3.6.4 Dyes

During search and rescue training operations brightly-colored fluorescein dye may be deployed to provide visual reference (USAF 2002). The dye, contained in a small plastic bag, may be discharged from aircraft and surface vessels, or by divers. It may also be released at the end of a torpedo run to mark its location (DON 2005b). The dye rapidly disperses on contact with the water and is visible at very low concentrations. At dilute concentrations the dye is relatively non-explosive (USAF 2002). The associated plastic bags may remain on the surface of the water or sink to the bottom, causing a potential ingestion hazard. However, sea dye bags would be a small fraction of the total man-made plastic debris to which local fish are exposed (Kullenberg 1994, Ocean Conservancy 2007). Adverse effects on EFH and fish would not result from the deployment of tactical dyes because of the small amount of dye released, its rapid dissolution in water, and infrequent use.

3.6.5 Marine Markers

Marine markers that produce chemical flames and smoke are used in training exercises to mark a surface position on the ocean. The flame of a marine marker burns like a flare but also produces smoke. The light generated from the marker is bright enough to be seen up to three miles away in ideal conditions, but as with flares is much less intense than the sun. Smoke from marine markers would be rapidly diffused by air movement. The marker itself is not designed to be recovered and would eventually sink to the bottom with similar, minimal effects of flares.

3.6.6 Sonobuoys

Sonobuoys are expendable acoustic devices used to detect subsurface objects and targets. They are powered by seawater-activated batteries containing lead, copper, silver, magnesium, and/or lithium (DON 2005b, 2007b). Seawater enters the battery to activate it, and the battery then powers the deployment of the sonobuoy’s flotation unit. Sonobuoys are deployed at the surface and in the water column.

All sonobuoys use a small, lithium-containing calculator-type battery to power the upper electronics unit. If the upper portion of the sonobuoy is lost to the seabed, these small lithium batteries are also lost. Active sonobuoys contain a larger battery pack in the lower electronics unit which also contains lithium – if the lower portion of the sonobuoy is lost to the seabed; these larger lithium battery packs become seabed debris.

If a sonobuoy were damaged, small concentrations of chemical components from the battery would enter the water but would be quickly diffused by the surrounding ocean water (DON 2005b). Modeling of the amount of lead, silver, and copper that could be released from damaged sonobuoys and batteries indicates compliance with EPA Ocean Water Quality Limits (see Water Quality Analysis, Section 3.4.4 of the EIS/OEIS).

Lead, copper, and silver are heavy, naturally-occurring metals, widely distributed in the marine environment. They have relatively low solubility in seawater and slow corrosion rates (D’Itri 1990). The slow rate at which metal components are corroded by seawater translates into slow release rates into the marine environment. Once the metal surfaces corrode, the rate of metal released would decline. Releases of chemical constituents from all metal and non-metal sonobuoy components would be further minimized as a result of natural encrustation of exposed surfaces. Therefore, corrosive components of the sonobuoy would not result in substantial degradation of marine water quality.

The majority of objects that fall to the sea floor become buried in the sediment. Metals like lead, copper, and silver will oxidize in the upper part of the sediment where bioturbation creates oxygen-rich conditions. Below this level, oxidation is less likely, and when leaching does occur, the metals tend to adsorb onto the particulate organic carbon in the sediments (Ankley 1996). Acid volatile sulphide is formed in anoxic zones and complexes with the metal ions in the porewater, rendering the metal relatively nontoxic and less subject to bioaccumulation. Metals can also form complexes with soluble ligands (both organic and inorganic) in pore water (Ankley 1996). Many of the heavier expendable objects are made of metal and tend to sink deeply into the anoxic layer of the sediments.

Magnesium naturally balances ocean pH and assists in normal biological functions of ocean organisms. Many species are equipped with the physiological capability to filter excess magnesium from their system. Lithium chloride can inhibit cell growth if an animal is exposed to high concentrations. However, relatively small amounts of battery chemicals would be released and they would be rapidly diluted by the surrounding sea water. The likelihood of a marine animal being exposed to concentrations great enough to cause damage is small, and little or no impact to marine life is expected.

Under the No Action Alternative, approximately 5,960 sonobuoys per year are planned to be used for training and Quality Assurance/Quality Control (QA/QC) testing (Section 3.3.3.2.1 of the EIS/OEIS). Approximately 3,180 sonobuoys would be used for QA/QC testing east of SCI in the San Clemente Island Underwater Range. Of the 3,180 sonobuoys, approximately 440 would be retrieved from the water to provide additional information about sonobuoy performance across a variety of conditions and sea states. The remainder of the sonobuoys would be used throughout the SOCAL RANGE COMPLEXs during training exercises. Using representative amounts of constituents found in sonobuoys, the total constituents deposited in the water were calculated. For the approximately 5,520 sonobuoys left in the SCIC, approximately 16,200 lb (7,360 kg) of materials would be released into the water.

Based on the known amounts of battery constituents, known battery life (eight hours), and known solubilities, maximum concentrations in seawater were estimated for lead and copper. The amount of lead released is based on a maximum amount of lead in the seawater cell of 0.9 lb (0.4 kg). Metallic lead is converted to lead ion in water. A concentration of 11 micrograms per liter (µg/L) (parts per billion [ppb]) was calculated for lead. The maximum concentration of copper in seawater from a cuprous thiocyanate seawater battery was estimated at 0.015 µg/L (DON 1993).

Lithium batteries, used only in active sonobuoys, consist of an exterior nickel-plated steel jacket containing sulfur dioxide (SO_2), lithium metal, carbon, acetonitrile, and lithium bromide. During battery operation, the lithium reacts with the SO_2 and forms lithium dioxide. The reaction proceeds nearly to completion once the cell is activated, so only a limited amount of reactants are present when the battery life terminates.

Based on estimates for the three types of batteries, marine water quality would not be substantially degraded by the release of metals from batteries (DON 1993). Other components that could affect marine water quality include the metal housing (nickel-plated steel coated with polyvinyl chloride plastic to reduce corrosion), lithium batteries, and internal wiring that, over time, could release chemical constituents into the water. Solid metal components of the sonobuoy are corroded by seawater at slow rates, which translates into slow release rates. Once the metal surfaces corrode, the rate of metal released into the environment would decrease.

About 0.7 ounces (20 grams) of lead solder are used in the internal wiring of each sonobuoy, and 15 ounces (425 grams) of lead are used for the transducer node and lead shot ballast. These lead sources are in the non-ionized metallic form of lead that is insoluble in water, so the lead shot and solder would not be released into the seawater. Various lead salts, such as $PbCl_2$, $PbCO_3$, and PbO H_2, would probably form eventually on the exposed metal surfaces, but these metal salts have very low solubilities: 9.9 grams/liter (g/L), 0.001 g/L, and 0.14 g/L, respectively (DON 1993).

All of the expendable materials would eventually sink to the bottom, but are unlikely to result in any physical impacts to the sea floor because they would sink into a soft bottom and eventually be covered by shifting sediments. Soft-bottom habitats are considered less sensitive than hard bottom habitats, and in such areas, the effects of debris would be minimal because the density of organisms and debris are low. Debris may also serve as a potential habitat or refuge for invertebrates and fish.

In summary, operations involving sonobuoys would result in the accumulation of scuttled sonobuoys on the ocean floor. However, because of the large area over which these sensors are deployed, the density would be quite low. Leaching of metals and chemicals from sonobuoys would have little potential for negative biological effects because of dilution by prevailing currents and low solubility/toxicity in the sediments. Expended sonobuoys eventually become encrusted and/or incorporated into the sediments by natural processes.

3.6.7 Expendable Bathythermographs

Operation of Naval vessels requires the routine determination of water temperature. This is done with an expendable bathythermograph (XBT) - a probe that measures temperature as it falls through the water. Data is relayed to the ship through a thin wire that unreels from the probe as it descends. The wire eventually breaks and the probe is lost (DON 2007a). XBTs do not use batteries and do not contain potentially hazardous materials.

With the exception of a chance encounter by a large marine animal as an XBT descends, it is unlikely that any sea life would ingest an XBT, due to its size and rapid decent. It is also unlikely that an XBT would collide with macroscopic sea life on arrival at the sea floor. The unreeled wire is too fragile to pose a threat of entanglement. Due to the benign nature of their operation and composition, XBTs are not expected to significantly affect marine fish or habitats.

3.6.8 Torpedo Accessories

Torpedo accessories include a control wires, flex hoses, ballast, and, protective nose covers, suspension bands, air stabilizers, and propeller baffles used with air-launched torpedoes. A single-strand control wire pays out from a torpedo as it moves through the water. At the end of a torpedo run, which can be several miles-long, the control wire is released from both the firing vessel and the torpedo to enable recovery of the torpedo. The long, thin-gauge copper wire sinks rapidly and settles on the ocean floor. Torpedoes use a flex hose to protect the control wire. It is also expended after completion of the torpedo run and sinks to the bottom. Practice torpedoes may have lead ballast, steel-jacketed lead ballast, or steel plates that are released to allow them to rise to the surface for retrieval. Air launched torpedoes have a variety of accessories that are expended, including protective nose covers, suspension bands, air stabilizers, and propeller baffles.

The copper wires, plastic flex hoses, ballast, and air-launch accessories left on the ocean bottom after torpedo exercises would not present a significant toxic hazard to marine life (DON 2005b). Encrustation by oxidation or by the growth of colonies of marine life (corals, barnacles, anemones, etc.) slows the rate of chemical diffusion into surrounding water. Over a period of years, torpedo accessories would degrade, corrode, become encrusted and/or be incorporated into the sediments.

Upon completion of a torpedo run, two lead ballast weights would be released. Because each ballast weighs 37 lb (16.8 kg), it would sink rapidly to the bottom and, in areas of soft bottoms, be buried in the sediments. Of the 228 torpedoes estimated for the No Action Alternative (Section 3.4.4.2.1 of the EIS/OEIS), about 150 would be non-running recoverable exercise torpedoes that do not drop ballast weights. The remaining 78 torpedoes would jettison their ballast weights. Therefore, 156 ballasts would be expended annually for ASW.

Lead (Pb) and lead compounds are designated as priority toxic pollutants pursuant to Section 304(a) of the CWA of 1977. The USEPA saltwater quality standard for lead is 8.1 µg/L, continuous, and 210 µg/L maximum concentration (65 Federal Register 31682). Lead is a minor constituent of seawater, with a background concentration of 0.02 to 0.4 µg/L (Section 3.4.4.2.1 of the EIS/OEIS).

The probability that the metallic lead of the ballast weights would mobilize into the sediment or water as lead ions is very low. First, the lead would be jacketed with steel, so the surface of the lead would not be exposed directly to the actions of seawater. Second, even if the lead were exposed, the general bottom conditions of slightly high pH and low oxygen content (i.e., a reducing environment) would prohibit the lead from ionizing. Finally, in areas of soft bottoms, the lead weight would be buried due to the velocity of its impact with the bottom. As a result, releases of soluble lead to bottom waters are expected to be negligible.

Lead has the potential to accumulate in bottom sediments, but the potential concentrations would be well below sediment quality criteria based on thresholds for negative biological effects (see Section 3.4 of the EIS/OEIS). By far the greatest amount of material is likely to be deposited in relatively non-explosive form, as the lead ballast weights that become encrusted with lead oxide and other salts and would be covered by the bottom sediments.

Analysis of possible adverse impact from expended torpedo accessories indicates minimal potential for effects to nearby organisms and no significant bioaccumulation in marine food webs (DON 2005b). Therefore, no adverse effect on the EFH or Managed Species is anticipated.

3.6.9 Targets

At sea targets are usually remotely operated airborne, surface or subsurface traveling units, most of which are designed to be recovered for reuse. A typical aerial target drone is powered by a jet fuel engine, generates radio frequency (RF) signals for tracking purposes, and is equipped with a parachute to allow recovery. There are also recoverable, remotely controlled target boats and underwater targets designed to simulate submarines. If severely damaged or displaced, targets may sink before they can be retrieved.

Targets could accidentally strike marine animals on the sea surface. However, given the large exercise area, few fish would suffer direct contact with targets.

Small concentrations of fuel from targets could enter the water and contaminate limited areas. This would occur in the open ocean away from sensitive EFH such as HAPCs. Target debris on the seafloor would gradually degrade, be overgrown by marine life, and/or be incorporated into the sediments.

Floating debris, such as Styrofoam, may be lost from target boats, but is non-explosive and either degrades over time, or washes ashore as flotsam. A few fish could die from contact or ingestion, but no adverse effect at the population level is anticipated.

3.6.10 Expendable Mobile Acoustic Torpedo Targets

Unlike torpedo targets that simulate submarines (that are recovered at the end of each run) expendable mobile acoustic torpedo targets (EMATTs) scuttle themselves and sink to the sea floor to be left in place. The EMATTs are unlikely to result in any physical impacts to the sea floor. They would sink into a soft bottom or would lie on a hard bottom, where they may provide a substrate for benthic colonization or eventually be covered by shifting sediments. Solid metal components are corroded by seawater at slow rates. Natural encrustation of exposed surfaces would eventually occur as invertebrates grow on the surfaces of the sunken objects. As the exterior becomes progressively more encrusted, the rates at which the metals will dissolve into the surrounding water will also decrease. Rates of deterioration would vary, depending on material and conditions in the immediate marine and benthic environment. Factors such as oxygen content, salinity, temperature and pH all contribute to the manner and speed at which metals will dissolve. Over a period of years, the EMATTs would degrade, corrode, and become encrusted or incorporated into the sediments, thus precluding adverse effects on EFH and Managed Species.

3.6.11 Acoustic Device Countermeasures

Submarines launch acoustic device countermeasures (ADCs) to foil opponents' sensors and weapons. ADCs are the size of small torpedoes and emit acoustic and electro-magnetic signals, which could be detected by elasmobranches (sharks, skates and rays) which can sense the electromagnetic potential from the muscle movements of prey. ADCs are normally retrieved but may be lost or intentionally discarded. Impacts of their operation and the consequences of their ocean disposal are similar to other expended material. Thus, resulting in no significant impact to EFH or managed species.

3.6.12 Sunken Vessels

During sinking exercises (SINKEXs), ordnance is fired at vessels that subsequently sink. The targets are primarily decommissioned naval vessels, such as former amphibious assault ships, destroyers, and frigates. They are empty, cleaned, and, environmentally remediated to U.S. EPA specifications (DON 2006a).

Materials expended during a SINKEX would be primarily metal from the target vessel and shell fragments that quickly settle to the bottom. Sinking debris would not include lines, rope, plastic, or other material with potential to ensnare or entangle marine animals (see Section 3.6.13). Because SINKEXs would not take place in the same location, expended material would be spread over a wide ocean area.

The vessels themselves would settle to the bottom eliminating the marine habitat directly underneath and altering the nature of the environment in the immediate vicinity. However, they would add vertical relief and protected niches especially on sedimentary bottoms and thus act as an artificial reef, enhancing habitat quality.

Only minimal concentrations of hazardous chemicals have been detected in water and sediments around Navy ships that were sunk to create artificial reefs (SPAWAR 2006). Chemical contaminants in fish and invertebrate tissues around sunken Navy vessels have also been analyzed. Johnston et al. (2005) reviewed data and studies on natural reefs, Navy vessel reefs, and other artificial reefs off of the South Carolina coast. Tissues samples in reef fish and invertebrates in proximity to Navy vessel reefs showed chemical concentrations below known effects levels and a risk assessment concluded that there was minimal threat of bioaccumulation by higher food chain predators (dolphins, fish eating birds, diving birds) feeding in the area.

The limited number of SINKEXs would be not be expected to have adverse effects on EFH and Managed Species.

3.6.13 Entanglement

Entanglement in man-made debris is an increasing source of injury and mortality to marine animals throughout the world (Kullenberg 1999). Although most incidents are related to commercial fishing operations (Ocean Conservancy 2007), fish in the SOCAL Range Complex may be exposed to Navy expended material that poses a risk of entanglement. Flare and sonobuoy parachutes, aerial target parachutes, and torpedo control wires and flex hoses are the primary sources of potential entanglement in related to training in the SOCAL Range Complex. Entanglement could cause tissue damage, strangulation, or drowning.

Aerial target parachutes are large and usually recovered during normal operations. The small, expendable parachutes that may be used with flares and sonobuoys are made of non-toxic material, but pose a risk of entanglement as they float on the ocean surface, sink through the water column, or lie on the sea floor. The limited number of parachutes expended during SOCAL Range Complex training operations would be scattered across a large area and should not have a substantial effect on critical habitats or fish assemblages.

Discarded torpedo control wires could snare marine life as they sink or rest on the bottom. The wire has a low breaking strength (40 lb (18 kg) (DON 2004a), but still could pose a potential threat if the wire loops or tangles. However, the wire is more rigid than materials like rope or fishing line which tend to loop and coil in the water. Instead, as the torpedo moves through the water, it leaves the copper wire in a relatively straight line, and the wire continues to fall in this form. The real danger comes from an animal becoming wrapped in the wire and the wire tightening, but because the fall to the ocean floor is essentially a straight line, the threat for looping and tangling is small. Thus, control wires are unlikely to pose significant threat to fish. Discarded flex hose could also present a threat. But, like control wire, it would be unlikely to loop and tangle. So, the discarded torpedo control wires and flex hoses are not likely to pose a significant risk of entanglement to marine life.

3.6.14 Hazardous Chemicals

Expended material would introduce small amounts of potentially hazardous chemicals into the marine environment. The water quality analysis of current and proposed operations indicates that concentrations of constituents of concern associated with material expended in the SOCAL Range Complex are well below water quality criteria established to protect aquatic life (see EIS/OEIS Section 3.4, Water Quality). This should adequately protect for EFH and Managed Species and avoid adverse effects.

3.6.15 Summary

Based on the analysis presented in Section 3.3.3.3.1 of the EIS/OEIS, approximately 50,000 pounds (23,000 kg) per year, or more, of hazardous constituents would be deposited in SOCAL RANGE COMPLEXs as a result of Navy training activities. Distributed over the approximately 120,000 nm^2 of this area, the density of discarded hazardous materials would be less than a pound per year per nm^2. This density of hazardous materials would not have adverse effects on EFH or Managed Species.

A total of about 1.7 million training items would be expended under the No-Action Alternative (see Table 3.2-1, EIS/OEIS). For an ocean floor area of 120,000 nm^2 (222,000 km^2), this would be 14 items per nm^2 (8 items per km^2). Over the entire period of military training, assuming the same amounts of training materials would be used annually for 20 years, the aggregate density of debris on the ocean floor would be 280 items per nm^2 (20 items per km^2). This would be about one item per 3 acres (1.2 hectares) of bottom habitat. At this density, training debris should have no discernable effect on EFH and Managed Species.

3.7 RADIO FREQUENCY EMISSIONS

Aircraft, surface ships, and land-based centers use radio frequency (RF) emissions to transmit data, track targets, and communicate with other personnel. Biological effects of high intensity, long-duration exposure to RF emissions include deep tissue heating, degradation of eye faculties, damage to reproductive organs, and, changes in behavior (DON 2007a,b). Unlike sonar which has the potential to affect marine animals because it propagates well in sea water, RF wavelengths are shorter and quickly attenuate. There would be no or minimal impact on fish since exposure to high intensity RF emissions for a sustained period of time would not occur.

3.8 SOUND GENERATING DEVICES

Aviation exercises include the use of Long Range Acoustic Devices (LRADs). These devices emit a sound within the hearing threshold of humans loud enough to cause hearing loss. The 33-inch wide beam of sound is used for only a few seconds to drive enemy personnel out from ships. This short duration results in annoyance, with no permanent hearing damage to personnel (DON 2007a). Impacts on fish in the vicinity of LRAD transmissions are unlikely because the sound is not sustained and is inefficiently transmitted through the air/water interface.

3.9 LASERS

Lasers are used to guide missiles and other munitions to their targets. Lasers are not pointed toward aircraft, ships, personnel, or at the water. Thus, marine life in the water would not be illuminated by laser beams and there should be no impact on EFH or Managed Species.

3.10 UNDERWATER DETONATIONS

Underwater detonations (UNDETs) during SOCAL Range Complex operations would be associated with Naval Special Warfare (NSW) training and with testing and use of the Improved Extended Echo Ranging (IEER) Sonobuoy. Navy SEAL Basic Underwater Demolitions courses and SEAL platoon training exercises involve a variety of single and multiple charge detonations. The IEER sonobuoy uses a ribbon charge that detonates in the water column. Navy SEAL underwater detonations take place in shallow water. IEER sonobuoy testing and use is conducted in deeper water.

Potential effects of explosive charge detonations on fish and EFH include: 1) disruption of habitat, 2) exposure to chemical by-products, 3) disturbance, injury, or death from the shock (pressure) wave, 4) acoustic impacts, and 5) indirect effects including those on prey species and other components of the food web.

3.10.1 Habitat Disruption

The underwater detonation of explosives may result in physical alteration of fish habitats (Wright and Hopky 1998). Live hard-bottom, artificial reefs, seagrass beds, and kelp beds harbor a wide variety of marine organisms (Cahoon et al. 1990). These habitats support productive biological assemblages and dense aggregations of fish (Thompson et al. 1999). The Navy selects UNDET areas to avoid these key habitats (DON 2005b). SOCAL Range Complex underwater detonations would only take place in waters overlying unconsolidated sediment. Thus, the cratering of soft-bottom seafloor is the only habitat disruption that would result.

Naval Special Warfare (NSW) forces (SEALs) conduct nearshore underwater demolition training at San Clemente Island in depths of 6 to 20 ft (2 to 6 m) at the Northwest Harbor area and at Horse Beach Cove. Detonations would include 5-lb (2.3-kg) C-4 blocks, 20-lb (9-kg) C-4 blocks, haversacks containing 20 lb (9 kg) of C-4, 4.6-lb (2-kg) limpet charges, a Mat Weave made from 10 MK-75 50-lb (23-kg) tubular charges, and an Obstacle Loading charge consisting of 16 haversacks each containing 20 lb (9 kg) of C-4.

Underwater detonations at San Clemente Island take place in areas of sandy bottom, which is not a sensitive habitat, nor are sensitive species present (see EIS/OEIS Sections 3.6 and 3.7). The explosions would disturb surface sediments and displace organisms living on and in the substrate, and in the overlying water column. Mobile species are expected to rapidly move back into the area following detonations, whereas sedentary species may or may not recover to previous abundances depending on the spatial overlap and time interval between detonations. The Marine Environment and Fish evaluations in the EIS/OEIS (Sections 3.6 and 3.7) conclude that impacts of UNDET would be less than significant. Turbidity increases following explosions would be brief, i.e., lasting a few minutes to a few hours, and not expected to extend a substantial distance away. The local sediments are coarse and would rapidly fall out of suspension or be dispersed by waves and currents. Effects on sediment-dwelling organisms, which are regularly exposed to high turbidity as a result of waves and currents, would be insignificant. Increased turbidity could temporarily decrease the foraging efficiency of fish, however, given the dynamic nature of the habitat and the grain size of the material, turbidity is expected to be minimal and localized. Detonation by-products are non-hazardous and would not degrade water quality (see following section, 3.10.2, Chemical By-products). Therefore, habitat disruption from NSW underwater demolition training would be less than significant.

3.10.2 Chemical By-products

Combustion products from the detonation of high explosives - CO, CO^2, H^2, H^2O, N^2, and NH^3 - are commonly found in sea water. The primary constituents that would be released from explosives training are nitroaromatic compounds such as trinitrotoluene (TNT), cyclonite (Royal Demolition Explosive or RDX), and octogen (High Melting Explosive or HMX) (URS et al. 2000). Initial concentrations of explosion by-products are not expected to be hazardous to marine life (DON 2001a) and would not accumulate in the training area because exercises are spread out over time and the chemicals will rapidly disperse in the ocean. Therefore, no adverse effects to EFH from chemical by-products of detonation would be expected.

3.10.3 Pressure Effects

An underwater explosion generates a shock wave that produces a sudden, intense change in local pressure as it passes through the water (DON 1998, 2001a). Pressure waves extend to a greater distance than other forms of energy produced by the explosion (i.e., heat and light) and are therefore the most likely source of negative impacts on marine life (Craig 2001, SIO 2005, DON 2006a).

The shock wave from an underwater explosion is lethal to fish at close range, causing massive organ and tissue damage and internal bleeding (Keevin and Hempen 1997). At greater distance from the detonation point, the extent of mortality or injury depends on a number of factors including fish size, body shape, orientation, and species (Wright 1982, Keevin and Hempen 1997). At the same distance from the source, larger fish are generally less susceptible to death or injury, elongated forms that are round in cross-section are less at risk than deep-bodied forms, and fish oriented sideways to the blast suffer the greatest impact (Yelverton et al. 1975, Wiley et al. 1981, O'Keefe and Young 1984a,b, Edds-Walton and Finneran 2006). Species with gas-filled organs have higher mortality than those without them (Goertner et al. 1994, CSA 2004).

Two aspects of the shock wave appear most responsible for injury and death to fish: the received peak pressure and the time required for the pressure to rise and decay (Dzwilewski and Fenton 2003). Higher peak pressure and abrupt rise and decay times are more likely to cause acute pathological effects (Wright and Hopky 1998). Rapidly oscillating pressure waves may rupture the kidney, liver, spleen, and sinus and cause venous hemorrhaging (Keevin and Hempen 1997). They can also generate bubbles in blood and other tissues, possibly causing embolism damage (Ketten 1998). Oscillating pressure waves may also burst gas-containing organs. The swim bladder, the gas-filled organ used by many pelagic fish to control buoyancy, is the primary site of damage from explosives (Yelverton et al. 1975, Wright 1982). Gas-filled fish swim bladders resonate at different frequencies than surrounding tissue and can be torn by rapid oscillation between high- and low-pressure waves. Swim bladders are a characteristic of bony fish and are not present in sharks and rays. However, hemorrhaging of the liver in sharks exposed to the shock waves from explosives could have deleterious effects on the buoyancy function provided by the livers of these species (Edds-Walton and Finneran 2006). Delayed lethality could result from the accumulation of sub-lethal injuries (DON 200a).

Studies that have documented fish killed during planned underwater explosions indicate that most fish that die do so within one to four hours, and almost all die within a day (Hubbs and Rechnizer 1952, Yelverton et al. 1975). Fitch and Young (1948) found that the type of fish killed changed when blasting was repeated at the same marine location within 24 hours of previous blasting. They observed that most fish killed on the second day were scavengers, presumably attracted by the victims of the previous day's blasts. However, fish collected during these types of studies have mostly been recovered floating on the waters surface. Gitschlag et al. (2000) collected both floating fish and those that were sinking or lying on the bottom after explosive removal of nine oil platforms in the northern Gulf of Mexico. They found that as few as 3% of the specimens killed during a blast may float to the surface. Other impediments to accurately characterizing the magnitude of fish kills included currents and winds that transported floating fish out of the sampling area and predation by seabirds or other fish.

There have been few studies of the impact of underwater explosions on early life stages of fish (eggs, larvae, juveniles). Fitch and Young (1948) reported the demise of larval anchovies exposed to underwater blasts off California, and Nix and Chapman (1985) found that anchovy and smelt larvae died following the detonation of buried charges. Similar to adult fish, the presence of a swim bladder contributes to shock wave-induced internal damage in larval and juvenile fish (Settle et al. 2002). Shock wave trauma to internal organs of larval Pinfish and Spot from shock waves was documented by Govoni et al. (2003). These were laboratory studies, however, and have not been verified in the field.

Data on the effects of underwater explosions on aquatic plants are extremely limited. The potential for injury and mortality to aquatic invertebrates from underwater blasts is a little better known (Keevin and

Hempen 1997). These studies indicate that invertebrates are relatively insensitive to pressure-related damage from underwater explosions, perhaps because they lack gas-containing organs which have been implicated in internal damage and mortality in vertebrates.

The variety of environmental parameters and biological features that can modify the impact of underwater explosions complicates the effort to predict lethal effect ranges in the field (Wright 1982, Keevin and Hempen 1997). Predictive models have, however, been developed over the past three decades (Wiley et al. 1981, Goertner 1982, Young 1991). These are based on measurements of the pressure produced by underwater explosions at increasing distance from the detonation point (O'Keefe and Young 1984, Wright and Hopky 1998, Dzwilewski and Fenton 2003). Different types of explosive materials are normalized in effect range models by establishing an equivalent weight of TNT known as the "Net Explosive Weight" or "n.e.w.".

Young (1991) provides equations that allow estimation of the potential effect on swim bladder fish using a damage prediction method developed by Goertner (1982). Young's parameters include the size of the fish and its location relative to the explosive source, but are independent of environmental conditions (e.g., depth of fish and explosive shot frequency). An example of such model predictions is shown in Table 3-1 which lists estimated fish-effects ranges using Young's (1991) method for swim bladder fish exposed to a 60-lb explosion at depth of 10 ft (3.3 m). The 10% mortality range is the distance beyond which 90% of the fish present would be expected to survive. It is difficult to predict the range of more subtle effects causing injury but not mortality (CSA 2004).

Table 3-1: Estimated Fish-Effects Ranges for 60-lb NEW Underwater Explosion

Weight of Fish	10% Mortality Range	
	ft	m
1 oz	712	217
1 lb	496	151
30 lbs	319	97

Young's model for 90 percent fish survivability applies to simple explosives. However, several of the explosives used in the San Clemente Island NSW training have complicated configurations and blast parameters. Thus, impulse and effects were computed separately for the fish effects analysis in the EIS/OEIS (Section 3.7). In addition, Young's model was based on open, deep-water conditions, where blast effects are predicted more easily. Explosives used in the SOCAL Range Complex NSW training at SCI are detonated in shallow water, just off the shoreline. This restricts the effected area to a small nearshore wedge, rather than a large circular area. Given the difficulty determining the areas of influence in these shallow-water conditions and the lack of definitive estimates of the size of fish populations in such small, nearshore areas, modeling of fish mortality was not done for Northwest Harbor and Horse Beach Cove. However, field studies indicate that previous demolition operations have not diminished or altered the composition of the fish populations (Kushner and Rich 2004). Fish injured or killed at Northwest Harbor and Horse Beach Cove appear to be rapidly replaced because fish were abundant at kelp monitoring sites in 2003 and 2004, and diversity was comparable to other Channel Islands within similar oceanographic regimes such as Catalina and Santa Barbara Islands.

Improved Extended Echo Ranging (IEER) sonobuoys would not be used in the No Action Alternative but would be used in Alternative 1. The IEER sonobuoy uses a ribbon charge that is detonated in the water column. Fish populations in the offshore, deep-water environment where IEER sonobuoys are tested are widely dispersed. Given the limited number of IEER tests spread over a large ocean area, only a very small fractions of fish stocks would be influenced. Thus, adverse effects of IEER sonobuoy detonations on fish are not anticipated.

To summarize, a limited number of fish would be killed in the immediate proximity of explosive charges detonated during NSW training and IEER sonobuoy testing. Additional fish would be injured and could subsequently die or suffer greater rates of predation. Beyond the range of direct physical impacts, there would be short-term, reversible behavioral responses. However, given the relatively small area that would be affected, and the abundance and distribution of the species concerned, no significant effects would be expected. When exercises are completed, the fish stock should repopulate the affected areas. The regional abundance and diversity of fish are unlikely to measurably decrease. While this conclusion is primarily based on qualitative judgments, it is supported by the best scientific information currently available. Reliable, quantitative predictions of population level effects are simply beyond the capacity of contemporary ocean science.

3.10.4 Acoustic Impacts

Sound is the only form of energy that propagates well underwater and is used by many aquatic animals for imaging, navigation, and communication. Light, so commonly employed in sensory perception by terrestrial animals, does not penetrate far in seawater, especially in turbid coastal environments. The following paragraphs present a brief introduction to the acoustic capabilities of fish and the potential for impact from anthropogenic (man-made) sounds. Comprehensive technical reviews are available elsewhere (e.g., Popper 2003, Popper et al. 2004, Hastings and Popper 2005, NRC 2003, 2005, ICES 2005, DON 2005b, Edds-Walton and Finneran 2006, NOAA 2007c,d,e).

Sound is a wave of energy from an impulse or vibration that alternately compresses and decompresses a medium like air or water. A sound wave moves through the medium causing two types of actions; an oscillation of the pressure of the medium and an oscillating movement of particles in the medium.

A sound wave has three basic attributes; frequency, wavelength, and amplitude. Frequency is the number of cycles of compression and decompression per second – expressed in units called Hertz (Hz) equal to one cycle per second. The human voice can generate frequencies between 100 and 10,000 Hz and the human ear can detect frequencies of 20 to 20,000 Hz. Some animals like dogs and bats can hear sounds at much higher frequencies - up to 160,000 Hz. At the other end of the spectrum, whales and elephants can produce and detect sounds at frequencies in the range of 15 to 35 Hz.

Wavelength is the distance between two successive compressions or the distance the wave travels in one cycle of vibration. The amplitude of a sound wave is the distance a vibrating particle is displaced. Small variations in amplitude produce weak or quiet sounds, while large variations produce strong or loud sounds. The amplitude of a sound is directly related to the amount of energy transmitted.

A number of factors determine the energy level of a sound received at a distance from the source. As sound travels through the ocean, the intensity associated with the wavefront diminishes, or attenuates. This decrease in intensity, called propagation or transmission loss, results from absorption, spreading, and scattering. How far sound waves travel before losing so much energy that they cannot cause the medium to oscillate depends on their frequency. High frequencies are more readily absorbed and thus travel shorter distances than low frequencies. The spreading of a wavefront causes the total power associated with the wavefront to be distributed over an increasingly large area with a concomitant decease in intensity. Sound waves can also be diminished by striking boundaries, such as the sea surface, thermocline, seafloor, or biota in the water column.

Ambient noise in the ocean is persistent, world-wide, and comes from all directions (NRDC 1999, NRC 2003, NOAA 2007c,d,e). Background environmental noise has been measured over frequency ranges from below 1 Hz to over 100,000 Hz (100 kHz) (Cato and McCauley 2001, Andrew et al. 2002).

The levels and frequencies of ambient noise in coastal waters are subject to wide variations depending on time and location. Anthropogenic noise is produced by watercraft (from jet skis to supertankers), offshore oil/gas exploration and production, sonar, underwater telemetry and communication, construction projects, and ocean research (Richardson et al. 1995, NRDC 1999). Naturally occurring environmental noises include the sound of wind and waves, tides and currents, rain, thunder and lightning, tectonic and volcanic activity, as well as sounds produced by marine animals. At any given time and place, the ambient noise level is a mixture of these noise types with higher sound levels over consolidated substrate than sand or mud.

Surface shipping is the most widespread source of anthropogenic, low frequency (0 to 1,000 Hz) noise in the oceans (NOAA 2007e). The radiated noise spectrum of merchant ships ranges from 20 to 500 Hz with higher frequencies produced by sonar operations (Richardson et al. 1995). Most ocean going vessels have sonar systems for navigating, depth sounding, and sometimes “fish finding”. Depth sounding sonars usually operate in the 15 kHz to 200 kHz frequency range, while locating, positioning, and navigational sonars use the mid frequency band of 1 kHz to 20 kHz. Long-range sonars generally operate in the 100 Hz to 3 kHz range. Commercial fishing boats may also use pingers to prevent seals, dolphins, and turtles from being caught in nets (Gearin et al. 2000). There are two basic types of pinger devices, harassment devices and deterrent devices. “Acoustic Harassment Devices” are pingers specifically used to deter pinnipeds from preying on captured fish. These devices use high intensity signals in the middle to high frequencies (5-30 kHz; Reeves et al. 2001). “Acoustic Deterrent Device” pingers use low intensity sound signals in the middle to high frequencies (2.5 – 10 kHz) with higher harmonic frequencies (up to 160-180 kHz). They are designed to prevent bycatch of small cetaceans (Reeves et al. 1996, 2001).

Of the estimated 27,000 fish species only a small percentage have been studied in terms of auditory capability or sound production. Of those studied, many fishes produce vocalizations in the low frequency band (50-3000 Hz). Hearing or sound production is documented in 247 species, while actual hearing capabilities data exist for only 100 of the 27,000 fish species (Hastings and Popper, 2005).

Fish have evolved two main sensory organs for detecting sound in the aquatic environment: the inner ear, located in the skull, and the lateral line system along the flanks and on the head (Ladich and Popper 2004). Fish have two inner ears, but no middle or external ear like terrestrial vertebrates. Sound passes directly through the body to the inner ear. The structure of the fish inner ear and the mechanism for converting acoustic energy to electrical signals received by the brain is similar to that found in all other vertebrates. Sensory hair cells translate vibrations into electrical signals conveyed by the nervous system to the brain (Popper et al. 2003). Fish have three fluid-filled otolith organs each containing a dense calcified otolith overlying tissue containing sensory hair cells. The otoliths sense the position of the head in the vertical plane and in other directions relative to the acceleration of the body (Popper and Lu 2000). The otoliths are denser than the surrounding tissues and the water so their sound-induced vibrations are at a different phase and amplitude which creates a shearing movement of the hair cells (Popper and Fay 1999).

The same sensory hair cells as in the ear are found in the lateral line system (Hastings and Popper 1996). They detect particle motion from sound waves over a distance of one to two body lengths, and at low frequencies (lower than 200 Hz). This acoustic input is used for coordinating group movements and maintaining coherent schools (Popper and Fay 1999).

The perception of sound pressure is restricted to fish species with gas-filled swim bladders. Due to the higher compressibility of gas than water, the swim bladder responds effectively to sound pressure fluctuations. In some species of fish, a series of modified vertebra connect the inner ear to the swim bladder acting as a transducer that converts sound pressure waves into particle motion which stimulates the otoliths. Species with no swim bladder (for example, mackerel, tuna, sharks) or a much-reduced one (many benthic species, including flatfish) tend to have relatively low auditory sensitivity.

With regard to auditory capabilities, fish have traditionally been divided into two groups – hearing generalists and hearing specialists. Most fish species do not have known hearing specializations and appear to only detect sounds from about 100 to 1,000 Hz (Hastings and Popper 2005). The best hearing sensitivity of many hearing generalists is at or around 300 Hz (Popper 2003). Hearing specialists perceive acoustic signals over a broader range of frequencies and at lower amplitudes than generalists. They have unique adaptations that facilitate their auditory sensitivity, such the previously mentioned acoustic coupling between the swim bladder and the ear. The auditory capability of most hearing specialists ranges to over 3,000 Hz, with best hearing from about 300 to 1000 Hz (Popper et al. 2003, Ladich and Popper 2004, Ramcharitar and Popper 2004). Specialists detect both the particle motion and pressure components of sound whereas generalists are limited to detection of the particle motion component of low frequency sounds at relatively high sound intensities (Amoser and Ladich 2005). Examples of specialists include goldfish, catfish, squirrelfish, and herrings. Hearing specializations are most often found in freshwater species, while in marine species, specializations are quite rare (Amoser and Ladich 2005). The evolution of hearing specializations appears to have been facilitated by low ambient noise levels found in lakes, slowly flowing waters, and the deep sea (Ladich and Bass 2003, Amoser and Ladich 2005). This evolution most likely came about due to the essential need to detect abiotic noise, avoid approaching predators and detect prey, and to a much lesser degree, communicate acoustically (Amoser and Ladich 2005). Some species like cod and salmon have hearing capabilities in the infrasonic range (< 20 Hz) (Knudsen et al. 1997, Sand et al. 2000, Sonny et al. 2006), while members of the shad family can detect sounds in the ultrasonic range, i.e., over 20 kHz. (Mann 2001, Gregory and Clabburn 2003, Popper et al. 2004, Higgs et al. 2004, Higgs 2005). However, other Clupeids, including species of sardines and anchovies, do not detect ultrasound; with peak hearing sensitivity generally ranging from 200 to 800 Hz.

Studies on the hearing ability of marine fish have mostly shown poor hearing sensitivity. Sharks and rays (Myrberg 2001, Casper et al. 2003, Casper and Mann 2006), scorpionfish, searobins, and sculpins (Lovell et al. 2005), scombrids (i.e. albacores, bonitos, mackerels, tunas) (Iversen 1967, 1969, Song et al. 2006), Atlantic salmon (*Salmo salar*) (Hawkins and Johnstone 1978), and Gulf toadfish (*Opsanus beta*) (Remage-Healey et al. 2006) are all believed to be hearing generalists. While the hearing of relatively few marine species has been investigated, and in a number of fish groups both generalists and specialists exist, it is reasonable to suggest that unless most species are very close (within a few meters) to very high intensity sounds (e.g. seismic air guns or sonar) from which they cannot swim away, short- and long-term effects may be minimal or non-existent (Song et al. 2006).

Experiments on elasmobranch fish have demonstrated poor hearing abilities and frequency sensitivity from 20 to 1,000 Hz with best sensitivity at lower ranges (Myrberg 2001, Casper et al. 2003; Casper and Mann 2006). While only five elasmobranch species have been tested for hearing thresholds it is believed that all elasmobranchs will only detect low frequency sounds because of their lack of a swim bladder. Without an air-filled cavity fish, theoretically, are limited to detecting particle motion and not pressure (Casper and Mann 2006).

The lateral line system of a fish also allows for sensitivity to sound (Hastings and Popper 2005). This system is a series of receptors along the body of the fish that detects water motion relative to the fish that arise from sources within a few body lengths of the animal. The sensitivity of the lateral line system is generally below a few hundred Hz (Hastings and Popper 2005). The only study on the effect of exposure to sound on the lateral line system suggests no effect on these sensory cells (Hastings et al. 1996). While studies on the effect of sound on the lateral line are limited, Hasting et al.'s (1996) work suggests sensitivity of a fish's lateral line system is limited to within a few body lengths and to sounds below a few hundred Hz.

Fish are able to distinguish sounds of different magnitudes and frequencies, detect a sound in the presence of other signals, and determine the direction of a sound source. Beyond the basic ability to detect sound, these higher level capabilities allow fish to discriminate between sounds of predator versus those of prey, sense the direction of a sound emitted by potential predators or prey, and establish the nature of one sound source in the presence of others including anthropogenic masking sounds.

In addition to their ability to hear sounds, fish are known to produce sound (vocalize), generally in the range of about 50 to 8,000 Hz. (URI 2007). The sound is generated by a variety of means to alert competitors, deceive prey, attract mates, and coordinate breeding and spawning (USF 2007). Grunts, croaks, clicks and snaps are produced by rubbing skeletal parts together (e.g., teeth, fins) and by resonating the swim bladder.

Most assessments of the potential impact of noise in the ocean have concerned marine mammals (Bowles et al. 1994, NRC 2003, 2005), but, there is growing interest in acoustic effects on fish (Popper 2003, Popper et al. 2004, Popper and Hastings 2005, Popper et al. 2005, Edds-Walton and Finneran 2006). In addition to the peer-reviewed scientific literature, information on fish hearing and anthropogenic effects is available in technical reviews (e.g., ICES 2005), on government and university web sites (e.g., NMFS 2007b, NOAA 2007b, ONR 2007, URI 2007, UM 2007, USF 2007), and from environmental impact/analysis documents (e.g., DON 2005, 2006, 2007, SIO 2005).

The potential acoustic impacts may be considered in four categorizes: masking - interference with the ability to hear biologically important sounds; stress - physiological responses including elevated heart rate and release of hormones; behavior - disruption of natural activities like swimming, schooling, feeding, breeding, and migration; and, hearing - permanent hearing loss from high intensity/long duration sounds or temporary hearing loss from less intense sounds.

3.10.4.1 Masking

Marine animals rely on sound for numerous life activities (e.g., to alert competitors, locate prey, escape predators, for schooling, and for mating) (Hastings and Popper 2005). A decrease in the ability of fish to detect biologically-relevant sounds because of interference by anthropogenic noise could have significant consequences (Richardson et al. 1995, McCauley et al 2003, NRC 2003, 2005). Laboratory studies have indicated the potential for auditory masking by anthropogenic sounds (DON 2005b).

Navigation by larval fish may be particularly vulnerable to masking. There is indication that larvae of some species navigate to juvenile and adult habitat by listening for sounds indicative of a particular habitat (Higgs 2005). In a study of an Australian reef system it was determined the sound signature emitted from fish choruses were between 800 Hz and 1,600 Hz (Cato 1978) and could be detected 5 to 8 km from the reef (McCauley and Cato 2000). This bandwidth is well within the detectable bandwidth of adults and larvae of many species of reef fish (Kenyon 1996).

Detecting effects of masking under field conditions is complicated. Hearing thresholds represent the lowest levels of sound animals can detect in a quiet environment. But the sea is usually noisy, even in the absence of man-made sounds. Potential consequences of masking, such as altered feeding success, predation rate, and reproductive success are difficult to distinguish from other possible causes including those related to natural cycles and human-related impacts. Consequently, the ecological effect of auditory masking in the ocean is virtually unknown.

The zone of masking is the region within which a noise is strong enough to interfere with detection of biologically-relevant sounds. In general, distant man-made noise is unlikely to mask short-distance acoustic communication. Given that the energy distribution of an explosion covers a broad frequency spectrum, sound from underwater explosions might overlap with some environmental cues significant to marine animals. However, the time scale of individual explosions is very limited, and training exercises involving explosions are dispersed in space and time. Thus, the likelihood of underwater detonations resulting in significant masking is considered low.

Studies have indicated that acoustic communication and orientation of fish may be restricted by noise regimes in their environment (Wysocki and Ladich 2005). Although some species may be able to produce sound at higher frequencies (> 1 kHz), vocal marine fish largely communicate below the range of mid-frequency levels used by most sonar employed in the proposed action. Further, most marine fish species are not expected to able to detect sounds in the mid-frequency range of the operational sonars. The few fish species that have been shown to be able to detect mid-frequencies do not have their best sensitivities in the range of the operational sonars. Thus, these fish can only hear mid-frequency sounds when they are very loud (i.e. when sonars are operating at their highest energy levels and fish are within a few meters). Considering the low frequency detection of most marine species and the limited time of exposure due to the moving sound sources, the most sonar sound sources used in the SOCAL Range Complex would not have the potential to significantly mask key environmental sounds.

3.10.4.2 Stress

Although an increase in background noise is known to cause stress in humans, there have been few studies on fish (Popper 2003, ICES 2005). There is some indication of physiological effects on fish such as a change in hormones levels and altered behavior (Pickering 1981, Smith et al. 2004a,b, Remage-Healey et al. 2006). Only a limited number of studies have measured biochemical responses by fish to acoustic stress. McCauley et al. (2000, 2002) investigated physiological effects of exposure to loud sounds on various fish species, squid, and cuttlefish. No significant increases in physiological stress were detected. Sverdrup et al. (1994) found that Atlantic salmon subjected to acoustic stress released primary stress hormones, adrenaline and cortisol, as a biochemical response. All experimental subjects returned to their normal physiological levels within 72 hours of exposure. Wysocki et al. 2006 report elevated cortisol levels in freshwater fish under laboratory conditions exposed to recorded ship noise versus broad-spectrum (control) noise.

Since stress affects human health, it seems reasonable that stress from loud sound may impact fish health, but available information is too limited to adequately address the issue. However, due to the punctuated nature of EOD exercises, the resulting stress on fish is not likely to jeopardize the health of widespread resident populations.

3.10.4.3 Behavior

Many factors affect how fish react when exposed to noise. The presence of predators or prey, seasonal and daily variations in physiology, spawning or migratory activities, and other factors may make them more or less sensitive to unfamiliar sounds (Popper et al. 2004).

Fish have been observed to change their behavior in response to sound by moving away from a sound source or up and down in the water column (Popper 2003). Studies of caged fish have identified three basic behavioral reactions to sound: startle, alarm, and avoidance (Pearson et al. 1992, McCauley et al. 2000, SIO 2005). The startle response in characterized by fish flexing their bodies powerfully and swimming away at high speed without changing direction. At lower levels of noise, alarm may occur in the absence of a startle response. For schooling fish, alarm involves a general increase in activity and tighter packing with abrupt changes in direction. During avoidance behavior, fish slowly move away from the sound source. The time of year, whether or not the fish have eaten, and the nature of the sound signal may all influence fish response. Changes in sound intensity may be more important to a fish's behavior than the maximum sound level. Sounds that reach their peak intensity rapidly tend to elicit stronger responses from fish than sounds with longer rise times, but equal peak intensities (Schwarz 1985).

Recent studies on the behavioral response of caged fish to low frequency sonar pulses (Popper et al. 2005a, 2007) documented an immediate "startle response" and displacement in the water column for some species. Rainbow trout exhibited only a small initial response and quickly returned to pre-stimulus behavior. Behavioral sensitivity is lowest in flatfish that have no swim bladder and also in salmonids in which the swim bladder is present but somewhat remote from the inner ear (Hastings and Popper 2005). Gadoid fish (cod, whiting) in which the swim bladder is closely associated with the inner ear display a relatively high sensitivity to sound pressure (Turnpenny et al. 1994).

Most studies have been conducted in the laboratory where fish can be readily observed under controlled conditions, but some field studies have been performed. A number of these have investigated the effect of sub-bottom profiling in seismic explorations. These explorations use airguns that release blasts of compressed air producing sounds loud enough to penetrate the ocean floor.

Pearson et al. (1992) used a floating enclosure off the California coast to observe individual responses of rockfish to intense low-frequency seismic survey noise. They observed startle and alarm responses to airgun blasts for two sensitive rockfish species, but not for two other species, as well as subtle changes in the behavior in other species of rockfish. The rockfish returned to their normal behavior within minutes of cessation of the seismic noise stimulus, however, their field data indicated that continuous air-gun noise could reduce catchability of free-ranging rockfish, which moved out of the range of the hooks-and-lines used by fishers (Skalski et al., 1992). Experiments conducted by Skalski et al. (1992), Dalen and Raknes (1985), and, Dalen and Knutsen (1986) demonstrated that some fish were forced to the bottom and others driven from the area in response to low-frequency airgun noise. Other studies have shown no impact of airguns on fish behavior. Wardle et al. 2001 used video cameras to document reef fish behavior after exposure to airgun emissions. The observations showed no apparent damage to fish and no dislocation from the reef during the course of the study.

An investigation by Engås et al. (1996) revealed persistent changes in the horizontal distribution of two important food fish following 5 days of continuous seismic shooting during surveys. The study indicated that fish populations had moved to sites over 18 nm from the shooting area. There was no evidence of fish mortality as a result of the seismic shooting. The decline in fish density in the shooting area persisted for at least 5 days, at which point the study was ended. Slotte et al. (2004) report both horizontal and vertical displacement of pelagic fish during seimic shooting.

Edds-Walton and Finneran (2006) point out that a shift in fish density of even a few days could have significant economic consequences given the restricted time limits placed on fishing for some commercially-important species. And, fish are found in particular locations for ecological or physiological reasons - forcing a departure from those areas can reduce the overall fitness of a population. In their review of the behavior of fish in response to human-generated noise sources, these authors also indicate that avoidance behavior appears to be less likely in territorial fish (like those on coral reefs or defending nest sites) for whom departure from an area would carry a heavy biological price. Fish that are actively feeding on patchy prey or that are part of a spawning aggregation are also less likely to abandon their location in the presence of noise levels that would cause avoidance under other circumstances. Diminished auditory capabilities are more likely to occur in species that do not avoid intense noise sources, although population-level consequences would be directly related to the role that sound plays in the normal behavior of the species involved.

Habituation and sensitization are results of repeated presentations of the same stimuli (NRC 2003). Habituation to repeated presentations of a signal that does not cause physical discomfort or immediate stress is a common adaptive response to almost every sort of stimuli, including noise (NRC 2005). It is not known if marine species habituate to the sound of distant explosions. The natural motility of fish decreases the probability that any particular animal would be exposed to multiple exercises. Therefore, habituation is possible but unlikely due to the brevity, frequency, and variable locations of the exercises. Sensitization is a conditioned response in conjunction with a particular stimulus (including noise) as a result of a previous negative experience for the animal (NRC 2003). Subsequent exposures produce responses that are more marked. Like habituation, the potential for an animal to become sensitized to the noise of underwater explosions exists, particularly if the exposure causes discomfort. However, sensitization becomes less likely because of the brevity, frequency, and variable location of the exercises.

Long-term behavioral impacts can include habitat abandonment. For example, long-term habitat abandonment, observed at a baleen whale calving area (Bryant et al. 1984) and at a killer whale feeding area (Morton and Symonds 2002), resulted from chronic exposures to specific types of anthropogenic sound (dredging operations and seal acoustic harassment devices) over long periods of time. Similar situations have not been established for fish. Repeated disturbance leading to habitat abandonment is not expected due to the infrequent nature and variability of locations of underwater detonations associated with proposed SOCAL Range Complex exercises.

Low frequency pulses of sound have been shown to attract sharks in both coastal and pelagic habitats (Nelson and Johnson 1972, Myrberg 2001). The pulsed sounds are most attractive when pulse presentation is intermittent and not continuous. These low frequency pulses (25-200 Hz) are similar to the sounds produced by struggling prey or actively feeding fish. Nelson and Johnson (1972) found that some sharks exhibited a startle response if they were within a meter of the speaker when pulsing began, but those sharks did not exhibit avoidance behavior after the initial startle reaction. Since low frequency sound travels far in sea water, sharks could be attracted from hundreds of meters away. The resulting concentration of sharks could alter normal behavioral patterns and induce aggressive interactions between sharks that normally would not interact. Myrberg et al. (1972) also suggested that the rotors of low-flying/hovering helicopters could produce pulsed sounds below the water surface at levels sufficient to attract epipelagic sharks.

In summary, sounds that disrupt natural patterns like sheltering, schooling, feeding, breeding, and migration can have significant consequences if basic life functions are appreciably altered. Effects on individuals can have population-level consequences, affecting the viability of fish stocks and the species. However, the difficulty tracking changes in the behavior of free-ranging fish and establishing the subsequent ecological impact limits our ability to establish the long-term ecological consequences of changes in fish behavior in response to anthropogenic noise.

Although some fish in the vicinity of the training exercises may react negatively to the noise of underwater detonations, the noises are relatively short-term and localized. Behavioral changes are not expected to have lasting impacts on the survival, growth, or reproduction of fish populations. As exercises commence, the natural reaction of fish in the vicinity would be to leave the area. When exercises are completed, the fish stock would be expected to repopulate the area. The abundance and diversity of fish is unlikely to decrease measurably as a result of SOCAL Range Complex underwater detonations.

3.10.4.4 Hearing

Studies of acoustic capabilities of fish have been aimed at establishing the range of frequencies (or bandwidth) that a fish can hear, and the “threshold” (lowest level) of the sound detected at each frequency (Hastings and Popper 2005). If, following exposure to intense acoustic input, a higher level of sound is required to detect that frequency, a threshold shift has occurred. For humans, temporary threshold shifts may occur after loud concerts or following exposure to industrial noise. There are two kinds of threshold shifts: temporary threshold shift (TTS) or permanent threshold shift (PTS). A TTS may continue for minutes, hours or days, but the auditory deficit is eventually reversed. With PTS, however, hearing is permanently compromised and never recovers.

Permanent threshold shifts in vertebrates may result from both chronic exposures to high noise levels and from a single, highly traumatic event. People who experience high noise levels on a daily basis and do not wear hearing protection devices can suffer PTS. Very loud sounds (e.g., an explosion) can also cause a PTS or even deafness. In mammals, permanent threshold shifts involve damage to the hair cells of the inner ear, and other auditory structures (Bohne and Harding 2000). In mammals, dead hair cells are not replaced by production of new hair cells, resulting in permanent loss of auditory receptors in the damaged area.

The impact of anthropogenic noise has been studied in a number of fish species. Some investigations have shown damage to fish hearing from loud sounds generated by air-guns used in seismic surveys. For example, McCauley et al. (2002) investigated the effects of exposure to blasts from a seismic air-gun on the pink snapper *Pagrus auratus*. Fish were placed in a large cage in a bay and exposed to air guns over several hours. The fish were allowed to survive for different intervals after exposure, and the ears were then examined for any damage resulting from exposure to the sound. There was extensive damage to the sensory cells of the ear and the level of damage increased the longer the fish were allowed to survive post-exposure. However, Popper et al. (2005b) examined three species, including a salmonid (broad whitefish *Coregonus nasus*), after stimulation with five or twenty blasts of a seismic air gun. The broad whitefish showed no loss of hearing after exposure to the sounds, whereas northern pike *Esox lucius* and lake chub *Couesius plumbeus* showed 10-15 dB of hearing loss, but with complete recovery within 24 hours after exposure. No animals died as a result of exposure.

Other studies also indicate that loud sound may damage the neuromasts of the fish's lateral line and hair cells in the ears (Popper 2003, McCauley et al. 2003, Hastings and Popper 2005) with the probability of harm increasing with the time of exposure (Hastings et al. 1996, Popper et al. 2005). Damage to the sensory cells may not be visible until several days after exposure to the intense sound. There is some evidence that fish subjected to ear and lateral line injury may eventually replace some of the damaged sensory hair cells (Hastings et al. 1996, Lombarte et al., 1993). No information is available on the incidence of permanent threshold shift in fish due to environmental noise. Temporary threshold shifts, however, have been documented in laboratory investigations. Edds-Walton and Finneran (2006) provide an extensive critique of these studies. As they suggest, even a temporary impairment in hearing could have negative results, such as, failure to find food, failed communication with other members of their population, or failure to detect the approach of a predator.

The hearing of fish beyond the lethal range of underwater detonations could be adversely affected. Temporary threshold shifts would be likely and permanent hearing loss could result if sensory cells in the ear and on the lateral line are damaged and do not recover or regenerate. However, blast noises would be highly constrained in time and space, affecting the hearing of only a small percentage of the indigenous fish. Lasting impact on the survival, growth, or reproduction of fish populations would not be expected.

3.10.5 Invertebrate Hearing and Sound Production

Because invertebrates do not have air-filled cavities or sensory cells like those in the ears of fish, they do not have the capacity to detect changes in pressure that accompany sound waves (URI 2007). However, invertebrates are sensitive to particle displacement (Popper et al. 2001). When exposed to sound during experiments, some marine invertebrates show definite responses. Vibrations associated with sound are detected by special water motion receptors known as chordotonal organs. These organs facilitate the detection of potential predators and prey and provide environmental information such as the movement of tides and currents. The fiddler crab and spiny lobster have both been shown to use chordotonal organs to respond to nearby predators and prey. There is very limited data on invertebrate hearing, with only cephalopods (octopus and squid) and decapods (lobster, shrimp, and crab) thought to sense low-frequency sound (Offutt, 1970, Budelmann and Williamson 1994, Lovell et al. 2005). Packard et al. (1990) reported sensitivity to sound vibrations between 1-100 Hz for three species of cephalopods. Wilson et al. 2007 documents a lack of physical or behavioral response for squid exposed to experiments using high intensity sounds designed to mimic killer whale echolocation signals.

Like fish, invertebrates produce sound for the purpose of communication. Sound is used in territorial behavior, to deter predators, to find a mate, and to pursue courtship (Zelick et al. 1999, Popper et al. 2001). Most marine invertebrates known to produce sounds do so by rubbing parts of their body together. Spiny lobsters, for example, make a rasping sound with their antennae that can startle predators. Snapping shrimp produce loud enough sounds to stun prey by closing a large, specialized claw at a very high speed. This causes the water to form a bubble of vapor that collapses energetically. Light, also produced when the bubble collapses, has been referred to as 'shrimpoluminescence' by researchers (URI 2007).

3.10.6 Indirect Impacts

In addition to directly affecting fish, underwater detonations could affect other species in the food web including prey species. For example, sharks may consume sea turtles and small marine mammals and could be indirectly affected by explosive impacts to those prey items.

The effects of underwater explosions would differ depending upon the type of prey species in the area of the blast. As previously indicated, fish with swim bladders are more susceptible to blast injuries than fish without swim bladders. Invertebrate species, however, like squid, do not possess air-filled cavities, and therefore are less prone to near-field blast effects (Voss 1965), although impulsive noise has been implicated in mortality of deep water species (Guerra et al. 2004).

In addition to physical effects of an underwater blast, prey may have behavioral reactions to underwater sound. For instance, squid may exhibit a strong startle reaction to detonations that may include swimming to the surface, jetting away from the source, and releasing ink (McCauley et al. 2000). This startle and flight response is the most common secondary defense among animals (Hanlon and Messenger 1996). The noise from underwater explosions may induce startle reactions and temporary dispersal of schooling fish and squid if they are within close proximity. The abundances of fish and invertebrate prey species near the detonation point could be diminished for a few hours before being repopulated by animals from adjacent waters. No lasting effect on prey availability or the pelagic food web is expected.

3.11 WEAPONS TRAINING

EFH and Managed Species could be affected from shock waves and noise associated with weapons use, from sound generated as the projectile travels to the target, and from shock waves, sound, and debris created by impact and/or explosion of the weapon.

3.11.1 Bombing

Typically, bombing exercises (BOMBEX) at sea involve one or more aircraft bombing a target simulating a hostile surface vessel (DON 2005c). Most of the bombs used in SOCAL Range Complex exercises will be practice bombs without explosive warheads (DON 2007b). Weapons with non-explosive warheads would generate physical shock entering the water but would not explode. The shock from practice bombs hitting the sea surface would cause a small number of fish kills or injuries and minor acoustic displacement but would not jeopardize fish populations. Based on the density of fish in the area, the annual mortality associated with non-explosive missiles, targets, and mines hitting the water during training exercises is estimated in Section 3.7.2.2.1 of the EIS/OEIS to be <3 lb (1.35 kg) of the commercial fish catch in the SOCAL Range Complex.

Practice bombs entering the water would be devoid of combustion chemicals found in the warheads of explosive bombs. After sinking to the bottom, the physical structure of bombs would be incorporated into the marine environment by natural encrustation and/or sedimentation.

Aircraft need to qualify with both explosive and non-explosive ordnance. Air-to-ground bombing using explosive ordnance is mostly conducted at land ranges. However, some live bombs are dropped at sea. Exploding bombs are also used in other exercises such as SINKEX.

As with underwater detonations, the range within which fish may sustain injury or death from an exploding bomb would depend on environmental parameters, the size, location, and species of the fish, and its internal anatomy (e.g., whether it has a swim bladder) (DON 2005c). Fish without swim bladders are far more resistant to explosions than those with swim bladders (Keevin and Hempen 1997).

Propelled fragments are produced by an exploding bomb. In close proximity to the explosion, fish could be killed outright or sustain injury from propelled fragments (Stuhmiller et al. 1990). However, studies of underwater bomb blasts have shown that fragments are larger than those produced during air blasts and decelerate much more rapidly (O’Keeffe and Young 1984, Swisdak Jr. and Montaro 1992), reducing the risk to marine life.

Explosive bombs will be fused to detonate on contact with the water and it is estimated that 99 percent of them will explode within 5 ft (1.5 m) of the ocean surface (DON 2005c). Table 3-2, based on Young’s (1991) model, displays 10-percent mortality (90-percent survival) ranges for the largest explosive bombs that may be deployed during at-sea exercises.

Table 3-2: Estimated Fish-Effects Ranges for Explosive Bombs

Warhead Weight NEW (lb-TNT)	10 % Mortality Range by Weight of Fish		
	1 ounce	1 pound	30 pounds
500-lb	1,289 ft (393 m)	899 ft (274 m)	578 ft (176 m)
1,000-lb	1,343 ft (409 m)	937 ft (286 m)	602 ft (184 m)
2,000-lb	1,900 ft (579 m)	1,325 ft (404 m)	852 ft (260 m)

Table 3-2, as expected, reflects the fact that smaller fish are more subject to mortal effects from underwater explosions than larger fish. It also shows the non-linear relationship of the model equations relating explosive weight to range of effect. A four-fold increase in NEW increases the 10% mortality range by one and one-half times (doubling the area of effect).

Unlike the nearshore, shallow-water San Clemente Island NSW underwater explosive training areas, live bombing exercises would take place in deep water, so fish-effects range models would be appropriate for estimating the impact on fish populations. Computations reported in the Fish Section (3.7.2.2.1) of the EIS/OEIS indicate for the No Action Alternative an estimated 763 lb (329 kg) of fish would be killed annually in training with explosive-warhead bombs. This represents 0.061 percent the commercial fish catch in the SOCAL Range Complex.

Fish would be killed or injured from detonation of explosive bombs in relatively small areas compared to the vast expanse of the SOCAL Range Complex. Beyond the range of physical effects, the natural reaction of fish would be to leave the area. When the exercise concludes, the area would be repopulated and the fish stock would rebound. The overall impact to water column habitat would be localized and transient. The abundance and diversity of fish within SOCAL Range Complex is unlikely to measurably decrease as a result of bombing exercises.

Acoustic impacts on fish during live bomb exercises would be similar to those discussed earlier for underwater detonations associated with underwater detonations. Although some fish in the vicinity of the exercises might react negatively to the noise of bomb explosions, the limited number of these events and the relatively small areas affected should minimize the effect on local fish populations. Chemical by-products of bomb detonations would not pose a hazard to marine animals since the chemicals will be diluted prevailing currents and the exercises will be dispersed in time and space.

Noise produced during weapons use may disrupt the behaviors of marine species in the immediate area. Because of the localized nature and short duration of the exercise, there would be no lasting impact on prey availability, as only small portions of the prey population would be affected and populations would rapidly replenish. Due to the shallow detonation depth (<5 ft (1.5 m) below the surface, bombs dropped in waters deeper than 100 m (328 ft) would have negligible effects on the seafloor and on the animals that dwell there. The detonation of large bombs in shallow water is very unlikely.

Fragments from detonated bombs would settle to the sea floor where solid metal components would be corroded by seawater at slow rates. Over time, natural encrustation of exposed surfaces would occur, reducing the rate at which subsequent corrosion occurs. Rates of deterioration would vary, depending on the type of material and on environmental conditions. Due to the large area of the SOCAL Range Complex, expended ordnance would be widely scattered on the ocean floor and would have a minimal impact on the benthic environment.

The proposed bombing exercises would not adversely affect the quality or quantity of EFH within SOCAL Range Complex. The disruption to habitat components that support feeding, resting, sheltering, reproduction, or migration of fish would be slight or non-existent.

3.11.2 Naval Gun Fire

Potential effects from the use of Naval gun systems have been analyzed in a variety of environmental documents (DON 2000, 2001a, 2002a, 2004a,b, 2007a). The 5-inch gun has the largest warhead fired during routine gunnery exercises. Most training uses non-explosive 5-inch rounds. The surface area of the ocean impacted by a non-explosive 5-in round has been estimated to be 129 cm^2 (20 in^2) (DON 2007a). So the approximately 6,000 non-explosive 5-in rounds fired annually in the SOCAL Range Complex would create a cumulative impact area of 77 m^2 (833 ft^2). Considering the vast expanse of the SOCAL Range Complex, few fish would be directly struck by a shell from a 5-inch gun.

Explosive rounds would have the greatest potential for impacts to fish in surface waters. As previously indicated, biological effects of an underwater explosion depend on many factors, including the size, type, and depth of both the animal and the explosive, the depth of the water column, the standoff distance from the charge to the animal, and the sound-propagation properties of the environment. Potential impacts can range from brief acoustic effects, tactile perception, and physical discomfort, to slight injury to internal organs and the auditory system, to death of the animal (Keevin and Hempen 1997).

Table 3-3 provides an estimation of the potential range of lethal effects on swim bladder fish based on Young's (1991) model for five-inch explosive projectiles. These rounds have a NEW of TNT of approximately 8 lbs (3.6 kg) and are assumed to detonate at a depth of 5 ft (1.3 m). Behavioral reactions of fish would extend over a substantially larger area. The overall impacts to water-column habitat would, however, be minor as fish would return following the exercise. The abundance and diversity of fish and the quality and quantity of fish habitat within the range is unlikely to decrease as a result of gun fire training.

Table 3-3: Estimated Fish-Effects Ranges for 5-in Naval Gunfire Rounds

Weight of Fish	10% Mortality Range	
	ft	m
1 oz	405	123
1 lb	282	86
30 lbs	181	55

Accurate measurements of the size of the debris field from the underwater explosion of 5-inch shells are not available. However, the shells are typically fused to explode at the sea surface. This, combined with the high downward velocity of the shell at impact, suggests that the debris field from the exploding shell would be restricted in size. As with exploding bombs, the shell fragments rapidly decelerate through contact with the surrounding water. The possibility that the exploding shell fragments and debris would significantly affect EFH and fish populations is considered negligible.

Contaminants released from the detonation of exploding shells would be similar to those discussed previously for bombs. Thus, it is unlikely that the explosive compounds or their combustion products would pose a threat to fish or EFH.

Unexploded five-inch shells and non-explosive ordnance practice shells would not be recovered and would sink to the bottom. The rapid-detonating explosive (RDX) material of unexploded ordnance would not be exposed to the marine environment, as it is encased in a non-buoyant cylindrical package. Should the RDX be exposed on the ocean floor, it would break down within a few hours (DON 2001a). It does not bioaccumulate in fish or in humans. Over time, the RDX residue would be covered by ocean sediments or diluted by ocean water.

Solid-metal components of unexploded ordnance and non-explosive ordnance would be corroded by seawater at slow rates, which comparable slow release rates. Exposure of fish to chemical constituents from all metallic and non-metallic ordnance components would be further reduced as a result of natural encrustation of external surfaces. Consequently, the release of contaminants from unexploded ordnance and non-explosive ordnance would not result in substantial degradation of marine water quality.

3.11.2.1 Acoustic Impacts of Naval Gunfire

Naval gunfire could have acoustic effects from: 1) noise generated by firing the gun (muzzle blast), 2) vibration from the blast propagating through the ship's hull, 3) sonic-booms generated by the shell flying through the air, and 4) noise from the impact and explosion of the shell.

Firing a deck gun produces a shock wave in air that propagates away from the muzzle in all directions, including toward the air/water surface. Direct measurements of shock wave pressures transferred through the air/water interface from the muzzle blast of a 5-inch gun are well below levels known to be harmful at shallow depths (DON 2000, Yagla and Stiegler 2003). Navy watch standers would observe waters surrounding the ship to ensure significant biological aggregations are not in proximity to the ship during firing exercises. Noise produced during gunfire may disturb fish in the vicinity of the ship. Because the noise is brief, no extended disruption of fish behavior is expected.

Gun fire sends energy through the ship structure, into the water, and away from the ship. This effect was also investigated in conjunction with the measurement of 5-inch caliber gun blasts described above (DON 2000, Yagla and Stiegler 2003). The energy transmitted through the ship to the water for a typical round was found to be about 6% of that from the air blast impinging on the water. Therefore, noise transmitted from the gun, through the hull into the water should have negligible impact on marine life.

The sound generated by a shell in its flight at supersonic speeds above the water is transmitted into the water in much the same way as a muzzle blast (Pater 1981). The region of underwater noise influence from a single traveling shell is relatively small, diminishes quickly as the shell gains altitude, and is of short duration. The penetration of sound through the air\water interface is relatively limited (Miller 1991, Yagla and Stiegler 2003). Studies reviewed in DON 2007a indicate only a small number of submerged species would be exposed to the pressure waves from sonic booms from 5-inch shells fired during routine training exercises.

The potential exists for energy from multiple sonic booms to accumulate over time from multiple, possibly rapid firings of a gun. However, because the area directly below the shells' path, where the conditions are correct for energy to enter the ocean is small, it is highly unlikely that the energy from more than two or three shells would be additive.

Behavioral effects from the noise of Naval gunnery shells exploding would be similar to that already described for other types of underwater explosions. Although fish in the vicinity of the explosion may exhibit avoidance reactions, the noises generated are relatively short-term and localized, and behavioral disruptions would not be expected to have lasting impacts on the survival, growth, or reproduction of fish populations.

3.11.3 Small Arms Fire

Small arms rounds and Close-In Weapons System (CIWS) rounds fired directly into the water decelerate to non-lethal velocity within 56 cm (22 in) of the water's surface after impact (DON 2007a, b). The Point Mugu Sea Range EIS/OEIS (DON 2002a) analyzed the impacts associated with CIWS operations. The maximum area of water surface that might be struck by the 20 mm CIWS rounds was estimated by taking the cross-sectional surface area of a 20 mm round multiplied by the total number of rounds fired during a typical year. Local marine mammal densities were then multiplied by the maximum area of water surface that might be hit by a round. The analyses determined that the probability of a marine mammal being hit or injured by a CIWS operation would be very low; so low that it could take hundreds of thousands of years before a marine mammal would be hit. Similarly, given the large area of the SOCAL Range Complex, limited fish mortality and injury would be expected from CIWS and other small arms fire.

Few fish would be directly hit by bullets striking the water during small arms exercises. Bullets rapidly decelerate on contact with water, presenting minimal threat to fish swimming below the surface. The shock waves generated by bullets hitting the water is not expected to be great enough to cause harm to marine animals (DON 2007a,b). Fish in the area would be startled by the sound, but should return to normal behavior shortly after the exercise.

Fish feeding in the vicinity of the small arms fire exercises could potentially ingest expended shells, shell fragments, or shell casings. The shiny metallic surface of a newly discharged shell casing and its movement through the water may trigger a feeding response. If ingested, the casing could lodge in the digestive system and interfere with food consumption and digestion. However, the probability of such events is low and significant consequences at the level of fish populations would not be likely. Spent shell casings deposited on the sea floor could also be mistaken for food, although, discharged casings will remain shiny for only a short period, reducing the potential for ingestion by fish.

Expended bullets may release small amounts of iron, aluminum, and copper into the sediments and the overlying water column as bullets corrode. Although, elevated levels of these elements can cause toxic reactions in exposed animals, high concentrations in sediments would be restricted to a small zone around the bullet, and releases to the overlying water column would be quickly diluted. The projectiles for 5.56-mm and 7.62-mm gun ammunition have lead cores; however, no significant releases of lead into the water through dissolution are expected because of the neutral pH of ocean waters and sediments (DON 2005d). Based on the low probability of ingestion and/or absorption of lead from bullet cores, slight to non-existent effects on fisheries are expected.

3.11.4 Torpedo Exercises

Torpedo exercises (TORPEXs) entail aircraft, surface ship, or submarine crews attacking targets with torpedoes (DON 2004c, 2005b). Submarines practice launching non-explosive training torpedoes against surface ship targets. When a torpedo “hits” its target, or runs out of fuel if it misses its intended target, it drops ballast weights (see previous expended material section) or inflates a gas chamber and floats to the surface to be recovered by a ship. Torpedoes used in aviation exercises typically employ recoverable exercise torpedoes which do not have fuel or propulsion. Attempts are made to recover all torpedoes.

No ordnance would be detonated during a TORPEX, so the physical force that marine organisms are exposed to would be limited to that produced by torpedo launching and movement. Due to the small area of torpedo traverse, the number of fish strikes by torpedoes would be low.

The primary potential impact to the marine environment would be the release of combustion products into the ocean from torpedo fuel. Torpedo exhaust products, nitrogen oxides, carbon monoxide, carbon dioxide, hydrogen, nitrogen, methane, ammonia, and hydrogen cyanide, would be rapidly dissolved, disassociated, or dispersed in the water column (DON 2004c). Carbon dioxide, nitrogen, methane and ammonia are naturally-occurring in seawater. Carbon monoxide and hydrogen have low solubility in seawater and would bubble to the surface dissipating into the air. Trace amounts of nitrogen oxides may be present, but are usually below detectable limits.

Hydrogen cyanide (HCN) does not normally occur in seawater, and if present in high-enough concentration, could pose a potential risk to marine biota. The US Environmental Protection Agency national water-quality criterion for HCN in marine waters is 1 part per billion for both acute and chronic effects. In order for the HCN concentration to be below this threshold and be considered non-toxic, marine life would need to be outside an estimated 6.3 m (21 ft) zone of influence around the torpedo’s path until such time that the HCN is diffused into the water (DON 2004c). Because HCN has extremely high solubility in seawater, the HCN will rapidly diffuse to levels below one ppb and thus would pose no significant threat to marine organisms. For a substantial quantity of torpedo fuel to be released into the ocean, the torpedo would have to be subjected to stresses beyond its structural design limits and catastrophically fail. Such stress is very unlikely to occur.

The Mk 50 torpedo uses lithium metal fuel. Its operation does not result in a routine discharge. A breach of the lithium-fueled boiler systems is extremely rare, but might occur at an estimated rate of once per year worldwide. Based on an analysis of worst-case scenarios, the Navy concluded that a breach of the lithium boiler system at any point in the torpedo run would not have a significant impact on the marine environment (DON 2004c).

3.11.5 ADC and EMATT Exercises

Lithium sulfur dioxide (LiSO2) battery cells power both ADCs and EMATTs. Since they are expended, battery chemical could eventually be released into the marine environment (DON 2005b). Lithium is the 17th most abundant element in seawater. In addition to it being found naturally in seawater, currents would rapidly diffuse its concentration around ADCs or EMATTs, thus minimizing the potential impact. The lithium metal contained in the ADC or EMATT is extremely reactive with water. When the lithium reacts with water it causes an exothermic (heat liberating) reaction that generates soluble hydrogen gas and lithium hydroxide. The hydrogen gas eventually enters the atmosphere and the lithium hydroxide dissociates, forming lithium ions and hydroxide ions. The hydroxide is neutralized by the hydrolysis of the acidic sulfur dioxide, ultimately forming water. Sulfur dioxide, a gas that is highly soluble in water, is the major reactive component in the battery. The sulfur dioxide ionizes in the water, forming bisulfite (HSO3) that is easily oxidized to sulfate in the slightly alkaline environment of the ocean. Sulfur is present as sulfate in large quantities in the ocean. Chemical reactions of the lithium sulfur dioxide batteries would be highly localized and short-lived. Ocean currents would greatly diffuse concentrations of the chemicals leached by the ADC or EMATT batteries. For these reasons the lithium sulfur dioxide batteries would not significantly affect water quality, marine fish, or EFH.

3.11.6 Missile Exercises

In these exercises, missiles are fired by aircraft, ships, and Naval Special Warfare (NSW) operatives at a variety of airborne and surface targets. Missiles used in most aviation exercises are non-explosive versions and do not explode upon contact with the target or sea surface. Practice missiles do not use rocket motors or their potentially hazardous rocket fuel. The main environmental impact would be the physical structure of the missile itself entering the water.

Intact missiles and aerial targets falling from the sky would impact the ocean surface with great force, producing shock waves that could kill and injure fish. In Section 3.2.2.y of the EIS/OEIS, the pressure levels known to cause injury and mortality were used to estimate effects of shock pulses created by falling missiles and targets. Calculations were also made for sea surface impact effects from non-explosive bombs and practice mines dropped from aircraft. For all of the exercises of these types in the SOCAL Range Complex, an amount of fish equivalent to <1 lb (0.45 kg) of commercial fish catch would be killed annually.

Exploding warheads may be used in air-to-air missile exercises, but to avoid damaging the aerial target, the missile explodes in the air, disintegrates, then, falls into the ocean. Regions of missile target practice are monitored by Navy personnel to identify marine animals and avoid areas of significant concentration.

The quantity of fish killed or injured by practice missiles or their debris striking the water would be a very small fraction of the indigenous fish community.

3.11.7 Expeditionary Assault

Expeditionary Assault involves a seaborne force assaulting across a beach in a combination of helicopters, vertical takeoff and landing (VTOL) aircraft, landing craft air cushion (LCAC), amphibious assault vehicles (AAVs), expeditionary fighting vehicle (EFV) and landing craft. More robust expeditionary assault operations include support by Naval surface fire support (NSFS), close air support (CAS), and Marine artillery.

The large vehicles and landing craft crossing shallow water and the beach in an amphibious assault could damage EFH. Before each major amphibious landing exercise is conducted, a hydrographic survey is performed to map out the precise transit routes through sandy bottom areas. During the landing, the crews follow established procedures, such as having a designated lookout watching for other vessels, obstructions to navigation, and significant concentrations of marine animals. Sensitive habitats such as rocky reefs, seagrass beds, and kelp beds would be avoided.

Although amphibious landings are restricted to specific areas of designated beaches, amphibious landings in nearshore sandy subtidal habitat could lead to a temporary adverse impact on Managed Species due to death or injury, loss of benthic epifauna and infauna that may serve as prey, and increased turbidity. Increases in turbidity could temporarily decrease the foraging efficiency of fish, however, given the dynamic nature of the habitat and the grain size of the material, turbidity is expected to be minimal and localized. Artillery rounds that fall short of land would destroy patches of sandy bottom habitat kill or injure nearby marine life. However, the overall impacts on marine biological resources would be limited because sandy beach habitats support relatively few organisms and are adapted to recover quickly from disturbance.

3.11.8 Shallow Water Minefield

Multiple possible sites off Tanner Bank, Cortes Bank, La Jolla, and Point Loma have been considered for a shallow water minefield. Of these, an area known as Advanced Research Project Agency Training Minefield (ARPA) off La Jolla (and historically used for shallow water submarine MCM training) is the desired location for expanding MCM training.

Shallow water minefield support of submarine MCM training requires a depth of 250-420 feet, and a sandy bottom and flat contour in an area relatively free from high swells and waves. The size of the area would be a minimum of 2x2 nm and optimally 3x3 nm. Mine shapes would be approximately 500-700 yards apart and 30-35 inches in size, and would consist of a mix of recoverable/replaceable bottom shapes (~10 cylinders weighed down with cement) and moored shapes (~15 shapes, no bottom drilling required for mooring). Localized, temporary impacts on water quality and sessile benthic fauna would occur during installation of the mine shapes; however, based on the project criteria, no adverse impact on Managed Species or EFH would be expected.

3.11.9 Shallow Water Training Range (SWTR) Extension

This component of the Proposed Action is to instrument and use two extensions of the current SOAR, one 250-nm^2 (463-km^2) area to the west in the area of the Tanner/Cortez Banks, and one 250-nm^2 (463-km^2) area between SOAR and the southern section of SCI. The instrumentation would be in the form of undersea cables and sensor nodes, which would constitute a SWTR portion of SOAR. The cables and sensors are similar to those that instrument the current deep-water range (SOAR). The combination of deep-water and shallow-water instrumentation provides range uninterrupted coverage of air, surface, and subsurface operations. The instrumented area would be connected to the shore via a single trunk cable. Installation of additional acoustic sensors in the nearshore and offshore shallow water extensions has the potential to have localized impacts on fish. These impacts would generally consist of fish fleeing the construction area, and would not have of adverse effects at the population level.

3.11.10 Sinking Exercises

During a SINKEX, Navy crews fire live and non-explosive ordnance at a target vessel that has been towed to a location in the SOCAL Range Complex. Target vessels are empty, cleaned, and, environmentally remediated to U.S. EPA specifications. A wide variety of assets may be involved, including aircraft, helicopters, surface ships, and submarines (DON 2006a).

The numbers and types of weapons used in a SINKEX depend on training requirements and the size of the target vessel, but could include air-to-surface missiles and bombs, surface-to-surface missiles, torpedoes, and naval gun fire. The total net explosive weight (NEW) expended would not exceed 20,000 lb (9,072 kg) per target during the exercise. The NEW of any individual weapon would not exceed 1000 lb (454 kg) (DON 2006a).

Prior to conducting an exercise, a Notice to Mariners and a Notice to Airmen delineating the exercise area and time would be published. Extensive range clearance operations would be conducted prior to the exercise, ensuring that no shipping is within the range of weapons being fired. In addition, for 90 minutes prior to the commencement of the exercise and between certain series of weapon firings, a 2.5 nm exclusion zone would be surveyed by visual and acoustic means to detect the presence of protected marine mammals and sea turtles. A safety zone would also be established which extends from the exclusion zone at 2.5 nm out another 2 nm. Together, the exclusion and safety zones extend out 4.5 nm from the target.

In the rare event that the deployed ordnance does not sink the target, EOD personnel would scuttle the ship, typically the following day, using charges placed in locations that would breech the hull to sink the unstable ship. Whether guided or unguided, the majority of ordnance would hit the target. Of all the weapons used, only the torpedo is designed to explode in the water column.

The transfer of pressure waves and acoustic energy from detonation of ordnance within the target should have minimal impact on adjacent marine life (DON 2006a). Effects from gun fire shells, bombs, and missiles that fall short of the target and torpedoes striking the vessel, as discussed previously, could cause mortality or injure pelagic marine life, but should not have significant, long-term, biological consequences. Although SINKEX can have an adverse effects on Managed Species, all vessel sinkings are conducted in water at least 1,000 fathoms (6,000 feet) deep and at least 50 nautical miles from land to avoid impacts to sensitive EFH,. Thus, SINKEX operations would not destroy or adversely effect sensitive benthic habitats, but may alter soft bottom habitats and may provide a beneficial use by providing consolidated habitat in the deep water environment.

3.12 SONAR USE

Antisubmarine warfare (ASW) and mine warfare (MIW) exercises include training sonar operators to detect, classify, and track underwater objects and targets. There are two basic types of sonar: passive and active. Passive sonars only listen to incoming sounds and, since they do not emit sound energy in the water, lack the potential to acoustically affect the environment. Active sonars emit acoustic energy to obtain information about a distant object from the reflected sound energy. Active sonars are the most effective detection systems against modern, ultra-quiet submarines and sea mines in shallow water.

Modern sonar technology has developed a multitude of sonar sensor and processing systems. In concept, the simplest active sonars emit acoustic pulses (“pings”) and time the arrival of the reflected echoes from the target object to determine range. More sophisticated active sonars emit a ping and then scan the received beam to provide directional as well as range information. Only about half of the U.S. Navy's ships are equipped with active sonar and their use is generally limited to training and maintenance activities - 90% of sonar activity by the Navy is passive (DON 2007e).

Active sonars operate at different frequencies, depending on their purpose. High frequency sonar (>10 kHz) is mainly used for establishing water depth, detecting mines, and guiding torpedoes. At higher frequencies, sound energy is greatly attenuated by scattering and absorption as it travels through the water. This results in shorter ranges, typically less than five nautical miles. Mid frequency sonar is the primary tool for identifying and tracking submarines. Mid frequency sonar (1 kHz - 10 kHz) suffers moderate attenuation and has typical ranges of 1-10 nautical miles. Low frequency sonar (<1 kHz) has the least attenuation, achieving ranges over 100 nautical miles. Low frequency sonars are primarily used for long-range search and surveillance of submarines. Surveillance Towed Array Sensor System Low Frequency Active (SURTASS LFA) is the U.S. Navy's low frequency sonar system (DON 2001b, 2005surtass). It employs a vertical array of 18 projectors using the 100-500 Hz frequency range.

Sonars used in ASW are predominantly in the mid frequency range (DON 2007e). ASW sonar systems may be deployed from surface ships, submarines, and rotary and fixed wing aircraft. The surface ships are typically equipped with hull mounted sonar but may tow sonar arrays as well. Helicopters are equipped with dipping sonar (lowered into the water). Helicopters and fixed wing aircraft and may also deploy both active and passive sonobuoys and towed sonar arrays to search for and track submarines.

Submarines also use sonars to detect and locate other subs and surface ships. A submarine's mission revolves around stealth, and therefore submarines use their active sonar very infrequently since the pinging of active sonar gives away their location. Submarines are also equipped with several types of auxiliary sonar systems for mine avoidance, for top and bottom soundings to determine the submarine's position in the water column, and for acoustic communications. ASW training targets simulating submarines may also emit sonic signals through acoustic projectors.

Sonars employed in MIW training are typically high frequency (greater than 10 kHz). They are used to detect, locate, and characterize mines that are moored, laid on the bottom, or buried (DON 2002c, 2005b, c,d). MIW sonars can be deployed from multiple platforms including towed systems, unmanned underwater vehicles (UUVs), surf zone crawlers, or surface ships.

Torpedoes use high-frequency, low-power, active sonar. Their guidance systems can be autonomous or electronically controlled from the launching platform through an attached wire. The autonomous guidance systems are acoustically based. They operate either passively, exploiting the emitted sound energy by the target, or actively, ensonifying the target and using the received echoes for tracking and targeting.

Military sonars for establishing depth and most commercial depth sounders and fish finders operate at high frequencies, typically between 24 and 200 kHz.

3.12.1 Low Frequency Sonar

Low frequency sound travels efficiently in the deep ocean and is used by whales for long-distance communication (Richardson et al. 1995, NRC 2003, 2005). Concern about the potential for low frequency sonar (<1 kHz) to interfere with cetacean behavior and communication has prompted extensive debate and research (DON 2001b, 2005b, 2007e, NRC 2000, 2003).

Some studies have shown that low frequency noise will alter the behavior of fish. For example, research on low frequency devices used to deter fish away from turbine inlets of hydroelectric power plants showed stronger avoidance responses from sounds in the infrasound range (5-10 Hz) than from 50 and 150 Hz sounds (Knudsen et al. 1992, 1994). In test pools, wild salmon exhibit an apparent avoidance response by swimming to a deeper section of the pool when exposed to low frequency sound (Knudsen et al. 1997).

Turnpenny et al. (1994) reviewed the risks to marine life, including fish, of high intensity, low frequency sonar. Their review focused on the effects of pure tones (sine waves) at frequencies between 50-1000 Hz. Johnson (2001) evaluated the potential for environmental impacts of employing the SURTASS LFA sonar system. While concentrating on the potential effects on whales, the analysis did consider the potential effects on fish, including bony fish and sharks. It appears that the swimbladders of most fish are too small to resonate at low frequencies and that only large pelagic species such as tunas have swimbladders big enough to resonate in the low frequency range. However, investigations by Sand and Hawkins (1973), and Sand and Karlsen (1986) revealed resonance frequencies of cod swim bladders from 2 kHz down to 100 Hz.

Hastings et al. (1996) studied the effects of low frequency underwater sound on fish hearing. More recently, Popper et al. (2005a, 2007) investigated the impact of U. S. Navy SURTASS LFA sonar on hearing and on non-auditory tissues of several fish species. In this study, three species of fish in Plexiglas cages suspended in a freshwater lake were exposed to high intensity LFA sonar pulses for periods of time considerably longer than likely LFA exposure. Results showed no mortality and no damage to body tissues either at the gross or histological level. Some individuals exhibited temporary hearing loss but recovered within several days of exposure. The study suggests that SURTASS LFA sonar does not kill or damage fish even in a worst case scenario.

Although some behavioral modification might occur, adverse effects from low frequency sonar on fish are not expected.

3.12.2 Mid Frequency Sonar

ASW training operations would use mid frequency (1-10 kHz) sound sources. Most fish only detect sound below this range (Popper, 2003; Hastings and Popper, 2005). Thus, it is expected that few fish species would be able to detect the ASW mid frequency sonar.

Some investigations have been conducted on the effect on fish of acoustic devices designed to deter marine mammals from gillnets (Gearin et al. 2000, Culik et al. 2001). These devices generally have a mid frequency range, similar to the sonar devices that would be used in ASW exercises. Adult sockeye salmon exhibited an initial startle response to the placement of inactive acoustic alarms designed to deter harbor porpoise. The fish resumed their normal swimming pattern within 10 to 15 seconds. After 30 seconds, the fish approached the inactive alarm to within 30 cm (1 ft). The same experiment was conducted with the alarm active. The fish exhibited the same initial startle response from the insertion of the alarm into the tank; however, within 30 seconds, the fish were swimming within 30 cm (1 ft) of the active alarm. After five minutes of observation, the fish did not show any reaction or behavior change except for the initial startle response. This demonstrated that the alarms were either inaudible to the fish, or the fish were not disturbed by the mid frequency sound.

Jørgensen et al. (2005) carried out experiments examining the effects of mid frequency (1 to 6.5 kHz) sound on survival, development, and behavior of fish larvae and juveniles. Experiments were conducted on the larvae and juveniles of Atlantic herring, Atlantic cod, saithe *Pollachius virens*, and spotted wolffish *Anarhichas minor*. Swimbladder resonance experiments were attempted on juvenile Atlantic herring, saithe, and Atlantic cod. Sound exposure simulated Naval sonar signals. These experiments did not cause any significant direct mortality among the exposed fish larvae or juveniles, except in two (of a total of 42) experiments on juvenile herring where significant mortality (20-30%) was observed. Among fish kept in tanks one to four weeks after sound exposure, no significant differences in mortality or growth related parameters (length, weight and condition) between exposed groups and control groups were observed. Some incidents of behavioral reactions were observed during or after the sound exposure - ‘panic’ swimming or confused and irregular swimming behavior. Histological studies of organs, tissues, or neuromasts from selected Atlantic herring experiments did not reveal obvious differences between control and exposed groups.

The work of Jørgensen et al. (2005) was used in a study by Kvadsheim and Sevaldsen (2005) to examine the possible ‘worse case’ scenario of sonar use over a spawning ground. They conjectured that normal sonar operations would affect less than 0.06% of the total stock of a juvenile fish of a species, which would constitute less than 1% of natural daily mortality. However, these authors did find that the use of continuous-wave transmissions within the frequency band corresponding to swim bladder resonance will escalate this impact by an order of magnitude. The authors therefore suggested that modest restrictions on the use of continuous-wave transmissions at specific frequencies in areas and at time periods when there are high densities of Atlantic herring present would be appropriate.

Studies have indicated that acoustic communication and orientation of fish may be restricted by noise regimes in their environment (Wysocki and Ladich 2005). Although some species may be able to produce sound at higher frequencies (> 1 kHz), vocal marine fish largely communicate below the range of mid-frequency levels used in the proposed action. Further, most marine fish species are not expected to able to detect sounds in the mid-frequency range of the operational sonars used in the proposed action. The few fish species that have been shown to be able to detect mid-frequencies do not have their best sensitivities in the range of the operational sonars. Thus, these fish can only hear mid-frequency sounds when they are very loud (i.e. when sonars are operating at their highest energy levels and fish are within a few meters). Considering the low frequency detection of most marine species and the limited time of exposure due to the moving sound sources, the mid frequency sound sources used in the proposed action do not have the potential to significantly mask key environmental sounds.

Experiments on fish classified as hearing specialists (but not those classified as hearing generalists) have shown that exposure to loud sound can result in temporary hearing loss, but it is not evident that this may lead to long-term behavioral disruptions in fish that are biologically significant (Amoser and Ladich 2003, Smith et al. 2004 a,b). There is no information available that suggests that exposure to non-impulsive acoustic sources results in significant fish mortality at the population level.

In summary, while some marine fish may be able to detect mid frequency sounds, most marine fish are hearing generalists and have their best hearing sensitivity below mid frequency sonar. If they occur, behavioral responses would be brief, reversible, and not biologically significant. Sustained auditory damage is not expected. Sensitive life stages (juvenile fish, larvae and eggs) very close to the sonar source may experience injury or mortality, but area-wide effects would likely be minor. The use of Navy mid frequency sonar would not compromise the productivity of fish or adversely affect their habitat.

3.12.3 High Frequency Sonar

Although most fish cannot hear sound frequencies over 10 kHz, some shad and herring species can detect sounds in the ultrasonic range, i.e., over 20 kHz. (Mann et al., 2001; Higgs et al., 2004). Ross et al., (1995, 1996) reviewed the use of high frequency sound to deter alewives from entering power station inlets. The alewife, a member of the shad family (Alosinae) which can hear sounds at ultrasonic frequencies (Mann et al., 2001), uses high frequency hearing to detect and avoid predation by cetaceans. Studies conducted on the following species showed avoidance to sound at frequencies over 100 kHz: alewife (*Alosa pseudoharengus*) (Dunning et al., 1992; Ross et al., 1996), blueback herring (*A. aestivalis*) (Nestler et al., 2002), Gulf menhaden (*Brevoortia patronus*) (Mann et al., 2001) and American shad (*A. sapidissima*) (Popper and Carlson, 1998). The highest frequency to solicit a response in any marine fish was 180 kHz for the American shad (Gregory and Clabburn, 2003; Higgs et al., 2004).

Since high-frequency sound attenuates quickly in water, high levels of sound from mine hunting sonars would be restricted to within a few meters of the source. Even for fish able to hear sound at high frequencies, only short-term exposure would occur, thus high frequency military sonars are not expected to have significant effects on resident fish populations.

Because a torpedo emits sonar pulses intermittently and is traveling through the water at a high speed, individual fish would be exposed to sonar from a torpedo for a brief period. At most, an individual animal would hear one or two pings from a torpedo and would be unlikely to hear pings from multiple torpedoes over an exercise period. Most fish hear best in the low- to mid-frequency range and therefore are unlikely to be disturbed by torpedo pings.

The effects of high frequency sonar, on fish behavior, for species that can hear high frequency sonar, would be transitory and of little biological consequence. Most species would probably not hear these sounds and would therefore experience no disturbance.

3.12.4 Conclusion

While the impact of anthropogenic noise on marine mammals has been extensively studied, the effects of noise on fish are largely unknown (Popper 2003, Hastings and Popper 2005). There is a dearth of empirical information on the effects of exposure to sound, let alone sonar, for the vast majority of fish. The few studies on sonar effects have focused on behavior of individuals of a few species and it is unlikely their responses are representative of the wide diversity of other marine fish species (ICES 2005, Jorgensen et al. 2005). The literature on vulnerability to injury from exposure to loud sounds is similarly limited, relevant to particular species, and, because of the great diversity of fish, not easily extrapolated. More well-controlled studies are needed on the hearing thresholds for fish species and on temporary and permanent hearing loss associated with exposure to sounds. The effects of sound may not only be species specific, but also depend on the mass of the fish (especially where any injuries are being considered) and life history phase (eggs and larvae may be more or less vulnerable to exposure than adult fish). The use of sounds during spawning by some fish, and their potential vulnerability to masking by anthropogenic sound sources, also requires further investigation. No studies have established effects of cumulative exposure of fish to any type of sound or have determined whether subtle and long-term effects on behavior or physiology could have an impact upon survival of fish populations. The use of sounds during spawning by some fish and their potential vulnerability to masking by anthropogenic sound sources requires closer investigation.

With these caveats and qualifications in mind, the limited information currently available suggests that populations of fish are unlikely to be affected by the projected rates and areas of use of military sonar. Thus, significant harm to fish is not anticipated from Navy sonar used in SOCAL Range Complex training.

3.13 RESEARCH, DEVELOPMENT, TESTING, AND EVALUATION

SOCAL Range Complex operations include a wide variety of Research, Development, Testing, and Evaluation (RDT&E) of underwater weapons, weapons systems, and components. Specific events include: Ship Tracking and Torpedo Tests; Unmanned Underwater Vehicle (UUV) Tests; Sonobuoy Quality Assurance (QA)/Quality Control (QC) Tests; Ocean Engineering Tests; Marine Mammal Mine Shape Location and Research; Radio Frequency (RF) Tests; Unmanned Aerial Vehicles (UAV) Tests Missile Flight Tests; and, Naval Undersea Warfare Center (NUWC) Acoustics Tests. With the exception of Marine Mammal Mine Shape Location and Research, the potential impact of various elements of RDT&E activities are considered in sections dealing with common components of offshore operations (e.g., weapons and sonar use).

Marine Mammal Mine Shape Location and Research involves the deployment of trained bottlenose dolphins and California sea lions to locate and retrieve non-explosive mine shapes. No ordnance is involved. The recoverable mine shapes emit pings for retrieval purposes. The only aspect of the training that has potential effects on fish is the use of the high frequency (28–45 kHz) pingers that are attached to non-explosive mines to allow recovery. High frequency sounds attenuate rapidly in seawater, and would be inaudible or only faintly audible to most fish (see Section 3.8 (Fish) of the EIS/OEIS). Any disturbance effects would be localized, short-term, and insignificant in an ecological context.

The Marine Communities and Fish evaluations in the EIS/OEIS (Sections 3.5 and 3.8) conclude that the only RDT&E activity that has the potential for adverse effects on marine animals is Underwater Acoustics Testing involving mid frequency sonar. Effects of mid frequency sonar on fish would be less than significant.

3.14 IMPACT SUMMARY

The SOCAL Range Complex covers a vast area from coastal beaches to 600 nautical miles (1,111 km) offshore encompassing approximately 120,000 nm^2 (411,588 km^2). The wide dispersion in time and space of Navy training operations superimposed on the variable temporal and seasonal distributions of the fish species present, minimizes the potential for interaction with local populations. Given the limited extent, duration, and magnitude of potential impacts, adverse effects on EFH and Managed Species are not expected (Table 3-4).

Table 3-4: Impact Summary

Action or Activity	Impact Assessment
Vessel Movement	Ship strikes on fish would be rare. Behavioral alterations would occur only close to a ship and involve short-term redistributions with little potential for adverse effect on fish populations.
Aircraft Over-Flight	Response of fish to aircraft over-flight would be within the range of normal behavior. Sonic booms would be sporadic and are not expected to have significant effects on underwater life.
Fuel Spills	Infrequent fuel spills, mitigated through standard spill control responses and wildlife rescue procedures, should not jeopardize EFH or Managed Species.
Discharges from Ships	Navy vessels would comply with National and International conventions, minimizing or eliminating potential impacts from discharges.
<u>Expended Material</u>	Expended material poses a risk from direct contact, ingestion, entanglement, and exposure to hazardous chemicals.
Lightsticks	Deploying a limited number of lightsticks over the large SOCAL Range Complex would have an insignificant biological effect.
Flares	Light from flares would not be bright enough or sustained enough to interfere with ecological processes. Flare debris is unlikely to injure fish, modify water quality, or degrade benthic sediments.
Chaff	Fish would not suffer lasting physical effects from chaff particles coating the skin, passing through the gills or from ingestion.
Dye	Dye would be rapidly dispersed and is non-toxic. The plastic bags containing the dye would pose a small ingestion hazard compared to the total load of man-made plastic to which local fish are exposed.
Markers	Light generated from marine markers is intense but brief, and associated smoke would be rapidly diffused by air movement. Marker debris would sink to the bottom and be encrusted and/or incorporated into the sediments.
Sonobuoys	The relatively small amounts of battery chemicals released if a sonobuoy were damaged would be quickly diluted to non-toxic concentrations. The physical components of expended sonobuoys would not pose a threat to marine life.
XBTs	It is possible, but unlikely, that fish would ingest an Expendable Bathythermograph, due to its size and rapid decent. XBTs would slowly degrade, corrode, and/or be buried by sediments on the seafloor.
Torpedo Accessories	Control wires, flex hoses, ballast weights, and other torpedo accessories left on the ocean bottom after torpedo exercises would not be a toxic hazard.
Targets	Airborne, surface or subsurface targets are designed to be recovered. If severely damaged, however, they may sink before retrieval is possible - but would not harm Managed Species or EFH.
EMATTs	Expendable Mobile Acoustic Torpedo Targets sink to the bottom after use, eventually settling into sediments or becoming encrusted on hard-bottom substrates with minimal impact.
ADCs	Acoustic Device Countermeasures are normally retrieved but may be lost or intentionally discarded. The consequences of their residence on the sea floor would be similar to other expended material.
	Clean, empty target vessels would settle to the bottom eliminating marine habitat directly underneath. They would subsequently function as artificial reefs possibly

Sunken Vessels Entanglement Hazardous Chemicals	enhancing habitat quality. Torpedo control wires and flex hoses resist looping and are unlikely to snare marine life. Small, expendable parachutes used with flares and sonobuoys pose a risk of entanglement, but the limited number deployed should not have adverse effects on fish populations or their habitats. The small amounts of potentially hazardous chemicals introduced into the ocean from expended material would not endanger aquatic life.
Radio Frequency Emissions	Fish would not be exposed to high intensity RF emissions for a sustained period of time.
Sound Generating Devices	Effects on fish from Long Range Acoustic Devices are unlikely since sound is not effectively transmitted through the air/water interface.
Lasers	Marine life in the water would not be illuminated by laser beams.
Underwater Detonation	Underwater detonation will only take place in waters overlying soft sediments. Displacement of bottom sediments and increased turbidity will be temporary and localized. Disturbed area recovery would be relatively rapid. Explosion by-products would not pose a risk to marine life and would not bioaccumulate. A limited number of fish would be killed by the shockwave or debris from explosive detonations. Some fish would be injured and could subsequently die or suffer greater rates of predation. However, the overall impact would be local and transient. When exercises are completed, the fish stock would repopulate the area. Fish abundance and diversity are unlikely to measurably decrease. Given the limited time scale of individual explosions and their broad distribution in time and space, masking of acoustic environmental cues and physiological stress should not be significant. Behavioral responses including alarm, avoidance, and interruption of communication would not substantially effect the ability of fish or their prey to survive, grow, or reproduce. The potential for permanent hearing loss is unknown, but temporary auditory deficits may occur, with normal hearing returning over a period of minutes to days.
Bombing	Most bombs used in training exercises will be practice bombs without explosive warheads. The shock from practice bombs hitting the sea surface could result in a small number of fish kills or injuries and minor acoustic displacement, but would not substantially affect fish populations. Practice bombs would not introduce combustion chemicals into the ocean. After sinking to the bottom, the physical structure of bombs would be incorporated into the marine environment by natural encrustation and/or sedimentation. Some fish would be killed or injured from the pressure wave created by the exploding bomb and by propelled fragments. Beyond the area of physical effects, the natural reaction of fish would be to leave, but the fish stock would be repopulated when the exercise concludes. The overall impact to water column habitat would be brief and would be restricted to a small area. The abundance and diversity of fish within SOCAL Range Complex are unlikely to measurably decrease as a result of bombing exercises.
Naval Gun Fire	Gun fire shells rapidly decelerate on contact with water. Few fish would be directly struck, but the shock wave from exploding rounds would cause death, injury, and behavioral disruptions. The overall impacts would be minor with fish returning after the exercise. Debris sinking to the bottom would have negligible

	influence on the benthic environment.
Torpedo Exercises	Ordnance would not be detonated during torpedo exercises. Due to the small size of the transit area of torpedoes, the probability of fish strikes would be low. Concentrations of combustion products from torpedo fuel would be below levels hazardous to marine life. Release of fuel from catastrophic torpedo failure is highly unlikely.
EMATT and ADC Exercises	Chemicals from lithium sulfur dioxide batteries used to power EMATTs and ADCs could be released into the marine environment. Chemical reactions would be localized and short-lived with insignificant impact on water quality.
Missile exercises	Missiles used in most training exercises are non-explosive. The main environmental impact would be the physical structure of the missile itself entering the water. Practice missiles do not use rocket motors or their potentially hazardous rocket fuel. The number of fish adversely affected by missile exercises would be a small fraction of the indigenous community.
Shallow Water Minefield	Localized, temporary impacts on water quality and sessile benthic fauna would occur during installation of mine shapes, but no adverse effect on Managed Species or EFH would be expected.
Shallow Water Training Range Extension	Installation of additional acoustic sensors would cause fish to leave the area, but would not have adverse effects at the level of fish populations.
Expeditionary Assault	Landing craft crossing shallow water and artillery shells that fall short could damage EFH. However, the biological impact would be limited because sandy beach habitats support relatively few organisms and those present are adapted to recover quickly from disturbance.
Sinking Exercises	Pressure waves from detonation of ordnance within target vessels should be relatively contained. Gun fire, bombs, and missiles that fall short of the target, and torpedoes striking the vessel, would affect nearby marine life, but would not have significant, long-term biological consequences.
SONAR Exercises	U.S. Navy low frequency sonar does not appear to have the potential to kill or injure marine fish. Temporary hearing loss and behavioral modifications have been demonstrated in laboratory studies, but field populations should not be compromised given the limited use of low frequency sonar. Most fish species would be not able to detect mid frequency sonar at the lower end of its range. For those who can, short-term behavioral responses such as startle and avoidance are possible which could adversely affect sensitive species during critical times such as breeding and spawning. The resulting ecological consequences are unknown, but major effects at the population level would not be anticipated. Most fish would not be able to detect high frequency sonar sounds. High frequencies quickly attenuate in water, restricting potential adverse effects to within a few meters of the source. Area-wide impacts are unlikely.
Research, Development, Testing, and Evaluation	The only RDT&E test with the potential to impact fish is Underwater Acoustics Testing, which involves mid frequency sonar use. Effects would be less than significant (see following SONAR summary).

3.15 ALTERNATIVES COMPARISON

Three alternatives are analyzed in the SOCAL Range Complex EIS/OEIS: 1) The No Action Alternative – Current Operations; 2) Alternative 1 - Increase Operational Training and Accommodate Force Structure

Changes, and 3) Alternative 2 – Increase Operational Training, Accommodate Force Structure Changes, and Implement Range Enhancements. As described in the Impact Definition section (3.1), for Essential Fish Habitat and Managed Species an adverse effect is: 1) more than minimal, 2) not temporary, 3) causes significant changes in ecological function, and, 4) does not allow the environment to recover without measurable impact.

On the basis of impact determinations in the EIS/OEIS (Sections: 3.1-3.14) and this EFH assessment, none of the three alternatives would be expected to have adverse effects on EFH and Managed Species (Table 3-5).

Table 3-5: Alternatives Comparison – Effects on EFH and Managed Species

Alternative	Impact Assessment
No Action Alternative - Current Operations	<u>No Adverse Effects.</u> • Vessel movement, aircraft over-flight, fuel spills, discharges from ships, expended materials, radio frequency emissions, sound generating devices, and lasers would have less than significant effects on Managed Species and EFH. • Munitions constituents and other materials from training devices and training and testing exercises would have no effect or result in short-term, localized impacts. • Small numbers of fish would be killed by shock waves from practice mines, non-explosive bombs, non-exploding gunfire rounds, and intact missiles and targets hitting the water surface. Minor, acoustic displacement would also occur, but would not substantially affect local fish populations. • Underwater detonation would only take place in waters overlying soft sediments. Disturbance of bottom sediments and increased turbidity would be temporary and localized with less than significant impacts on EFH and Managed Species. • Relatively small numbers of fish would be killed by bombs exploding near the surface, but effects on EFH would be less than significant since live bombing exercises are conducted away from sensitive habitats or HAPCs. • Landing craft crossing shallow water would have short-term impacts on small areas of sandy bottom. The biological effect would be limited because this type of habitat is naturally resilient and recovers quickly from disturbance. • Only a few species of fish would detect the relatively high frequencies generated by tactical sonar - effects of sonar use on EFH and Managed Species would be less than significant. • No long-term changes in diversity or abundance of Managed Species. • No loss or degradation of Essential Fish Habitat or HAPCs.
Alternative 1 - Increased Operational Training and Force Structure Changes	<u>No Adverse Effects.</u> Impacts as described in the No Action Alternative plus the following: • Effects of sonar used in the Surface Ship ASW Integrated Anti-submarine Warfare exercises on Managed Species would be less than significant. • Relatively small numbers of fish would be killed by Improved Extended Echo Ranging (IEER) sonobuoy detonation in ASW exercises, but effects on fish populations would be insignificant. • Battalion-sized amphibious landings and USMC Amphibious Warfare exercises added in Alternative 1 involve types of activities common to many exercises discussed above, and would have less than significant effects on EFH. • Small increases in the number of Offshore Operations, Underwater Demolitions exercises, and RDT&E tests would have insignificant

	impacts on Managed Species and EFH.
Alternative 2 (Preferred Alternative) - Increased Operational Training, Force Structure Changes, and Range Enhancements	No Adverse Effects. Impacts same as described for No Action Alternative plus Alternative 1. • Small increases in the number of Offshore Operations, Underwater Demolitions exercises, and RDT&E tests would result in less than significant impacts on EFH and Managed Species. • Increased Commercial Air Services, use of the Shallow Water Mine Minefield, extension of the Shallow Water Training Range would have similar, less than significant impacts associated with other offshore testing and training operations.

4 MITIGATION MEASURES

The Navy has established standard protective measures to minimize potential environmental impacts from training exercises. Some of these mitigation measures are generally applicable and others are designed to apply to certain geographic areas during certain times of year, for specific types of Navy training. Mitigation measures covering habitats and species occurring in the SOCAL Range Complex have been developed through various environmental analyses conducted by the Navy for land and sea ranges and adjacent coastal waters (see DON BAs, EAs, OEAs, EISs, and OEISs in the Reference Section). Consultations with the NMFS on previous training events that included the SOCAL Range Complex have produced mitigation measures specifically designed to protect local threatened and endangered species (e.g., NMFS 2002c). In addition, the Navy also has a Protective Measures Assessment Protocol (PMAP) initiative in place which is intended to ensure the latest protected species/habitats mitigation data and guidance are available to the operators conducting training exercises (DON 2004a, 2006f). These mitigation measures are typically promulgated through the use of Navy messages issued to all units and commands participating in an exercise as well as to non-Navy participants (other DOD services and NATO allies) to encourage their overall use.

Each element of the EIS/OEIS includes mitigation measures specific to that resource area (e.g., Water Resources Section 3.1.2.4). General mitigation measures that help minimize impacts on Managed Species and EFH include: using non-explosive versions of ordnance and passive acoustical and tracking tools, avoiding protected and/or sensitive habitats, including HAPCs, conducting most exercises during daylight hours in calm seas, and visual monitoring to assure an area is clear of significant concentrations of sea life including fish before ordnance or explosives are used. In addition, zones of influence (or buffer zones) have been designated for various types of training operations. For example, underwater detonations may not be conducted if marine mammals or sea turtles are detected within 1,000 yards (914 m) of a 60-lb mine neutralization charge site (DON 2005d). Furthermore, no detonations may take place: within 1,000 m (1,094 yd) of any artificial reef, shipwreck, or live hard-bottom community; within 3,000 m (1.6 nm) of shoreline; or, within 6,000 m (3.2 nm) of an estuarine inlet (DON 2005d). General and specific mitigation measures are also presented in Navy environmental documents covering specific types of training exercises, individual Range exercises, and joint exercises covering multiple ranges (see DON references in the Reference Section).

5 CUMULATIVE IMPACTS

Federal and Department of the Navy regulations implementing NEPA (42 USC § 4321 *et seq*. and 32 C.F.R. § 775 respectively) require that the cumulative impacts of a proposed action be assessed. CEQ Regulations implementing the procedural provisions of NEPA define cumulative impact as: the impact on the environment which results from the incremental impact of the action when added to other past, present, and reasonably foreseeable future action regardless of what agency (Federal or non-Federal) or person undertakes such other actions. Cumulative impacts can result from individually minor but collectively significant actions taking place over a period of time" (40 CFR § 1508.7).

In general, a particular action or group of actions must meet all of the following criteria to be considered a cumulative impact: effects of several actions occur in a common locale or region; effects on a particular resource are similar in nature, such that the same specific element of a resource is affected in the same specific way; and, effects are long-term as short-term impacts dissipate over time and cease to contribute to cumulative impacts.

Human uses of the SOCAL Range Complex include prior, current, and future Navy activities, navigation, transportation, coastal development, oil/gas exploration and development, sand and mineral mining, dredge and fill operations, beach nourishment, cooling water intake and discharge, wastewater discharge, mariculture, recreational and commercial fishing, and whale-watching. Potential threats to EFH and Managed Species include degradation of water quality, habitat modification, pollution (chemicals, marine debris, etc.), introduction of exotic species, disease, natural events, and global climate change (Field et al. 2003, Jackson et al. 2001, IEF (In Ex Fishing) 2006).

Fishing and non-fishing activities, individually or in combination, can adversely affect EFH and Managed Species (NOAA 1998, Dayton et al. 2003, Morgan and Chuenpagdee 2003, Levin et al. 2006). Potential impacts of commercial fishing include over-fishing of targeted species and bycatch, both of which negatively affect fish stocks (Barnette 2001, NRC 2002, Dieter et al. 2003). Mobile fishing gears such as bottom trawls disturb the seafloor and reduce structural complexity (Auster and Langton 1998, Johnson 2002). Indirect effects of trawls include increased turbidity; alteration of surface sediment, removal of prey (leading to declines in predator abundance), removal of predators, ghost fishing, and generation of marine debris (Hamilton 2000). Lost gill nets, purse seines, and long-lines may foul and disrupt bottom habitats. Recreational fishing also poses a threat because of the large number of participants and the intense, concentrated use of specific habitats (Coleman et al. 2004).

Removal of fish by fishing can have a profound influence on individual populations, their survival, and shifts in community composition. In a recent study of retrospective data, Jackson et al. (2001) analyzed paleoecological records from marine sediments from 125,000 years ago to present, archaeological records from 10,000 years before present, historical documents, and ecological records from scientific literature sources over the past century. Examining this longer term data and information, they concluded that ecological extinction caused by overfishing preceeds all other pervasive human disturbance to coastal ecosystems including pollution, degradation of water quality, and anthropogenic climatic change.

Natural stresses include storms and climate-based environmental shifts, such as harmful algal blooms and hypoxia (DON 2005a). Disturbance from ship traffic and exposure to biotoxins and anthropogenic contaminants may stress animals, weaken their immune systems, and make them vulnerable to parasites and diseases that would not normally compromise natural activities or be fatal (Pew Oceans Commissions 2003).

Potential cumulative impacts of Navy training exercises include release of chemicals into the ocean, introduction of debris into the water column and onto the seafloor, mortality and injury of marine organisms near the detonation or impact point of ordnance or explosives, and, physical and acoustic impacts of vessel activity. The incremental contribution by the proposed action or alternatives to impacts on the marine environment is expected to be insignificant. The overall effect on fish stocks would be negligible compared to the impact of commercial and recreational fishing in the SOCAL Range Complex. After completion of an exercise, repopulation of an area by fish should take place within a matter of hours. Implementation of mitigation measures designed to avoid significant or long-term impacts would further protect marine life and the environment.

Because of the transient nature of the training exercises and the minor, localized potential effects, there would not be incremental or synergistic impacts on present or reasonably foreseeable future uses of the SOCAL Range Complex. The proposed action and alternatives would not make a significant contribution to the regional cumulative impacts on EFH or Managed Species.

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1 OVERVIEW AND TECHNICAL APPROACH

1.1 DATA SOURCES

The Marine Resource Assessment (MRA) for the Southern California Operating Area (DoN 2005) was used as a baseline for describing the physical, biological, marine, terrestrial, and cultural features particular to this region. The MRA was supplemented during the development of this EIS/OEIS to update information since the MRA was published in 2005. This supplementation included a detailed search of multiple peer-review scientific journals, and government reports. Several search engines were used in this process including *Science Direct*®, *High Wire Press*®, *Directory of Open Access Journals,* the *Journal of the Acoustical Society of America-Online (JASA-O)*. *Science Direct*® databases provide access to more than 8 million articles in over 2,000 journals focused on the physical sciences and engineering, life sciences, health sciences, and social sciences and humanities. *High Wire Press*® offers access to nearly 4.3 million articles published by approximately 1,040 journals. Topics for journals in these databases include biological, social, medical, and physical sciences and the humanities. The *Directory of Open Access Journals* includes peer-reviewed scientific and scholarly publications that are available to the public free of charge. The searches of each database included general queries in the resource areas of and potential effects to marine species (marine mammals, sea turtles, fish, and birds), socioeconomics (fisheries, tourism, boating, and diving), natural resources (oil and gas), artificial reefs, whale and dolphin watching, and cultural resources. Finally, *JASA-O* offers search capabilities for and access to articles as early as 1929. Searches for articles available from this journal included focused information on hearing capabilities and potential effects on marine species such as marine mammals, sea turtles, manatees, fish, and diving birds. In addition to search engines and science information portals, a direct review was conducted of other journals that regularly publish marine mammal related articles (e.g., Marine Mammal Science, Canadian Journal of Zoology, Journal of Acoustical Society of America, Journal of Zoology, Aquatic Mammals). References were also obtained from previous environmental documents where applicable, and from mitigation and regional monitoring reports. The original reference authors were contacted directly if necessary to clarify particular points presented in a paper or gain additional insight into the data analysis.

1.2 DATA QUALITY AND AVAILABILITY

Recent advances in marine mammal tagging and tracking have contributed to the growth of biological information including at-sea movements and diving behavior. Given the development of this new technology and difficulties in placing tags on marine mammals in the wild, the body of literature and sample size, while growing, is still relatively small. For difficult to study marine mammals such as an audiogram from a single Gervais beaked whale stranded from natural causes (Cook et al. 2006), even a sample size of one contributes new information that had not been available previously. Addition information was also solicited from acknowledged experts within academic institutions and government agencies such as Southwest Fisheries Science Center, NMFS with expertise in marine mammal biology, distribution, and acoustics.

2 SOUTHERN CALIFORNIA MARINE MAMMALS

There are 41 marine mammal species or separate stocks with possible or confirmed occurrence in the SOCAL Range Complex. As shown in Table 2-1, there are 34 cetacean species (whales, dolphins, and porpoises), six pinnipeds (sea lions, fur seals and true seals) and one sea otter species.

2.1 SPECIES SUMMARIES AND LIFE HISTORY

The California Current passes through the SOCAL Range Complex, creating a mixing of temperate and tropical waters, and making this area one of the most productive ocean systems in the world (DoN 2002a). Because of this productive environment, there is a rich marine mammal fauna, as evidenced in abundance and species diversity (Leatherwood et al. 1988; Bonnell and Dailey 1993). In addition to many marine mammal species that live here year-round and use the region's coasts and islands for breeding and hauling out, there is a community of seasonal residents and migrants. The narrow continental shelf along the Pacific coast and the presence of the cold California Current sweeping down from Alaska allows cold-water marine mammal species to reach nearshore waters as far south as Baja California. The SCB is the major geological region occurring within the SOCAL Range Complex and can be described as a complex combination of islands, ridges, and basins that exhibit wide ranges in water temperature. San Diego Bay, a naturally-formed, crescent-shaped embayment is located along the southern end of the SCB (Largier 1995; DoN 2000); the bay provides habitat for a number of oceanic and estuarine species as the ebb and flood of tides within the Bay circulate and mix ocean and Bay waters, creating for distinct circulation zones within San Diego Bay (see Chapter 2 for further detail regarding these zones) (Largier et al. 1996; DoN 2000).

Forty-one marine mammal species or populations/stocks have confirmed or possible occurrence in the study area off southern California, including 34 cetacean (whales, dolphins, and porpoises), six pinniped (seals, sea lions, and fur seals), and one fissiped species (the sea otter) (Table 2-1). Information on marine mammal occurrence at the Point Mugu Sea Range (just to the north of the SOCAL Range Complex) is analyzed in Koski et al. (1998). Temperate and warm-water toothed whales often change their distribution and abundance as oceanographic conditions vary both seasonally (Forney and Barlow 1998) and interannually (Forney 2000). Forney and Barlow (1998) noted significant north/south shifts in distribution for Dall's porpoises, common dolphins, and Pacific white-sided dolphins, and they identified significant inshore/offshore differences for northern right whale dolphins and humpback whales. Several authors have noted the impact of the El Niño events of 1982/1983 and 1997/1998 on marine mammal occurrence patterns and population dynamics in the waters off California (Wells et al. 1990; Forney and Barlow 1998; Benson et al. 2002).

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Table 2-1. Summary of the Abundance, ESA/MMPA Status, Population Trend, Seasonal Occurrence of Marine Mammal Species Found In Southern California Waters.

Common Name Species Name	Abundance (CV)	Stock	Southern California Abundance	ESA/ MMPA Status	Annual Population Trend	Occurrence	Warm Season May-Sep	Cold Season Nov-Apr
ESA Listed Species								
Blue whale *Balaenoptera musculus*	1,744 (0.28)	Eastern North Pacific	842 (0.20)	E, D, S	May be increasing	Seasonal; Arrive Apr-May; more common late summer to fall	YES	NO
Fin whale *Balaenoptera physalus*	2,099 (0.18)	California, Oregon, & Washington	359 (0.40)	E, D, S	May be increasing	Year round species; small population	YES MORE	YES LESS
Humpback whale *Megaptera novaeangliae*	1,391 (0.22)	California, Oregon, & Washington	36 (051)	E, D, S	Increasing 6-7%	Seasonal; More sightings around the northern Channel Islands	YES	NO
North Pacific right whale *Eubalaena japonica*	Unknown	Eastern North Pacific	Unknown	E, D, S	Unknown	Very rare: Rare throughout the Pacific; only 12 sightings in California since 1900	RARE	RARE
Sei whale *Balaenoptera borealis*	56 (0.61)	Eastern North Pacific	0 (7 Bryde's or Sei Whales)[3]	E, D, S	May be increasing	Rare; Less than three sightings within the last 30 years	UNK	UNK
Sperm whale *Physeter macrocephalus*	1,934 (0.31)	California, Oregon, & Washington	607 (0.57)	E, D, S	Unknown	Common year round; More likely in waters > 1000 m, most often > 2000 m	YES MORE	YES LESS
Guadalupe fur seal *Arctocephalus townsendi*	7,408	Mexico		T, D, S	Increasing 13.7%	Rare; Occasional visitor to northern Channel Islands; mainly breeds on Guadalupe Is., Mexico, May-Jul	UNK	UNK
Steller sea lion *Eumetopias jubatus*	6,555	California, Oregon, & Washington		T, D	Decreasing	Very rare; Summer distribution north of 36°N; last seen in northern Channel Islands in 1998	NO	NO
Southern Sea Otter *Enhydra lutris*	2,359	California	~29 (from ground surveys)	T, D (Only north of Pt. Conception)	Increasing	Main distribution just north of the SOCAL OPAREAs; translocated population of approximately 29 animals at San Nicolas Island is an experimental population and is not considered endangered	YES	YES

Common Name Species Name	Abundance (CV)	Stock	Southern California Abundance	ESA & MMPA Status	Annual Population Trend	Occurrence	Warm Season May-Oct	Cold Season Nov-Apr
Mysticetes								
Bryde's whale *Balaenoptera edeni*	12 (2.0)	Eastern Tropical Pacific	0 (7 Bryde's or Sei Whales)[3]		Unknown	Rare; Only one confirmed sighting in California	UNK	UNK
Gray whale *Eschrichtius robustus*	26,635 (0.10)	Eastern North Pacific	Population migrate through SOCAL		Increasing ~ 2.5%	Transient during seasonal migrations		
Minke whale *Balaenoptera acutorostrata*	823 (0.56)	California, Oregon, & Washington	226 (1.02)		No Trends	Less common in summer; small numbers around northern Channel Islands	NO	YES
Odontocetes								
Baird's beaked whale *Berardius bairdii*	1,005 (0.37)	California, Oregon, & Washington	127 (1.14)		Unknown	Rare	UNK	UNK
Bottlenose dolphin coastal *Tursiops truncatus*	323 (012)	California Coastal	323 (0.12)		Stable	Limited, small population within one km of shore	YES	YES
Bottlenose dolphin offshore *Tursiops truncatus*	2,026 (0.54)	California Offshore	1,831 (0.47)		No Trend	Common	YES	YES
Cuvier's beaked whale *Ziphius cavirostris*	4,342 (0.58)	California, Oregon, & Washington	911 (0.68)		Unknown	Uncommon; seaward of 1000 m; only limited sightings in winter	YES	UNK
Dall's porpoise *Phocoenoides dalli*	85,955 (0.45)	California, Oregon, & Washington	727 (0.99)		Unknown	Common; year round cool water species; more abundant Nov-Apr	NO	YES
Dwarf sperm whale *Kogia sima*	Unknown	California, Oregon, & Washington	0		Unknown	Possible visitor; seaward of 500-1000 m; limited sightings over entire SCB	UNK	YES LESS
False killer whale *Pseudorca crassidens*	Unknown Rare	Eastern Tropical Pacific	Unknown		Unknown	Uncommon; warm water species; although stranding records from the Channel Islands	UNK	UNK
Killer whale offshore *Orcinus orca*	1,340 (0.31)	Eastern North Pacific	30 (0.73)		Unknown	Uncommon; occurs infrequently; more likely in winter	NO	YES

Common Name Species Name	Abundance (CV)	Stock	Southern California Abundance	ESA & MMPA Status	Annual Population Trend	Occurrence	Warm Season May-Oct	Cold Season Nov-Apr
Killer whale transient *Orcinus orca*	346	Eastern North Pacific	Unknown		Unknown	Uncommon; occurs infrequently; more likely in winter	NO	YES
Long-beaked common dolphin *Delphinus capensis*	21,902 (0.50)	California	17,530 (0.57)	S	Varies by oceanographic conditions	Common; more inshore distribution	YES	YES
Mesoplodont beaked whales[4] *Mesoplodon spp.*	1,177 (0.40)	California, Oregon, & Washington	132 (0.96)		Unknown	Rare; seaward of 500-1000 m; limited sightings	UNK	UNK
Northern right whale dolphin *Lissodelphis borealis*	11,097 (0.26)	California, Oregon, & Washington	1,172 (0.52)		No Trend	Common; cool water species; more abundant Nov-Apr		
Pacific white-sided dolphin *Lagenorhynchus obliguidens*	23,817 (0.36)	California, Oregon, & Washington	2,196 (0.71)		No Trend	Common; year round cool water species; more abundant Nov-Apr	YES LESS	YES MORE
Pantropical spotted dolphin *Stenella attenuate*	Unknown	Eastern Tropical Pacific	Unknown		Unknown	Rare	UNK	UNK
Pygmy sperm whale *Kogia breviceps*	247 (1.06)	California, Oregon, & Washington	0		Unknown	Rare; seaward of 500-1000 m; limited sightings over entire SCB	UNK	UNK
Risso's Dolphin *Grampus griseus*	11,910 (0.24)	California, Oregon, & Washington	3,418 (0.31)		No Trend	Common; present in summer, but higher densities Nov-Apr	YES LESS	YES MORE
Rough-toothed dolphin *Steno bredanensis*	Unknown	Tropical and warm temperate	Unknown		Unknown	Rare; more tropical offshore species	RARE	RARE
Short-beaked common dolphin *Delphinus delphis*	352,069 (0.18)	California, Oregon, & Washington	165,400 (0.19)		Varies by oceanographic conditions	Common; one of the most abundant SOCAL dolphins; higher summer densities	YES MORE	YES LESS
Short-finned pilot whale *Globicephala macrorhynchus*	350 (0.48)	California, Oregon, & Washington	118 (1.04)		Unknown	Uncommon; more common before 1982	UNK	UNK

Common Name Species Name	Abundance[1] (CV)	Stock[1]	Southern California Abundance	ESA & MMPA Status	Annual Population Trend	Occurrence	Warm Season May-Oct	Cold Season Nov-Apr
Spinner dolphin *Stenella longirostris*	2,805 (0.66)	Tropical and warm temperate	Unknown		Unknown	Rare	RARE	RARE
Striped dolphin *Stenella coeruleoalba*	18,976 (0.28)	California, Oregon, & Washington	12,529 (0.28)		No Trend	Occasional visitor; cool water oceanic species	NO	RARE
Pinniped								
Harbor seal *Phoca vitulina*	34,233	California	5,271 (All age classes from aerial counts)[5]		Stabilizing	Common; Channel Islands haul-outs including SCI	YES	YES
Northern elephant seal *Mirounga angustirostris*	101,000	California Breeding	SNI 9,794 pups in 2000. SCI up to 16 through 2000 [6]		Increasing < 8,3%	Common; Channel Island haul-outs of different age classes; including SCI Dec-Mar and Apr-Aug; spend 8-10 months at sea	YES	YES
California sea lion *Zalophus californianus*	237,000	U.S. Stock	All pupping occurs in Southern California		Increasing 6.1%	Common; most common pinniped, Channel Islands breeding sites in summer	YES	YES
Northern fur seal *Callorhinus ursinus*	9,424	San Miguel Island	San Miguel Is. is within Southern California but is outside of the SOCAL Range Complex		Increasing 8.6%	Common; small population that breeds on San Miguel Is. May-Oct	YES MORE	YES LESS

[1] Stock or population abundance estimates and correlation of variance (CV) status under the Endangered Species Act (ESA) and the Marine Mammal Protection Act (MMPA), and the population trend are from NMFS 2006 Pacific Stock Assessment Reports (SAR) (Carretta et al., 2007; Angliss and Outlaw, 2007; Barlow and Forney, 2007), **E**=Endangered under the ESA; **D** = Depleted under the MMPA; and **S**=Strategic Stock under the MMPA. Due to lack of information, several beaked whale species have been grouped together under Mesoplodont by the National Marine Fisheries Service.

[2] Sources used to define trend are Carretta et al. (2007), Angliss and Outlaw (2007) and NMFS (2006e)

[3] Seven whales were identified as either Bryde's or Sei whales but could not be identified to the species level

4 Mesoplodont whales includes five species of *Mesoplodon* spp. that are not easily identifiable in the field.

[5] Lowry and Carretta (2003)[6] Lowry (2002)

Southern California abundance is from Point Conception to the US-Mexican border

2.1.1 Federally Designated Threatened and Endangered Species

There are nine marine mammal species within Southern California marine waters listed as endangered under the Endangered Species Act (ESA) with confirmed or historic occurrence in the study area. These include the blue whale, fin whale, humpback whale, North Pacific right whale, sei whale, sperm whale, Guadalupe fur seal, Steller sea lion, and southern sea otter.

2.1.1.1 Listed Marine Mammal Species in the Action Area But Excluded

Killer whale, Southern Resident Stock-(*Orcinus orca*) The Southern Resident stock of killer whale is not likely to be present within Southern California. Of the three stocks of killer whales that may be found in the action area, Eastern North Pacific (ENP) Southern Residents, ENP Offshores, and ENP transients, only the ENP Southern Resident stock is listed as endangered under the ESA. This stock is most commonly seen in the inland waters of Washington state and southern Vancouver Island; however, individuals from this stock have been observed in Monterey Bay, California in January, 2000 and March, 2003, near the Farallon Islands in February 2005 and off Point Reyes in January 2006 (Pacific Fishery Management Council (PFMC) and NMFS 2006). Although one killer whale from the non-ESA listed ENP Transient Stock was observed taken in the California/Oregon drift gillnet fishery in 1995 (Carretta et al. 2006), no ENP resident killer whales have been observed taken in any California-based fisheries. Based on the above known information, there is a very low likelihood of Southern Resident killer whales being present in the action area, so this species will not be considered in greater detail in the remainder this analysis.

North Pacific right whale-(*Eubalaena japonica*) The likelihood of a North Pacific right whale being present in the action area is extremely low. It may be the most endangered of the large whale species (Perry et al. 1999), and currently, there is no reliable population estimate, although the population in the eastern North Pacific Ocean is considered to be very small, perhaps in the tens to low hundreds of animals. Despite many years of systematic aerial and ship-based surveys for marine mammals off the western coast of the U.S., only seven documented sightings of right whales were made from 1990 through 2000 (Waite et al. 2003). Based on this information, it is highly unlikely for this species to be present in the action area, so consequently, this species will not be considered in greater detail in the remainder of this analysis.

Steller sea lion (***Eumetopias jubatus***) Eastern Distinct Population Segment- Steller sea lions are also not expected to be present in the action area. Steller sea lions range along the North Pacific Rim from northern Japan to California (Loughlin et al. 1984), with centers of abundance and distribution in the Gulf of Alaska and Aleutian Islands, respectively. In U.S. waters, there are two separate stocks of Steller sea lions: an eastern U.S. stock, which includes animals east of Cape Suckling, Alaska (144oW longitude), and a western U.S. stock, which includes animals at and west of Cape Suckling (Loughlin 1997). The closest rookery to the action area is Año Nuevo Island, which declined by 85% between 1970 and 1987 (LeBoeuf et al. 1991). Pup counts at this location have declined steadily at approximately 5% annually since 1990 (Angliss and Lodge 2004). Steller sea lions are rarely sighted in Southern California waters and have not been documented interacting with southern California fisheries in over a decade. The last documented interaction with California-based fisheries was in northern California, in 1994, with the California/Oregon drift gillnet fishery (NMFS 2000). The last sighting of a Steller sea lion (a sub adult male) on the Channel Islands was in 1998 (Thorson et al. 1998). For the reasons listed above, Steller sea lions are not likely to be present in the action area, consequently, this species will not be considered in greater detail in the remainder of this analysis.

2.1.1.2 Listed Marine Mammal Species in the Action Area and Included

The ESA-listed blue whale, fin whale, humpback whale, and sperm whale are expected to regularly occur in Southern California and each species is described below. The sei whale is a rare and infrequently sighted species, but is also included in this analysis as a conservative conservation approach. Information on at sea density estimates and dive depth distribution provided for each species are used in the acoustic exposure analysis.

Blue whale (*Balaenoptera musculus*) Eastern North Pacific Stock

Listing Status—In the North Pacific, the IWC began management of commercial whaling for blue whales in 1969; blue whales were fully protected from commercial whaling in 1976 (Allen 1980). Blue whales were listed as endangered under the ESA in 1973, therefore the California/Oregon/Washington Stock is, considered depleted and strategic under the MMPA They are also protected by the Convention on International Trade in Endangered Species of wild flora and fauna and the Marine Mammal Protection Act of 1972. Blue whales are listed as endangered on the IUCN Red List of Threatened Animals (Baillie and Groombridge 1996). Critical habitat has not been designated for blue whales.

Population Status- The blue whale was severely depleted by commercial whaling in the twentieth century (NMFS 1998). In the North Pacific, pre-exploitation population size is speculated to be approximately 4,900 blue whales and the current population estimate is a minimum of 3,300 blue whales (Wade and Gerrodette 1993, NMFS 2006e). Blue whale population structure in the North Pacific remains uncertain, but two stocks are recognized within U.S. waters: the Hawaiian and the eastern North Pacific (NMFS 2006e). There is no clear information on the population trend of blue whales off California. Population estimate for this stock of blue whales is 1,744 (CV =0.28) individuals (Carretta et al. 2007).

A clear population trend for blue whales is difficult to detect under current survey methods. An increasing trend between 1979/80 and 1991 and between 1991 and 1996 was suggested by available survey data, but it was not statistically significant (Carretta et al. 2006). The abundance of blue whales along the California coast has clearly been increasing during the past two decades (Calambokidis et al. 1990; Barlow 1994; Calambokidis 1995). The magnitude of this increase is considered too large to be explained by population growth alone, and it is therefore assumed that a shift in distribution may have occurred (NMFS 1998). However, the scarcity of blue whales in areas of former abundance (e.g., Gulf of Alaska near the Aleutian Islands) suggests that the increasing trend does not apply to the species' entire range in the eastern North Pacific (Calambokidis et al. 1990). Although the population in the North Pacific is expected to have grown since being given protected status in 1966, the possibility of continued unauthorized takes by Soviet whaling vessels after blue whales were protected in 1966 (Yablokov 1994) and the existence of incidental ship strikes and gillnet mortality makes this uncertain.

Distribution—The blue whale has a worldwide distribution in circumpolar and temperate waters. Blue whales undertake seasonal migrations and were historically hunted on their summer, feeding areas. It is assumed that blue whale distribution is governed largely by food requirements and that populations are seasonally migratory. Poleward movements in spring allow the whales to take advantage of high zooplankton production in summer. Movement toward the subtropics in the fall allows blue whales to reduce their energy expenditure while fasting, avoid ice entrapment in some areas, and engage in reproductive activities in warmer waters of lower latitudes (~30º N or S). For example, blue whales were taken off the west coast of Baja California as early as the mid-19th century (Scammon 1874). The timing varied, but whalers located few blue whales in wintering areas from December to February. Observations made after whaling was banned revealed a similar pattern: blue whales spend most of the summer foraging at higher latitudes (where the waters are more productive (Sears 1990; Calambokidis et al. 1990; Calambokidis 1995).

The eastern North Pacific stock feeds in waters from California to Alaska in summer and fall, and migrates south to waters from Mexico to Costa Rica in winter (NMFS 2006e). They are fairly widespread and unpredictable in their areas of concentration from August to November. Some of the whales that spend the summer and fall (August-October) off the California coast migrate to Mexican waters, where they have been re-identified by photographs in spring (March-April) (Calambokidis et al. 1990). The population that uses coastal waters of California is present there primarily from June to November, with a peak in blue whale calling intensity observed in September (Burtenshaw et al. 2004). Foraging areas include the edges of continental shelves and upwelling regions (Reilly and Thayer 1990; Schoenherr 1991). Feeding grounds have been identified in coastal upwelling zones off the coast of California (Croll et al. 1998; Fiedler et al.. 1998; Burtenshaw et al. 2004), Baja California (Reilly and Thayer 1990). Blue whales are found around the Northern Channel Islands, Santa Rosa and San Miguel Islands, from summer through the fall where currents provide dense layers of euphausiids for them to feed on. This population is thought to inhabit waters off Central America from December to May (Calambokidis 1995). During the cold-water months, very few blue whales are present in waters off California (Forney and Barlow 1998; Larkman and Veit 1998; U.S. Navy 1998). These seasonal movement patterns are thought to coincide with productivity, particularly abundance of euphausiids which are the main food source of blue whales.

Blue whales are not expected to be in the SOCAL Range Complex from December through May (Calambokidis 1995; Burtenshaw et al. 2004). Ingebrigtsen (1929) reported that blue whales appeared off the Baja California coast “from the north” in October and traveled southward along the shore, returning in April, May, and June. Recently, some blue whales have been seen along the west coast of Baja California between March and July (Gendron and Zavala-Hernandez 1995). They are first observed in Monterey Bay, around the Channel Islands, and in the Gulf of the Farallons in June and July (Calambokidis et al. 1990; Calambokidis 1995). In addition, the strongest seasonal acoustic signal off of San Nicolas Island in California, from June through January, is due to blue whales singing (Burtenshaw et al. 2004), which appears primarily as a broad peak near 20 Hz in the spectral data (McDonald et al. 2006). Blue whales are commonly seen around the Channel Islands during the late spring and summer and primarily occur in the northeastern portion of the SOCAL OPAREAs. Calambokidis (1995) concluded that such changes in distribution reflect a shift in feeding from the more offshore euphausiid, *Euphasia pacifica*, to the primarily neritic euphausiid, *Thysanoessa spinifera*. Recent studies in the coastal waters of California have found blue whales feed primarily on the latter (Schoenherr 1991; Kieckhefer et al. 1995; Fiedler et al. 1998).

A few blue whales were observed in or near the SOCAL Range Complex in early to mid spring (U.S. Navy 1998), but were most common during July–September (Hill and Barlow 1992; Mangels and Gerrodette 1994; Teranishi et al. 1997; Larkman and Veit 1998; U.S. Navy 1998). During the SWFSC/NMFS surveys in 1998–1999, blue whales arrived in late May and were common into August, with one whale seen as late as November (Carretta et al. 2000). In other years, blue whales were common in waters west of San Clemente Island as late as mid-October (e.g., in 1995) (Spikes and Clark 1996; Clark and Fristrup 1997; Clark et al. 1998).

Photographic studies have proven that blue whales remain in waters off California throughout the summer, apparently to feed (Calambokidis 1995; Larkman and Veit 1998). Over 100 blue whales were present in the Santa Barbara Channel in 1992 and 1994 (Calambokidis 1995).Concentrations of blue whales have been seen elsewhere off southern California in some years.

At Sea Density Estimates—The most recent vessel survey took place from August to December 2005 during CSCAPE. Pro-rated densities incorporating vessel survey results from 1986-2005 resulted in densities of 0.0041222 for both warm and cold water seasons (Barlow 2007; Table 2-2).

Reproduction/Breeding—The eastern North Pacific stock feeds in waters from California to Alaska in summer and fall, migrates south to the waters of Mexico to Costa Rica in winter (NMFS 2006e) for breeding and to give birth (Mate et al.1999).

Diving Behavior—Blue whales spend more than 94 percent of their time below the water's surface (Lagerquist et al. 2000). Croll et al. (2001) determined that blue whales dived to an average of 462 ft. and for 7.8 minutes (min) when foraging and to 222 ft. and for 4.9 min when not foraging. Data from southern California and Mexico showed that whales dived to >100 m for foraging; once at depth, vertical lunge-feeding often occurred (lunging after prey). Lunge-feeding at depth is energetically expensive and likely limits the deeper diving capability of blue whales. Foraging dives are deeper than traveling dives; traveling dives were generally to ~ 30m. Typical dive shape is somewhat V-shaped, although the bottom of the V is wide to account for the vertical lunges at bottom of dive. Blue whales also have shallower foraging dives. Calambokidis et al. (2003) deployed tags on blue whales and collected data on dives as deep as about 984 ft. Lunge-feeding at depth is energetically expensive and likely limits the deeper diving capability of blue whales. Foraging dives are deeper than traveling dives; traveling dives were generally to ~ 30m. Typical dive shape is somewhat V-shaped, although the bottom of the V is wide to account for the vertical lunges at bottom of dive. Blue whales also have shallower foraging dives. Best information for percentage of time at depth is from Lagerquist et al (2000) collected on blue whales off central California: 78% in 0-16 m, 9% in 17-32 m, 13% in >32 m.

Acoustics—Blue whales produce calls with the lowest frequency and highest source levels of all cetaceans.). Blue whale vocalizations are long, patterned low-frequency sounds with durations up to 36 sec (Richardson et al. 1995) repeated every 1 to 2 min (Mellinger and Clark 2003). The frequency range of their vocalizations is 12 to 400 hertz (Hz), with dominant energy in the infrasonic range at 12 to 25 Hz (Ketten 1998; Mellinger and Clark 2003). Source levels are up to 188 decibels (dB) re 1 µPa-m (Ketten 1998; McDonald et al, 2001). During the Magellan II Sea Test (at-sea exercises designed to test systems for antisubmarine warfare), off the coast of California in 1994, blue whale vocalization source levels at 17 Hz were estimated in the range of 195 dB re 1 µPa-m (Aburto et al. 1997). Širović et al. (2007) reported that blue whales produced vocalizations with a source level of 189 ± 3 dB re:1 Pa-1 m over a range of 25–29 Hz and could be detected up to 200 km away. A comparison of recordings between November 2003 and November 1964 and 1965, reveals a strong blue whale presence near San Nicolas Island (McDonald et al. 2006). A long-term shift in the frequency of the blue whale calling is seen; in 2003 the spectral energy peak was 16 Hz, whereas in 1964-65 the energy peak was near 22.5 Hz, illustrating a more than 30% shift in call frequency over four decades (McDonald et al. 2006).

Vocalizations of blue whales appear to vary among geographic areas (Rivers 1997), with clear differences in call structure suggestive of separate populations for the western and eastern regions of the North Pacific (Stafford et al. 2001). Stafford et al. (2005) recorded the highest calling rates when blue whale prey was closest to the surface during its vertical migration. Wiggins et al. (2005) reported the same trend of reduced vocalization during daytime foraging and then an increase in vocalizations at dusk as prey move up into the water column and disperse. Blue whales make seasonal migrations to areas of high productivity to feed and vocalize less in the feeding grounds than during the migration (Burtenshaw et al. 2004). Oleson et al. (2007) reported higher calling rates in shallow diving (<100 ft) whales while deeper diving whales (> 165 ft) were likely feeding and calling less.

As with other mysticete sounds, the function of vocalizations produced by blue whales is unknown. Hypothesized functions include: (1) maintenance of inter-individual distance, (2) species and individual recognition, (3) contextual information transmission (e.g. feeding, alarm, courtship), (4) maintenance of social organization (e.g. contact calls between females and offspring), (5) location of topographic features, and (6) location of prey resources (Thompson et al. 1992). Responses to conspecific sounds have been demonstrated in a number of mysticetes (Edds-Walton 1997), and there is no reason to believe that blue whales do not communicate similarly. While no data on hearing ability for this species are available, Ketten (1997) hypothesized that mysticetes have acute infrasonic hearing. Although no recent studies have directly measured the sound sensitivity in blue whales, we assume that blue whales are able to receive sound signals in roughly the same frequencies as the signals they produce.

Impacts of human activity—Historic Whaling- Blue whales were occasionally hunted by the sailing-vessel whalers of the 19th century (Scammon 1874). The introduction of steam power in the second half of that century made it possible for boats to overtake large, fast-swimming blue whales and other rorquals. From the turn of the century until the mid-1960s, blue whales from various stocks were intensely hunted in all the world's oceans. Blue whales were protected in portions of the Southern Hemisphere beginning in 1939, but were not fully protected in the Antarctic until 1965. In 1955, they were given complete protection in the North Atlantic under the International Convention for the Regulation of Whaling; this protection was extended to the Antarctic in 1965 and the North Pacific in 1966 (Gambell 1979; Best 1993). The protected status of North Atlantic blue whales was not recognized by Iceland until 1960 (Sigurjonsson 1988). Only a few illegal kills of blue whales have been documented in the Northern Hemisphere, including three at Canadian east-coast whaling stations during 1966-69 (Mitchell 1974), some at shore stations in Spain during the late 1950s to early 1970s (Aguilar and Lens 1981; Sanpera and Aguilar 1992), and at least two by "pirate" whalers in the eastern North Atlantic in 1978 (Best 1992). Some illegal whaling by the USSR also occurred in the North Pacific (Yablokov 1994); it is likely that blue whales were among the species taken by these operations, but the extent of the catches is not known. Since gaining complete legal protection from commercial whaling in 1966, some populations have shown signs of recovery, while others have not been adequately monitored to determine their status (NMFS 1998). Removal of this significant threat has allowed increased recruitment in the population, and therefore, the blue whale population in the eastern North Pacific is expected to have grown.

Fisheries Interactions—Because little evidence of entanglement in fishing gear exists, and large whales such as the blue whale may often die later and drift far enough not to strand on land after such incidents, it is difficult to estimate the numbers of blue whales killed and injured by gear entanglements. In addition, the injury or mortality of large whales due to interactions or entanglements in fisheries may go unobserved because large whales swim away with a portion of the net or gear. Fishers have reported that large whales tend to swim through their nets without entangling and causing little damage to nets (Barlow et al. 1997).

Ship Strikes-Because little evidence of ship strikes exists, and large whales such as the blue whale may often die later and drift far enough not to strand on land after such incidents, it is difficult to estimate the numbers of blue whales killed and injured by ship strikes. In addition, a boat owner may be unaware of the strike when it happens. Ship strikes were implicated in the deaths of blue whales in 1980, 1986, 1987, 1993, and 2002 (Carretta et al. 2006). Additional mortality from ship strikes probably goes unreported because the whales do not strand, or if they do, they do not always have obvious signs of trauma (Carretta et al. 2006). However, several blue whales have been photographed in California with large gashes in their dorsal surface that appear to be from ship strikes (Carretta et al. 2006). According to the California Marine Mammal Stranding Network Database (2006), six blue whales were struck by ships off of California from 1982-2005. The average number of blue whale mortalities in California attributed to ship strikes was 0.2 whales per year for 1998-2002 (Carretta et al. 2006). In addition, there were 9 unidentified whales and one unidentified balaenopterid struck by ships in California from 1982-2005

(California Marine Mammal Stranding Network Database 2006). Of these 10 animals, five were reported by the Navy as being struck offshore of the Channel Islands (e.g., San Nicholas and San Clemente Islands).

Some whale watching focused on blue whales has developed in recent years off the coast of California, notably in the Santa Barbara Channel, where the species occur with regularity in July and August. Major shipping lanes pass through, or near, whale watching areas, and underwater noise by commercial ship traffic may have a much greater impact than that produced by whale watching. However, little is known about whether, or how, vessel noise affects blue whales.

Fin whale (Balaenoptera physalus) California/Oregon/Washington Stock

Listing—In the North Pacific, the IWC began management of commercial whaling for fin whales in 1969; fin whales were fully protected from commercial whaling in 1976 (Allen 1980). Fin whales were listed as endangered under the ESA in 1973. Since the fin whale is listed as endangered under the ESA, the California/Oregon/Washington Stock is, therefore, considered depleted and strategic under the MMPA. They are also protected by the Convention on International Trade in Endangered Species of wild flora and fauna and the Marine Mammal Protection Act of 1972. Fin whales are listed as endangered on the IUCN Red List of Threatened Animals (Baillie and Groombridge 1996). Critical habitat has not been designated for fin whales.

Population Status—In the North Pacific, the total pre-exploitation population size of fin whales is estimated at 42,000 to 45,000 whales (Ohsumi and Wada 1974). The most recent abundance estimate (early 1970s) for fin whales in the entire North Pacific basin is between 14,620 and 18,630 whales (NMFS 2006e). Fin whales have a worldwide distribution with two distinct stocks recognized in the North Pacific: the East China Sea Stock and “the rest of the North Pacific Stock” (Donovan 1991). Currently, there are considered to be three stocks in the North Pacific for management purposes: an Alaska Stock, a Hawaii Stock, and a California/Oregon/Washington Stock (Barlow et al. 1997). Currently, the best estimate for the California/Oregon/Washington Stock is 2,099 (CV = 0.18) individuals (Barlow and Forney 2007).

During the early 1970s, 8,520 to 10,970 fin whales were surveyed in the eastern half of the North Pacific (Braham 1991). Moore et al. (2000) conducted surveys for whales in the central Bering Sea in 1999 and tentatively estimated the fin whale population was about 4,951 animals (95% C.I. 2,833-8,653). If these historic estimates are statistically reliable, the population size of fin whales has not increased significantly over the past 20 years despite an international ban on whaling in the North Pacific. The strongest contrary evidence comes from investigators conducting seabird surveys around the Pribilof Islands in 1975-1978 and 1987-1989. These investigators observed more fin whales in the second survey and suggested they were more abundant in the survey area (Baretta and Hunt 1994). However, observations of increased counts of fin whales in an area do not support a conclusion that there are more fin whales until changes in distribution have been ruled out first.

Distribution—Fin whales occur in oceans of both Northern and Southern Hemispheres between 20–75° N and S latitudes (NMFS 2006e). Fin whales are distributed widely in the world’s oceans. In the northern hemisphere, most migrate seasonally from high Arctic feeding areas in summer to low latitude (~30º N or S) breeding and calving areas in winter. During the summer in the North Pacific Ocean, fin whales are distributed in the Chukchi Sea, around the Aleutian Islands, the Gulf of Alaska, and along the coast of North America to CaliforniaWorldwide, fin whales were severely depleted by commercial whaling activities. The fin whale is found in continental shelf and oceanic waters (Gregr and Trites 2001; Reeves et al. 2002). Globally, it tends to be aggregated in locations where populations of prey are most plentiful, irrespective of water depth, although those locations may shift seasonally or annually (Payne et al. 1986, 1990;

Kenney et al. 1997; Notarbartolo-di-Sciara et al. 2003). Fin whales in the North Pacific spend the summer feeding along the cold eastern boundary currents (Perry et al. 1999).

The North Pacific population summers from the Chukchi Sea to California, and winters from California southward (Gambell 1985). Aggregations of fin whales are found year-round off southern and central California (Dohl et al. 1983; Forney et al. 1995; Barlow 1997). In the NMFS 1998–1999 surveys in SCIRC, they were sighted most frequently during warm-water months (Carretta et al. 2000). The fin whale was the second most commonly-encountered baleen whale (after gray whales) during those surveys; there were 21 sightings, with most sightings on the western side of San Clemente Island. Fin whales can be found in the SOCAL OPAREAs throughout the year (Barlow 1997).

At Sea Density Estimates—Pro-rated densities incorporating vessel survey results from 1986-2005 resulted in densities of 0.0024267 for warm water seasons and 0.0008008 for cold water season (Barlow 2007;Table 2-2).

Life history information—Fin whales become sexually mature between six to ten years of age, depending on density-dependent factors (Gambell 1985b). Reproductive activities for fin whales occur primarily in the winter. Gestation lasts about 12 months and nursing occurs for 6 to 11 months (Perry et al. 1999). The age distribution of fin whales in the North Pacific is unknown. Natural sources and rates of mortality are largely unknown, but Aguilar and Lockyer (1987) suggest annual natural mortality rates may range from 0.04 to 0.06 (based on studies of northeast Atlantic fin whales). The occurrence of the nematode Crassicauda boopis appears to increase the potential for kidney failure in fin whales and may be preventing some fin whale stocks from recovering from whaling (Lambertsen 1992, as cited in Perry et al. 1999). Killer whale or shark attacks may result in serious injury or death in very young and sick whales (Perry et al. 1999). NMFS has no records of fin whales being killed or injured by commercial fisheries operating in the North Pacific (Ferrero et al. 2000). Natural sources and rates of mortality are largely unknown, but Aguilar and Lockyer (1987) suggest annual natural mortality rates may range from 0.04 to 0.06 (based on studies of northeast Atlantic fin whales). The occurrence of the nematode. *Crassicauda boopis*, appears to increase the potential for kidney failure in fin whales and may be preventing some fin whale stocks from recovering from whaling (Lambertsen 1992, as cited in Perry et al. 1999). Killer whale or shark attacks may result in serious injury or death in very young and sick whales (Perry et al. 1999). NMFS has no records of fin whales being killed or injured by commercial fisheries operating in the North Pacific (Ferrero et al. 2000).

Reproduction/Breeding—Reproductive activities for fin whales occur primarily in low latitude areas (~30º N or S)in the winter (Reeves 1998; Carretta et al. 2007).

Diving Behavior—Fin whales typically dive for 5 to 15 min, separated by sequences of 4 to 5 blows at 10 to 20 sec intervals (Cetacean and Turtle Assessment Program 1982; Stone et al. 1992; Lafortuna et al. 2003). Kopelman and Sadove (1995) found significant differences in blow intervals, dive times, and blows per hour between surface feeding and non-surface-feeding fin whales. Croll et al. (2001) determined that fin whales dived to 321 ft (Standard Deviation [SD] = ± 106.8 ft) with a duration of 6.3 min (SD = ± 1.53 min) when foraging and to 168 ft (SD = ± 97.3 ft) with a duration of 4.2 min (SD = ± 1.67 min) when not foraging. Goldbogen et al. (2006) reported that fin whales in California made foraging dives to a maximum of 748-889 ft and dive durations of 6.2-7.0 min. Fin whale dives exceeding 492 ft and coinciding with the diel migration of krill were reported by Panigada et al. (1999). Fin whales feed on planktonic crustaceans, including *Thysanoessa* sp and *Calanus* sp, as well as schooling fish including herring, capelin and mackerel (Aguilar 2002). Depth distribution data from the Ligurian Sea in the Mediterranean are the most complete (Panigada et al. 2003), and showed differences between day and night diving; daytime dives were shallower (<100m) and night dives were deeper (>400m), likely taking advantage of nocturnal prey migrations into shallower depths; this data may be atypical of fin whales elsewhere in areas where they do not feed on vertically-migrating prey.

Goldbogen et al. (2006) studied fin whales in southern California and found that 60% of total time was spent diving, with the other 40% near surface (<50m); dives were to >225 m and were characterized by rapid gliding ascent, foraging lunges near the bottom of dive, and rapid ascent with flukes. Dives were somewhat V-shaped although the bottom of the V is wide. Based on information from Goldbogen et al. (2006), percentage of time at depth levels is estimated as 44% at <50m, 23% at 50-225 m (covering the ascent and descent times) and 33% at >225 m.

Acoustics—Underwater sounds produced by fin whales are one of the most studied Balaenoptera sounds. Fin whales produce calls with the lowest frequency and highest source levels of all cetaceans. Infrasonic (10-200 Hz), pattern sounds have been documented for fin whales (Watkins et al. 1987; Clark and Fristrup 1997; McDonald and Fox 1999). ; Charif et al. 2002). Charif et al. (2002) estimated source levels between 159-184 dB *re*:1 µPa-1 m for fin whales vocalizations recorded between Oregon and Northern California. Fin whales can also produce a variety of sounds with a frequency range up to 750 Hz. The long, patterned 15 to 30 Hz vocal sequence is most typically recorded; only males are known to produce these (Croll et al. 2002). The most typical signals are long, patterned sequences of short duration (0.5-2s) infrasonic pulses in the 18-35 Hz range (Patterson and Hamilton 1964). Estimated source levels are as high as 190 dB (Patterson and Hamilton 1964; Watkins et al. 1987a; Thompson et al. 1992; McDonald et al. 1995). Širović et al. (2007) reported that fin whales produced vocalizations with a source level of 189 ± 4 dB re:1 Pa-1 m over a range of 15–28 Hz and could be detected up to 56 km away. In temperate waters intense bouts of long patterned sounds are very common from fall through spring, but also occur to a lesser extent during the summer in high latitude feeding areas (Clark and Charif 1998). Short sequences of rapid pulses in the 20-70 Hz band are associated with animals in social groups (McDonald et al. 1995; Clark pers. comm.; McDonald pers. comm.). Each pulse lasts on the order of one second and contains twenty cycles (Tyack 1999). Particularly in the breeding season, fin whales produce series of pulses in a regularly repeating pattern. These bouts of pulsing may last for longer than one day (Tyack 1999). The seasonality and stereotype of the bouts of patterned sounds suggest that these sounds are male reproductive displays (Watkins et al. 1987a), while the individual counter-calling data of McDonald et al. (1995) suggest that the more variable calls are contact calls. Some authors feel there are geographic differences in the frequency, duration and repetition of the pulses (Thompson et al. 1992). As with other mysticete sounds, the function of vocalizations produced by fin whales is unknown. Hypothesized functions include: (1) maintenance of inter-individual distance, (2) species and individual recognition, (3) contextual information transmission (e.g. feeding, alarm, courtship), (4) maintenance of social organization (e.g. contact calls between females and offspring), (5) location of topographic features, and (6) location of prey resources (review by Thompson et al. 1992). Responses to conspecific sounds have been demonstrated in a number of mysticetes, and there is no reason to believe that fin whales do not communicate similarly (Edds-Walton 1997). The low-frequency sounds produced by fin whales have the potential to travel over long distances, and it is possible that long-distance communication occurs in fin whales (Payne and Webb 1971; Edds-Walton 1997). Also, there is speculation that the sounds may function for long-range echolocation of large-scale geographic targets such as seamounts, which might be used for orientation and navigation (Tyack 1999).

The most typical fin whale sound is a 20 Hz infrasonic pulse (actually an FM sweep from about 23 to 18 Hz) with durations of about 1 sec and can reach source levels of 184 to 186 dB re 1 µPa-m (maximum up to 200) (Richardson et al. 1995; Charif et al. 2002). Croll et al. (2002) suggested that these long, patterned vocalizations might function as male breeding displays, much like those that male humpback whales sing. The source depth, or depth of calling fin whales, has been reported to be about 162 ft (Watkins et al. 1987).

Although no studies have directly measured the hearing sensitivity of fin whales, we assume that fin whales are able to receive sound signals in roughly the same frequencies as the signals they produce. This suggests fin whales, like other baleen whales are more likely to have their best hearing capacities at low frequencies, including infrasonic frequencies, rather than at mid- to high-frequencies (Ketten 1997).

Impacts of human activity—As early as the mid-seventeenth century, the Japanese were capturing fin, blue, and other large whales using a fairly primitive open-water netting technique (Tønnessen and Johnsen 1982, Cherfas 1989). In 1864, explosive harpoons and steam-powered catcher boats were introduced in Norway, allowing the large-scale exploitation of previously unobtainable whale species. The North Pacific and Antarctic whaling operations soon added this >modern' equipment to their arsenal. After blue whales were depleted in most areas, the smaller fin whale became the focus of whaling operations and more than 700,000 fin whales were landed in the twentieth century. The incidental take of fin whales in fisheries is extremely rare. In the California/Oregon drift gillnet fishery, observers recorded the entanglement and mortality of one fin whale, in 1999, off southern California (NMFS 2000). Based on a worst-case scenario, NMFS estimates that a maximum of six fin whales (based on calculations that adjusted the fin whale observed entangled and killed in 1999 by the number of sets per year) in a given year could be captured by the California-Oregon drift gillnet fleet and killed (NMFS 2000). Anecdotal observations from fishermen, suggest that large whales swim through their nets rather than get caught in them (NMFS 2000). Because of their size and strength, fin whales probably swim through fishing nets which might explain why these whales are rarely reported as having become entangled in fishing gear.

Humpback whale (*Megaptera novaeangliae*) Eastern North Pacific Stock

Listing Status—The IWC first protected humpback whales in the North Pacific in 1966. They are also protected under CITES. In the U.S., humpback whales were listed as endangered under the ESA in 1973 and are therefore classified as depleted and strategic stock under the MMPA. Critical habitat has not been designated for this species in waters off California, Oregon, and Washington.

Population Status—Humpback whales live in all major ocean basins from equatorial to sub-polar latitudes migrating from tropical breeding areas to polar or sub-polar feeding areas (Jefferson et al. 1993, NMFS 2006e). Three Pacific stocks of humpback whales are recognized in the Pacific Ocean and include the western North Pacific stock, central North Pacific stock, and eastern North Pacific stock Calambokidis et al. 1997; Baker et al. 1998). The Eastern North Pacific humpback whale stock is the one most likely to be encountered within Southern California. In the entire North Pacific Ocean prior to 1905, it is estimated that there were 15,000 humpback whales basin-wide (Rice 1978). In 1966, after heavy commercial exploitation, humpback abundance was estimated at 1,000 to 1,200 whales (Rice 1978), although it is unclear if estimates were for the entire North Pacific or just the eastern North Pacific. There are no reliable estimates for current humpback whale abundance in the entire North Pacific (NMFS 2006e). The most recent estimate of population size for the Eastern North Pacific Stock is 1,391 (CV = 0.22; Carretta et al. 2007).

Distribution—The Eastern North Pacific Stock inhabits waters from Costa Rica (Steiger et al. 1991) to southern British Columbia (Calambokidis et al. 1993). This Stock is most abundant in coastal waters off California during spring and summer, and off Mexico during autumn and winter. Although humpback whales typically travel over deep, oceanic waters during migration, their feeding and breeding habitats are mostly in shallow, coastal waters over continental shelves (Clapham and Mead 1999). Shallow banks or ledges with high sea-floor relief characterize feeding grounds (Payne et al. 1990; Hamazaki 2002). North Pacific humpback whales are distributed primarily in four more-or-less distinct wintering areas: the Ryukyu and Ogasawara (Bonin) Islands (south of Japan), Hawai'i, the Revillagigedo Islands off Mexico, and along the coast of mainland Mexico (Calambokidis et al. 2001). There is known to be some interchange of whales among different wintering grounds, and some matches between Hawaii and Japan, and between Hawaii and Mexico have been found (Salden et al. 1999; Calambokidis et al. 2000; 2001). During summer months, North Pacific humpback whales feed in a nearly continuous band from southern California to the Aleutian Islands, Kamchatka Peninsula, and the Bering and Chukchi seas (Calambokidis et al., 2001). Humpback whales are mainly found in the Southern Califorina from December through June (Calambokidis et al. 2001). During late summer, more humpback whales are sighted north of the Channel Islands, and limited occurrence expected south of the northern Channel Islands (San Miguel, Santa Rosa, Santa Cruz) (Carretta et al. 2000). Humpback whales summer throughout the central and western portions of the Gulf of Alaska, including Prince William Sound, around Kodiak Island (including Shelikof Strait and the Barren Islands), and along the southern coastline of the Alaska Peninsula. The northern Bering Sea, Bering Strait, and the southern Chukchi Sea along the Chukchi Peninsula, appear to form the northern extreme of the humpback whale's range (Nikulin 1946, Berzin and Rovnin 1966).

At Sea Density Estimates—Pro-rated densities incorporating vessel survey results from 1986-2005 resulted in densities of 0.0001613 for warm water season and 0.0000984 for cold water season (Barlow, 2007; Table 2-2).

Life History—Humpbacks primarily feed on small schooling fish and krill (Caldwell and Caldwell 1983). While in California waters, humpback prey includes euphausiids and small schooling fish like anchovies, sardines, and mackerel (Wynne and Folkens, 1992). It is believed that minimal feeding occurs in wintering grounds, such as the Hawaiian Islands (Balcomb 1987; Salden 1989).

Reproduction/Breeding—Humpback whales migrate south from California to the waters off Mexico and Costa Rica to breed and to give birth (Calambokidis et al. 2004).

Diving Behavior—Humpback whale diving behavior depends on the time of year (Clapham and Mead 1999). In summer, most dives last less than 5 min; those exceeding 10 min are atypical. In winter (December through March), dives average 10 to 15 min; dives of greater than 30 min have been recorded (Clapham and Mead 1999). Although humpback whales have been recorded to dive as deep as about 1,638 ft (Dietz et al. 2002), on the feeding grounds they spend the majority of their time in the upper 400 ft of the water column (Dolphin 1987; Dietz et al. 2002). Humpback whales on the wintering grounds do dive deeply; Baird et al. (2000) recorded dives to 577 ft.

Like other large mysticetes, they are a "lunge feeder" taking advantage of dense prey patches and engulfing as much food as possible in a single gulp. They also blow nets, or curtains, of bubbles around or below prey patches to concentrate the prey in one area, then lunge with mouths open through the middle. Dives appear to be closely correlated with the depths of prey patches, which vary from location to location. In the north Pacific, most dives were of fairly short duration (<4 min) with the deepest dive to 148 m (southeast Alaska; Dolphin 1987), while whales observed feeding on Stellwagen Bank in the North Atlantic dove to <40 m (Hain et al. 1995). Depth distribution data collected at a feeding area in Greenland resulted in the following best estimation of depth distribution: 37% of time at <4 m, 25% at 4-20 m, 7% at 21-35m, 4% at 36-50 m, 6% at 51-100 m, 7% at 101-150 m, 8% at 151-200 m, 6% at 201-300 m, and <1% at >300 m (Dietz et al. 2002).

Acoustics—Humpback whales are known to produce three classes of vocalizations: (1) "songs" in the late fall, winter, and spring by solitary males; (2) sounds made within groups on the wintering (calving) grounds; and (3) social sounds made on the feeding grounds (Richardson et al. 1995). The best-known types of sounds produced by humpback whales are songs, which are thought to be breeding displays used only by adult males (Helweg et al. 1992). Singing is most common on breeding grounds during the winter and spring months, but is occasionally heard outside breeding areas and out of season (Matilla et al. 1987; Clark and Clapham 2004). There is geographical variation in humpback whale song, with different populations singing different songs, and all members of a population using the same basic song. However, the song evolves over the course of a breeding season, but remains nearly unchanged from the end of one season to the start of the next (Payne et al. 1983). Social calls are from 50 Hz to over 10 kilohertz (kHz), with the highest energy below 3 kHz (Silber 1986). Female vocalizations appear to be simple; Simão and Moreira (2005) noted little complexity. The male song, however, is complex and changes between seasons. Components of the song range from under 20 Hz to 4 kHz and occasionally 8 kHz, with source levels of 144 to 174 dB re 1 µPa m, with a mean of 155 dB re 1 µPa-m (Thompson et al. 1979; Payne and Payne 1985, Frazer and Mercado 2000). Au et al. (2001) recorded high-frequency harmonics (out to 13.5 kHz) and source level (between 171 and 189 dB re 1 µPa-m) of humpback whale songs. Au et al. (2006) took recordings of whales off Hawaii and found high frequency harmonics of songs extending beyond 24 kHz, which may indicate that they can hear at least as high as this frequency. Songs have also been recorded on feeding grounds (Mattila et al. 1987; Clark and Clapham 2004). "Feeding calls," unlike song and social sounds are highly stereotyped series of narrow-band trumpeting calls. They are 20 Hz to 2 kHz, less than 1 second in duration, and have source levels of 175 to 192 dB re 1 μPa-m (U.S. Navy 2006a).

The main energy of humpback whale songs lies between 0.2 and 3.0 kHz, with frequency peaks at 4.7 kHz. Feeding calls, unlike song and social sounds, are highly stereotyped series of narrow-band trumpeting calls. They are 20 Hz to 2 kHz, less than 1 sec in duration, and have source levels of 175 to 192 dB re 1 µPa-m. The fundamental frequency of feeding calls is approximately 500 Hz (D'Vincent et al. 1985).

No tests on humpback whale hearing have been made. Houser et al. (2001) constructed a humpback audiogram using a mathematical model based on the internal structure of the ear. The predicted audiogram indicates sensitivity to frequencies from 700 Hz to 10 kHz, with maximum relative sensitivity between 2 and 6 kHz. Recent information on the songs of humpback whales suggests that their hearing, if animals hear the sounds they make, may extend to frequencies of at least 24 kHz (Au et al. 2006). Maybaum (1989) reported that humpback whales showed a mild response to a hand held sonar marine mammal detection and location device (frequency of 3.3 kHz at 219 dB re 1µPa @ 1 meter or frequency sweep of 3.1-3.6 kHz) although this system is significantly different from the Navy's hull mounted sonars. In addition, the system had some low frequency components (below 1 kHz) which may be an artifact of the acoustic equipment. This may have affected the response of the whales to both the control and sonar playbacks.

Impacts of human activity- Historic whaling—Commercial whaling, the single most significant impact on humpback whales ceased in the North Atlantic in 1955 and in all other oceans in 1966. The humpback whale was the most heavily exploited by Soviet whaling fleets after World War II.

Fisheries Interactions-Entanglement in fishing gear poses a threat to individual humpback whales throughout the Pacific. Reports of entangled humpbacks whales found swimming, floating, or stranded with fishing gear attached, have been documented in the North Pacific. A number of fisheries based out of west coasts ports may incidentally take the ENP stock of humpback whale, and documented interactions are summarized in the U.S. Pacific Marine Mammal Stock Assessments: 2006 (Carretta et al. 2007). The estimated impact of fisheries on the ENP humpback whale stock is likely underestimated, since the serious injury or mortality of large whales due to entanglement in gear, may go unobserved because whales swim away with a portion of the net, line, buoys, or pots. According to Carretta et al. (2007) and the California

Marine Mammal Stranding Network Database (U.S Department of Commerce 2006), 12 humpback whales and two unidentified whales have been reported as entangled in fishing gear (all crab pot gear, except for one of the unidentified whales) since 1997.

Ship Strikes-Humpback whales, especially calves and juveniles, are highly vulnerable to ship strikes and other interactions with non-fishing vessels. Younger whales spend more time at the surface, are less visible, and closer to shore (Herman et al. 1980; Mobley et al. 1999), thereby making them more susceptible to collisions. Humpback whale distribution overlaps significantly with the transit routes of large commercial vessels, including cruise ships, large tug and barge transport vessels, and oil tankers.

Ship strikes were implicated in the deaths of at least two humpback whales in 1993, one in 1995, and one in 2000 (Carretta et al. 2006). During 1999-2003, there were an additional 5 injuries and two mortalities of unidentified whales, attributed to ship strikes. Additional mortality from ship strikes probably goes unreported because the whales do not strand or, if they do, they do not have obvious signs of trauma. Several humpback whales have been photographed in California with large gashes in their dorsal surface that appear to be from ship strikes (Carretta et al. 2006). According to the California Marine Mammal Stranding Network Database (2006), one humpback whale was struck by a ship off of California from 1982-2005. The average number of humpback whale deaths by ship strikes for 1999-2003 is at least 0.2 per year (Carretta et al. 2006). In addition, there were 9 unidentified whales and one unidentified balaenopterid struck by ships in California from 1982-2005 (California Marine Mammal Stranding Network Database 2006). Of these 10 animals, 5 were reported by the Navy as being struck offshore of the Channel Islands (e.g., San Nicholas and San Clemente Islands).

Whale watching boats and boats from which scientific research is being conducted specifically direct their activities toward whales and may have direct or indirect impacts on humpback whales. The growth of the whale-watching industry has not increased as rapidly for the ENP stock of humpback whales, as it has for the Central North Pacific stock (wintering grounds in Hawaii and summering grounds in Alaska), but whale-watching activities do occur throughout the ENP stock's range. There is concern regarding the impacts of close vessel approaches to large whales, since harassment may occur, preferred habitats may be abandoned, and fitness and survivability may be compromised if disturbance levels are too high. While a 1996 study in Hawaii measured the acoustic noise of different whale-watching boats (Au and Green 2000) and determined that the sound levels were unlikely to produce grave effects on the humpback whale auditory system, the potential direct and indirect effects of harassment due to vessels cannot be discounted. Several investigators have suggested shipping noise may have caused humpback whales to avoid or leave feeding or nursery areas (Jurasz and Jurasz 1979; Dean et al. 1985), while others have suggested that humpback whales may become habituated to vessel traffic and its associated noise. Still other researchers suggest that humpback whales may become more vulnerable to vessel strikes once they habituate to vessel traffic (Swingle et al. 1993; Wiley et al. 1995).

Other Threats-Similar to fin whales, humpbacks are potentially affected by a resumption of commercial whaling, loss of habitat, loss of prey (for a variety of reasons including climate variability), underwater noise, and pollutants. Generally, very little is known about the effects of organochlorine pesticides, heavy metals, and PCB's and other toxins in baleen whales, although the impacts may be less than higher trophic level odontocetes due to baleen whales' lower levels of bioaccumulation from prey.

Anthropogenic noise may also affect humpback whales, as humpback whales seem to respond to moving sound sources, such as whale-watching vessels, fishing vessels, recreational vessels, and low-flying aircraft (Beach and Weinrich 1989; Clapham et al. 1993; Atkins and Swartz 1989).

Their responses to noise are variable and have been correlated with the size, composition, and behavior of the whales when the noises occurred (Herman et al. 1980; Watkins et al. 1981; Krieger and Wing 1986).

Sei whale (*Balaenoptera borealis*) Eastern North Pacific Stock

Listing Status—Sei whales did not have meaningful protection at the international level until 1970, when catch quotas for the North Pacific began to be set on a species basis (rather than on the basis of total production, with six sei whales considered equivalent to one “blue whale unit”). Prior to that time, the kill was limited only to the extent that whalers hunted selectively for the larger species with greater return on effort (Allen 1980). The sei whale was given complete protection from commercial whaling in the North Pacific in 1976. In the late 1970's, some “pirate” whaling for sei whales took place in the eastern North Atlantic (Best 1992). There is no direct evidence of illegal whaling for this species in the North Pacific although the acknowledged misreporting of whaling data by Soviet authorities (Yablokov 1994) means that catch data are not wholly reliable. In the U.S., humpback whales were listed as endangered under the ESA in 1973 and are therefore classified as depleted and strategic stock under the MMPA. It is also classified as “endangered” by the IUCN (Baillie and Groombridge 1996) and is listed in CITES Appendix I. Critical habitat has not been designated for this species for the eastern North Pacific stock.

Population Status—The IWC groups all of sei whales in the entire North Pacific Ocean into one stock (Donovan 1991). However, some mark-recapture, catch distribution, and morphological research, indicated that more than one stock exists; one between 175°W and 155°W longitude, and another east of 155° W longitude (Masaki 1976; Masaki 1977). In the U.S. Pacific EEZ only the Eastern North Pacific Stock is recognized. Worldwide, sei whales were severely depleted by commercial whaling activities. In the North Pacific, the pre-exploitation population estimate for sei whales is 42,000 whales and the most current population estimate for sei whales in the entire North Pacific (from 1977) is 9,110 (NMFS, 2006z).

Application of various models to whaling catch and effort data suggests that the total population of adult sei whales in the North Pacific declined from about 42,000 to 8,600 between 1963 and 1974 (Tillman 1977). Since 500-600 sei whales per year were killed off Japan from 1910 to the late 1950s, the stock size presumably was already, by 1963, below its carrying capacity level (Tillman 1977). The most current population estimate for sei whales in the entire North Pacific (from 1977) is 9,110 (NMFS, 2006z). The current estimate for sei whales in the Eastern North Pacific stock is 56 (CV=0.61) individuals (Carretta et al. 2007).

Distribution—Sei whales live in temperate regions of all oceans in the Northern and Southern Hemispheres and are not usually associated with coastal features (NMFS, 2006z). Sei whales are highly mobile, and there is no indication that any population remains in the same area year-round, i.e., is resident. Pole-ward summer feeding migrations occur, and sei whales generally winter in warm temperate or subtropical waters. The species is cosmopolitan, but with a generally anti-tropical distribution centered in the temperate zones. During the winter, sei whales are found from 20°- 23° N and during the summer from 35°-50° N (Masaki 1976; Masaki 1977).

Sei whales are most often found in deep, oceanic waters of the cool temperate zone. They appear to prefer regions of steep bathymetric relief, such as the continental shelf break, canyons, or basins situated between banks and ledges (Kenney and Winn 1987; Schilling et al. 1992; Gregr and Trites 2001; Best and Lockyer 2002). On feeding grounds, the distribution is largely associated with oceanic frontal systems (Horwood 1987). In the North Pacific, sei whales are found feeding particularly along the cold eastern currents (Perry et al. 1999).

Historically, sei whales occurred in the California Current off central California (37ºN–39ºN), and they may have ranged as far south as the area west of the Channel Islands (32º47’N) (Rice 1977). A few early sightings were made in May and June, but they were encountered there primarily during July–September, and had left California waters by mid-October. Their offshore distribution along the continental slope probably explains, at least in part, the infrequency of observations in shelf waters between northern California and Washington.

Three sightings were made north of the SOCAL Range Complex in the PMSR during the warm-water months (June–September); there were two sightings north of Point Conception and one sighting south of the western tip of Santa Cruz Island (U.S. Navy 1998). Recently, only one confirmed sighting of sei whales and five possible sightings (identified as either sei or Bryde's whales) were made in California waters during extensive ship and aerial surveys during 1991–1993 (Mangels and Gerrodette 1994; Barlow, 1995; Forney et al. 1995). The confirmed sighting was more than 200 nm (370 km) off northern California. Sei whales were not seen during vessel surveys conducted off southern California in 1996, 2001 or 2005 (Appler et al. 2004; Barlow 2003; Forney 2007) nor during aerial surveys conducted in 1991-92 or 1998-99 (Carretta and Forney 1993; Carretta et al. 2000). Sei whales are found in the SOCAL Range Complex from May through October (U.S. Navy, 1998).

At Sea Density Estimates—Pro-rated densities incorporating vessel survey results from 1986-2005 resulted in densities of 0.0000081 for warm water seasons and 0.0000050 for cold water season (Barlow 2007;Table 2-2).

Reproduction/Breeding—No breeding areas have been determined but calving is thought to occur from September to March (Rice 1977).

Diving Behavior—There are no reported diving depths or durations for Sei whales. In lieu of depth data, minke whale depth distribution percentages will be extrapolated to sei whales for use in the acoustic exposure modeling.

Acoustics—Sei whale vocalizations have been recorded only on a few occasions. They consist of paired sequences (0.5 to 0.8 sec, separated by 0.4 to 1.0 sec) of 7 to 20 short (4 milliseconds [msec]) frequency modulated sweeps between 1.5 and 3.5 kHz (Richardson et al. 1995). Sei whales in the Antarctic produced broadband "growls" and "whooshes" at frequency of 433 ±192 kHz and source level of 156 ±3.6 dB re 1 µPa at 1 m (Mc Donald et al., 2005). While no data on hearing ability for this species are available, Ketten (1997) hypothesized that mysticetes have acute infrasonic hearing.

Impact of human activity-Historic Whaling—Several hundred sei whales in the North Pacific were taken each year by whalers based at shore stations in Japan and Korea between 1910 and the start of World War II (Committee for Whaling Statistics 1942). From 1910 to 1975, approximately 74,215 sei whales were caught in the entire North Pacific Ocean (Perry et al. 1999). The species was taken less regularly and in much smaller numbers by pelagic whalers elsewhere in the North Pacific during this period (Committee for Whaling Statistics 1942). Small numbers were taken sporadically at shore stations in British Columbia from the early 1900s until the 1950s, when their importance began to increase (Pike and MacAskie 1969). More than 2,000 were killed in British Columbia waters between 1962 and 1967, when the last whaling station in western Canada closed (Pike and MacAskie 1969). Small numbers were taken by shore whalers in Washington (Scheffer and Slipp 1948) and California (Clapham et al. 1997) in the early twentieth century, and California shore whalers took 386 from 1957 to 1971 (Rice 1977). Heavy exploitation by pelagic whalers began in the early 1960s, with total catches throughout the North Pacific averaging 3,643 per year from 1963 to 1974 (total 43,719; annual range 1,280-6,053; Tillman 1977). The total reported kill of sei whales in the North Pacific by commercial whalers was 61,500 between 1947 and 1987 (Barlow et al. 1997).

A major area of discussion in recent years has been IWC member nations issuing permits to kill whales for scientific purposes. Since the moratorium on commercial whaling came into effect

Japan, Norway, and Iceland have issued scientific permits as part of their research programs. For the last five years, only Japan has issued permits to harvest sei whales although Iceland asked for a proposal to be reviewed by the IWC SC in 2003. The Government of Japan has captured minke, Bryde's, and sperm whales (*Physeter macrocephalus*) in the North Pacific (JARPN II). The Government of Japan extended the captures to include 50 sei whales from pelagic areas of the western North Pacific. Twelve takes of sei whales occurred from 1988 to 1995 in the North Atlantic off Iceland and West Greenland although the IWC has set a catch limit of 0 for all stocks in 1985.

Fisheries Interactions-Sei whales, because of their offshore distribution and relative scarcity in U.S. Atlantic and Pacific waters, probably have a lower incidence of entrapment and entanglement than fin whales. Data on entanglement and entrapment in non-U.S. waters are not reported systematically. Heyning and Lewis (1990) made a crude estimate of about 73 rorquals killed/year in the southern California offshore drift gillnet fishery during the 1980's. Some of these may have been fin whales and some of them sei whales. Some balaenopterids, particularly fin whales, may also be taken in the drift gillnet fisheries for sharks and swordfish along the Pacific coast of Baja California, Mexico (Barlow et al. 1997). Heyning and Lewis (1990) suggested that most whales killed by offshore fishing gear do not drift far enough to strand on beaches or to be detected floating in the nearshore corridor where most whale-watching and other types of boat traffic occur. Thus, the small amount of documentation should not be interpreted to mean that entanglement in fishing gear is an insignificant cause of mortality. Observer coverage in the Pacific offshore fisheries has been too low for any confident assessment of species-specific entanglement rates (Barlow et al. 1997). Sei whales, similar to other large whales, may break through or carry away fishing gear. Whales carrying gear may die later, become debilitated or seriously injured, or have normal functions impaired, but with no evidence recorded.

Ship Strikes—The decomposing carcass of a sei whale was found on the bow of a container ship in Boston harbor, suggesting that sei whales, like fin whales, are killed at least occasionally by ship strikes (Waring et al. 1997). Sei whales are observed from whale-watching vessels in eastern North America only occasionally (Edds et al. 1984) or in years when exceptional foraging conditions arise (Weinrich et al. 1986; Schilling et al. 1992). There is no comparable evidence available for evaluating the possibility that sei whales experience significant disturbance from vessel traffic. There were 9 unidentified whales and one unidentified balaenopterid struck by ships in California from 1982-2005 (California Marine Mammal Stranding Network Database 2006). Of these 10 animals, 5 were reported by the Navy as being struck offshore of the Channel Islands (e.g., San Nicholas and San Clemente Islands).

Other Threats-No major habitat concerns have been identified for sei whales in either the North Atlantic or the North Pacific. However, fishery-caused reductions in prey resources could have influenced sei whale abundance. The sei whale's strong preference for copepods and euphausiids (i.e., low trophic level organisms), at least in the North Atlantic, may make it less susceptible to the bioaccumulation of organochlorine and metal contaminants than, for example, fin, humpback, and minke whales, all of which seem to feed more regularly on fish and euphausiids (O'Shea and Brownell 1995). Since sei whales off California often feed on pelagic fish as well as invertebrates (Rice 1977), they might accumulate contaminants to a greater degree than do sei whales in the North Atlantic. There is no evidence that levels of organochlorines, organotins, or heavy metals in baleen whales generally (including fin and sei whales) are high enough to cause toxic or other damaging effects (O'Shea and Brownell 1995). It should be emphasized, however, that very little is known about the possible long-term and trans-generational effects of exposure to pollutants.

Sperm whale (Physeter macrocephalus) California/Oregon/Washington Stock

Listing Status—Sperm whales have been protected from commercial harvest by the IWC since 1981, although the Japanese continued to harvest sperm whales in the North Pacific until 1988 (Reeves and Whitehead 1997). Sperm whales were listed as endangered under the ESA in 1973. Since the sperm whale is listed as endangered under the ESA, the California/Oregon/Washington Stock is, therefore, considered depleted and strategic under the MMPA. They are also protected by the Convention on International Trade in Endangered Species of wild flora and they are also protected by the Convention on International Trade in Endangered Species of wild flora and fauna and the Marine Mammal Protection Act of 1972. Critical habitat has not been designated for sperm whales.

Population Status—Current estimates for population abundance, status, and trends for the Alaska stock of sperm whales are not available (Hill and DeMaster 1999). Approximately 258,000 sperm whales in the North Pacific were harvested by commercial whalers between 1947 and 1987 (Hill and DeMaster 1999). However, this number may be negatively biased by as much as 60% because of under-reporting by Soviet whalers (Brownell et al. 1998). In particular, the Bering Sea population of sperm whales (consisting mostly of males) was severely depleted (Perry et al. 1999). Catches in the North Pacific continued to climb until 1968, when 16,357 sperm whales were harvested. Catches declined after 1968, in part through limits imposed by the IWC (Rice 1989). Reliable estimates of current and historical sperm whale abundance across each ocean basin are not available (NMFS 2006e). Five stocks of sperm whales are recognized in U.S. waters: the North Atlantic stock, the northern Gulf of Mexico stock, the Hawaiian stock, the California/Oregon/Washington stock, and the North Pacific stock (NMFS 2006e). Sperm whales are widely distributed across the entire North Pacific Ocean and into the southern Bering Sea in summer, but the majority are thought to occur south of 40°N in winter. Estimates of pre-whaling abundance in the North Pacific are considered somewhat unreliable, but may have totaled 1,260,000 sperm whales. Whaling harvests between 1800 and the 1980s took at least 436,000 sperm whales from the entire North Pacific Ocean (NMFS 2006e).

Several authors have proposed population structures that recognize at least three sperm whales populations in the North Pacific for management purposes (Kasuya 1991, Bannister and Mitchell 1980). At the same time, the IWC's Scientific Committee designated two sperm whale stocks in the North Pacific: a western and eastern stock or population (Donovan 1991). The line separating these populations has been debated since their acceptance by the IWC's Scientific Committee. For stock assessment purposes, NMFS recognizes three discrete population centers of sperm whales in the Pacific: (1) Alaska, (2) California/Oregon/Washington, and (3) Hawai'I (Carretta et al., 2007). California, Oregon, and Washington and those sampled offshore to the Hawaiian Islands (Mesnick et al. 1999; Carretta et al. 2007).

The available data suggest that sperm whale abundance has been relatively stable in California waters since 1979 (Barlow 1994), but there is uncertainty about both the population size and the annual mortality rates. Population is estimate to be 1,233 (CV=0.41) for the California/Oregon/Washington Stock (Carretta et al. 2007). Sperm whale abundance in the eastern temperate North Pacific Ocean is estimated to be 32,100 and 26,300 by acoustic and visual detection methods, respectively (Barlow and Taylor 2005).

Preliminary genetic analyses reveal significant differences between sperm whales off the coast of California, Oregon, and Washington and those sampled offshore to the Hawaiian Islands (Mesnick et al. 1999; Carretta et al. 2007). The NOAA stock assessment report divides sperm whales within the U.S. Pacific EEZ into three discrete, noncontiguous areas: (1) water around the Hawaiian Islands, (2) California, Oregon, and Washington waters, and (3) Alaskan waters (Carretta et al. 2007).

Distribution—Sperm whales occur throughout all ocean basins from equatorial to polar waters, including the entire North Atlantic, North Pacific, northern Indian Ocean, and the southern oceans. Sperm whales are found throughout the North Pacific and are distributed broadly from tropical and temperate waters to the Bering Sea as far north as Cape Navarin. Mature, female, and immature sperm whales of both sexes are found in more temperate and tropical waters from the equator to around 45˚N throughout the year. These groups of adult females and immature sperm whales are rarely found at latitudes higher than 50˚N and 50˚S (Reeves and Whitehead 1997). Sexually mature males join these groups throughout the winter. During the summer, mature male sperm whales are thought to move north into the Aleutian Islands, Gulf of Alaska, and the Bering Sea. Sperm whales are rarely found in waters less than 300 meters in depth. They are often concentrated around oceanic islands in areas of upwelling, and along the outer continental shelf and mid-ocean waters. Sperm whales show a strong preference for deep waters (Rice 1989), especially areas with high sea-floor relief. Sperm whale distribution is associated with waters over the continental shelf edge, over the continental slope, and into deeper waters (Hain et al., 1985; Kenney and Winn 1987; Waring and Finn 1995; Gannier 2000; Gregr and Trites 2001; Waring et al. 2001). However, in some areas, such as off New England, on the southwestern and eastern Scotian Shelf, and in the northern Gulf of California, adult males are reported to quite consistently use waters with bottom depths <100 m and as shallow as 40 m (Whitehead et al. 1992; Scott and Sadove 1997; Croll et al. 1999; Garrigue and Greaves 2001; Waring et al. 2002).

The geographic distribution of the California/Oregon/Washington stock of sperm whales varies seasonally. Sperm whales are found year-round in California waters, but peak in abundance from April through mid-June and from the end of August to mid-November (NMFS 2006e). The sperm whale was reported to be rare over the continental shelf of the Southern California Bight, but abundant directly offshore of the Southern California Bight (Bonnell and Dailey 1993). During the 1991 and 1993 NMFS ship-based surveys, sperm whales were more abundant farther offshore and farther south than they were in the Southern California Bight. There are widely scattered sightings of sperm whales in deep waters of the SOCAL Range Complex in the warm-water period, and few sightings in the cold-water period. No sperm whales were sighted during the 1998–1999 NMFS aerial surveys of the SCIRC (Carretta et al. 2000). Vessel surveys conducted in 2001 and 2005 both yielded sightings of sperm whales (Forney 2007; Appler et al. 2004). However, sperm whales are found in the SOCAL Range Complex throughout the year (Carretta et al. 2000).

At Sea Density Estimates—Pro-rated densities incorporating vessel survey results from 1986-2005 resulted in densities of 0.0014313 for warm water season and 0.0008731 for cold water season (Barlow 2007; Table 2-2).

Life history information—Female sperm whales become sexually mature at about 9 years of age (Kasuya 1991). Male sperm whales take between 9 and 20 years to become sexually mature, but will require another 10 years to become large enough to successfully compete for breeding rights (Kasuya 1991). Adult females give birth after about 15 months gestation and nurse their calves for 2 to 3 years. The calving interval is estimated to be about four to six years (Kasuya 1991). The age distribution of the sperm whale population is unknown, but sperm whales are believed to live at least 60 years (Rice 1978). Estimated annual mortality rates of sperm whales are thought to vary by age, but previous estimates of mortality rate for juveniles and adults are now considered unreliable (IWC 1980).

Reproduction/Breeding—Calving generally occurs in the summer at lower latitudes and the tropics (DoN 2005).

Diving Behavior—Sperm whales forage during deep dives that routinely exceed a depth of 1,314 ft and 30 min duration (Watkins et al. 2002). Sperm whales are capable of diving to depths of over 6,564 ft with durations of over 60 min (Watkins et al., 1993). Sperm whales spend up to 83 percent of daylight hours underwater (Jaquet et al. 2000; Amano and Yoshioka 2003). Males do not spend extensive periods of time at the surface (Jaquet et al. 2000). In contrast, females spend prolonged periods of time at the surface (1 to 5 hours daily) without foraging (Whitehead and Weilgart 1991; Amano and Yoshioka 2003). The average swimming speed is estimated to be 0.7 m/sec (Watkins et al. 2002). Dive descents averaged 11 min at a rate of 1.52 m/sec, and ascents averaged 11.8 min at a rate of 1.4 m/sec (Watkins et al. 2002).

Amano and Yoshioka (2003) attached a tag to a female sperm whale near Japan in an area where water depth was 1000-1500m. For dives with active bottom periods, the total mean dive sequence was 45.9 min (mean surface time plus dive duration). Mean post dive surface time divided by total time (8.5/45.9), plus time at surface between deep dive sequences, yields a percentage of time at the surface (<10 m) of 31%. Mean bottom time divided by total time (17.5/45.9) and adjusted to include the % of time at the surface between dives, yields a percentage of time at the bottom of the dive (in this case >800 m as the mean maximum depth was 840 m) of 34%. Total time in the water column descending or ascending equals duration of dive minus bottom time (37.4-17.5) or ~20 minutes. Assuming a fairly equal descent and ascent rate (as shown in the table) and a fairly consistent descent/ascent rate over depth, we assume 10 minutes each for descent and ascent and equal amounts of time in each depth gradient in either direction. Therefore, 0-200 m = 2.5 minutes one direction (which correlates well with the descent/ascent rates provided) and therefore 5 minutes for both directions; and for 201-400 m, 401-600 m and 601-800 m. Therefore, the depth distribution for sperm whales based on information in the Amano paper is: 31% in <10 m, 8% in 10-200 m, 9% in 201-400 m, 9% in 401-600 m, 9% in 601-800 m and 34% in >800 m. The percentages derived above from data in Amano and Yoshioka (2003) are in fairly close agreement with those derived from Table 1 in Watwood et al. (2006) for sperm whales in the Ligurian Sea, Atlantic Ocean and Gulf of Mexico.

Acoustics—Sperm whales produce short-duration (generally less than 3 sec), broadband clicks from about 0.1 to 30 kHz (Weilgart and Whitehead 1993, 1997; Goold and Jones 1995; Thode et al. 2002). These clicks range in frequency from 100 Hz to 30 kHz, with dominant energy in two bands (2 to 4 kHz and 10 to 16 kHz).). The source levels can be up to 236 dB re 1 µPa-m (Møhl et al., 2003). Thode et al. (2002) suggested that the acoustic directivity (angular beam pattern) from sperm whales must range between 10 and 30 dB in the 5 to 20 kHz region. The clicks of neonate sperm whales are very different from usual clicks of adults in that they are of low directionality, long duration, and low-frequency (centroid frequency between 300 and 1,700 Hz) with estimated source levels between 140 and 162 dB re 1 µPa-m (Madsen et al. 2003). Clicks are heard most frequently when sperm whales are engaged in diving/foraging behavior (Whitehead and Weilgart 1991; Miller et al. 2004; Zimmer et al. 2005). These may be echolocation clicks used in feeding, contact calls (for communication), and orientation during dives. When sperm whales are socializing, they tend to repeat series of clicks (codas), which follow a precise rhythm and may last for hours (Watkins and Schevill 1977). Codas are shared between individuals of a social unit and are considered to be primarily for intragroup communication (Weilgart and Whitehead 1997; Rendell and Whitehead 2004). Sperm whales have been observed to frequently stop echolocating in the presence of underwater pulses made by echosounders and submarine sonar (Watkins and Schevill 1975; Watkins et al. 1985). They also stop vocalizing for brief periods when codas are being produced by other individuals, perhaps because they can hear better when not vocalizing themselves (Goold and Jones 1995).

The anatomy of the sperm whale's ear indicates that it hears high-frequency sounds (Ketten 1992). Anatomical studies also suggest that the sperm whale has some high-frequency hearing, but at a lower maximum frequency than many other odontocetes (Ketten, 1992). The sperm whale may also possess better low-frequency hearing than some other odontocetes, although not as extraordinarily low as many baleen whales (Ketten, 1992). The only data on the hearing range of sperm whales are evoked potentials from a stranded neonate (Carder and Ridgway 1991). These data suggest that neonatal sperm whales respond to sounds from 2.5-60 kHz with the highest sensitivity to frequencies between 5 and 20 kHz (Ridgway and Carder, 2001).

Impacts of human activity—In U.S. waters in the Pacific, sperm whales are known to have been incidentally taken only in drift gillnet operations, which killed or seriously injured an average of 9 sperm whales per year from 1991-1995 (Barlow et al. 1997). Of the eight sperm whales observed taken by the California/Oregon drift gillnet fishery, three were released alive and uninjured (37.5 percent), one was released injured (12.5 percent), and four were killed (50 percent) (NMFS 2000). Therefore, approximately 63 percent of captured sperm whales could be killed accidentally or injured (based on the mortality and injury rate of sperm whales observed taken by the U.S. fleet from 1990-2000). Based on past fishery performance, sperm whales are not observed taken in every year; they were observed taken in four out of the last ten years (NMFS 2000). During the three years the Pacific Coast Take Reduction Plan has been in place, a sperm whale was observed taken only once (in a set that did not comply with the Take Reduction Plan; NMFS 2000).

Interactions between longline fisheries and sperm whales in the Gulf of Alaska have been reported over the past decade (Rice 1989, Hill and DeMaster 1999). Observers aboard Alaskan sablefish and halibut longline vessels have documented sperm whales feeding on longline-caught fish in the Gulf of Alaska (Hill and Mitchell 1998) and in the South Atlantic (Ashford and Martin 1996). During 1997, the first entanglement of a sperm whale in Alaska's longline fishery was recorded, although the animal was not seriously injured (Hill and DeMaster 1998). The available evidence does not indicate sperm whales are being killed or seriously injured as a result of these interactions, although the nature and extent of interactions between sperm whales and long-line gear is not yet clear. Ashford and Martin (1996) suggested that sperm whales pluck, rather than bite, the fish from the long-line.

In 2000, the Japanese Whaling Association announced that it planned to kill 10 sperm whales and 50 Bryde's whales in the Pacific Ocean for research purposes, which would be the first time sperm whales would be taken since the international ban on commercial whaling took effect in 1987. Despite protests from the U.S. government and members of the IWC, the Japanese government harvested 5 sperm whales and 43 Bryde's whales in the last six months of 2000. According to the Japanese Institute of Cetacean Research (Institute of Cetacean Research undated), another 5 sperm whales were killed for research in 2002 – 2003. The consequences of these deaths on the status and trend of sperm whales remains uncertain; however, the renewal of a program that intentional targets and kills sperm whales before we can be certain the population has recovered from earlier harvests places this species at risk in the foreseeable future.

Guadalupe fur seal (*Arctocephalus townsendi*) Guadalupe Island, Mexico Stock

Listing Status—In the U.S., Guadalupe fur seals were listed as threatened under the ESA in 1985 and consequently, are listed as depleted and a strategic stock under the MMPA. The population is considered a single stock because all are recent descendents from one breeding colony at Isla Guadalupe, Mexico. The state of California lists the Guadalupe fur seal as a fully protected mammal in the Fish and Game Code of California (Chapter 8, Section 4700, d), and it is also listed as a threatened species in the Fish and Game Commission California Code of Regulations (Title 14, Section 670.5, b, 6, H). The Guadalupe fur seal is also protected under CITES and fully protected under Mexican law. Guadalupe Island was declared a pinniped sanctuary by the Mexican government in 1975. Critical habitat has not been designated for this species in the U.S.

Population Status—Commercial sealing during the 19th century reduced the once-abundant Guadalupe fur seal to near extinction in 1894. None were seen until a fisherman found slightly more than two dozen at Guadalupe Island in 1926. The size of the population prior to the commercial harvests of the 19th century is not known, but estimates range from 20,000 to 100,000 animals (NMFS 2006e). The Guadalupe fur seal population has increased at an average annual rate of 13.7% from 1954 to 1993 (Gallo-Reynoso, 1994; Carretta et al. 2007), and it may be expanding its range (Gallo-Reynoso 1994; Le Boeuf and Bonnell 1980; Maravilla-Chavez and Lowry 1999). The most recent population estimate of Guadalupe fur seals was 7,408 (Carretta et al. 2007).

Distribution—Prior to commercial sealing during the 19th century, this species ranged from Monterey Bay, California, to the Revillagigedo Islands, Mexico (NMFS 2006e). The only breeding colony of Guadalupe fur seals is at Isla Guadalupe, Mexico, approximately 10 km south of the Southern California Range Complex. Between 1969 and 1989, 48 sightings of Guadalupe fur seals were made on the southern Channel Islands, including one territorial male that was seen from 1981 to 1990 and a second bull established a territory from 1989 to 1991 (Reeves et al. 1992). Previous to 1985, there were only two sightings of Guadalupe fur seals from central and northern California (Monterey in 1977 and Princeton Harbor in 1984; Weber and Roletto 1987). Guadalupe fur seals pup and breed, mainly at Isla Guadalupe, Mexico. In 1997, a second rookery was discovered at Isla Benito del Este, Baja California, and a pup was born at San Miguel Island, California (Melin and DeLong 1999). The population is considered to be a single stock because all individuals are recent descendants from one breeding colony at Isla Guadalupe, Mexico. When ashore during the breeding season, Guadalupe fur seals favor rocky habitats near the water's edge and caves at windier sections of coastlines (Reeves et al. 2002). A few Guadalupe fur seals (1-2 per year) are haul-out at San Miguel Island in the Channel Islands, but do not breed or pup there (S. Melin, NMML-NMFS, Personal Communication). Distribution at sea is unknown (Reeves et al. 1992), but Guadalupe fur seals may migrate at least 600 km from the rookery sites, based on pelagic observations of individuals in the Southern California Bight (Seagars 1984). Occasional sighting have been made in offshore waters in or near the Point Mugu Sea Range as well as on the Channel Islands (Koski et al. 1998). At San Nicolas Island, male Guadalupe fur seals have occasionally established territories among breeding California sea lions. The Guadalupe fur seal is expected to be rare, except perhaps for a small area around Guadalupe Island. Researchers suspect that water temperature and prey availability would affect fur seal movements to the north of Guadalupe Island (Le Boeuf and Crocker 2005). With cooler water seals would stay further south of the SOCAL EIS/OEIS area to feed, and occur further north with warmer water temperatures as it affects prey movement. There was a warming of the Eastern North Pacific (ETP) as part of the Pacific Decadal Oscillation from the mid 1970s to the mid 1990s but the ETP may currently be in a cooling trend (Le Boeuf and Crocker 2005). From 1982 to 2005, 12 Guadalupe fur seals have stranded in California, ranging from San Diego to Santa Barbara counties (California Marine Mammal Stranding Network Database 2007).

At-sea sightings of Guadalupe fur seals are very limited in the SOCAL Range Complex, and expected density information can not meaningfully be calculated using existing survey protocols. Sightings Guadalupe fur seals hauling out on California shores are also infrequent. A single adult female regularly hauls out on San Miguel Island each breeding season (S. Melin, NMFS-Marine Mammal Laboratory 2007) but no other Guadalupe fur seals have hauled out there since the mid 1990's (Melin and DeLong 1999). Thirty-one juvenile Guadalupe fur seals have stranded in Southern California during the period of 1975 to 2006 with 2-5 strandings per year during El Niño events (D. Greig, The Mariine Mammal Center 2007).

At Sea Density Estimates—To determine the density of Guadalupe fur seals in the southern California area, the entire population size was divided by the area. While it is more likely that males would be found in the southern California Bight, the SOCAL Range Complex extends to just north of Isla Guadalupe, so all age and sex classes were included in the overall density. Therefore, density for Guadalupe fur seals is 0.007/km^2 (7,408/1,034,289 km^2), which is applicable for September-May only. Pinniped densities were averaged to warm and cold water seasons by summing monthly densities and dividing by six months. The warm water density for guadalupe fur seals was 0.004 and the cold water density was 0.007 (Gallo-Reynoso 1994; Table 2-2), which are applicable to southern California.

Life history—Researchers know little about the whereabouts of Guadalupe fur seals during the non-breeding season, from September through May, but they are presumably solitary when at sea. Females give birth from early June through July, with a peak in late June. They mate about a week after giving birth, and then begin a series of foraging trips lasting two to six days. They come ashore for four to six days between foraging trips to nurse their pups. Lactating females may travel a thousand miles or more from the breeding colony to forage.

Reproduction/Breeding—All breeding and pupping occurs from approximately June through late July on Isla Guadalupe and Isla Benito del Este in Baja Mexico (Gallo 1994) which are south of the SOCAL Range Complex.

Diving Behavior—There is little information on feeding habitats of the Guadalupe fur seal, but it is likely that they feed on deep-water cephalapods and small schooling fish like their relative the northern fur seal (Seagars 1984). Digestive tracts of stranded animals in central and northern California contained primarily squid (*Loligo opalescens* and *Onychoteuthis borealojaponica*) with a few otoliths of lampfish (*Lampanyctus*) and Pacific sanddab (*Citharichthys sordidus*) (Hanni et al. 1997). They appear to feed mainly at night, at depths of about 20 m (65 ft), with dives lasting approximately 2 ½ minutes (Reeves et al. 2002). Gallo-Reynoso (1994) instrumented one female with a time-depth recorder and analyzed scat. Most dives occurred from dusk to dawn, with mean dive depth 16.8 m and maximum dive depth 82 m. The mean bottom time (1.4 min) represented 54% of the mean dive duration (2.6 min). Dives occurred in bouts, separated by extended periods at the surface or transiting to other foraging areas. Approximately 14% of time was spent transiting from the island to foraging areas. Analysis of scat showed that fur seals feed on vertically migrating squid found in relatively shallow depths. Additional dive information was obtained by Lander et al. (2000) on a rehabilitated fur seal outfitted with a satellite-linked time-depth recorder. During migration north from a release site at Point Piedras Blancas, California, to Isla Guadalupe, mean dive depth was 15.7 m, but the majority of time was spent <4 m; nearly all of the migration time was spent <20 m. Once the seal arrived at Isla Guadalupe, the majority of dives occurred from dusk through dawn. Most dives were shallow (<20 m), and mean dive depth was 13.9 m. Based on this limited dataset, the following are estimates for depth distribution: daytime: 90% at 0-4m; 10% at 4-82 m; nighttime: 75% at <4 m; 25% at 4-82 m.

Acoustics—In-air sounds of Guadalupe fur seals include barks, roars, and coughs; few details are known (Peterson et al. 1968). There is no published information on the hearing range of the Guadalupe fur seal although it is most likely similar to other fur seals species. The underwater hearing range of the northern fur seal ranges from 0.5 Hz to 40 kHz (Moore and Schusterman 1987; Babushina et al., 1991) and the threshold is 50 to 60 dB re 1 µPa (Moore and Schusterman 1987). The best underwater hearing occurs between 4 and 17 to 28 kHz (Moore and Schusterman 1987; Babushina et al., 1991). The maximum sensitivity in air is at 3 to 5 kHz (Babushina et al. 1991), after which there is an anomalous hearing loss at around 4 or 5 kHz (Moore and Schusterman 1987; Babushina 1999).

Impacts of human activity-Hunting—Sealing on the California coast was first recorded in 1805 and Native Americans left the remains of Guadalupe fur seals in their middens (Bonner 1994).

The species was evidently exterminated from southern California waters by 1825. Commercial sealing continued, although with declining returns, in Mexican waters through 1894. Incomplete sealing records suggest that perhaps as many as 52,000 fur seals were killed on Mexican islands between 1806 and 1890, mostly before 1848; from 1877 to 1984, only some 6,600 fur seals were harvested (Reeves et al. 1992). Due to its full protection in Mexico and in the U.S., it is presumed that Guadalupe fur seals are not presently hunted, although it is not known if Guadalupe fur seals are illegally killed.

Fisheries Interactions—Drift and set gillnet fisheries may cause incidental mortality of Guadalupe fur seals in Mexico and the United States. In the United States, there have been no reports of incidental mortalities or injuries of Guadalupe fur seals in commercial fisheries. No information is available for human-caused mortalities or injuries in Mexico; however, similar drift gillnet fisheries for swordfish and sharks exist along the entire Pacific coast of Baja California, Mexico, and may take animals from the population. NMFS has documented strandings of Guadalupe fur seals in California. Although most of these animals likely died of natural causes, some mortalities likely can be attributed to interactions with commercial fisheries and marine debris. NMFS documented an increasing number of stranded Guadalupe fur seals on California's Channel Islands and along the central California coast. Juvenile female Guadalupe fur seals have stranded in central and northern California with net abrasions around the neck, fish hooks and monofilament line, and polyfilament string (Hanni et al. 1997).

Sea otter (*Enhydra lutris nereis*) California Stock

Listing Status—The sea otter falls under the regulatory oversight of the USFWS, while all other species of marine mammals occurring within Southern California fall under the regulatory oversight of NMFS. The southern sea otter is listed as threatened under the ESA and the California Stock is, therefore, considered depleted under the MMPA. If restrictions on the use of gill and trammel nets in areas inhabited by southern sea otters were lifted, the southern sea otter population would be designated as a strategic stock as defined by the MMPA (USFWS, 1995 in Carretta et al., 2007).

Population Status—Until recent years, the northern population had increased to well over 100,000 individuals, while the southern or California population had grown more slowly, apparently because of a lower rate of pup survival (Riedman et al. 1994). Except during 1976–1983, the southern population increased steadily between 1983-1994 at a rate of five to seven percent since it received protection in 1911.

Distribution—Historically, sea otters occupied a large range throughout the northern Pacific Coastal region, extending from Russia and Alaska to Mexico (Kenyon 1969). Harvests of sea otters in the 18th and 19th centuries nearly exterminated the species (Orr and Helm 1989). The southern sea otter's primary range is restricted to the coastal area of central California, from Point Año Nuevo to south of Point Conception (Orr and Helm 1989; USFWS 1996, 2005), plus a small translocated population around San Nicolas Island that diminished to about 17 by 1995, which was not considered viable because the population size was too small (Ralls et al. 1995; USFWS 1996). As the population has increased, its range has also expanded.

At Sea Density Estimates—To determine the density of sea otters in the SOCAL area, the entire experimental population size (maximum of 27) was divided by geographic area (90 km^2, which represents the ~2 km perimeter around San Nicolas Island). Density for sea otters is 0.30/km^2, which is applicable year round. The warm and cold water densities for sea otters are both 0.30/km^2. These densities are applicable only to 0.06% of sonar area 1, and 0% of all other sonar areas.

Life History—Sea otters prefer rocky shorelines with kelp beds and waters about 66 ft (20 m) deep (USFWS 1996). Few sea otters venture beyond 5,200 ft (1,600 m) from shore, and most remain within 1,600 ft (500 m) (Estes and Jameson 1988). They require a high intake of energy to satisfy their metabolic requirements. Most sea otters in California tend to be active at night and rest in the middle of the day (Ralls and Siniff, 1990), but there is extensive variation in the activity of individuals both among and within age and sex classes (Ralls et al. 1995).

Sea otters are rarely sighted in the SOCAL Range Complex. Only a limited number of sea otter sightings have been reported near SCI (only three sightings) (Leatherwood et al. 1978). All of those were ~3 mi (5 km) from SCI during the NMFS/SWFSC 1998–1999 surveys (Carretta et al. 2000). Since this species is not expected to be present; therefore, density information can not meaningfully be calculated and this sea otters are not included in subsequent underwater effects modeling.

Reproduction/Breeding—Sea otters breed through out their range and have two peaks in pupping (January to March and October; USFWS 2003).

Diving Behavior—Sea otters feed on or near the bottom in shallow waters, often in kelp beds. Major prey items are benthic invertebrates such as abalones, sea urchins, and rock crabs. Sea otters also eat other types of shellfish, cephalopods, and sluggish near-bottom fishes. The diet varies with the physical and biological characteristics of the habitats in which they live (reviews by Riedman and Estes 1990; Estes and Bodkin 2002). Sea otters exhibit individual differences not only in prey choice, but also in choice and method of tool use, area in which they tend to forage, and water depth (Riedman and Estes 1990; Estes et al. 2003b). In rocky-bottom habitats, sea otters generally forage for large-bodied prey offering the greatest caloric reward. In softbottom habitats, prey is smaller and more difficult to find; sea otters feed on a variety of burrowing invertebrates. Sea otters in California typically forage in waters with a bottom depth less than 25 m though individuals have been sighted foraging in waters with a bottom depth as great as 36 m (Riedman and Estes 1990; Ralls et al. 1995). The record dive depth occurred in the Aleutian Islands, where a sea otter drowned in a king crab pot set at a bottom depth of approximately 100 m (Riedman and Estes 1990). Mean dive duration exceeds 125 sec (Ralls et al. 1995).

Sea otters spend about one-quarter to one-third of their time foraging to meet metabolic needs. They dive to the bottom to collect crabs, clams, urchins, and mussels, and return to the surface to open and consume prey. Tinker et al. (2007) collected dive and forage data via time-depth recorders on otters in California. Their data indicate that 36-52% of time was spent at the surface between dives, depending on the size and type of prey being consumed. Sea otters usually dive to less than 30 m for food (Lance et al. 2004). Using this information, the following are estimated time at depth for sea otters: 50% at <1 m, 50% at 1-30 m.

Acoustics and Hearing—Sea otter vocalizations are considered to be most suitable for short range communication among individuals (McShane et al. 1995). Airborne sounds include screams; whines or whistles; hisses; deep-throated snarls or growls; soft cooing sounds; grunts; and barks (Kenyon 1975; McShane et al. 1995). The high-pitched, piercing scream of a pup can be heard from distances of greater than 1 km (McShane et al. 1995). In-air mother-pup contact vocalizations have most of their energy at 3 to 5 kHz, but there are higher harmonics (McShane et al. 1995; Richardson et al. 1995). There is no hearing data available for this species (Ketten 1998).

2.1.2 Non-Endangered and Non-Threatened Species

Other marine mammal species occurring within Southern California are described below. All of these species, while protected under the MMPA, are not listed as endangered under the ESA, and nor considered depleted or strategic under the MMPA

2.1.2.1 Baleen Whales (Sub-Order Mysticeti)

Bryde's whale (*Balaenoptera edeni*) Eastern Tropical Pacific

Population Status—The best estimate of the entire eastern tropical Pacific population size is 11,163 (CV=0.20) individuals, with only an estimated 12 (CV = 2.0) individuals in California, Oregon and Washington waters (Carretta et al. 2007).

Distribution—Bryde's whale is found in tropical and subtropical waters, generally not moving poleward of 40° in either hemisphere (Jefferson et al. 1993). Long migrations are not typical of Bryde's whales, though limited shifts in distribution toward and away from the equator, in winter and summer, respectively, have been observed (Cummings 1985). Bryde's whales are year-round residents of the inshore waters on the west coast of Baja California south to at least as far as the Islas Tres Marias, at 21°N (Rice 1977). The species is rarely seen near the SOCAL Range Complex. None were sighted in the San Clemente Island Range Complex (SCIRC) during past surveys (U.S. Navy 1998; Carretta et al. 2000). Only one Bryde's whale has ever been positively identified in surveys of California coastal waters (Barlow 1994). Only one Bryde's whale has ever been positively identified in surveys of California coastal waters (Barlow 1994b). It is possible that Bryde's whales could be sighted in the southernmost portion of the SOCAL Range Complex, but it is not known how many of the eastern tropical Pacific population could occur in California waters. One estimate is 12 (CV=2.0) individuals (Carretta et al. 2007), another is 160 (Tershy et al. 1990). Bryde's whales are more likely to be found in non-territorial waters but are occasionally sighted in nearshore areas. There was only one sighting of Bryde's whales in SOCAL Range Complex (Barlow 1994), therefore, the seasonal occurrence of the Bryde's whale can not be determined. Occurrence off southern California is unknown, and they were not seen during vessel surveys conducted off southern California in 1996, 2001 or 2005 (Appler et al. 2004; Barlow, 2003; Forney, 2007) nor during aerial surveys conducted in 1991-92 or 1998-99 (Carretta and Forney 1993; Carretta et al. 2000).

At Sea Density Estimates—Pro-rated densities incorporating vessel survey results from 1986-2005 resulted in densities of 0.0000081 for warm and cold water seasons (Table 2-2).

Reproduction/Breeding—Breeding and calving occur in warm temperate and tropical areas.

Diving Behavior—Bryde's whales are lunge-feeders, feeding on fish and krill (Nemoto and Kawamura 1977). Cummings (1985) reported that Bryde's whales might dive as long as 20 min.

Bryde's whales feed on pelagic schooling fish, small crustaceans including euphausiids and copepods and cephalopods (Kato, 2002). Feeding appears to be regionally different. Off South Africa, the inshore form feeds on epipelagic fish while the offshore form feeds on mesopelagic fish and euphausiids (Best, 1977; Bannister, 2002). Stomach content analysis from whales in the southern Pacific and Indian oceans indicated that most feeding apparently occurred at dawn and dusk, and were primarily euphausiids (Kawamura, 1980). There have been no depth distribution data collected on Bryde's whales. In lieu of depth data, minke whale depth distribution percentages will be extrapolated to Bryde's whales.

Acoustics—Bryde's whales produce low frequency tonal and swept calls similar to those of other rorquals (Oleson et al. 2003). Calls vary regionally, yet all but one of the call types have a fundamental frequency below 60 Hz; they last from 0.25 sec to several seconds; and they are produced in extended sequences (Oleson et al. 2003). Heimlich et al. (2005) recently described five tone types. While no data on hearing ability for this species are available, Ketten (1997) hypothesized that mysticetes have acute infrasonic hearing.

Gray whale (*Eschrichtius robustus*) Eastern North Pacific

Population Status—The Eastern North Pacific stock was believed to consist of 26,635 (CV=0.10) individuals in 2002 (Anglis and Outlaw, 2007. This estimate is similar to previous estimates in 1997–1998 (26,635; CV=0.101; Hobbs and Rugh [1999]), 1993–1994 (23,109; CV=0.054; Laake et al. [1994]) and 1995–1996 (22,263; CV=0.093; Hobbs et al. [1996]).

Distribution—The gray whale makes a well-defined seasonal north-south migration (Fig. 10). Most of the population summers in the shallow waters of the northern Bering Sea, the Chukchi Sea, and the western Beaufort Sea (Rice and Wolman 1971), whereas some individuals also summer along the Pacific coast from Vancouver Island to central California (Rice and Wolman 1971; Darling 1984; Nerini 1984). In October and November, the whales begin to migrate southeast through Unimak Pass and follow the shoreline south to breeding grounds on the west coast of Baja California and the southeastern Gulf of California (Braham 1984; Rugh 1984). The average gray whale migrates 7,500–10,000 km at a rate of 147 km/d (Rugh et al. 2001; Jones and Swartz 2002). Although some calves are born along the coast of California, most are born in the shallow, protected waters on the Pacific coast of Baja California from Morro de Santo Domingo (28°N) south to Isla Creciente (24°N) (Urban et al. 2003). The main calving sites are Laguna Guerrero Negro, Laguna Ojo de Liebre, Laguna San Ignacio, and Estero Soledad (Rice et al. 1981).

Almost all of the population passes through the SOCAL Range Complex during both the northward and the southward migration. Gray whales are common there only during cold-water months; none were sighted in the warm season (May–October) in the 1998–1999 NMFS surveys of the SCIRC (Carretta et al. 2000). Southbound and northbound migrations through the SOCAL Range Complex occur, for the most part, at predictable times. The southbound migration begins in the third week of December, peaks in January, and extends through February (Gilmore 1960; Leatherwood 1974). The northbound migration generally begins in mid-February, peaks in March, and lasts at least through May. Gray whales do not spend much time feeding in the Range Complex. Northbound mothers and calves travel more slowly than other whales, and tend to be seen later in the season. Not all gray whales make the full migration south to wintering areas; a "resident" Pacific Feeding Aggregation estimated at ~300 whales remains offshore northern California to southeast Alaska (Calambokidis et al. 2004b).

A mean group size of 2.9 gray whales was reported for both coastal (16 groups) and non-coastal (15 groups) areas in the SCIRC (Carretta *et al*. 2000). The largest group reported was nine animals. The largest group reported by U.S. Navy (1998) was 27 animals. There is no apparent difference in group sizes between day and night (Donahue et al. 1995).

Gray whales are typically absent from August to November (Rice et al. 1981), although there have been a few summer sightings in southern California waters (Patten and Samaras 1977). The nearshore route follows the shoreline between Point Conception and Point Vicente but includes a more direct line from Santa Barbara to Ventura and across Santa Monica Bay. Around Point Vicente or Point Fermin, some whales veer south towards Santa Catalina Island and return to the nearshore route near Newport Beach. Others join the inshore route that includes the northern chain of the Channel Islands along Santa Cruz Island and the Anacapas and east along the Santa Cruz Basin to Santa Barbara Island and the Osborn Bank. From here, gray whales migrate east directly to Santa Catalina Island and then to Point Loma or Punta Descanso, or southeast to San Clemente Island and on to the area near Punta Banda. A significant portion of the eastern North Pacific Stock passes by San Clemente Island and its associated offshore waters (Carretta et al. 2000). The offshore route follows the undersea ridge from Santa Rosa Island to the mainland shore of Baja California and includes San Nicolas Island and Tanner and Cortes banks (Bonnell and Dailey 1993). Gray whales are not expected to be in the SOCAL Range Complex from August through November (Rice et al. 1981).

At Sea Density Estimates—Carretta et al. (2000) calculated a density of 0.051 for gray whales from aerial surveys conducted near San Clemente Island, which is applicable for January through April.*Life history*—When foraging, gray whales typically dive to 50 to 60 m for 5 to 8 min. In the breeding lagoons, dives are usually less than 6 min (Jones and Swartz 2002), although dives as long as 26 min have been recorded (Harvey and Mate 1984). When migrating, gray whales may remain submerged near the surface for 7 to 10 min and travel 500 m or more before resurfacing to breathe. The maximum known dive depth is 170 m (Jones and Swartz 2002). Migrating gray whales sometimes exhibit a unique "snorkeling" behavior in which they surface cautiously, exposing only the area around the blow hole, exhale quietly without a visible blow, and sink silently beneath the surface (Jones and Swartz 2002). A mean group size of 2.9 gray whales was reported for both coastal (16 groups) and non-coastal (15 groups) areas in the SCIRC (Carretta et al. 2000). The largest group reported was nine animals. The largest group reported by U.S. Navy (1998) was 27 animals. There is no apparent difference in group sizes between day and night (Donahue *et al*. 1995).

Reproduction/Breeding—Although some calves are born along the coast of Southern California, most are born in the shallow, protected waters on the Pacific coast of Baja California (Urban et al. 2003).

Diving Behavior—When foraging, gray whales typically dive to 50 to 60 m for 5 to 8 min. In the breeding lagoons, dives are usually less than 6 min (Jones and Swartz, 2002), although dives as long as 26 min have been recorded (Harvey and Mate 1984). When migrating, gray whales may remain submerged near the surface for 7 to 10 min and travel 500 m or more before resurfacing to breathe. The maximum known dive depth is 170 m (Jones and Swartz 2002). Migrating gray whales sometimes exhibit a unique "snorkeling" behavior in which they surface cautiously, exposing only the area around the blow hole, exhale quietly without a visible blow, and sink silently beneath the surface (Jones and Swartz 2002).

Mate and Urban Ramirez (2003) noted that 30 of 36 locations for a migratory gray whale with a satellite tag were in water <100m deep, with the deeper water locations all in the southern California Bight within the Channel Islands. Whales in that study maintained consistent speed indicating directed movement. There has been only one study yielding a gray whale dive profile, and all information was collected from a single animal that was foraging off the west coast of Vancouver Island (Malcolm and Duffus, 2000; Malcolm et al.,1995/96). They noted that the majority of time was spent near the surface on interventilation dives (<3 m depth) and near the bottom (extremely nearshore in a protected bay with mean dive depth of 18 m, range 14-22 m depth). There was very little time spent in the water column between surface and bottom. Foraging depth on summer feeding grounds is generally between 50-60 m (Jones and Swartz, 2002). Based on this very limited information, the following is a rough estimate of depth distribution for gray whales: 50% at <4 m (surface and interventilation dives), 50% at 4-18 m.

Acoustics—Au (2000) reviewed the characteristics of gray whale vocalizations. Gray whales produce broadband signals ranging from 100 Hz to 4 kHz (and up to 12 kHz) (Dahlheim et al. 1984; Jones and Swartz 2002). The most common sounds on the breeding and feeding grounds are knocks (Jones and Swartz 2002), which are broadband pulses from about 100 Hz to 2 kHz and most energy at 327 to 825 Hz (Richardson et al. 1995). The source level for knocks is approximately 142 dB re 1 µPa-m (Cummings et al. 1968). During migration, individuals most often produce low-frequency moans (Crane and Lashkari 1996). The structure of the gray whale ear is evolved for low-frequency hearing (Ketten, 1992). The ability of gray whales to hear frequencies below 2 kHz has been demonstrated in playback studies (Cummings and Thompson 1971; Dahlheim and Ljungblad 1990; Moore and Clarke 2002) and in their responsiveness to underwater noise associated with oil and gas activities (Malme *et al*. 1986; Moore and Clarke 2002). Gray whale responses to noise include changes in swimming speed and direction to move away from the sound source; abrupt behavioral changes from feeding to avoidance, with a resumption of feeding after exposure; changes in calling rates and call structure; and changes in surface behavior, usually from traveling to milling (e.g., Moore and Clarke 2002).

Minke whale (*Balaenoptera acutorostrata*) California/Oregon/Washington Stock

Population Status—The population abundance for offshore California, Oregon, and Washington stock is estimated to be 823 (CV=0.56) individuals (Barlow and Forney 2007).

Distribution—In the Northeast Pacific Ocean, minke whales range from the Chukchi Sea south to Baja California (Leatherwood et al. 1987). They occur year-round off California (Dohl et al. 1983; Barlow 1995; Forney et al. 1995). The minke whales found in waters off California, Oregon, and Washington appear to be resident in that area, and to have home ranges, whereas those farther north are migratory. The minke whale generally occupies waters over the continental shelf, including inshore bays and estuaries (Mitchell and Kozicki 1975; Ivashin and Vitrogov, 1981; Murphy, 1995; Mignucci-Giannoni, 1998; Calambokidis et al. 2004). However, based on whaling catches and surveys worldwide, there is also a deep-ocean component to the minke whale's distribution (Slijper et al. 1964; Horwood 1990; Mitchell 1991; Mellinger et al. 2000; Roden and Mullin 2000).

Minke whale abundance in the Southern California Bight fluctuates dramatically through the year, with warm-water months being the period of greatest abundance (Dohl et al. 1981). Because of the apparent fluctuations in abundance, Bonnell and Dailey (1993) believed that some minke whales migrated northward through the Southern California Bight in spring and returned southward through the same area in autumn. Leatherwood et al. (1987) suggested that minke whales may remain in the area throughout the year, and that the scarcity of sightings during autumn and winter may be attributable to behavioral and environmental considerations. The lack of sightings in autumn and winter may also be attributable to movements into offshore areas where there has been less survey effort. The surveys conducted in the SCIRC in 1998–1999 recorded minke whales during the cold-water but not the warm-water period (Carretta et al. 2000), whereas the densities calculated for the Point Mugu EIS/OEIS showed no preference for cold or warm water (U.S. Navy 1998). The summer distribution of minke whales was described by Bonnell and Dailey (1993). They are seen commonly along the shelves associated with the southern coasts of the Channel Islands and offshore features south of there. Ship-based surveys during the summers of 1991 and 1993 seem to confirm the importance of the Southern California Bight for minke whales. Three of the eight sightings made during those two extensive surveys were in or adjacent to the Southern California Bight despite relatively little survey effort in that area. Few minke whales are present in the nearshore and continental slope parts of the Southern California Bight during winter, but they appear to be present in offshore waters. The few sightings in winter sometimes include newborn or small calves, suggesting that the Southern California Bight is part of, or at least near, the calving grounds of this Stock (Bonnell and Dailey 1993). In the Southern California, during both the warm-water and cold-water periods, the minke whale appears to be concentrated nearshore and over the continental shelf and slope. Data from acoustic surveys indicate that minke whales also occur further offshore on the westernmost fringe of the SOCAL Range Complex (Barlow et al. 2004). Minke whales are found in the SOCAL Range Complex throughout the year but in higher numbers June through December (Bonnell and Dailey 1993).

At Sea Density Estimates—Pro-rated densities incorporating vessel survey results from 1986-2005 resulted in densities of 0.0010313 for warm and cold water seasons (Table 2-2).

Reproduction/Breeding—Stewart and Leatherwood (1985) suggested that mating occurs in winter or early spring although it had never been observed.

Diving Behavior—Stern (1992) described a general surfacing pattern of minke whales consisting of about four surfacings, interspersed by short-duration dives averaging 38 sec. After the fourth surfacing, there was a longer duration dive ranging from approximately 2 to 6 min. Minke whales are “gulpers,” like the other rorquals (Pivorunas 1979). Hoelzel et al. (1989) reported on different feeding strategies used by minke whales. In the North Pacific, major food items include krill, Japanese anchovy, Pacific saury, and walleye Pollock (Perrin and Brownell 2002).

The only depth distribution data for this species are reported from a study on daily energy expenditure conducted off northern Norway and Svalbard (Blix and Folkow 1995). The limited depth information available (from Figure 2 in Blix and Folkow 1995) is representative of a 75-min diving sequence where the whale was apparently searching for capelin, then foraging, then searching for another school of capelin. Search dives were mostly to ~20 m, while foraging dives were to 65 m. Based on this very limited depth information, rough estimates for % of time at depth are as follows: 53% at <20 m and 47% at 20-65 m.

Acoustics—Recordings in the presence of minke whales have included both high-and low-frequency sounds (Beamish and Mitchell 1973; Winn and Perkins 1976; Mellinger et al. 2000). Mellinger et al. (2000) described two basic forms of pulse trains that were attributed to minke whales: a “speed up” pulse train with energy in the 200 to 400 Hz band, with individual pulses lasting 40 to 60 msec, and a less-common “slow-down” pulse train characterized by a decelerating series of pulses with energy in the 250 to 350 Hz band. Recorded vocalizations from minke whales have dominant frequencies of 60 Hz to greater than 12,000 Hz, depending on vocalization type (Richardson et al. 1995). Recorded source levels, depending on vocalization type, range from 151 to 175 dB re 1 µPa-m (Ketten 1998). Gedamke et al. (2001) recorded a complex and stereotyped sound sequence (“star-wars vocalization”) in the Southern Hemisphere that spanned a frequency range of 50 Hz to 9.4 kHz. Broadband source levels between 150 and 165 dB re 1 µPa-m were calculated. “Boings,” recently confirmed to be produced by minke whales and suggested to be a breeding call, consist of a brief pulse at 1.3 kHz, followed by an amplitude-modulated call with greatest energy at 1.4 kHz, with slight frequency modulation over a duration of 2.5 sec (Anonymous 2002; Rankin and Barlow 2003). While no data on hearing ability for this species are available, Ketten (1997) hypothesized that mysticetes have acute infrasonic hearing.

2.1.2.2 Toothed whales (Sub-Order Odontoceti)

Baird’s beaked whale (*Berardius bairdii*) California/Oregon/Washington Stock

Population Status—Population size for the California/Oregon/Washington Stock is estimated to be 1,005 (CV=0.37) individuals (Carretta et al. 2007).

Distribution—Baird’s beaked whales appear to occur mainly in deep waters over the continental slope, oceanic seamounts, and areas with submarine escarpments (Ohsumi 1983; Kasuya and Ohsumi 1984; Willis and Baird 1998; Kasuya 2002). They may be seen close to shore where deep water approaches the coast (Jefferson et al. 1993) and in shallow waters in the central Okhotsk Sea (Kasuya 2002). Recent information suggests that some beaked whales (Blaineville’s and Cuvier’s beaked whales, and northern bottlenose whales) show site fidelity and can be sighted in the area over many years (Hooker et al. 2002; Wimmer and Whitehead 2005; McSweeney et al. 2007).

Baird's beaked whales are infrequently encountered along the continental slope and throughout deep waters of the eastern North Pacific (Forney et al. 1994; Barlow et al. 1997). No sightings were made during the 1998–1999 NMFS surveys offshore of San Clemente (Carretta et al. 2000). All Baird's beaked whales found in the SOCAL Range Complex are expected to be found in non-territorial waters. There are few sightings of Baird's beaked whales in the SOCAL Range Complex, sightings occurred in both the cold and warm seasons (U.S. Navy 1998).

At Sea Density Estimates—Pro-rated densities incorporating vessel survey results from 1986-2005 resulted in densities of 0.0001434 for warm and cold water seasons (Table 2-2).

Reproduction/Breeding—Mating generally occurs in October and November but little else is known of their reproductive behavior (Balcomb 1989).

Diving Behavior—Analysis of stomach contents from captured and stranded individuals suggests that beaked whales are deep-diving animals, feeding by suction (Heyning and Mead 1996). The Baird's beaked whale, feeds mainly on benthic fishes and cephalopods, but occasionally on pelagic fish such as mackerel, sardine, and saury (Kasuya 2002; Walker et al. 2002; Ohizumi et al. 2003). Baird et al. (2006) reported on the diving behavior of four Blaineville's beaked whales (a similar species) off the west coast of Hawaii. The four beaked whales foraged in deep ocean areas (2,270-9,855ft) with a maximum dive to 4,619 ft. Dives ranged from at least 13 min (lost dive recorder during the dive) to a maximum of 68 min (Baird et al. 2006).

In lieu of other information, the depth distribution for northern bottlenose whales, *Hyperoodon ampullatus*, will be extrapolated to Baird's. There has been one study on northern bottlenose whales, which provides some guidance as to depth distribution (Hooker and Baird 1999). Most (62-70%, average = 66%) of the time was spent diving (deeper than 40 m), and most dives were somewhat V-shaped. Both shallow dives (<400 m) and deep dives (>800 m) were recorded, and whales spent 24-30% (therefore, average of 27%) of dives at 85% maximum depth indicating they feed near the bottom. Using these data points, we estimate 34% of time at 0-40 m, 39% at 41-800 m, 27% at >800 m for *H. ampullatus* and extrapolate this to *B. berardius*.

Acoustics—MacLeod (1999) suggested that beaked whales use frequencies of between 300 Hz and 129 kHz for echolocation, and between 2 and 10 kHz, and possibly up to 16 kHz, for social communication. Both whistles and clicks have been recorded from Baird's beaked whales in the eastern North Pacific Ocean (Dawson et al. 1998). Whistles had fundamental frequencies between 4 and 8 kHz, with 2 to 3 strong harmonics within the recording bandwidth (Dawson et al. 1998). Pulsed sounds (clicks) had a dominant frequency around 23 kHz, with a second frequency peak around 42 kHz (Dawson et al. 1998). The clicks were most often emitted in irregular series of very few clicks; this acoustic behavior appears unlike that of many species that do echolocate (Dawson et al. 1998). Cuvier's beaked whales echolocation clicks were recorded at frequencies from 20 to 70 kHz (Zimmer et al. 2005).

Cook et al. (2006) reported that the Gervais beaked whale (Mesoplodon europeus) could hear in the range of 5 to 80 kHz although no measurements were attempted above 80 kHz). The Gervais beaked whale was most sensitive from 40 to 80 kHz (Cook et al. 2006).

Bottlenose dolphin, Coastal (*Tursiops truncatus*) California Coastal Stock

Population Status—There are two distinct populations of bottlenose dolphins within Southern California, a coastal population found within 0.5 nm (0.9 km) of shore and a larger offshore population (Hansen 1990). Population size for the California Coastal Stock of the bottlenose dolphin is estimated to be 323 (CV=0.13) individuals (Carretta et al. 2007).

Distribution—The coastal population of bottlenose dolphins inhabits waters from Point Loma to San Pedro (Dohl et al. 1981; Hansen 1990). Occasionally, during warm-water incursions such as during the 1982–1983 El Niño event, their range extends as far north as Monterey Bay (Wells et al. 1990). Bottlenose dolphins in the Southern California Bight appear to be highly mobile within a relatively narrow coastal zone (Defran et al. 1999), and exhibit no seasonal site fidelity to the region (Defran and Weller, 1999). Sightings of coastal bottlenose dolphins are common along the coast east of the SCIRC (Barlow et al. 1997). Bottlenose dolphins are found in the SOCAL Range Complex throughout the year (Defran and Weller 1999).

At Sea Density Estimates—At sea densities of the California coastal stock of bottlenose dolphins was not calculated.

Reproduction/Breeding—Newborn calves are seen through out the year and reproduction may be influenced by productivity and food abundance (Urian et al. 1996).

Diving Behavior—Pacific coast bottlenose dolphins feed primarily on surf perches (Family Embiotocidae) and croakers (Family Sciaendae) (Norris and Prescott 1961; Walker 1981; Schwartz et al. 1992; Hanson and Defran 1993), and also consume squid (Loligo opalescens) (Schwartz et al., 1992). Navy bottlenose dolphins have been trained to reach maximum diving depths of about 984 ft (Ridgway et al. 1969). Reeves et al. (2002) noted that the presence of deep-sea fish in the stomachs of some offshore individual bottlenose dolphins suggests that they dive to depths of more than 1,638 ft. Dive durations up to 15 min have been recorded for trained individuals (Ridgway et al. 1969). Typical dives, however, are more shallow and of a much shorter duration. Bottlenose dolphins utilize the entire water column by feeding on prey that concentrate near the surface, midwater areas and benthic areas (Hastie et al. 2005).

Acoustics—Sounds emitted by bottlenose dolphins have been classified into two broad categories: pulsed sounds (including clicks and burst-pulses) and narrow-band continuous sounds (whistles), which usually are frequency modulated (FM). Generally, whistles range in frequency from 0.8 to 24 kHz but can also go much higher (Richardson et al. 1995). Clicks and whistles have a dominant frequency range of 110 to 130 kHz and a source level of 218 to 228 dB re 1 μPa-m (peak to peak levels; Au, 1993) and 3.5 to 14.5 kHz with a source level of 125 to 173 dB re 1 μPa-m, respectively (Ketten, 1998).

The bottlenose dolphin has a functional high-frequency hearing limit of 160 kHz (Au 1993) and can hear sounds at frequencies as low as 40 to 125 Hz (Turl 1993). Inner ear anatomy of this species has been described (Ketten 1992). Electrophysiological experiments suggest that the bottlenose dolphin brain has a dual analysis system: one specialized for ultrasonic clicks and the other for lower-frequency sounds, such as whistles (Ridgway 2000). The audiogram of the bottlenose dolphin shows that the lowest thresholds occurred near 50 kHz at a level around 45 dB re 1 μPa (Nachtigall et al. 2000; Finneran and Houser 2006; Houser and Finneran 2007). Below the maximum sensitivity, thresholds increased continuously up to a level of 137 dB at 75 Hz. Above 50 kHz, thresholds increased slowly up to a level of 55 dB at 100 kHz, then increased rapidly above this to about 135 dB at 150 kHz. Scientists have reported a range of best sensitivity between 25 and 70 kHz, with peaks in sensitivity occurring at 25 and 50 kHz at levels of 47 and 46 dB re 1 μPa (Nachtigall et al. 2000).

Temporary threshold shifts (TTS) in hearing have been experimentally induced and behavioral responses observed in captive bottlenose dolphins (Ridgway et al. 1997; Schlundt et al. 2000; 2006; Nachtigall et al. 2003; Finneran et al. 2002; 2005; 2007b). Ridgway et al. (1997) observed changes in behavior at the following minimum levels for 1 sec tones: 186 dB at 3 kHz, 181 dB at 20 kHz, and 178 dB at 75 kHz (all re 1 μPa). TTS levels were 194 to 201 dB at 3 kHz, 193 to 196 dB at 20 kHz, and 192 to 194 dB at 75 kHz (all re 1 μPa). Schlundt et al. (2000) exposed bottlenose dolphins to intense tones (0.4, 3, 10, 20, and 75 kHz); the animals demonstrated altered behavior at source levels of 178 to 193 dB re 1 μPa, with TTS after exposures generally between 192 and 201 dB re 1 μPa-m (though one dolphin exhibited TTS after exposure at 182 dB re 1 μPa). Nachtigall et al. (2003) determined threshold for a 7.5 kHz pure tone stimulus. No shifts were observed at 165 or 171 dB re 1 μPa, but when the sound level reached 179 dB re 1 μPa, the animal showed the first sign of TTS. Recovery apparently occurred rapidly, with full recovery apparently within 45 min following sound exposure. TTS measured between 8 and 16 kHz (negligible or absent at higher frequencies) after 30 min of sound exposure (4 to 11 kHz) at 160 dB re 1 μPa (Nachtigall et al. 2004). Further details of TTS in bottlenose dolphins are described in section 3.10.

Bottlenose dolphin, Offshore (Tursiops truncatus) California/Oregon/Washington Offshore Stock

Population Status—Population size for the California/Oregon/Washington bottlenose dolphin stock is estimated to be 2,026 (CV=0.54) individuals (Barlow and Forney 2007).

Distribution—Offshore bottlenose dolphins are thought to have a continuous distribution in California (Mangels and Gerrodette 1994). They have been found in the Southern California Bight and in waters as far north as ~41ºN (Barlow et al. 1997). During most of the year, a relatively large population of bottlenose dolphins occurs in offshore waters of the Southern California Bight centered around Santa Catalina Island and, to a lesser degree, the eastern coast of San Clemente Island. The population may disperse more broadly in summer than in winter (Dohl et al. 1981). Offshore bottlenose dolphins are found in the SOCAL Range Complex throughout the year (Carretta et al. 2007).

At Sea Density Estimates—Pro-rated densities incorporating vessel survey results from 1986-2005 resulted in densities of 0.0123205 for warm water season and 0.0184808 for cold water season (Table 2-2).

Reproduction/Breeding—Newborn calves are seen through out the year and reproduction may be influenced by productivity and food abundance (Urian et al. 1996).

Diving Behavior—Offshore bottlenose dolphins in the Bahamas dove to depths below 450 m and for over 5 min during the night but dives were shallow (<50m) during the day (Klatsky et al. 2007). In contrast, the dives of offshore bottlenose dolphins off the east coast of Australia were mostly within 5 m of the surface (approximately 67% of dives) with the deepest dives to only 150 meters (Corkeron and Martin 2004). A comparison of hemoglobin concentration and hematocrit, important to oxygen storage for diving, between Atlantic coastal and offshore bottlenose dolphins shows higher levels of both in offshore dolphins (Hersh and Duffield 1990). The increase in hemoglobin and hematocrit suggest greater oxygen storage capacity in the offshore dolphin which may allow it to dive longer in the deep offshore areas that they inhabit.

Based on data presented in Klatsky et al. (2007), the following depth distribution has been estimated for offshore bottlenose dolphins: Daytime: 96% at <50 m, 4% at >50 m; nightime: 51% at <50 m, 8% at 50-100 m, 19% at 101-250 m, 13% at 251-450 m and 9% at >450 m. Data on time spent at the surface were not published, therefore, it was included in the least shallow depth category published.

Acoustics—The acoustic abilities of offshore bottlenose dolphins is assume to be similar to the coastal population of bottlenose dolphins described in the previous discussion.

Cuvier's beaked whale (*Ziphius cavirostris*) California/Oregon/Washington Stock

Population Status—Population size for the California/Oregon/Washington Cuvier's beaked whale stock is estimated to be 4,342 (CV=0.58) individuals (Barlow and Forney 2007).

Distribution—Little is known about the habitat preferences of any beaked whale. Based on current knowledge, beaked whales normally inhabit deep ocean waters (>2,000 m) or continental slopes (200–2,000 m), and only rarely stray over the continental shelf (Pitman 2002). Cuvier's beaked whale generally is sighted in waters >200 m deep, and is frequently recorded at depths >1,000 m (Gannier 2000; MacLeod et al. 2004). They are commonly sighted around seamounts, escarpments, and canyons. MacLeod et al. (2004) reported that Cuvier's beaked whales occur in deeper waters than Blainville's beaked whales in the Bahamas. Recent data from Ferguson et al. (2006) demonstrated that beaked whales can be found in habitats ranging from continental slopes to abyssal plains. In Hawaii Cuvier's beaked whales showed a high degree of site fidelity in a study spanning 21 years and showed that there was a offshore population and an island associated population (McSweeney et al. 2007). The site fidelity in the island associated population was hypothesized to take advange of the influence of islands on oceanographic conditions that may increase productivity (McSweeney et al. 2007).

The distribution and abundance of beaked whales in the SOCAL Range Complex are not well known because they are difficult to identify; many of the beaked whales sighted have not been identified to species. Based on those that were identified, Cuvier's beaked whale appears to be the most abundant beaked whale in the area, representing almost 80% of the identified beaked whale sightings (Barlow and Gerrodette 1996). While they are sighted only during the cold-water season, it is unknown if Cuvier's beaked whales are found in the SOCAL Range Complex year-round or shift distribution.

At Sea Density Estimates—Pro-rated densities incorporating vessel survey results from 1986-2005 resulted in densities of 0.0036883 for warm and cold water seasons (Table 2-2).

Reproductive/Breeding—Little is known of beaked whale reproductive behavior.

Diving Behavior—Cuvier's beaked whales are generally sighted in waters with a bottom depth greater than about 650 ft and are frequently recorded at depths of 3,282 ft or more (Gannier 2000; MacLeod et al. 2004). They are commonly sighted around seamounts, escarpments, and canyons. In the eastern tropical Pacific Ocean, the mean bottom depth for Cuvier's beaked whales is approximately 11,154 ft, with a maximum depth of over 16,732 ft. (Ferguson 2005). Recent studies by Baird et al. (2006) show that Cuvier's beaked whales dive deeply (maximum of 4,757 ft) and for long periods (maximum dive duration of 68.7 min) but also spent time at shallow depths. Tyack et al. (2006b) has also reported deep diving for Cuvier's beaked whales with mean depth of 3,510 ft and mean duration of 58 min. Gouge marks were observed on mud volcanoes on the seafloor at 5,580–6,564, and Woodside et al. (2006) speculated that they were caused by Cuvier's beaked whales foraging on benthic prey.

Total time at surface (0-2 m) was calculated by subtracting the mean length of deep foraging dives and two shallow duration dives from the total dive cycle (121.4 - 58.0 – 30.4 = 33 min). Total (DFD) time at deepest depth was taken from the vocal phase duration time, as echolocation clicks generally commenced when animals were deepest, and was 32.8 min. The amount of time spent descending and ascending on DFDs was calculated by subtracting the mean Vocal phase duration time from the mean total DFD (58.0 - 32.8 = 25.2 min) and then dividing by five (# of 200 m depth categories between surface and 1070 m) which equals ~five min per 200 m. The five-minute value was applied to each 200 m depth category from 400-1070 m; for the 2-220 m category, the mean length of shallow duration dives was added to the time for descent/ascent (30.4 + 5 = 35.4 min). Therefore, the depth distribution for Cuvier's beaked whales based on best available information from Tyack et al. (2006b) is: 27% at <2 m, 29% at 2-220 m, 4% at 221-400 m, 4% at 401-600 m, 4% at 601-800 m, 5% at 801-1070 m and 27% in >1070 m.

Acoustics—MacLeod (1999) suggested that beaked whales use frequencies of between 300 Hz and 129 kHz for echolocation, and between 2 and 10 kHz, and possibly up to 16 kHz, for social communication. Blaineville's beaked whales echolocation clicks were recorded at frequencies from 20 to 40 kHz (Johnson et al. 2004) and Cuvier's beaked whales at frequencies from 20 to 70 kHz (Zimmer et al. 2005). Soto et al. (2006) reported changes in vocalizations during diving on close approaches of large cargo ships which may have masked their vocalizations. Cuvier's beaked whales only echolocated below 200 m (Tyack et al. 2006a). Echolocation clicks are produced in trains (interclick intervals near 0.4 s and individual clicks are frequency modulated pulses with durations of 200-300 µsec, the center frequency was around 40 kHz with no energy below 20 kHz (Tyack et al. 2006a).

Cook et al. (2006) reported that the Gervais beaked whale (Mesoplodon europeus) could hear in the range of 5 to 80 kHz although no measurements were attempted above 80 kHz.

Dall's porpoise (*Phocoenoides dalli*) California/Oregon/Washington stock

Population Status—Population size for the Washington/Oregon/California Dall's porpoise stock is estimated to be 85,955 (CV=0.45) individuals (Barlow and Forney 2007). No specific data are available regarding trends in population size in California or adjacent waters.

Distribution—Dall's porpoise's range in the eastern North Pacific extends from Alaska south to Baja California (Morejohn 1979). It is probably the most abundant small cetacean in the North Pacific Ocean. Its abundance changes seasonally, probably in relation to water temperature. It is considered to be a cold-water species, and is rarely seen in areas where water temperatures exceed 17°C (Leatherwood et al. 1982). Its distribution shifts southward and nearshore in autumn, especially near the northern Channel Islands, and northward and offshore in late spring (Dohl et al. 1981; Leatherwood et al. 1987; Barlow et al. 1997; Forney and Barlow 1998). Dall's porpoises are found in the SOCAL Range Complex throughout the year (Forney and Barlow 1998).

Although feeding aggregations of up to 200 have been sighted (Leatherwood et al. 1987), recent sightings in and near the Southern California Bight have been of groups averaging 3.1–3.4 (Barlow 1995; Forney et al. 1995; Carretta et al. 2000). During the 1998–1999 NMFS surveys of the SCIRC, the mean size of 8 groups was 3.4 (Carretta et al. 2000).

At Sea Density Estimates—Pro-rated densities incorporating vessel survey results from 1986-2005 resulted in densities of 0.0016877 for warm water season and 0.0081008 for cold water season (Table 2-2).

Reproduction/Breeding—Calving occurs in the north Pacific from early June through late July (Ferrero and Walker 1999).

Diving Behavior—Dall's porpoises feed primarily on small fish and squid (Houck and Jefferson 1999). Dall's porpoises in some areas appear to feed preferentially at night on vertically migrating fish and squid associated with the DSL (Houck and Jefferson 1999). Hanson and Baird (1998) provided the first data on diving behavior for this species, an individual tagged for 41 min dove to a mean depth of 33.4 m (S.D. = + 23.9 m) for a mean duration of 1.29 min (S.D. = + 0.84 min).

Total time at the surface was 10.27 min (time between dives minus the dive durations). Dives within 10 m totaled 2.11 min, dives to >60 m totaled 0.4 min, and dives with bottom time between 41 and 60 m totaled 1.83 min. The remaining time can be assumed to be spent diving between 11 and 40 m.

Based on this information, the depth distribution can be estimated as 39% at <1 m, 8% at 1-10 m, 45% at 11-40 m, and 8% at >40 m.

Acoustics—Only short duration pulsed sounds have been recorded for Dall's porpoise (Houck and Jefferson 1999); this species apparently does not whistle often (Richardson et al. 1995). Dall's porpoises produce short-duration (50 to 1,500 µs), high-frequency, narrow band clicks, with peak energies between 120 and 160 kHz (Jefferson 1988). There are no published data on hearing ability of this species.

Dwarf and Pygmy sperm whale (Kogia spp) California/Oregon/Washington Stock

Population Status—The two species *Kogia*, dwarf and pygmy sperm whales whales are distributed widely in the world's oceans, but they are poorly known (Caldwell and Caldwell 1989). Their small size, non-gregarious nature, and cryptic behavior make dwarf sperm and pygmy whales whales difficult to observe. The two species are also difficult to distinguish when sighted at sea, and are often jointly categorized as *Kogia* spp. Dwarf sperm whales within the U.S. Pacific EEZ are each divided into two discrete, non-contiguous areas: (1) Hawaiian waters, and (2) waters off California, Oregon, and Washington (Carretta et al. 2007). The best available estimate of abundance for the California/Oregon/Washington stock of the dwarf sperm whale is unknown (Carretta et al. 2007). Both Kogia species have a worldwide distribution in tropical and temperate waters (Jefferson et al. 1993). There is insufficient information available to estimate population size of the dwarf sperm whale off the Pacific coast of the U.S (Carretta et al. 2007).

Distribution—Dwarf and pygmy sperm whales are sighted primarily along the continental shelf edge and over deeper waters off the shelf (Hansen et al. 1994; Davis et al. 1998). However, along the U.S. west coast, sightings of the whales have been rare, although that is likely a reflection of their pelagic distribution and small size rather than their true abundance (Carretta et al. 2002). Several studies have suggested that pygmy sperm whales live mostly beyond the continental shelf edge, whereas dwarf sperm whales tend to occur closer to shore, often over the continental shelf (Rice 1998; Wang et al. 2002; MacLeod et al. 2004). Barros et al. (1998), on the other hand, suggested that dwarf sperm whales might be more pelagic and dive deeper than pygmy sperm whales.

Another suggestion is that the pygmy sperm whale is more temperate, and the dwarf sperm whale more tropical, based at least partially on live sightings at sea from a large database from the eastern tropical Pacific Ocean (Wade and Gerrodette 1993). There, the pygmy sperm whale was not seen in truly tropical waters south of the southern tip of Baja California, but the dwarf sperm whale was common in those waters. This idea is also supported by the distribution of strandings in South American waters (Muñioz-Hincapié et al. 1998). Also, in the western tropical Indian Ocean, the dwarf sperm whale was much more common than the pygmy sperm whale, which is consistent with this hypothesis (Balance and Pitman 1998). There have been few sightings of Dwarf sperm whales in the SOCAL Range Complex; therefore, seasonal occurrence can not be determined (Wade and Gerrodette 1993). Both species of Kogia generally occur in waters along the continental shelf break and over the continental slope (e.g., Baumgartner et al. 2001; McAlpine 2002; Baird 2005). The primary occurrence for Kogia is seaward of the shelf break in and in deep water with a mean depth of 4,675 ft (Baird 2005). This takes into account their preference for deep waters. There is a rare occurrence for Kogia inshore of the area of primary occurrence. Occurrence is expected to be the same throughout the year. Dwarf sperm whales showed a high degree of site fidelity, determined from photo identification over several years, in area of west of the island of Hawaii (Baird et al. 2006).

At Sea Density Estimates—There were no sightings of *Kogia* during vessel surveys conducted in 2005 (Forney, 2007) and one sighting off central California in 2001 (Appler et al. 2004). Pro-rated densities incorporating vessel survey results from 1986-2005 resulted in densities of 0.0013785 for warm and cold water seasons (Table 2-1).

Reproduction/Breeding—There is no information on the breeding behavior in this area.

Diving Behavior—*Kogia* feed on cephalopods and, less often, on deep-sea fishes and shrimps (Caldwell and Caldwell 1989; Baird et al. 1996; Willis and Baird 1998; Wang et al. 2002). Willis and Baird (1998) reported that Kogia make dives of up to 25 min. Median dive times of around 11 min have been documented for *Kogia* (Barlow 1999). A satellite-tagged pygmy sperm whale released off Florida was found to make long nighttime dives, presumably indicating foraging on squid in the deep scattering layer (Scott et al. 2001). Most sightings of Kogia are brief; these whales are often difficult to approach and they actively avoid aircraft and vessels (Würsig et al. 1998).

Prey preference, based on stomach content analysis from Atlantic Canada (McAlpine et al. 1997) and New Zealand (Beatson 2007), appears to be mid and deep water cephalopods, crustaceans and fish. There is some evidence that they may use suction feeding and feed at or near the bottom. They may also take advantage of prey undergoing vertical migrations to shallower waters at night (Beatson 2007). In lieu of any other information, Blainville's beaked whale depth distribution data will be extrapolated to pygmy sperm whales as the two species appear to have similar prey preferences and are closer in size than either is to sperm or Cuvier's beaked whales. Blainville's undertakes shallower non-foraging dives in-between deep foraging dives. Blainville's beaked whale depth distribution data, taken from Tyack et al. (2006b) and summarized in greater depth later in this document is: 26% at <2 m, 41% at 2-71 m, 2% at 72-200 m, 4% at 201-400 m, 4% at 401-600 m, 4% at 601-835 m and 19% at >838 m.

Acoustics—No information is available on dwarf sperm whale vocalizations or hearing capabilities. Pygmy sperm whale clicks range from 60 to 200 kHz, with a dominant frequency of 120 kHz (Richardson et al. 1995). An auditory brainstem response study indicates that pygmy sperm whales have their best hearing between 90 and 150 kHz (Ridgway and Carder 2001).

False killer whale (*Pseudorca crassidens*) Not defined for this area.

Population Status—This stock is listed as a strategic stock by NMFS because the estimated level of serious injury and mortality from the Hawaii-based tuna and swordfish long-line fishery is greater than the potential biological removal (Carretta et al. 2007). Genetic evidence suggests that the Hawaiian stock might be a reproductively isolated population from false killer whales in the eastern tropical Pacific (Chivers et al. 2003).

Distribution—False killer whales are found in tropical and temperate waters, generally between 50°S and 50°N latitude with a few records north of 50°N in the Pacific and the Atlantic (Odell and McClune 1999). Seasonal movements in the western North Pacific may be related to prey distribution (Odell and McClune 1999). Baird et al. (2005) noted considerable inter-island movements of individuals in the Hawaiian Islands.

False killer whales are commonly sighted in offshore waters from small boats and aircraft, as well as offshore from long-line fishing vessels (e.g., Mobley et al. 2000; Baird et al. 2003; Walsh and Kobayashi 2004).

At Sea Density Estimates—There are no density estimates for false killer whales in Southern California.

Reproduction/Breeding—Little is known of their reproductive behavior.

Diving Behavior—False killer whales primarily eat deep-sea cephalopods and fish (Odell and McClune 1999), but they have been known to attack other cetaceans, including dolphins

(Perryman and Foster 1980; Stacey and Baird 1991), sperm whales (Palacios and Mate 1996), and baleen whales.

Acoustics—The dominant frequencies of false killer whale whistles are 4 to 9.5 kHz; those of their clicks are 25 to 30 kHz and 95 to 130 kHz (Thomas et al. 1990; Richardson et al. 1995). The source level of clicks is 220 to 228 dB re 1 µPa-m (Ketten 1998). Best hearing sensitivity measured for a false killer whale was around 16 to 64 kHz (Thomas et al. 1988, 1990). Yuen et al. (2005) tested a stranded false killer whale using auditory evoke potentials produce an audiogram in the range of 4-44 kHz and with best sensitivity at 16-24 kHz.

Killer whale, Offshore (*Orcinus orca*) Eastern North Pacific Offshore

Population Status—Killer whales are segregated socially, genetically, and ecologically into three distinct groups: residents, transients, and offshore animals. Offshore whales do not appear to mix with the other types of killer whales (Black et al. 1997; Dahlheim et al. 1997). Most of the killer whales off California are from transient and offshore groups. Population size for all killer whales along the coasts of California, Oregon and Washington is estimated to be 1,340 (CV=0.31) individuals (Carretta et al. 2007).

Distribution—Killer whales from the Eastern North Pacific Southern Offshore Stock, range from Washington to the Southern California Bight and could occur in the SOCAL Range Complex. No killer whales were sighted during the 1998–1999 NMFS surveys offshore of San Clemente Island (Carretta et al. 2000), although killer whales could theorectically be sighted throughout the year (Black et al. 1997).

At Sea Density Estimates—Killer whales were seen off southern California during vessel surveys conducted in 2005 (Forney 2007). Pro-rated densities incorporating vessel survey results from 1986-2005 resulted in densities of 0.0000812 for warm and cold water seasons (Table 2-2).

Reproduction/Breeding—There is no information the reproductive behavior of killer whales in this area.

Diving Behavior—The maximum depth recorded for free-ranging killer whales diving off British Columbia is about 864 ft (Baird et al. 2005). On average, however, for seven tagged individuals, less than 1 percent of all dives examined were to depths greater than about 30 m (Baird et al. 2003). The longest duration of a recorded dive from a radio-tagged killer whale was 17 min (Dahlheim and Heyning 1999).

Transient" stocks of killer whales feed on other marine mammals, including other whales, pinnipeds (e.g., London 2006) and sea otters (e.g., Estes et al. 1998). Diving studies on killer whales have been undertaken mainly on "resident" (fish-eating) killer whales in Puget Sound and may not be applicable across all populations of killer whales. Diving is usually related to foraging, and mammal-eating killer whales may display different dive patterns. Killer whales in one study (Baird et al. 2005b) dove as deep as 264 m, and males dove more frequently and more often to depths >100 m than females, with fewer deep dives at night. Dives to deeper depths were often characterized by velocity bursts which may be associated with foraging or social activities.

Using best available data from Baird et al. (2003a), it would appear that killer whales spend ~4% of time at depths >30 m and 96% of time at depths 0-30 m.

Acoustics—The killer whale produces a wide variety of clicks and whistles, but most of its sounds are pulsed and at 1 to 6 kHz (Richardson et al. 1995). The peak to peak source levels of echolocation signals range between 195 and 224 dB re 1 µPa-m (Au et al. 2004). The source level of social vocalizations ranges between 137 to 157 dB re 1 µPa-m (Veirs 2004). Acoustic studies of resident killer whales in British Columbia have found that there are dialects, in their highly stereotyped, repetitive discrete calls, which are group-specific and shared by all group members (Ford 2002). These dialects likely are used to maintain group identity and cohesion, and may serve as indicators of relatedness that help in the avoidance of inbreeding between closely related whales (Ford 2002). Dialects also have been documented in killer whales occurring in northern Norway, and likely occur in other locales as well (Ford 2002). The killer whale has the lowest frequency of maximum sensitivity and one of the lowest high frequency hearing limits known among toothed whales (Szymanski et al. 1999). The upper limit of hearing is 100 kHz for this species. The most sensitive frequency, in both behavioral and in auditory brainstem response audiograms, has been determined to be 20 kHz (Szymanski et al. 1999).

Killer whale, Transient (*Orcinus orca*) Eastern North Pacific Transient

Population Status—The population estimate for the Eastern North Pacific Stock of transient killer whales is 346 (Carretta et al. 2007) and along the coast of California 105 killer whales have been identified by Forney et al. 2000).

Distribution—Little is known about the movements and range of the Eastern Pacific Transient stock (Caretta et al. 2007).

Reproduction/Breeding—There is no information the reproductive behavior of killer whales in this area.

*Diving Behavio*r—Diving behavior is assumed to be similar to that of the offshore stock but may feed on different prey items.

Acoustics—The acoustic abilities of transient killer whales is assume to be similar to the population of killer whales described in the section on the killer whale offshore stock.

Long-beaked common dolphin (*Delphinus capensis*) California

Population Status—Two species of common dolphin occur off California, the more coastal long-beaked dolphin (*D. capensis*) and the more offshore short-beaked dolphin (*D. delphis*). The long-beaked common dolphin is less abundant, and only recently has been recognized as a separate species (Heyning and Perrin 1994). Thus, much of the available information has not differentiated between the two species. Population size is estimated to be 21,902 (CV = 0.50) individuals (Carretta et al. 2007). Available data regarding trends in population size in California and adjacent waters suggest an increase in numbers of short-beaked , likely because of gradual warming of waters off California with the population shifting north (Heyning and Perrin 1994; Barlow et al. 1997; Forney 1997) but long beaked common dolphins decreased (Barlow and Forney, 2007). The long-beaked common dolphin is considered threatened or endangered under the ESA but is considered a strategic stock under theMMPA. It is considered as a strategic stock because the human caused more mortality exceeds the potential biological removal (Carreta et al., 2008; draft stock assessment report)

Distribution—Common dolphin distributions are related to bathymetry; high-relief areas known to be associated with high concentrations of anchovies (Hui 1979) are used more frequently than are low-relief areas. Short-beaked common dolphins have been sighted as far as 300 nm (556 km) from shore, and are likely present further offshore (Barlow et al. 1997, Bearzi 2005, 2006). Long-beaked common dolphins are usually found within 50 nm (92.5 km) of shore (Barlow et al. 1997, Bearzi 2005, 2006) and are generally not sighted further than 100 nm (185 km) from shore (Perrin et al. 1985; Barlow 1992 in Heyning et al. 1994).

Between the two common dolphin species, the short-beaked common dolphin is more abundant in the waters of the SOCAL Range Complex and the long-beaked common dolphin relatively less common, occurring mostly in the warm-water period. Long beaked common dolphins are found in the region throughout the year (Carretta et al. 2000), although abundance of common dolphins has been shown to change on both seasonal and inter-annual time scales in southern California (Dohl et al. 1986; Barlow 1995; Forney et al. 1995; Forney and Barlow 1998). The common dolphin is the most abundant cetacean in the SCIRC; it comprised 74.6% of the estimated number of cetaceans in cold-water months and 98.0% in warm-water months (Carretta et al. 2000). The available data show a mean group size of 353.6 animals (based on n=61 groups) offshore of San Clemente Island (Carretta et al. 2000). The largest group of common dolphins seen there was 2,700.

At Sea Density Estimates—Pro-rated densities incorporating vessel survey results from 1986-2005 resulted in densities of 0.0965747 for warm water season and 0.0366984 for cold water season (Table 2-2).

Reproduction/Breeding—The peak calving season occurs from spring and early summer (Forney 1994).

Diving Behavior—Stomach contents of *Delphinus* from California waters revealed 19 species of fish and two species of cephalopods; *Delphinus* feeds primarily on organisms in the vertically migrating DSL (Evans 1994). Diel fluctuations in vocal activity of this species (more vocal activity during late evening and early morning) appear to be linked to feeding on the DSL as it rises during the sametime (Goold 2000). A tagged individual tracked off San Diego conducted dives deeper than 200 m, but with most in the range of 9 to 50 m (Evans 1971; 1994).

This species is an opportunistic feeder of small mesopelagic fishes and squids found in the deep scattering layer. There have been several studies on localized feeding behavior of short-beaked common dolphins, but none specifically on long-beaked common dolphins as they have only been differentiated as a separate species since the late 1990s. There have been no studies on depth distribution of either *Delphinus* species**.** Most foraging behavior studies (many based on stomach content analysis of stranded animals) indicate that common dolphins take advantage of small schooling fish that undergo vertical migrations at night and that most feeding takes place at dusk and early evening (Pusineri et al. 2007). Perrin (2002b) indicates that common dolphins may forage to depths of 200 m but that most dives occur in less than 100 m.

Based on this limited information, depth distribution is estimated as: 100% at 0-200m.

Acoustics—Recorded Delphinus vocalizations include whistles, chirps, barks, and clicks (Ketten 1998). Clicks and whistles have dominant frequency ranges of 23 to 67 kHz and 0.5 to 18 kHz, respectively (Ketten 1998). Maximum source levels were approximately 180 dB 1 μPa-m (Fish and Turl 1976). Popov and Klishin (1998) recorded auditory brainstem responses from a short-beaked common dolphin. The audiogram was U-shaped with a steeper high-frequency branch. The audiogram bandwidth was up to 128 kHz at a level of 100 dB above the minimum threshold. The minimum thresholds were observed at frequencies of 60 to 70 kHz.

Longman's beaked whale (Indopacetus pacificus) Undefined for Southern California and Mexico

Population Status—There is no information on the population trend of Longman's beaked whale (Carretta et al. 2007).

Distribution—Longman's beaked whale sightings in the Eastern Tropical Pacific were south of 25°N Ferguson and Barlow (2001). The northernmost records in the eastern North Pacific Ocean are five sightings off Baja California, during an El Niño event (Gallo-Reynoso and Figueroa-Carranza 1995). Beaked whales may be expected to occur in the area including around seaward of the shelf break. There is a low or unknown occurrence of beaked whales on the shelf between the 162 ft isobath and the shelf break, which takes into account that deep waters come very close to the shore in this area. In some locales, beaked whales can be found in waters over the shelf, so it is possible that beaked whales have similar habitat preferences here.

Longman's beaked whale is not as rare as previously thought. However, the frequency with which it has been sighted in the eastern and western tropical Pacific oceans (MacLeod et al. 2004) suggests that it is probably not as common as the Cuvier's and Mesoplodon beaked whales (Ferguson and Barlow 2001). Recent information shows that Cuvier's and Mesoplodon beaked whales may not always inhabit deep ocean areas and may be found over the continental slope (Ferguson et al. 2006).

At Sea Density Estimates—There is no density estimate for the SOCAL Range Complex area.

Reproduction/Breeding—There is no information the reproductive behavior of Longman's beaked whales in this area.

Diving Behavior—Analysis of stomach contents from captured and stranded individuals suggests that beaked whales are deep-diving animals, feeding by suction (Heyning and Mead 1996). Another species of beaked whales, the Baird's beaked whale, feed mainly on benthic fishes and cephalopods, but occasionally on pelagic fish such as mackerel, sardine, and saury (Kasuya 2002; Walker et al. 2002; Ohizumi et al. 2003). Prolonged dives by the Baird's beaked whales for periods of up to 67 min have been reported (Kasuya, 2002), though dives of about 84 to 114 ft are typical, and dives of 45 min are not unusual (Balcomb 1989; Von Saunder and Barlow 1999).

Acoustics—MacLeod (1999) suggested that beaked whales use frequencies of between 300 Hz and 129 kHz for pulse sounds, and between 2 and 10 kHz, and possibly up to 16 kHz, for social communication. Cuvier's beaked whales echolocation clicks were recorded at frequencies from 20 to 70 kHz (Zimmer et al. 2005).

There is no hearing information on Longman's beaked whale acoustics but they may be similar to other beaked whales. Cook et al. (2006) reported that the Gervais beaked whale (Mesoplodon europeus) could hear in the range of 5 to 80 kHz although no measurements were attempted above 80 kHz). The Gervais beaked whale was most sensitive from 40 to 80 kHz (Cook et al. 2006).

Mesoplodont beaked whales (Mesoplodon spp.) California/Oregon/Washington

Population Status—Mesoplodonts are difficult to distinguish in the field. They are pelagic, spending most of their time in deep water far from shore, and dive for long periods. Five species of Mesoplodon may occur off the coast of southern California: Blainville's beaked whale (*M. densirostris*), Hubb's beaked whale (*M. carlhubbsi*), Perrin's beaked whale (*M. perrini*), pygmy beaked whale (*M. peruvianus*), and ginkgo-toothed beaked whale (*M. ginkgodens*) (Mead 1981). Until better methods are developed for distinguishing the different Mesoplodon species from one another, the management unit is defined to include all Mesoplodon populations. Population size of California/Oregon/Washington Stock of Mesoplodont beaked whales is estimated to be 1,177 (CV=0.40) individuals (Barlow and Forney 2007).

Distribution—Blainville's beaked whale is the *Mesoplodon* species with the widest distribution throughout the world (Mead 1989), although it is generally limited to tropical and warmer temperate waters (Leatherwood and Reeves 1983). Occasional occurrences in cooler higher-latitude waters are presumably related to warm-water incursions (Reeves et al. 2002). In the North Pacific Ocean, the northernmost documented occurrence of this species is a stranding off central California (Reeves et al. 2002). Seasonal movements or migrations by Blainville's beaked whales are not known to occur.

Blainville's beaked whale distribution is mainly derived from stranding data. It is mainly a pelagic species, and like other beaked whales, is generally found in deep slope waters ~500–1000 m deep (Davis et al. 1998; Reeves et al. 2002). However, it may also occur in coastal areas, particularly where deep water gullies come close to shore. Most strandings involved single individuals, although groups of 3–7 were observed in tropical waters (Jefferson et al. 1993). Ritter and Brederlau (1999) estimated group size to range from 2–9 (mean 3.44).

Hubb's beaked whale occurs in temperate waters of the North Pacific (Mead 1989). Most (22 of 35) of the records are from California, including two records in Santa Barbara County (Mead, 1989). The distribution of the species appears to be correlated with the deep subarctic current (Mead et al. 1982). Hubb's beaked whales are often killed in drift gillnets off California (Reeves et al. 2002).

Perrin's beaked whale was first discovered in 2002, when genetic analysis was carried out on four whales stranded between 1975 and 1979 in California, all along <80 km of beach just north of San Diego (Dalebout et al. 2002). The whales previously were identified by Mead (1981) as Hector's beaked whale (*Mesoplodon hectori*), which before then was known only from the Southern Hemisphere. A fifth Perrin's beaked whale was identified by genetic analysis of a stranded whale near Monterey in 1997 that previously had been identified as a neonate Cuvier's beaked whale. Dalebout et al. (2002) also suggested that two sightings off the coast of California in the 1970s that were tentatively identified as Hector's beaked whales were Perrin's beaked whale.

The ginkgo-toothed beaked whale is only known from stranding records (Mead 1989). Strandings have been reported for the western and eastern North Pacific, South Pacific, and Indian oceans, and from the Galápagos Islands (Palacios 1996b). Two of the thirteen total records reported by Mead (1989) were from the eastern North Pacific, one from Del Mar, California, and one from Baja California. The species is hypothesized to occupy relatively cool areas in the temperate and tropical Pacific, where upwelling is known to occur, such as in the California and Peru Currents and the equatorial front (Palacios 1996b).

The pygmy beaked whale is the smallest Mesoplodont (Reyes et al. 1991). It is hypothesized to forage in mid-to-deep waters (Urbán-Ramírez and Aurioles-Gamboa 1992). The pygmy beaked whale is thought to occur between the latitudes 25°N and 15°S, from Baja California to Peru (Urbán-Ramírez and Aurioles-Gamboa 1992), although Pitman and Lynn (2001) noted a stranding record for the species in Chile, at latitude 29°15'S. Carretta et al. (2005) reported that is known to occur off the U.S. west coast, and Reeves et al. (2002) reported that it is also known to occur off southern California.

There have been few sightings of Mesoplodon species; therefore, seasonal occurrence in the SOCAL Range Complex can not be determined.

At Sea Density Estimates—Pro-rated densities incorporating vessel survey results from 1986-2005 resulted in densities of 0.0011125 for warm and cold water seasons (Table 2-2).

Reproduction/Breeding—There is no information the reproductive behavior of Mesoplodont whales in this area.

Diving Behavior—Analysis of stomach contents from captured and stranded individuals suggests that beaked whales are deep-diving animals, feeding by suction (Heyning and Mead 1996). Another species of beaked whales, the Baird's beaked whale, feeds mainly on benthic fishes and cephalopods, but occasionally on pelagic fish such as mackerel, sardine, and saury (Kasuya, 2002; Walker et al., 2002; Ohizumi et al. 2003). Baird et al. (2006) reported on the diving behavior of four Blaineville's beaked whales off the west coast of Hawaii. The four beaked whales foraged in deep ocean areas (2,270-9,855ft) with a maximum dive to 4,619 ft. Dives ranged from at least 13 min (lost dive recorder during the dive) to a maximum of 68 min (Baird et al. 2006). Tyack et al. (2006b) reported a mean depth of 2,740 ft and mean duration of 46.5 min for Baird's beaked whales.

Total time at surface (0-2 m) was calculated by subtracting the mean length of Deep Foraging Dives (DFD) and six shallow duration dives from the total dive cycle (Tyack et al. 2006b; 138.8 – 46.5 – 55.8 = 36.5 min). Total time at mean deepest depth was taken from the Vocal phase duration time, as echolocation clicks generally commenced when animals were deepest, and was 26.4 min. The amount of time spent descending and ascending on DFDs was calculated by subtracting the mean Vocal phase duration time from the mean total DFD (46.5 – 26.4 = 20.1 min) and then dividing by 12 (# of 70 m depth categories between surface and 838 m), which equals 1.7 min per 70 m. The 1.7 min value was applied to each 70 m depth category from 72-838 m; for the 2-71 m category, the mean length of shallow duration dives was added to the time for descent/ascent (55.8 + 1.7 = 57.5 min).

The depth distribution for Blainville's beaked whales (and applicable to *Mesoplodon* sp) based on best available information from Tyack et al. (2006b) is: 26% at <2 m, 41% in 2-71 m, 2% at 72-200 m, 4% at 201-400 m, 4% at 401-600 m, 4% at 601-835 m, and 19% at >835 m.

Acoustics—Rankin and Barlow (2007) reported on the vocalizations of Blaineville's beaked whales in Hawaii that included four mid frequency sounds: a frequency-modulated whistle and three frequency and amplitude modulated pulsed sounds within the range of 6 and 16 kHz. Vocalizations recorded from two juvenile Hubbs' beaked whales consisted of low and high frequency click trains ranging in frequency from 300 Hz to 80 kHz and whistles with a frequency range of 2.6 to 10.7 kHz and duration of 156 to 450 msec (Lynn and Reiss, 1992; Marten, 2000).

MacLeod (1999) suggested that beaked whales use frequencies of between 300 Hz and 129 kHz for pulse sounds, and between 2 and 10 kHz, and possibly up to 16 kHz, for social communication. Cuvier's beaked whale's echolocation clicks were recorded at frequencies from 20 to 70 kHz (Zimmer et al. 2005).

There is no hearing information on these beaked whale acoustics but they may be similar to other beaked whales. Cook et al. (2006) reported that the Gervais beaked whale (*Mesoplodon europeus*) could hear in the range of 5 to 80 kHz although no measurements were attempted above 80 kHz). The Gervais beaked whale was most sensitive from 40 to 80 kHz (Cook et al. 2006).

Northern right whale dolphin (*Lissodelphis borealis*) California/Oregon/Washington Stock

Population Status—The northern right whale dolphin is not listed under the ESA, and the California/ Oregon/Washington Stock is not considered depleted or strategic. There are no available data regarding trends in population size in California or adjacent waters. Population size of the California/Oregon/Washington Stock is estimated to be 11,097 (CV=0.26) individuals (Barlow and Forney 2007).

Distribution—This species is endemic to the North Pacific Ocean, and is found primarily in temperate (8–19ºC) continental shelf and slope waters (Leatherwood and Walker 1979; Barlow et al. 1997). There is strong evidence of seasonal movements, probably related to water temperature. Peak numbers of northern right whale dolphins are seen in southern California in December and January. Northern right whale dolphins were dispersed throughout offshore waters in the SCIRC during the cold water months, with several sightings near San Clemente Island. They were rare in the continental slope waters of the SCIRC during the warm-water months (Forney 1997; Carretta et al. 2000). The mean size of 11 groups in the SCIRC was 12.4

(Carretta et al. 2000). Northern right whale dolphins are found in SOCAL Range Complex throughout the year (Carretta et al. 2000).

At Sea Density Estimates—Pro-rated densities incorporating vessel survey results from 1986-2005 resulted in densities of 0.0056284 for warm water season and 0.0270163 for cold water season (Table 2-2).

Reproduction/Breeding—The calving season is unknown although small calves are seen in winter or early spring (Jefferson et al. 1994).

Diving Behavior—There is no information on the diving behavior of northern right whale dolphins. They feed on small fish, especially lanternfish and squid (Lipsky 2002), and are believed to take advantage of the deep scattering layer around 200 m. Based on the lack of specific information, spinner dolphin depth distribution data will be extrapolated to northern right whale dolphins. Studies on spinner dolphins in Hawaii have been carried out using active acoustics (fish-finders) (Benoit-Bird and Au 2003). These studies show an extremely close association between spinner dolphins and their prey (small, mesopelagic fishes). Mean depth of spinner dolphins was always within 10 m of the depth of the highest prey density. These studies have been carried out exclusively at night, as stomach content analysis indicates that spinners feed almost exclusively at night when the deep scattering layer moves toward the surface bringing potential prey into relatively shallower (0-400 m) waters. Prey distribution during the day is estimated at 400-700 m.

Based on these data, the following are very rough order estimates of time at depth: daytime: 100% at 0-50 m; nighttime: 100% at 0-400 m.

Acoustics—Clicks with high repetition rates and whistles have been recorded from animals at sea (Fish and Turl 1976; Leatherwood and Walker, 1979). Maximum source levels were approximately 170 dB 1 μPa-m (Fish and Turl 1976). Rankin et al. (2007) reported the mean frequency of individual echolocation clicks were 31.3 kHz (Range of 23 – 41 kHz; SD = 3.7 kHz). There is no published data on the hearing abilities of this species.

Pacific white-sided dolphin (*Lagenorhynchus obliquidens*) California/Oregon/Washington

Population Status—The Pacific white-sided dolphin is not listed under the ESA, and the California/Oregon/Washington Stock is not considered depleted or strategic under the MMPA. No population trends have been observed in California or adjacent waters. Size of the California/Oregon/Washington Stock is estimated to be 23,817 (CV=0.36) individuals (Barlow and Forney 2007).

Distribution—There is conflicting evidence concerning seasonal shifts in distribution and numbers of Pacific white-sided dolphins in the Southern California Bight. Analyses of many years of data suggest that peak numbers probably occur in and near the SOCAL Range Complex in the cold-water months (Leatherwood et al. 1984). Most winter Pacific white-sided dolphin sightings offshore of San Clemente Island occurred in coastal waters on the western side of the island (Carretta et al. 2000).

The Pacific white-sided dolphin is most common in waters over the continental shelf and slope. Sighting records and captures in pelagic driftnets indicate that this species occurs in oceanic waters well beyond the shelf and slope (Leatherwood et al. 1984; Ferreo and Walker 1999). The Pacific white-sided dolphin occurs across temperate Pacific waters, to latitudes as low as (or lower than) 38°N, and northward to the Bering Sea and coastal areas of southeast Alaska (Leatherwood et al. 1984). Surveys suggest a seasonal north-south movement of Pacific white-sided dolphins in the eastern North Pacific, with animals found primarily off California during the colder water months and shifting northward into Oregon and Washington as water temperatures increase during late spring and summer (Green et al. 1992; Forney 1994; Carretta et al. 2007). Peak abundance in California waters occurs from November to April (Leatherwood et al. 1984). Pacific white-sided dolphins are found in the SOCAL Range Complex throughout the year (Carretta et al. 2007).

At Sea Density Estimates—Pro-rated densities incorporating vessel survey results from 1986-2005 resulted in densities of 0.0160748 for warm and cold water seasons (Table 2-2).

Reproduction/Breeding—Calving occurs from June through August (Heise 1997)

Diving Behavior— Studies on diving by this species have not been undertaken. Pacific white-sided dolphins in the eastern North Pacific feed primarily on epipelagic fishes and cephalopods (e.g., Schwartz et al. 1992; Black 1994; Heise 1997; Brownell et al. 1999; Morton 2000). Leatherwood (1975) observed Pacific white-sided dolphins and California sea lions feeding together on anchovies off southern California. This does not appear to be a deep-diving species. Based on feeding habits, Fitch and Brownell (1968) inferred that Pacific white-sided dolphins dive to at least 120 m. The majority of foraging dives last less than 15 to 25 sec (Black 1994; Heise 1997). Pacific white-sided dolphins are generalist feeders (van Waerebeek and Wursig, 2002). Satellite tag studies of a rehabilitated related species (*Lagenorhynchus acutus*) in the Gulf of Maine indicated that nearly all time was spent in waters <100 m total depth with largely directed movement (Mate et al., 1994). Another related species, *Lagenorhynchus obscurus*, was observed feeding in two circumstances; at night to 130 m depth to take advantage of the deep scattering layer closer to the surface and during the day in shallower depths (<65 m) where they fed on schooling fish (Benoit-Bird et al. 2004).

In lieu of the lack of other data available for this species, the following are very rough estimates of time at depth: daytime - 100% at 0-65 m; night time – 100% at 0-130 m.

Acoustics—Vocalizations produced by Pacific white-sided dolphins include whistles and clicks. Whistles are in the frequency range of 2 to 20 Hz (Richardson et al., 1995). Peak frequencies of the pulse trains for echolocation fall between 50 and 80 kHz; the peak amplitude is 170 dB re 1µPa-m (Fahner et al. 2004). Tremel et al. (1998) measured the underwater hearing sensitivity of the Pacific white-sided dolphin from 75 Hz through 150 kHz. The greatest sensitivities were from 4 to 128 kHz.Below 8 Hz and above 100 kHz, this dolphin's hearing was similar to that of other toothed whales.

Pantropical spotted dolphin (*Stenella attenuata*) Undefined for Southern California

Population Status—The pantropical spotted dolphin is not listed as endangered under the ESA, and is not considered to be a strategic stock under the MMPA. There are no abundance estimates available for this species in the NOAA Stock Assessment Reports for this area of the Pacific.

Distribution—The pantropical spotted dolphin can be found throughout tropical and some subtropical oceans of the world (Perrin and Hohn 1994). In the eastern Pacific, its range is from 25ºN (Baja California, Mexico) to 17ºS (southern Peru) (Perrin and Hohn 1994). Pantropical spotted dolphins are associated with warm tropical surface water (Au and Perryman 1985; Reilly 1990; Reilly and Fiedler 1994). Au and Perryman (1985) noted that the species occurs primarily north of the Equator, off southern Mexico, and westward along 10ºN. They also noted its occurrence in seasonal tropical waters south of the Galápagos Islands.

Pantropical spotted dolphins usually occur in deeper waters, and rarely over the continental shelf or continental shelf edge (Davis et al. 1998; Waring et al. 2002). They are extremely gregarious, forming groups of hundreds or even thousands of individuals. In the Eastern Tropical Pacific (ETP), spotted and spinner dolphins are often seen together in mixed groups (Au and Perryman

1985). There have been few sightings of pantropical spotted dolphins in the SOCAL Range Complex; therefore seasonal occurrence can not be determined (Waring et al. 2002).

At Sea Density Estimates—There are no density estimates for pantropical spotted dolphns in Southern California.

Reproduction/Breeding—In the Eastern Tropical Pacific there are two calving peaks, one in spring and one in fall (Perrin and Hohn1994).

Diving Behavior—Results from various tracking and food habit studies suggest that pantropical spotted dolphins in the eastern tropical Pacific and off Hawaii feed primarily at night on epipelagic species and on mesopelagic species which rise towards the water's surface after dark (Robertson and Chivers 1997; Scott and Cattanach 1998; Baird et al. 2001). Dives during the day generally are shorter and shallower than dives at night; rates of descent and ascent are higher at night than during the day (Baird et al. 2001). Similar mean dive durations and depths have been obtained for tagged pantropical spotted dolphins in the eastern tropical Pacific and off Hawaii (Baird et al. 2001).

Acoustics—Pantropical spotted dolphin whistles have a dominant frequency range of 6.7 to 17.8 kHz (Ketten 1998). The frequency range of clicks are 40-140 kHz and source levels between 197 and 220 dB re 1 μPa-m have been recorded for pantropical spotted dolphins (Schotten et al. 2004). There are no published hearing data for pantropical spotted dolphins (Ketten 1998). Anatomy of the ear of the pantropical spotted dolphin has been studied; Ketten (1992, 1997) found that they have a Type II cochlea, like other delphinids.

Risso's dolphin (*Grampus griseus*) California/Oregon/Washington Stock

Population Status—Risso's dolphin is not listed under the ESA and the California/Oregon/Washington Stock is not considered depleted or strategic. There are no quantitative data regarding trends in population size in California or adjacent waters, although sightings have become more frequent in the past 20 years. The population estimate of the California/Oregon/Washington Stock is 11,910 (CV=0.24) individuals (Barlow and Forney 2007).

Distribution—A comprehensive study of the distribution of Risso's dolphin in the Gulf of Mexico found that they used the steeper sections of the upper continental slope in waters 1,150–3,200 ft (350–975 m) deep (Baumgartner 1997). Risso's dolphins have been sighted in waters of the SOCAL Range Complex during all seasons. However, in most years, higher numbers are present during the cold-water months than during other times of the year (Forney and Barlow 1998). Most sightings in the study area have been well offshore, but Risso's dolphins have been sighted close to the eastern shore of San Clemente Island during the cold season (Carretta et al. 2000). Risso's dolphins occur individually or in small to moderate-sized groups, normally ranging in numbers from 2 to nearly 250. The majority of groups contain fewer than 50 (Leatherwood et al. 1980; Carretta et al. 1995 and 2000), however group sizes may reach as high as 2,500. Risso's dolphins are found in the SOCAL Range Complex throughout the year (Carretta et al. 2000).

At Sea Density Estimates—Pro-rated densities incorporating vessel survey results from 1986-2005 resulted in densities of 0.0180045 for warm water season and 0.0540134 for cold water season (Table 2-2).

Reproduction/Breeding—There is no information on the breeding behavior in this area.

Diving Behavior—There are no depth distribution data for this species. They may remain submerged on dives for up to 30 min (Kruse et al. 1999). Cephalopods are the primary prey (Clarke 1996). They are primarily squid eaters and feeding is presumed to take place at night. A study undertaken in the Gulf of Mexico demonstrated that Risso's are distributed non-uniformly with respect to depth and depth gradient (Baumgartner 1997), utilizing mainly the steep sections of upper continental slope bounded by the 350 m and 975 m isobaths. That data agrees closely with Blanco et al. (2006), who collected stomach samples from stranded Risso's dolphins in the western Mediterranean. Their results indicate that, based on prey items, Risso's feed on the middle slope at depths ranging from 600-800 m. Stomach content analysis from three animals elsewhere in the Mediterranean indicated that Risso's fed on species that showed greater vertical migrations than those ingested by striped dolphins (Ozturk et al. 2007).

In lieu of depth distribution information or information on shape of dives, the following are very rough estimates of time at depth based on habitat and prey distribution: 50% at <50 m, 15% at 51-200 m, 15% at 201-400 m, 10% at 401-600 m and 10% at >600 m.

Acoustics—Risso's dolphin vocalizations include broadband clicks, barks, buzzes, grunts, chirps, whistles, and simultaneous whistle and burst-pulse sounds (Corkeron and Van Parijs 2001). The combined whistle and burst pulse sound appears to be unique to Risso's dolphin (Corkeron and Van Parijs 2001). Corkeron and Van Parijs (2001) recorded five different whistle types, ranging in frequency from 4 to 22 kHz. Broadband clicks had a frequency range of 6 to greater than 22 kHz. Low-frequency narrowband grunt vocalizations had a frequency range of 0.4 to 0.8 kHz. A recent study established empirically that Risso's dolphins echolocate; estimated peak to peak source levels were up to 216 dB re 1 μPa-m at frequencies of 27.4-104.7 kHz (Philips et al. 2003).

The range of hearing in Risso's dolphins is 1.6-122.9 kHz with maximum sensitivity occurring between 8 and 64 kHz (Nachtigall et al. 1995).

Rough-toothed dolphin (*Steno bredanensis*) Undefined for Southern California

Population Status—The rough-toothed dolphin is not listed as endangered under the ESA or as depleted or strategic under the MMPA. There are no abundance estimates available for this species in the NOAA Stock Assessment Report for this area of the Pacific.

Distribution—Rough-toothed dolphins are typically found in tropical and warm temperate waters (Perrin and Walker, 1975 in Bonnell and Dailey 1993), rarely ranging north of 40°N or south of 35°S (Miyazaki and Perrin 1994). Rough-toothed dolphins occur in low densities throughout the ETP where surface water temperatures are generally above 25°C (Perrin and Walker 1975). Sighting and stranding records in the eastern North Pacific Ocean are rare (e.g., Ferrero et al. 1994).

Rough-toothed dolphins usually form groups of 10–20 (Reeves et al. 2002), but aggregations of hundreds can be found (Leatherwood and Reeves 1983). In the ETP, they have been found in mixed groups with spotted, spinner, and bottlenose dolphins (Perrin and Walker 1975). Reeves et al. (2002) suggested that they are deep divers, and can dive for up to 15 min. They usually inhabit deep waters (Davis et al. 1998), where they prey on fish and cephalopods (Reeves et al., 2002). There have been few sightings of rough-toothed dolphins in the SOCAL Range Complex; therefore seasonal occurrence can not be determined (Ferrero et al. 1994).

At Sea Density Estimates—There are no density estimates for rough-tooth dolphins in Southern California.

Reproduction/Breeding—There is no information on the breeding behavior in this area.

Diving Behavior—Rough-toothed dolphins are deep divers and can stay under for up to 15 min (Reeves et al. 2002). They usually inhabit deep waters (Davis et al. 1998), where they prey on fish and cephalopods (Reeves et al., 2002). Rough-toothed dolphins may stay submerged for up to 15 min and are known to dive as deep as 230 ft, but can probably dive much deeper (Miyazaki and Perrin 1994).

Acoustics—The vocal repertoire of the rough-toothed dolphin includes broad-band clicks, barks, and whistles (Yu et al. 2003). Echolocation clicks of rough-toothed dolphins are in the frequency range of 0.1 to 200 kHz, with a peak of about 25 kHz (Miyazaki and Perrin 1994; Yu et al. 2003). Whistles show a wide frequency range: 0.3 to >24 kHz (Yu et al. 2003). There is no published information on hearing ability of this species.

Short-beaked common dolphin (*Delphinus delphis*) California/Oregon/Washington Stock

Population Status—The short-beaked common dolphin is the most abundant cetacean off California (Dohl et al. 1981; Forney et al. 1995; Carretta et al. 2007). The single current management unit for the short-beaked common dolphin in this area is a California/Oregon/Washington Stock with a population estimate of 352,069 (CV = 0.18) individuals (Carretta et al. 2007). The abundance of common dolphins varies seasonally but may be increasing in California with a northward shift in the population (Heyning and Perrin 1994; Barlow et al. 1997; Forney 1997). The short beaked common dolphin is not listed as endangered under the ESA or as depleted or strategic under the MMPA.

Distribution—Along the U.S. west coast, the short-beaked common dolphins' distribution overlaps with that of the long-beaked common dolphin. The short-beaked common dolphin is distributed between the coast and at least 556 km from shore (Carretta et al. 2007). Short-beaked common dolphin abundance off California has increased dramatically since the late 1970s, along with a concomitant decrease in abundance in the ETP, suggesting a large-scale shift in the distribution of this species in the eastern North Pacific (Forney et al. 1995; Forney and Barlow 1998). The northward extent of short-beaked common dolphin distribution appears to vary interannually and with changing oceanographic conditions (Forney and Barlow 1998). Short beaked common dolphins are found in the SOCAL Range Complex throughout the year (Forney and Barlow 1998).

Stomach contents of *Delphinus* from California waters revealed 19 species of fish and 2 species of cephalopods; *Delphinus* feeds primarily on organisms in the vertically migrating DSL (Evans 1994). Diel fluctuations in vocal activity of this species (more vocal activity during late evening and early morning) appear to be linked to feeding on the DSL as it rises during the same time (Goold 2000).

At Sea Density Estimates—Pro-rated densities incorporating vessel survey results from 1986-2005 resulted in densities of 0.8299606 for warm water season and 0.3153850 for cold water season (Table 2-2).*Reproduction/Breeding*—The peak calving season occurs from spring and early summer (Forney 1994).

Diving Behavior—Limited direct measurements but dives to >200 meters possible, but most in the range of 9-50 m based on a study on one tagged individual tracked off San Diego (Evans 1971, 1994). Common dolphins feed on small schooling fish as well as squid and crustaceans, and varies by habitat and location. They appear to take advantage of the deep scattering layer at dusk and during early night-time hours, when the layer migrates closer to the water surface, as several prey species identified from stomach contents are known to vertically migrate (e.g., Ohizumi et al., 1998; Pusineri et al., 2007). Perrin (2002b) reports foraging dives to 200 m, but there have been no detailed studies of diving behavior.

Based on this limited information, depth distribution is estimated as: 100% at 0-200m.

Acoustics—Recorded Delphinus vocalizations include whistles, chirps, barks, and clicks (Ketten 1998). Clicks and whistles have dominant frequency ranges of 23 to 67 kHz and 0.5 to 18 kHz, respectively (Ketten 1998). Maximum source levels of clicks were approximately 180 dB 1 μPa-m (Fish and Turl 1976). Oswald et al. (2003) found that short-beaked common dolphins in the ETP have whistles with a mean frequency range of 6.3 kHz, mean maximum frequency of 13.6 kHz, and mean duration of 0.8 sec. Popov and Klishin (1998) recorded auditory brainstem responses from a common dolphin. The audiogram was U-shaped with a steeper high-frequency branch. The audiogram bandwidth was up to 128 kHz at a level of 100 dB above the minimum threshold. The minimum thresholds were observed at frequencies of 60 to 70 kHz.

Short-finned pilot whale (*Globicephala macrorhynchus*) California/Oregon/Washington Stock

Population Status—The short-finned pilot whale is not listed under the ESA. However, the California/Oregon/Washington Stock is considered strategic under the MMPA because the average human-caused mortality may not be sustainable (Barlow et al. 1997). Population size for the California/Oregon/Washington Stock is 350 (CV=0.48) individuals (Barlow and Forney 2007).

Distribution—The range of the short-finned pilot whale in the eastern North Pacific extends from the tropics to the Gulf of Alaska. However, sightings north of Point Conception are uncommon (Forney, 1994). Prior to the 1982–1983 El Niño event, short-finned pilot whales were commonly seen off southern California, with an apparently resident population around Santa Catalina Island (Dohl et al. 1981). After the El Niño event, they virtually disappeared from the region, and few sightings were made from 1984 to 1992. The reason for the decrease in numbers is unknown (Heyning et al. 1994b), but the El Niño event apparently disrupted their distribution pattern, and they have not returned as residents to waters off southern California (Forney 1994). Short finned pilot whales are found in the SOCAL Range Complex throughout the year (Forney 1994).

Pilot whales are deep divers; the maximum dive depth measured is 971 m (Baird personal communication). Pilot whales feed primarily on squid, but also take fish (Bernard and Reilly 1999). Pilot whales are not generally known to prey on other marine mammals; however, records from the ETP suggest that the short-finned pilot whale does occasionally chase, attack, and may eat dolphins during fishery operations (Perryman and Foster 1980), and they have been observed harassing sperm whales in the Gulf of Mexico (Weller et al. 1996).

At Sea Density Estimates—Pro-rated densities incorporating vessel survey results from 1986-2005 resulted in densities of 0.0003315 for warm and cold water seasons (Table 2-2).

Reproduction/Breeding—Calving and breeding primarily occurs in the summer (Jefferson et al. 1993).

Diving Behavior—Pilot whales are deep divers; the maximum dive depth measured is about 3,186 ft (Baird et al. 2002). Short-finned pilot whales feed on squid and fish. Stomach content analysis of pilot whales in the southern California Bight consisted entirely of cephalopod remains (Sinclair 1992). The most common prey item identified by Sinclair (1992) was *Loligo opalescens*, which has been documented in spawning concentrations at depths of 20-55 m. Stomach content analysis from the closely related long-finned pilot whale (*Globicephala melas*) from the U.S mid-Atlantic coast demonstrated preference for cephalopods as well as a relatively high diversity of prey species taken (Gannon et al. 1997). Stomach content analysis from *G. melas* off New Zealand did not show the same diversity of prey (Beatson et al. 2007a) which indicates that pilot whales may differ significantly in prey selection based on geographic location. Pilot whales feed primarily on squid, but also take fish (Bernard and Reilly 1999). Pilot whales are not generally known to prey on other marine mammals; however, records from the eastern tropical Pacific suggest that the short-finned pilot whale does occasionally chase, attack, and may eat dolphins during fishery operations (Perryman and Foster 1980), and they have been observed harassing sperm whales in the Gulf of Mexico (Weller et al. 1996). A diving study on *G. melas* also showed marked differences in daytime and nighttime diving in studies in the Ligurian Sea (Baird et al. 2002), but there was no information on percentage of time at various depth categories. A study following two rehabilitated and released long-finned pilot whales provides a breakdown of percentage of time at depth distribution for two whales (Nawojchik et al. 2003), although this data may be skewed due to the unique situation. Heide-Jorgensen et al. (2002) studied diving behavior of long-finned pilot whales near the Faroe Islands in the north Atlantic. Most diving activity occurred at depth of less than 36 m and >90% of dives were within 12-17 m.

Based on this information, the following are estimates of time at depth for both species of pilot whale: 60% at <7 m, 36% at 7-17 m and 4% at 18-828 m.

Acoustics—Short-finned pilot whale whistles and clicks have a dominant frequency range of 2 to 14 kHz and a source level of 180 dB re 1 μPa-m for whistles (Fish and Turl 1976; Ketten 1998). There are no published hearing data available for this species.

Spinner dolphin (Stenella longirostris) Not defined for Southern California

Population Status—Spinner dolphins are not found in California but inhabit the warm waters of Central America, therefore, they are a possible summer visitor to southern California waters. The spinner dolphin is not listed as endangered under the ESA, and is not considered to be depleted or strategic under the MMPA.

Distribution—The spinner dolphin is found in tropical and subtropical waters worldwide. Limits are near 40°N and 40°s (Jefferson et al. 1993). There have been few sightings of spinner dolphins in the SOCAL Range Complex; therefore, seasonal occurrence can not be determined (Forney 1994).

At Sea Density Estimates—There are no at sea density estimates for spinner dolphins in the SOCAL Range Complex.

Reproductive/Breeding—There is no information on the breeding behavior in this area.

Diving Behavior—Spinner dolphins feed primarily on small mesopelagic fishes, squids, and sergestid shrimps and they dive to at least 654 to 984 ft (Perrin and Gilpatrick 1994). Foraging takes place primarily at night when the mesopelagic prey migrates vertically towards the surface and also horizontally towards the shore (Benoit-Bird et al. 2001; Benoit-Bird and Au 2004; Dollar et al. 2003).

Acoustics—There is little information on the acoustic abilities of the spinner dolphin. They produce whistles in the range of 1 to 22.5 kHz with the dominant frequency being 6.8 to 17.9 kHz (Richardson et al. 1995; Nedwell et al. 2004). They also display pulse burst sounds in the range of 5 to 60 kHz. Their echolocation clicks range up to at least 65 kHz (Richardson et al. 1995). There is no information on their hearing.

Striped dolphin (Stenella coeruleoalba) California/Oregon/Washington Stock

Population Status—The striped dolphin is not listed as endangered under the ESA, and the California/Oregon/Washington Stock is not considered to be depleted or strategic under the MMPA. The best estimate of the size of the California/Oregon/Washington Stock is 18,976 (CV=0.28) individuals (Barlow and Forney 2007).

Distribution—Striped dolphins have a cosmopolitan distribution in tropical to warm temperate waters (Perrin *et al.* 1994a). Their preferred habitat seems to be deep water (Davis et al. 1998) along the edge and seaward of the continental shelf, particularly in areas influenced by warm currents (Waring et al. 2002). This species is well documented in both the western and eastern Pacific off the coasts of Japan and North America (Perrin et al. 1994); the northern limits are the Sea of Japan, Hokkaido, Washington state, and along roughly 40°N across the western and central Pacific (Reeves et al. 2002). In and near the SOCAL Range Complex, striped dolphins are found mostly offshore, and are much more common in the warm-water period. Striped dolphins are found in the SOCAL Range Complex throughout the year (Waring et al. 2002).

Striped dolphins are gregarious (groups of 20 or more are common) and active at the surface (Whitehead et al. 1998). Wade and Gerrodette (1993) noted a mean group size of 61 in the ETP, and Smith and Whitehead (1999) reported a mean group size of 50 in the Galápagos.

Reproduction/Breeding—There is no information on the breeding behavior in this area.

Diving Behavior—Striped dolphins often feed in pelagic or benthopelagic zones along the continental slope or just beyond oceanic waters. A majority of the prey possess luminescent organs, suggesting that striped dolphins may be feeding at great depths, possibly diving to about 109 to 383 fathoms to reach potential prey (Archer and Perrin 1999). Striped dolphins may feed at night, in order to take advantage of the deep scattering layer's diurnal vertical movements. Small, mid-water fishes (in particular, myctophids or lanternfish) and squids are the dominant prey (Perrin *et al*. 1994).

Acoustics—Striped dolphin whistles range from 6 to at least 24 kHz, with dominant frequencies ranging from 8 to 12.5 kHz (Richardson et al. 1995). The striped dolphin's range of most sensitive hearing (defined as the frequency range with sensitivities within 10 dB of maximum sensitivity) was determined to be 29 to 123 kHz using standard psycho-acoustic techniques; maximum sensitivity occurred at 64 kHz (Kastelein et al. 2003). Hearing ability became less sensitive below 32 kHz and above 120 kHz (Kastelein et al. 2003).

2.1.2.3 Pinnipeds

Northern Elephant Seal (*Mirounga angustirostris*) California Breeding Stock

Population Status—The California Breeding stock has recovered from near extinction in the early 1900s to an estimated 101,000 (Carretta et al. 2004).

Distribution—Northern elephant seals molt, breed, and give birth primarily on offshore islands off Baja California and California. Rookeries are found as far north as the South Farallon Islands and Point Reyes (Barlow et al. 1993). The California population is demographically isolated from the Baja California population, and is considered a separate stock, although genetically the two populations are indistinguishable (Barlow *et al*. 1997). About two thirds of the California population hauls out on San Miguel Island, about 32% on San Nicolas Island, and the remaining seals use Santa Rosa (1%), Santa Cruz, Anacapa, Santa Barbara, and San Clemente islands (Bonnell and Dailey 1993; U.S. Navy 1998; Carretta et al. 2000).

Life History-Northern elephant seals haul out on land to give birth and breed from December through March, and pups remain hauled out through April. After spending time at sea to feed (post-breeding migration), they generally return to the same areas to molt (Odell 1974; Stewart and Yochem 1984; Stewart 1989; Stewart and DeLong 1995). However, they do not necessarily return to the same beach. Adult males tend to haul out to molt between June and August (peaking in July), whereas females and juveniles haul out to most between March and May (peaking in April). Different age classes of northern elephant seals are found in the SOCAL Range Complex throughout the year (Carretta et al. 2000). For much of the year, northern elephant seals feed mostly in deep, offshore waters, and their foraging range extends thousands of kilometers offshore from the breeding range into the eastern and central North Pacific (Stewart and DeLong 1995; Stewart 1997; Le Boeuf et al. 2000). Adult males and females segregate while foraging and migrating; females mostly range west to about 173°W, between the latitudes of 40°N and 45°N, whereas males range further north into the Gulf of Alaska and along the Aleutian Islands, to between 47°N and 58°N (Stewart and Huber 1993; Stewart and DeLong 1995; Le Boeuf *et al*. 2000).

Reproduction/Breeding—Northern elephant seals haul out on land to give birth and breed from December through March, and pups remain hauled out through April.

Diving Behavior—Both sexes routinely dive deep (up to 4,500 ft) (Le Boeuf et al. 2000); dives average 15–25 min, depending on time of year, and surface intervals between dives are 2–3 min. The deepest dives recorded for both sexes are over 5,000 ft (e.g., Le Boeuf et al. 2000; Schreer *et al*. 2001). Females remain submerged about 86–92 percent of the time and males about 88–90 percent (Le Boeuf et al. 1989; Stewart and Delong 1995).

Feeding juvenile northern elephant seals dive for slightly shorter periods (13–18 min), but they dive to similar depths (978 to 1,500 ft) and spend a similar proportion (86–92 percent) of their time submerged (Le Boeuf et al. 2000).

Acoustics—The northern elephant seal produces loud, low-frequency in-air vocalizations (Bartholomew and Collias 1962). The mean fundamental frequencies are in the range of 147 to 334 Hz for adult males (Le Boeuf and Petrinovich 1974). The mean source level of the male-produced vocalizations during the breeding season is 110 dB re 20 μPa (Sanvito and Galimberti 2003). In-air calls made by aggressive males include: (1) snoring, which is a low intensity threat; (2) a snort (0.2 to 0.6 kHz) made by a dominant male when approached by a subdominant male; and (3) a clap threat (<2.5 kHz) which may contain signature information at the individual level (Richardson et al. 1995). These sounds appear to be important social cues (Shipley et al. 1992). The mean fundamental frequency of airborne calls for adult females is 500 to 1,000 Hz (Bartholomew and Collias 1962). In-air sounds produced by females include a <0.7 kHz belch roar used in aggressive situations and a 0.5 to 1 kHz bark used to attract the pup (Bartholomew and Collias 1962). As noted by Kastak and Schusterman (1999), evidence for underwater sound production by this species is scant. Except for one unsubstantiated report), none have been definitively identified (Fletcher et al. 1993; Burgess et al. 1998). Burgess et al. (1998) detected possible vocalizations in the form of click trains that resembled those used by males for communication in air.

The audiogram of the northern elephant seal indicates that this species is well-adapted for underwater hearing; sensitivity is best between 3.2 and 45 kHz, with greatest sensitivity at 6.4 kHz and an upper frequency cutoff of approximately 55 kHz (Kastak and Schusterman 1999).

Pacific Harbor Seal (Phoca vitulina richardii) California Stock

Population Status—The California population has increased from the mid-1960s to the mid-1990s, although the rate of increase may have slowed during the 1990s (Hanan 1996). The minimum population estimate of the California Stock is 25,720 (Carretta 2005).

Distribution—Harbor seals are considered abundant throughout most of their range from Baja California to the eastern Aleutian Islands. The Southern California Bight is near the southern limit of the harbor seal's range (Bonnell and Dailey 1993). Some harbor seals haul out and breed on Santa Barbara and Santa Catalina islands within the SOCAL Range Complex, but most harbor seals haul out further north.

Life history- Peak numbers of harbor seals haul out on land during late May to early June, which coincides with the peak of their molt. They generally favor sandy, cobble, and gravel beaches (Stewart and Yochem 1994), and most haul out on the mainland (Carretta et al. 2007). When at sea during May and June (and March to May for breeding females), they generally remain in the vicinity of haul-out sites and forage close to shore in relatively shallow waters. Nursing of pups begins in late February, and pups start to become weaned in May. Breeding occurs between late March and early May. Harbor seals are found in the SOCAL Range Complex throughout the year (Carretta et al. 2000).

Reproduction/Breeding—Pupping in late January, and pups start to become weaned in May. Breeding occurs between late March and early May.

Diving-While feeding, harbor seals dive to depths of 33–130 ft (10–40 m) in the case of females with nursing pups, and 260–390 ft (79–119 m) in the case of other seals. Dives as deep as 1,463 ft (446 m) have been recorded, although dives greater than 460 ft (140 m) are infrequent.

Acoustics—Harbor seals produce a variety of airborne vocalizations including snorts, snarls, and belching sounds (Bigg 1981). Adult males produce low frequency vocalizations underwater during the breeding season (Hanggi and Schusterman 1994; Van Parijs et al. 2003). Male harbor seals produce communication sounds in the frequency range of 100 to 1,000 Hz (Richardson et al. 1995).

The harbor seal hears almost equally well in air and underwater (Kastak and Schusterman 1998). Harbor seals hear best at frequencies from 1 to 180 kHz; the peak hearing sensitivity is at 32 kHz in water and 12 kHz in air (Terhune and Turnball 1995; Kastak and Schusterman 1998; Wolski et al. 2003). Kastak and Schusterman (1996) observed a TTS of 8 dB at 100 Hz from 6-7 hours of intermitten broadband continuous construction noise (sandblasting; 200-2000 Hz at 95-105 dB SPL unweighted in the seal's enclosure) per day for six days, with complete recovery approximately one week following exposure. Kastak et al. (1999) determined that underwater noise of moderate intensity (65 to 75 dB above the animals hearing threshold at 100, 500 and 1000 Hz) and continuous duration of 20 min is sufficient to induce a small TTS of 4.8 dB in harbor seals.

California Sea Lion (Zalophus californianus) United States Stock

Population Status—The California sea lion is not listed under the ESA, and the U.S. Stock, some of which occurs in the SOCAL Range Complex, is not considered a strategic stock under the MMPA. The U.S. Stock has increased from the early 1900s to the present; the counts of pups increased at an annual rate of 5.4% between 1975 and 2001 (Carretta et al. 2007). The minimum population estimate of the U.S. Stock, based on a 2001 census, is 138,881 (Carretta et al. 2007).

Distribution—Nearly all of the U.S. Stock (more than 95%) breeds and gives birth to pups on San Miguel, San Nicolas, and Santa Barbara islands, only one of which–Santa Barbara, the smallest–is in the SOCAL Range Complex. Smaller numbers of pups are born on San Clemente Island, the Farallon Islands, and Año Nuevo Island (Lowry et al. 1992). The California sea lion is by far the most commonly-sighted pinniped species at sea or on land in the vicinity of the SOCAL Range Complex. In California waters, sea lions made up 87.7% (2,976 of 3,393) of identified pinniped sightings at sea during all of the studies summarized in the SCIRC EIS/OEIS. Similarly, they represented 97% (381 of 393) of identified pinniped sightings at sea during the 1998–1999 NMFS surveys (Carretta et al. 2000). They were sighted during all seasons and in all areas with survey coverage from nearshore to offshore areas (Carretta et al. 2000).

Life history- Survey data from 1975 to 1978 were analyzed to describe the seasonal shifts in the offshore distribution of California sea lions (Bonnell and Ford 1987). During summer, the highest densities were found immediately west of San Miguel Island. During autumn, peak densities of sea lions were centered on Santa Cruz Island. During winter and spring, peak densities occurred just north of San Clemente Island. The seasonal changes in the center of distribution were attributed to changes in the distribution of the prey species. If California sea lion distribution is determined primarily by prey abundance, these same areas might not be the center of sea lion distribution every year.

The distribution and habitat use of California sea lions vary with the sex of the animals and their reproductive phase. Adult males haul out on land to defend territories and breed from mid-to-late May until late July. Individual males remain on territories for 27–45 days without going to sea to feed. During August and September, after the mating season, the adult males migrate northward to feeding areas as far away as Washington (Puget Sound) and British Columbia (Lowry et al. 1992). They remain there until spring (March–May), when they migrate back to the breeding colonies. Thus, adult males are present in offshore areas of the SOCAL Range Complex only briefly as they move to and from rookeries. Distribution of immature California sea lions is less well known, but some make northward migrations that are shorter in length than the migrations of adult males (Huber 1991). However, most immature seals are presumed to remain near the rookeries, and thus remain in or near the SOCAL Range Complex for most of the year (Lowry et al. 1992). Adult females remain near the rookeries throughout the year. Most births occur from mid-June to mid-July (peak in late June).

Higher densities of California sea lions are observed during cold-water months. At-sea densities likely decrease during warm-water months because females spend more time ashore to give birth and attend their pups. Radio-tagged female California sea lions at San Miguel Island spent approximately 70% of their time at sea during the non-breeding season (cold-water months) and pups spent an average of 67% of their time ashore during their mother's absence (Melin et al. 2000). Different age classes of California sea lions are found in the SOCAL Range Complex throughout the year (Lowry et al. 1992). Although adult male California sea lions feed in areas north of the SOCAL Range Complex, animals of all other ages and sexes spend most, but not all, of their time feeding at sea during winter so the winter estimates likely are somewhat low. During warm-water months, a high proportion of the adult males and females are hauled out at terrestrial sites during much of the period, so the summer estimates are low to a greater degree. Information on movements and foraging at sea has been restricted to breeding females (adult males do not forage near the rookeries, do not feed during the breeding season, and migrate north after the breeding season).

Reproduction/Breeding—The pupping and mating season for sea lions begins in late may and continues through July (Heath 2002).

Diving-Over one third of the foraging dives by breeding females are 1–2 min in duration; 75% of dives are <3 min, and the longest recorded dive was 9.9 min (Feldkamp et al. 1989). Approximately 45% of dives were to depths of 66–160 ft (20–50 m) and the maximum depth of a dive was 900 ft (274 m) (Feldkamp et al. 1989). Much of the variation in duration and depth of dives appears to be related to sea lions foraging on vertically-migrating prey. Longer dives to greater depths typically occur during the day, and shorter dives to shallower depths typically occur at night, when prey migrate toward the surface (Feldkamp et al. 1989).

Acoustics—In-air, California sea lions make incessant, raucous barking sounds; these have most of their energy at less than 2 kHz (Schusterman et al. 1967; Richardson et al. 1995). Males vary both the number and rhythm of their barks depending on the social context; the barks appear to control the movements and other behavior patterns of nearby conspecifics (Schusterman 1977). Females produce barks, squeals, belches, and growls in the frequency range of 0.25 to 5 kHz, while pups make bleating sounds at 0.25 to 6 kHz (Richardson et al. 1995). California sea lions produce two types of underwater sounds: clicks (or short-duration sound pulses) and barks (Schusterman et al. 1966, 1967; Schusterman and Baillet 1969). All underwater sounds have most of their energy below 4 kHz (Schusterman et al. 1967).

The range of maximal sensitivity underwater is between 1 and 28 kHz (Schusterman et al. 1972). Functional underwater high frequency hearing limits are between 35 and 40 kHz, with peak sensitivities from 15 to 30 kHz (Schusterman et al. 1972). The California sea lion shows relatively poor hearing at frequencies below 1,000 Hz (Kastak and Schusterman 1998). Peak sensitivities in air are shifted to lower frequencies; the effective upper hearing limit is approximately 36 kHz (Schusterman 1974). The best range of sound detection is from 2 to 16 kHz (Schusterman, 1974). Kastak and Schusterman (2002) determined that hearing sensitivity generally worsens with depth—hearing thresholds were lower in shallow water, except at the highest frequency tested (35 kHz), where this trend was reversed. Octave band noise levels of 65 to 70 dB above the animal's threshold produced an average TTS of 4.9 dB in the California sea lion (Kastak et al. 1999). Center frequencies were 1,000 Hz for corresponding threshold testing at 1000Hz and 2,000 Hz for threshold testing at 2,000 Hz; the duration of exposure was 20 min.

Northern Fur Seal (Callorhinus ursinus) San Miguel Island Stock

Listing Status-The Eastern Pacific Stock of northern fur seal is classified as a strategic stock because it is designated as depleted under the MMPA. The San Miguel Island Stock, which occurs north of the SOCAL Range Complex, is not considered depleted or strategic under the MMPA.

Population Status—The range of the northern fur seal extends from southern California north to the Bering Sea, and west to the Okhotsk Sea and the Sea of Japan (Antonelis and Fiscus 1980). Two separate stocks of northern fur seals are recognized within U.S. waters, the Eastern Pacific Stock and the San Miguel Island Stock (Barlow et al. 1998). The minimum population estimate for the Eastern Pacific Stock is 751,714 (Angliss and Lodge 2004). A minimum population estimate for the San Miguel Island Stock is 4,190 (Carretta et al. 2007).

Distribution—The Eastern Pacific Stock spends May–November in northern waters and at northern breeding colonies. In late November, females and young begin to arrive in offshore waters of California, with some animals moving south into continental shelf and slope waters. Maximum numbers are found in waters from 34ºN to 42ºN during February–April; most are found offshore of the continental slope. By early June, most seals of the eastern Pacific Stock have migrated back to northern waters (Antonelis and Fiscus 1980). Adult males from the Eastern Pacific Stock generally migrate only as far south as the Gulf of Alaska (Kajimura 1984).

Northern fur seals were made locally extinct at San Miguel Island during the mid-1800s by commercial sealing operations. After an absence of over 100 years, they recolonized the island during the late 1950s or early 1960s (DeLong 1982). The population at San Miguel Island has been increasing steadily since 1972, except for a drop in numbers during the El Niño events of 1982 (Barlow et al. 1998) and 1997–1998 (Barlow et al. 1999). The 1997 live pup count was the highest since the colony was reported in 1968, but up to 75% of those pups died within 5 months of birth. A 1998 pup count resulted in a total count of 627 pups, a 79.6% decrease from the 1997 count of 3,068 (Melin and DeLong 2000). In 1999, the population began to recover, and by 2002 the total pup count was 1,946 (Carretta et al. 2007).

Reproduction/Breeding—The northern fur seal pupping and mating season begins in June and continues through July (Bonnell et al. 1978).

Diving-Although they feed primarily in deep offshore waters, average depths of dives of lactating females are relatively shallow (223 ft [68 m]) with an average dive duration of 2.6 min (Reeves et al. 1992).

Acoustics—Northern fur seals produce underwater clicks, and in-air bleating, barking, coughing, and roaring sounds (Schusterman 1978; Richardson et al. 1995). Males vocalize (roar) almost continuously at rookeries (Gentry 1998). In-air and underwater audiograms are available for the northern fur seal. Of all the pinniped species for which hearing information is available, the northern fur seal is the most sensitive to airborne sound (Moore and Schusterman 1987). The underwater hearing range of the northern fur seal ranges from 0.5 Hz to 40 kHz (Moore and Schusterman 1987; Babushina et al. 1991).. The underwater hearing threshold is 90 to 100 dB re 1 µPa-m at 1 kHz; best underwater hearing occurs between 4 and 17 to 28 kHz (Moore and Schusterman 1987; Babushina et al. 1991). The underwater hearing sensitivity of this species is

15 to 20 dB better than in the air (Babushina et al. 1991). The maximum sensitivity in air is at 2 to 16 kHz (Moore and Schustermant 1987; Babushina et al. 1991), after which there is an anomalous hearing loss at around 4 or 5 kHz (Moore and Schusterman 1987; Babushin 1999).

Table 2-2. Biological Information For Marine Mammal Species.

Common Name	Food Preference	Depth or Oceanic Preference	Dive Pattern(s)	Surface Pattern(s)	Refs	Behavioral State	Geographic Region	Depth Information	Depth Dist-ribution	Sample Size/ Time of Year/Method	References
Baird's beaked whale	-	-	-	-	-	-	-	25-67 min	-	-	Von Saunder and Barlow 1999, Kasuya 2002
Bottlenose dolphin	-	-	-	-	-	-	-	500 m max and 15 min	-	-	Ridgway et al. 1969
Bottlenose dolphin	-	-	-	-	-	-	North Atlantic (Bermuda)	8.9 % of night dives to 450 m with 46.4% > 5 min; day dives 96% to 50 m with 52.7% less than one min; number of dives increased at dusk	-	-	Klatsky et al. 2007
Blainville's beaked whale	-	-	-	-	-	-	-	975 m max dives; 20-45 min	-	-	Barlow 1999, Baird et al. 2004, Johnson et al. 2004
Blue whale	Euphausiid crustaceans, including *Euphasia* sp and *Thysanoessa* sp	Coastal as well as offshore	V-shaped, but wide at bottom of V to accommodate the lunges; foraging dives deeper than non-foraging dives; foraging charaterized by lunge-feeding with greater prey capture during lunge ascent	Greater amount of time at surface to recover positively related to number of lunges during feeding	Perrin et al. (2002); Croll et al. (2001); Acevado et al. (2002)	Feeding at depth	Northeast Pacific (Mexico, California)	Mean depth 140 +- 46 m; mean dive time 7.8 +- 1.9 min	-	Seven whales/ May-August/Time-depth-recorder	Croll et al. (2001)

Common Name	Food Preference	Depth or Oceanic Preference	Dive Pattern(s)	Surface Pattern(s)	Refs	Behavioral State	Geographic Region	Depth Information	Depth Dist-ribution	Sample Size/ Time of Year/Method	References
Blue whale	-	-	-	-	-	Feeding near surface; surface intervals between deeper dives	Northeast Pacific (central California)	Mean depth 105 +- 13 m; mean dive time 5.8 +- 1.5 min	78% in 0-16 m; 9% in 17-32; 13% in >32 m; most dives to <16 m and 96-152 m ranges, but only 1.2% of total time was spent in deeper range	One whale/ August-September/ Satellite depth-sensor-tag	Lagerquist et al. (2000)
Blue whale	-	-	-	-	-	Non-foraging	Northeast Pacific (Mexico, California)	Mean depth 68 +- 51 m; mean dive time 4.9 +- 2.5 min; most dives to ~30 m with occasional deeper V-shaped dives to >100m	-	Seven whales/ May-August/Time-depth-recorder	Croll et al. (2001)
Bryde's whale	Pelagic schooling fish, small crustaceans (euphausiids, copepods), cephalopods; feeding is regionally different; preferred both anchovy and krill in Northwestern Pacific	Coastal and Offshore; off South Africa inshore form feeds on epipelagic fish (e.g., anchovies) while offshore form feeds on mesopelagic fish and euphausiids	Possibly V-shaped as they are lunge feeders	Unknown	Perrin et al. (2002); Murase et al. (2007); Best (1977)	Feeding	South Pacific and Indian Oceans	Main prey items were euphausiids, including *Euphausia* sp and *Thysanoessa* sp; most feeding apparently at dawn and dusk; 20 min dives	-	Several hundred/ year-round/ stomach content	Kawamura (1980); Cummings 1985
California sea lion			-					80-480 m; 16 min			Feldkamp et al. 1989, Melin 2002

Common Name	Food Preference	Depth or Oceanic Preference	Dive Pattern(s)	Surface Pattern(s)	Refs	Behavioral State	Geographic Region	Depth Information	Depth Dist-ribution	Sample Size/ Time of Year/Method	References
Cuvier's beaked whale								1,400 m; 45 min			Jefferson et al. 1993, Barlow 1993, Johnson et al. 2004
Dall's porpoise	-	-	-	-	-	-	-	50 m; 2 min	-	-	Hanson and Baird 1998
Dwarf sperm whale	Likely feeds in shallower water than K breviceps; otherwise food is similar	continental slope and deep zones of shelf, epi- and meso-pelagic zones	-	-	Perrin et al. (2002)	-	-	-	-	-	-
Fin whale	Planktonic crustaceans, including *Thyanoessa* sp and *Calanus* sp, as well as scholling fishes such as capelin (*Mallotus*), herring (*Clupea*) and mackerel (*Scomber*)	Pelagic with some occurrence over continental shelf areas	V-shaped, but wide at bottom of V to accommod ate the lunges; foraging dives deeper than non-foraging dives; foraging charaterize d by lunge-feeding with greater prey capture during lunge ascent	Greater amount of time at surface to recover positively related to number of lunges during feeding	Perrin et al. (2002); Croll et al. (2001); Acevado et al. (2002): Notarbartol o-di-Sciara et al. (2003)	Feeding at depth	Northeast Pacific (Mexico, California)	Mean depth 98 +- 33 m; mean dive time 6.3+- 1.5 min	-	Fifteen whales/ April-October/Time-depth-recorder	Croll et al. (2001)
Fin whale	-	-	-	-	-	Non-foraging	Northeast Pacific (Mexico, California)	Mean depth 59 +-30 m; mean dive time 4.2 +- 1.7 min; most dives to ~ 30 m with occasional deeper V-shaped dives to >90 m	-	Fifteen whales/ April-October/Time-depth-recorder	Croll et al. (2001)

Common Name	Food Preference	Depth or Oceanic Preference	Dive Pattern(s)	Surface Pattern(s)	Refs	Behavioral State	Geographic Region	Depth Information	Depth Dist-ribution	Sample Size/ Time of Year/Method	References
Fin whale	-	-	-	-	-	Feeding	Mediterranean (Ligurian Sea)	shallow dives (mean 26-33 m, with all <100m) until late afternoon; then dives in excess of 400 m (perhaps to 540 m); in one case a whale showed deep diving in midday; deeper dives probably were to feed on specific prey (*Meganyctiphanes norvegica*) that undergo diel vertical migration	-	Three whales/ Summer/ Velocity-time-depth-recorder	Panigada et al. (1999); Panigada et al. (2003); Panigada et al. (2006)
Fin whale	-	-	-	-	-	Traveling	Mediterranean (Ligurian Sea)	shallow dives (mean 9.8 +- 5.3 m, with max 20 m) , shorter dive times and slower swimming speed indicate travel mode; deep dives (mean 181.3 +-195.4 m, max 474 m), longer dive times and faster swimming speeds indicate feeding mode	-	One whale/ Summer/ Velocity-time-depth-recorder	Jahoda et al. (1999)

Common Name	Food Preference	Depth or Oceanic Preference	Dive Pattern(s)	Surface Pattern(s)	Refs	Behavioral State	Geographic Region	Depth Information	Depth Dist-ribution	Sample Size/ Time of Year/Method	References
Fin whale	-	-	-	-	-	Feeding	Northeast Pacific (Southern California Bight)	mean dive depth 248+-18 m; total dive duration mean 7.0+-1.0 min with mean descent of 1.7+-0.4 min and mean ascet of 1.4+-0.3 min; 60% (i.e., 7.0 min) of total time spent diving with 40% (i.e., 4.7 min) total time spent near sea surface (<50m)	44% in 0-49m (includes surface time plus descent and ascent to 49 m); 23% in 50-225 m (includes descent and ascent times taken from Table 1 minus time spent descending and ascending through 0-49 m); 33% at >225 m (total dive duration minus surface, descent and ascent times)	Seven whales/ August/ Bioacoustic probe	Goldbogen et al. (2006)
Fin whale	-	-	-	-	-	Feeding	Northeast Pacific (Southern California Bight)	Distribution of foraging dives mirrored distribution of krill in water collumn, with peaks at 75 and 200-250 m.	-	Two whales/ September-October/ Time-depth-recorder	Croll et al. (2001)

Common Name	Food Preference	Depth or Oceanic Preference	Dive Pattern(s)	Surface Pattern(s)	Refs	Behavioral State	Geographic Region	Depth Information	Depth Dist- ribution	Sample Size/ Time of Year/Method	References
Gray whale	Amphipods, including *Ampelisca* sp, and other organisms living in the seafloor; also occasionally surface skim and engulfing; dependent on location	Continental shelf, 4-120 m depth	Migrating dives are generally shallow an dshort (3-5 min); feeding dives are longer and to ~50-60 m	Variable depending on behavior	Perrin et al. (2002); Dunham et al. (2002); Jones and Swartz (2002)	Migrating	Northeast Pacific (coastal Baja California to northern California)	30 of 36 locations in depths <100m deep (mean 39 m); consistent speed indicating directed movement	-	One whale/ February/ Satellite tag	Mate and Urban Ramirez (2003)
Gray whale	-	-	-	-	-	Feeding	Bering and Chukchi Seas	Depths at feeding locations from 5-51 m depth	-	Several whales/ July-November/ Aerial surveys and benthic sampling	Clarke et al. (1989); Clarke and Moore (2002); Moore et al. (2003)
Gray whale	-	-	-	-	-	Feeding	Northeast Pacific (Kodiak Island)	Feeding on cumacean invertebrates	-	Several whales/ Year-round/ Aerial surveys	Moore et al. (2007)
Gray whale	-	-	-	-	-	Feeding	Northeast Pacific (Vancouver Island)	majority of time was spent near the surface on interventilation dives (<3 m depth) and near the bottom (extremely nearshore in a protected bay with mean dive depth of 18 m, range 14-22 m depth; little time spent in the water column between surface and bottom.	40% of time at <4 m (surface and interventilation dives), 38% of time at 3-18 m (active migration), 22% of time at >18 m (foraging).	One whale/ August/ Time-depth recorder	Malcolm et al. (1995/96); Malcolm and Duffus (2000)

Common Name	Food Preference	Depth or Oceanic Preference	Dive Pattern(s)	Surface Pattern(s)	Refs	Behavioral State	Geographic Region	Depth Information	Depth Dist-ribution	Sample Size/ Time of Year/Method	References
Harbor seal	-	-	-	-	-	-	-	Capable of diving to 450 m (1,476 ft), although dives of 10-150 m (33-492 ft) are more typical, Dives generally last a few minutes, spend as much as 85% of each day diving for food	-	-	Gjertz et al. 2001, Krafft et al. 2002, Eguchi and Harvey 2005
Humpback whale	Pelagic schooling euphausiids and small fish including capelin, herring, mackerel, croaker, spot, and weakfish	Coastal, inshore, near islands and reefs, migration through pelagic waters	lunge feeder using "bubble nets" to corral prey; also known to bottom-feed on sand lance	-	Perrin et al. (2002); Hain et al. (1995); Laerm et al. (1997)	Feeding	North Atlantic (Stellwagen Bank)	Depths <40 m	-	Several whales/ August/ Visual Observations	Hain et al. (1995)
Humpback whale	-	-	-	-	-	Feeding (in breeding area)	Tropical Atlantic (Samana Bay - winter breeding area)	Not provided; lunge feeding with bubblenet	-	One whale/ January/ Visual observations	Baraff et al. (1991)
Humpback whale	-	-	-	-	-	Breeding	North Pacific (Hawaii)	Depths in excess of 170 m recorded; some depths to bottom, others to mid- or surface waters; dive duration was not necessarily related to dive depth	40% in 0-10 m, 27% in 11-20 m, 12% in 21-30 m, 4% in 31-40 m, 3% in 41-50 m, 2% in 51-60 m, 2% in 61-70 m, 2% in 71-80 m, 2% in 81-90 m, 2% in 91-100 m, 3% in >100 m	Ten Males/ February-April/ Time-depth-recorder	Baird et al. (2000)

Common Name	Food Preference	Depth or Oceanic Preference	Dive Pattern(s)	Surface Pattern(s)	Refs	Behavioral State	Geographic Region	Depth Information	Depth Dist-ribution	Sample Size/ Time of Year/Method	References
Humpback whale	-	-	-	-	-	Feeding	Northeast Atlantic (Greenland)	Dive data was catalogued for time spent in upper 8 m as well as maximum dive depth; diving did not extend to the bottom (~1000 m) with most time in upper 4 m of depth with few dives in excess of 400 m	37% of time in <4 m, 25% of time in 4-20 m, 7% of time in 21-35m, 4% of time in 36-50 m, 6% of time in 51-100 m, 7% of time in 101-150 m, 8% of time in 151-200 m, 6% of time in 201-300 m, and <1% in >300 m (from Figure 3.10)	Four whales/ June-July/ Satellite transmitters	Dietz et al. (2002)
Humpback whale	-	-	-	-	-	Feeding	North Pacific (Southeast Alaska)	Dives were short and shallow (<60 m); percent of time at surface increased with increased dive depth and with dives exceeding 60 m	-	?? Whales/ July-September/ Passive sonar	Dolphin (1987)
Killer whale	-	-	-	-	-	-	-	30-264 m; 17 min	-	-	Dahlheim and Heyning 1999, Baird et al. 2005
Longman's beaked whale	-	-	-	-	-	-	-	18-25 min max time	-	-	Gallo-Reynoso and Figueroa-Carranza 1995
Melon-headed whale	-	-	-	-	-	-	-	1,500 m	-	-	Jefferson and Barros 1997

Common Name	Food Preference	Depth or Oceanic Preference	Dive Pattern(s)	Surface Pattern(s)	Refs	Behavioral State	Geographic Region	Depth Information	Depth Dist-ribution	Sample Size/ Time of Year/Method	References
Minke whale	Regionally dependent; can include euphausiids, copepods, small fish: Japanese anchovy preferred in western North Pacific	Coastal, inshore and offshore	Possibly V-shaped due to lunge feeding (patchy prey concentration); also bird-association feeding near surface (concentrated prey)	Unknown	Perrin et al. (2002); Jefferson et al. (1993); Wells et al. (1999); Murase et al. (2007)	Feeding, Searching	North Atlantic (Norway)	Searching for capelin at less than 20 m, then lunge-feeding at depths from 15 to 55 m, then searching again at shallower depths	Based on time series in Figure 2, 47% of time was spent foraging from 21-55 m; 53% of time was spent searching for food from 0-20 m	One whale/ August/ Dive-depth-transmitters	Blix and Folkow (1995)
North Pacific right whale	-	-	-	-	-	-	-	80-300 m; 5-15 min	-	-	Winn et al. 1995, Barlow et al. 1997, Mate et al. 1997, NMFS 2002, Baumgartner and Mate 2003
Northern elephant seal	-	-	-	-	-	-	-	Deepest diving of the pinnipeds and spend 80-90% of their time underwater, Interdive periods at the surface are usually only a few minutes	-	-	DeLong and Stewart 1991, Stewart and Huber 1993, Asaga et al. 1994, Cocker et al. 1994
Pacific white-sided dolphin	-	-	-	-	-	-	-	120 m max	-	-	Fitch and Brownell 1968
Pygmy beaked whale	-	-	-	-	-	-	-	18-25 min max time	-	-	Gallo-Reynoso and Figueroa-Carranza 1995

Common Name	Food Preference	Depth or Oceanic Preference	Dive Pattern(s)	Surface Pattern(s)	Refs	Behavioral State	Geographic Region	Depth Information	Depth Dist-ribution	Sample Size/ Time of Year/Method	References
Pygmy sperm whale	mid and deep water cephalopods , fish, crustaceans; probably feeding at or near bottom, possibly using suction feeding	continental slope and deep zones of shelf, epi- and meso-pelagic zones			Perrin et al., (2002); McAlpine et al. (1997)	Feeding	Northwest Atlantic (Canada)	Prey items included squid beaks, fish otolith and crustacean; squids representative of mesopelagic slope-water community		One whale/ December/ Stomach contents	McAlpine et al. (1997)
Risso's dolphin	-	-	-	-	-	-	-	30 min	-	-	Kruse et al. 1999
Rough-toothed dolphin	-	-	-	-	-	-	-	70 m max; 15 min max	-	-	Miyazaki and Perrin 1994
Sei whale	Copepods, amphipods, euphausiids, shoaling fish and squid	More open ocean than coastal	Unknown	Unknown	Perrin et al. (2002); Jefferson et al. (1993); Nemoto and Kawamura (1977)	Feeding	Northwest Pacific - coastal	skim feeder that takes swarms in low density	-	Several/ Year-round/ Stomach content analysis	Nemoto and Kawamura (1977)
Short-finned pilot whale	-	-	-	-	-	-	-	fast, energetic deep dives with mean duration of 15 minutes (max 20 min). Concentrated on mid-water prey at two depth ranges, centered at 270 m and 670 m	-	-	Baird et al. 2003, Aguilar De Soto et al. 2005
Sperm whale	Squids and other cephalopods , demersal and mesopelagic fish; varies according to region	Deep waters, areas of upwelling	U-shaped dives, generally vertical ascent and descent with foraging at bottom of dive; may or may not dive to bottom	Prolonged resting at surface both in large matrilineal groups as well as solitary males	Perrin et al. (2002)	Feeding	Mediterranea n Sea	Overall dive cycle duration mean = 54.78 min, with 9.14 min (17% of time) at the surface between dives; no measurement of depth of dive	-	16 whales/ July-August/ visual observations and click recordings	Drouot et al. (2004

Common Name	Food Preference	Depth or Oceanic Preference	Dive Pattern(s)	Surface Pattern(s)	Refs	Behavioral State	Geographic Region	Depth Information	Depth Dist-ribution	Sample Size/ Time of Year/Method	References
			depth								
Sperm whale	-	-	-	-	-	Feeding	South Pacific (Kaikoura, New Zealand)	83% of time spent underwater; no change in abundance between summer and winter but prey likely changed between seasons	-	>100 whales/ Year-round/ visual observations	Jacquet et al. (2000)
Sperm whale	-	-	-	-	-	Feeding	Equatorial Pacific (Galapagos)	Fecal sampling indicated four species of cephalopods predominated diet, but is likely biased against very small and very large cephalopods; samples showed variation over time and place	-	Several whales/ January-June/ fecal sampling	Smith and Whitehead (2000)
Sperm whale	-	-	-	-	-	Feeding	Equatorial Pacific (Galapagos)	Dives were not to ocean floor (2000-4000 m) but were to mean 382 m in one year and mean of 314 in another year; no diurnal patterns noted; general pattern was 10 min at surface followed by dive of 40 min; clicks (indicating feeding) started usually after descent to few hundred meters	-	Several whales/ January-June/ acoustic sampling	Papastavrou et al. (1989)

Common Name	Food Preference	Depth or Oceanic Preference	Dive Pattern(s)	Surface Pattern(s)	Refs	Behavioral State	Geographic Region	Depth Information	Depth Dist-ribution	Sample Size/ Time of Year/Method	References
Sperm whale	-	-	-	-	-	Feeding	North Pacific (Baja California)	Deep dives (>100m) accounted for 26% of all dives; average depth 418 +- 216 m; most (91%) deep dives were to 100-500 m; deepest dives were 1250-1500m; average dive duration was 27 min; average surface time was 8.0; whale dives closely correlated with depth of squid (200-400 m) during day; nighttime squid were shallower but whales still dove to same depths	74% in <100 m; 24% in 100-500 m; 2% in >500m	Five whales/ October-November/ Satellite-linked dive recorder	Davis et al. (2007)
Sperm whale	-	-	-	-	-	Resting/ socializing	North Pacific (Baja California)	Most dives (74%) shallow (8-100 m) and short duration; likely resting and/or socializing	-	Five whales/ October-November/ Satellite-linked dive recorder	Davis et al. (2007)
Sperm whale	-	-	-	-	-	Feeding	North Atlantic (Norway)	Maximum dive depths near seafloor and beyond scattering layer	-	Unknown # male whales/ July/ hydrophone array	Wahlberg (2002)
Sperm whale	-	-	-	-	-	Feeding	North Pacific (Southeast Alaska)	Maximum dive depth if 340 m when fishing activity was absent; max dive depth during fishing activity was 105 m	-	Two whales/ May/ acoustic monitoring	Tiemann et al. (2006)

Common Name	Food Preference	Depth or Oceanic Preference	Dive Pattern(s)	Surface Pattern(s)	Refs	Behavioral State	Geographic Region	Depth Information	Depth Dist-ribution	Sample Size/ Time of Year/Method	References
Sperm whale	-	-	-	-	-	Feeding	Northwest Atlantic (Georges Bank)	Dives somewhat more U-shaped than observed elsewhere; animals made both shallow and deep dives; average of 27% of time at surface; deepest dive of 1186 m while deepest depths in area were 1500-3000 m so foraging was mid-water column; surface interval averaged 7.1 min	-	Nine Whales/ July 2003/ DTAG	Palka and Johnson (2007)
Sperm whale	-	-	-	-	-	Feeding	Northwest Atlantic (Georges Bank)	37% of total time was spent near surface (0-10m); foraging dive statistics provided in Table 1 and used to calculate percentages of time in depth categories, adjusted for total time at surface	48% in <10 m; 3% in 10-100 m; 7% in 101-300 m; 7% in 301-500 m; 4% in 501-636 m; 31% in >636 m	Six females or immatures/ September-October/ DTAG	Watwood et al. (2006)
Sperm whale	-	-	-	-	-	Feeding	Mediterranean Sea	20% of total time was spent near surface (0-10m); foraging dive statistics provided in Table 1 and used to calculate percentages of time in depth categories, adjusted for total time at surface	35% in <10 m; 4% in 10-100 m; 9% in 101-300 m; 9% in 301-500 m; 5% in 501-623 m; 38% in >636 m	Eleven females or immatures/ July/ DTAG	Watwood et al. (2006)

Common Name	Food Preference	Depth or Oceanic Preference	Dive Pattern(s)	Surface Pattern(s)	Refs	Behavioral State	Geographic Region	Depth Information	Depth Dist-ribution	Sample Size/ Time of Year/Method	References
Sperm whale	-	-	-	-	-	Feeding	Gulf of Mexico	28% of total time was spent near surface (0-10m); foraging dive statistics provided in Table 1 and used to calculate percentages of time in depth categories, adjusted for total time at surface	41% in <10 m; 4% in 10-100 m; 8% in 101-300 m; 7% in 301-468 m; 40% >468 m	20 females or immatures/ June-September/ DTAG	Watwood et al. (2006)
Sperm whale	-	-	-	-	-	Feeding/ Resting	North Pacific (Japan)	Dives to 400-1200 m; active bursts in velocity at bottom of dive suggesting search-and-pursue strategy for feeding; 14% of total time was spent at surface not feeding or diving at all, with 86% of time spent actively feeding; used numbers from Table 1 to determine percentages of time in each depth category during feeding then adjusted by total time at surface	31% in <10 m (surface time); 8% in 10-200 m; 9% in 201-400 m; 9% in 401-600 m; 9% in 601-800m; 34% in >800 m	One female/ June/ Time-depth-recorder	Amano and Yoshioka (2003)
Sperm whale	-	-	-	-	-	Feeding/ Resting	North Atlantic (Caribbean)	Whales within 5 km of shore during day but moved offshore at night; calves remained mostly at surface with one or more adults; night time tracking more difficult due to increased biological noise from scattering layer; both whales spent long periods of time (>2hr) at surface during diving periods	-	Two whales/ October/ Acoustic transponder	Watkins et al. (1993)

Common Name	Food Preference	Depth or Oceanic Preference	Dive Pattern(s)	Surface Pattern(s)	Refs	Behavioral State	Geographic Region	Depth Information	Depth Dist-ribution	Sample Size/ Time of Year/Method	References
Sperm whale	-	-	-	-	-		North Atlantic (Caribbean)	Dives did not approach bottom of ocean (usually >200 m shallower than bottom depth); day dives deeper than night dives but not significantly; 63% of total time in deep dives with 37% of time near surface or shallow dives (within 100 m of surface)	-	One whale/ April/ Time-depth tag	Watkins et al. (2002)
Sperm whale	-	-	-	-	-	Feeding	South Pacific (New Zealand)	Primarily cephalopod prey of genus *Histioteuthis* sp, mostly immatures, which is know to undergo vertical migrations; also mysides that are usually found at 650 m during day and between 274 and 650 m at night; some prey species also found in shallower (<100 m) depths in trawls	-	27 whales/ Year round/ Stomach contents	Beatson (2007)
Short-beaked common dolphin	-	-	-	-	-	-	-	200 m	-	-	Evans 1971, Evans 1994, Goold 2000
Striped dolphin	-	-	-	-	-	-	-	200-700 m	-	-	Archer and Perrin 1999

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2.1.3 San Clemente Island-Pinnipeds

Six species of pinnipeds may occur on or near San Clemente Island (SCI), including the California sea lion, northern elephant sea, Pacific harbor seal, Guadalupe fur seal, Steller sea lion, and northern fur seal. Only one of the species, the California sea lion, is abundant and breeds regularly on SCI. Two other species, the harbor seal and the northern elephant seal, haul out regularly in small numbers and occasionally pup on SCI. The overall abundance of these species increased rapidly on the Channel Islands between the end of commercial exploitation in the 1920s and the mid-1980s. The growth rates of populations of some species appear to have declined in the SOCAL OEIS/EIS Study Area after the mid-1980s, and some recent survey data suggest that localized populations of some species may be declining. The declines may be a result of either interspecific competition or population numbers having exceeded the carrying capacity of the environment (Stewart et al. 1993; Hanan 1996). However, most populations continue to increase rapidly, and in some cases seals have recently occupied new rookeries and haul-out areas. The aforementioned pinniped species are not listed as endangered or threatened under the ESA (Barlow et al. 1997).

Three of the six pinniped species; the northern fur seal, the Guadalupe fur seal, and the Steller sea lion, that could potentially be found near SCI are less common. The northern fur seal breeds on San Miguel Island northwest of SCI, and is occasionally seen feeding in offshore waters. The Guadalupe fur seal is an occasional visitor to the Channel Islands but only breeds on Guadalupe Island, Mexico, which is approximately 225 nm (416 km) south of SCI. This species is thought to have expanded its range from Guadalupe Island in recent years (Maravilla-Chavez and Lowry 1999). An adult male Guadalupe fur seal has been observed hauled out among the breeding California sea lions on SCI during several recent breeding seasons (J. Carretta, Southwest Fisheries Science Center, National Marine Fisheries Service, pers. comm.). The Steller sea lion was once abundant in the northern portion of the SOCAL EIS/OEIS Study Area, but has declined rapidly since 1938. The northern fur seal is not listed as endangered or threatened under the ESA. The Guadalupe fur seal and the Steller sea lion are both designated as threatened under the ESA, and depleted under the MMPA. Their stocks are considered to be strategic. The state of California also lists the Guadalupe fur seal as threatened per the Fish and Game Commission California Code of Regulations (Title 14, Section 670.5, b, 6, H).

The only pinniped that is seen in large numbers on or near SCI is the California sea lion. It hauls out on rockier sections of the island and nearshore rocky outcroppings near SCI. Small numbers of northern elephant seals haul out and breed at SCI, and harbor seals are the least commonly seen of the three pinniped species. A single male Guadalupe fur seal hauled out with California sea lions for several years prior to the 1997–1998 El Niño event (J. Carretta and M. Lowry, pers. comm.).

Recent NMFS/SWFSC surveys of pinnipeds hauled out at sites on SCI involved the use of both ground surveys and aerial photogrammetric surveys (Carretta et al. 2000). This report uses aerial counts obtained in the surveys for estimates of the numbers of pinnipeds hauled out because aerial photographs are considered more precise than ground counts (ground counts are often obstructed by natural structures, and animal movements often result in recounting the same individual) (Lowry 1999). However, the occurrence of pinnipeds at haul-out sites that were not photographed is also noted.

.	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Harbor seal												
adult males				B	M	M						
adult females			N	B N	N M	M						
pups			N	N	N							
juveniles					M	M						
Northern elephant seal												
adult males	B	B				M	M	M				
adult females	B N	B N	M N	M	M							N
pups	N	N	N									N
juveniles			M	M	M							
California sea lion												
adult males						B	B	B				
adult females	N					B N	B N	B N	N M	N	N	N
pups	N					N	N	N	N	N	N	N
juveniles												

Note: Green indicates not near SOCAL(> 100 km; elephant seals may migrate several thousand km to forage and sea lion males move up to central California to Washington to forage), Yellow indicates found in SOCAL at sea and hauled out periodically, but not engaged in sensitive activities, and Red indicates found in SOCAL at sea and hauled out for prolonged periods engaged in sensitive activities: M = molting, B = Breeding, N = Nursing.

Figure 2-1. Activities Of Pinnipeds Throughout The Year At San Clemente Island

California Sea Lion

The general biology, seasonal distribution, and movements of California sea lions in Southern California are described in Section 2.1.1. The following is a description of their use of terrestrial haul-out sites on and near SCI. The California sea lion is the most abundant pinniped species that hauls out on SCI, and it has been sighted in nearshore areas and onshore at SCI during all seasons. Areas where they have been observed to haul out include Mail Point, NW Harbor Islet, Tiki Area, Seal Cove, China Point, Citadel Rock, The Shack, and Bird Rock (immediately northwest of Northwest Harbor) (Figure 2-2). They have also been observed at other locations scattered along the south coast of SCI. Small numbers have been seen hauled out on rocky outcrops outside the breeding season.

Adult females often remain near rookeries throughout the year, and return there to give birth to their pups and breed. As in other areas in the Southern California Bight, most births occur from mid-June to mid-July (with a peak in late June). Females nurse their pups for ~8 days before going to sea to feed for two days. Subsequent feeding trips range from 1.7 to 3.9 days in duration, and subsequent nursing periods are 1.7–1.9 days long.

Male California sea lions arrive at breeding areas at the same time as females. Males display towards other males and females in a form of territorial defense (Boness 1991), where it appears that females choose which male they mate with based on both the male's characteristics and qualities of the site they occupy. The operational sex ratio of females to males appears to be relatively high at larger breeding colonies (although not necessarily at SCI), and the maximum number of females mated by a single male is 27 (Boness 1991). The greatest numbers of hauled-out California sea lions are usually seen during June and July, when adults tend to be found at or near breeding areas (Figure 2-2 and Table 2-1). This pattern was evident for adult males in both 1998 and 1999 on SCI, as most of the 317 males were sighted during the breeding season of the NMFS/SWFSC photogrammetric aerial surveys (Figure 2-2). In 1998, more adult female

California sea lions were also hauled out during the breeding season relative to the non-breeding portions of the survey (conducted in April and October) (Figure 2-2 and Table 2-1). However, in 1999 the pattern was reversed. Relatively more animals were hauled out in both January (2,483) and April (2,942) than during the breeding month of July (1,814). Fewer pups (600) were observed on SCI during the 1998 breeding season than during the same period in 1999 (1,005) (Figure 2-2 and Table 2-1). The decrease probably resulted from increased pup mortality attributable to decreased attendance by California sea lion mothers as they prolonged their foraging bouts in attempts to find food limited by the effects of the 1997–1998 El Niño event. However, the extent of the difference in pup numbers between 1998 and 1999 may be suspect, as surveys were conducted at different dates and times in July, and weather and tidal conditions may have differed between the years. All of these factors are known to influence haul-out behavior of pinnipeds, including California sea lion pups (Melin et al. 2000).

The population on SCI appears to be relatively small when compared with San Nicolas Island to the north (USDoN 1998), and numbers hauled out are variable (Figure 2-2 and Table 2-1). El Niño events have caused substantial reductions in numbers of pups produced in 1983, 1992, 1993, 1997, and 1998 (Forney et al. 2000). Estimates of pup numbers in 1997 (1,259), 1998 (657), and 1999 (645) suggest that the breeding success of California sea lions on SCI has been reduced during the recent El Niño event (Carretta et al. 2000; M. Lowry, pers. comm.).

Northern Elephant Seal

Northern elephant seals have been seen near and on SCI, although in total numbers far less than those of California sea lions. Haul-out sites include China Point, Mail Point/The Shack, Tiki Arae, Citadel Rock/ Seal Cove Point, and NW Harbor Inlet (Figure 2-3). Individuals include seals of all age classes, including some pups. Northern elephant seals probably breed in low numbers on SCI; the number of pups seen each year has been consistently <20 (J. Carretta, pers. comm.). One pup was sighted at the Mail Point Area during the pupping season (January) in 1999, eight pups were sighted during April 1998, and four pups were sighted in April 1999.

The general biology, seasonal distribution, and movements of northern elephant seals through the SCIRC are described in Section 2.1.1.

In larger colonies, northern elephant seals prefer gradually sloping sandy beaches or sand spits as haul-out sites. If sandy beaches are not available, they will haul out on pebbles or, as a last resort, on boulders and rocky shores (as some appear to do on SCI).

In early December, all bulls are hauled out at the rookeries. Pregnant females begin to arrive in mid-December and peak numbers are present at the end of January and in early February. Numbers of females then begin to decline until the first week in March when they have left the beaches to regain energy stores depleted during their fasting lactation period. Younger adult males begin to leave the rookery in late February, but some of the older males remain there until late March (Clinton 1994). This generalized pattern, characteristic of the larger colonies such as those at San Nicolas Island to the north of SCI, may not be in evidence at SCI, as the population density is relatively low. No adult males were sighted on SCI during photographic aerial surveys conducted by NMFS/SWFSC in 1998–1999, and only one adult male was sighted at Mail Point during a ground survey in January 1999 (Carretta et al. 2000).

NMFS/SWFSC has conducted ground surveys of northern elephant seals at SCI since 1982 and aerial surveys since 1988. Between 1982 and 2001, pup births increased at an average annual rate of 13.4 percent. SCI is, however, the smallest elephant seal rookery in southern California; during some years, no pups are born, and the largest number of pups born in any single year was 16 in 1996.

It is estimated that there are usually fewer than ~100 elephant seals of all age classes on SCI over the course of the year (M. Lowry, pers. comm.). That represents only ~0.18 percent of the California stock and ~21 percent of the population that occurs in the SCI.

Harbor Seal

Much of the general biology and status of harbor seals is described in Section 2.1.1. Harbor seals remain near their terrestrial haul-out sites and frequently haul out on land throughout the year, at least for brief periods. However, at most haul-out sites, harbor seals are seen on land only during the pupping, nursing, and molting periods. On SCI, as at most sites along the southern coast of California, the pupping period extends from late February to early April, with a peak in pupping in late March. The nursing period extends from late February to early May. Females and pups haul out for long periods at this time of year. The molting period is in late May–June, and all ages and sexes of harbor seals haul out at that time.

The harbor seal is a year-round resident at SCI. Results from the recent NMFS/SWFSC surveys (Carretta et al. 2000) of SCI indicate that five sites on San Clemente Island are used regularly by harbor seals for hauling out. They include Northwest Harbor Islet, The Shack, South Point, SHOBA, and China Point (Figure 2-4). Three other sites were used less frequently (Eastern Side, Mail Point, and the area from Tiki to Mail Point). Harbor seals may have avoided Mail Point, despite its proximity to other haul-out sites, because both California sea lions and northern elephant seals haul out regularly at that location. Of all of the harbor seal sites, only two, NW Harbor Islet and The Shack, were occupied by harbor seals during all six aerial photographic surveys conducted by NMFS in 1998 and 1999. Also, relatively more harbor seals hauled out at those two sites (26.4 percent of total at NW Harbor Islet and 18.5 percent at The Shack). Most harbor seals (44.4 percent of total) were observed hauled out during the survey on 23 April 1999. Harbor seals hauled out during both the warm and cold seasons at most haul-out sites. None of the NMFS/SWFSC surveys were conducted during molt (late May–June), when peak numbers of harbor seals are known to haul out. Therefore, it is difficult to provide comparable haul-out numbers to other studies.

Since 1983, scientists have conducted annual counts of harbor seals in the Southern California Bight, including those hauled out at SCI (Hanan 1996). In the early to mid-1980s, usually fewer than 100 harbor seals were counted there during the molting period (from 31 in May 1983 to 245 in June 1989). From 1983 to 1998, 31–95 harbor seals were counted in May–June during the index counts conducted by D. Hanan (1996; 1999; pers. comm.). Aerial counts of this type underestimate total numbers using the area, as animals at sea during the time of the count are not recorded.

Northern Fur Seal

Northern fur seals have not been seen hauled out on SCI. Their distribution during the winter and spring, when they are most abundant in the general area, is offshore.

Guadalupe Fur Seal

Several sightings of a male Guadalupe fur seal have been made on SCI beginning in July 1991 near Mail Point. These were of an adult male seen hauled out among California sea lions. This seal (if it is the same individual) has not been sighted since the onset of the 1997–1998 El Niño event (J. Carretta and M. Lowry, NMFS/SWFSC, pers. comm.).

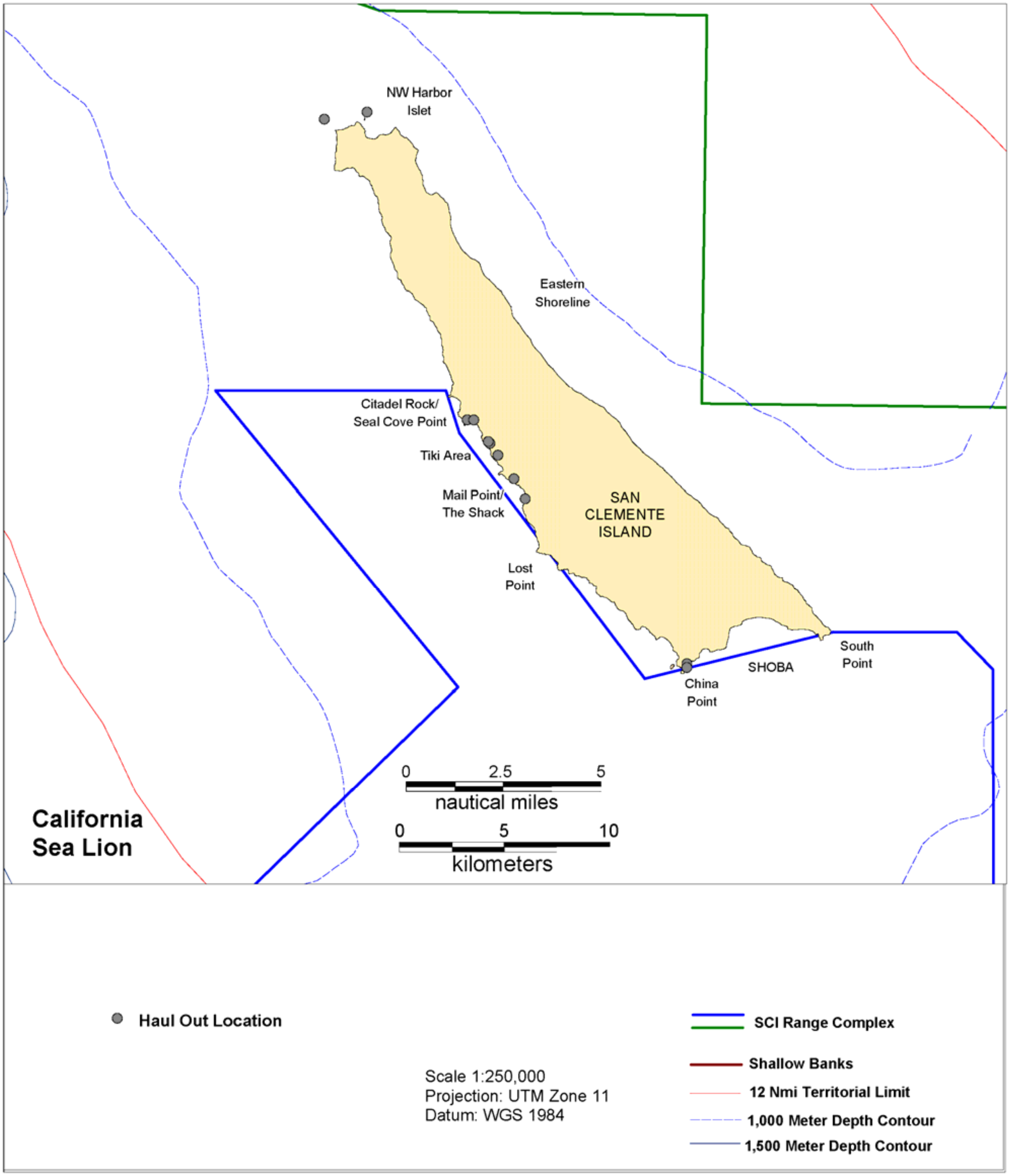
Steller Sea Lion

There are no published records of Steller sea lion sightings on SCI. Furthermore, no adults have been sighted in the Channel Islands since 1983 (see Section 2.1.1).

Sea Otter

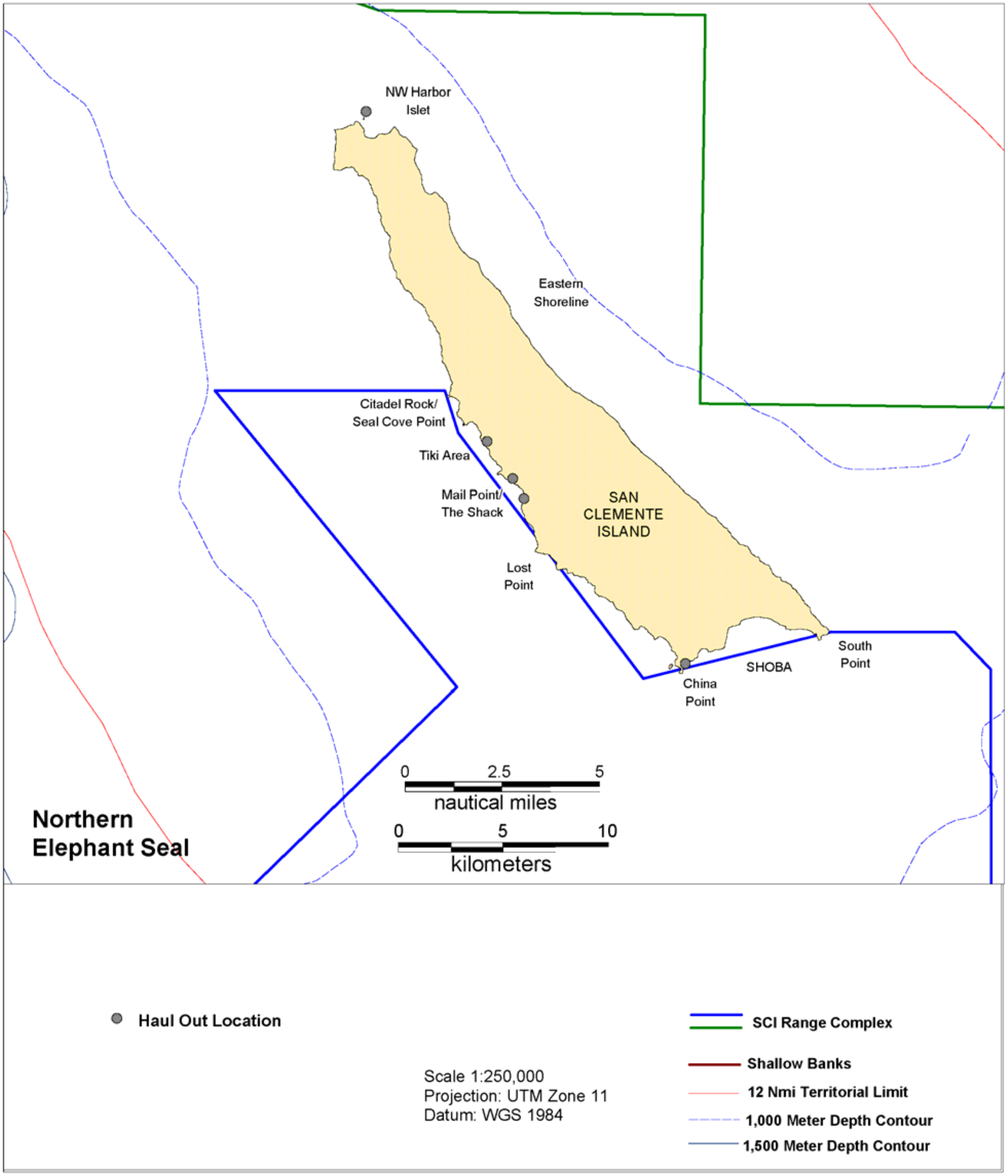
The distribution and life history of sea otters in California is described in Section 2.1.1. Prior to the fur trade, sea otters were common throughout the SCI. There have been rare sightings of a sea otter along the coast south of SCI. South of Point Conception, sea otters are rare but expanding southward along the coast.

SCI has been designated as an “otter free” zone by the USFWS, sea otters attempting to reside or colonize the island may be removed to other areas at the discretion of the USFWS. Recently the USFWS has sought to overturn the “otter free” zone because of the failure of the San Nicolas Island translocation (USFWS 2003) and has not been enforcing that zone since 2001 (USFWS 2001).



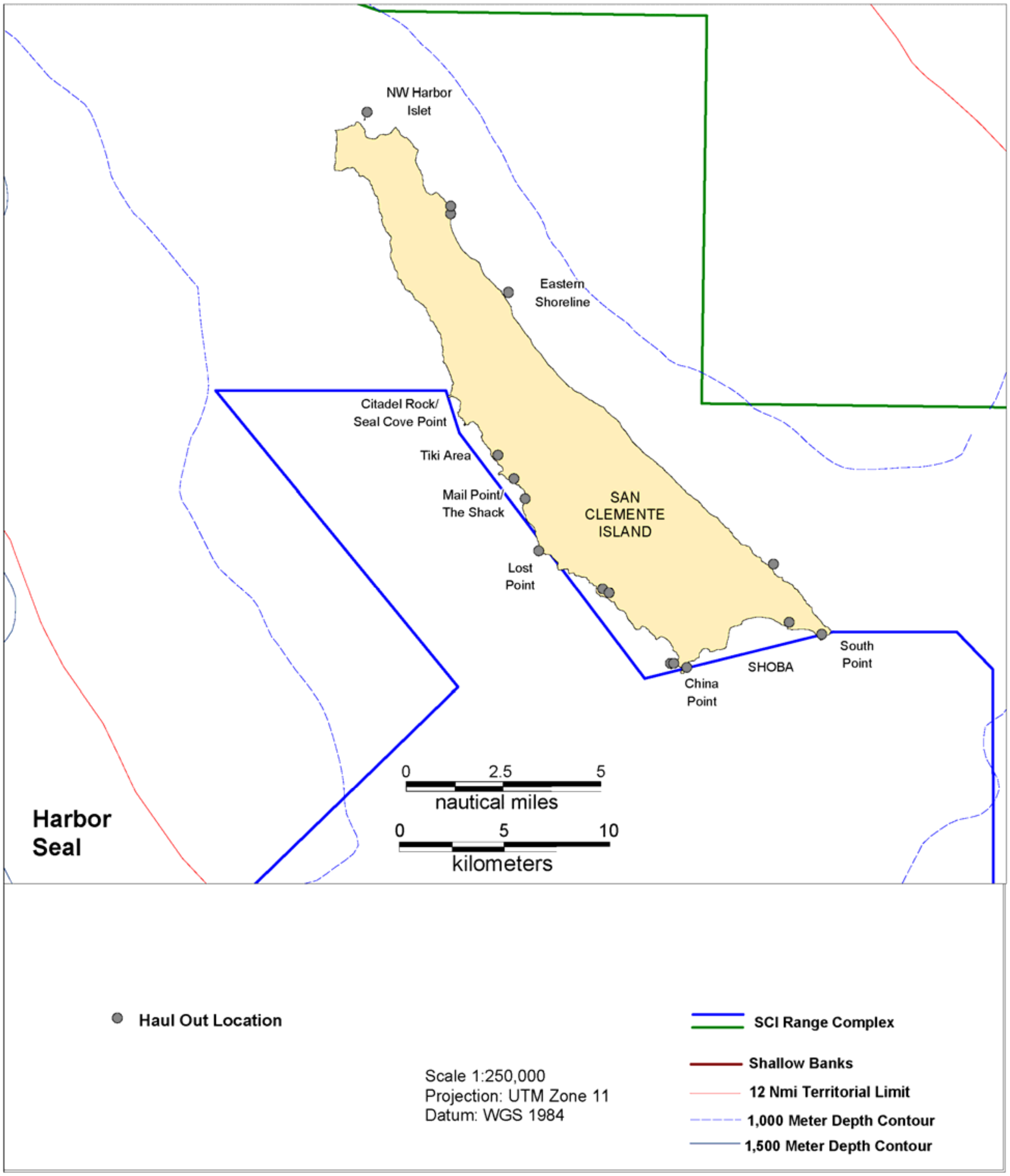
Source: Caretta et al. 2000 and Maravilla-Chavez (in press)

Figure 2-2. California Sea Lion Haul-out Locations On SCI



Source: Caretta et al. 2000 and Lowry 2002

Figure 2-3. Northern Elephant Seal SCI Haul-out Locations



Source: Caretta et al. 2000 and Lowry and Carretta 2003

Figure 2-4. Harbor Seal Haul Out Locations On San Clemente Island

2.2 MARINE MAMMAL ACOUSTICS

2.2.1 Summary

Cetaceans

Cetaceans have an auditory anatomy that follows the basic mammalian pattern, with some adaptations to the demands of hearing underwater. The typical mammalian ear is divided into an outer ear, middle ear, and inner ear. The outer ear is separated from the inner ear by a tympanic membrane, or eardrum. In terrestrial mammals, the outer ear, eardrum, and middle ear transmit airborne sound to the inner ear, where the sound is detected in a fluid. Since cetaceans already live in a fluid medium, they do not require this matching, and thus do not have an air-filled external ear canal. Sound may enter through the lower jaw in cetaceans (Brill et al. 1988; Ketten 1997, 2000). The inner ear is where sound energy is converted into neural signals that are transmitted to the central nervous system via the auditory nerve. Acoustic energy causes the basilar membrane in the cochlea to vibrate. Sensory cells at different positions along the basilar membrane are excited by different frequencies of sound (Tyack 1999). Marine mammal vocalizations often extend both above and below the range of human hearing. Vocalizations with frequencies lower than 18 Hertz (Hz) are labeled as infrasonic and those higher than 20 kilohertz (kHz) as ultrasonic. Measured data on the hearing abilities of cetaceans are sparse, and are non-existent for the larger cetaceans such as the baleen whales. The auditory thresholds of some of the smaller odontocetes have been determined in captivity. It is generally believed that cetaceans should at least be sensitive to the frequencies of their own vocalizations. Comparisons of the anatomy of cetacean inner ears and models of the structural properties and the response to vibrations of the ear's components in different species provide an indication of likely sensitivity to various sound frequencies. The ears of small toothed whales are optimized for receiving high-frequency sound, while baleen whale inner ears are best in low to infrasonic frequencies (Ketten 1992, 1997, 1998).

Baleen whales primarily use the lower frequencies, producing tonal sounds in the frequency range of 15 to 3,000 Hz, with good suggested sensitivity from 20 Hz to 2 kHz depending on the species (Ketten 1998). Clark and Ellison (2004) suggested that baleen whales use low frequency sounds not only for long-range communication, but also as a simple form of echo ranging, using echoes to navigate and orient relative to physical features of the ocean. Information on auditory function in mysticetes is extremely lacking. Sensitivity to low-frequency sound by baleen whales has been inferred from observed vocalization frequencies, observed reactions to playback of sounds, and anatomical analyses of the auditory system.

Baleen whale vocalizations are composed primarily of frequencies below 1 kHz, and some contain fundamental frequencies as low as 16 Hz (Watkins et al. 1987; Richardson et al. 1995; Rivers 1997; Moore et al. 1998; Stafford et al. 1999; Wartzok and Ketten 1999) but can be as high as 24 kHz (humpback whale; Au et al. 2006). Although there is apparently much variation, the source levels of most baleen whale vocalizations lie in the range of 150-190 dB re 1 µPa at 1 m. Low-frequency vocalizations made by baleen whales and their corresponding auditory anatomy suggest that they have good low-frequency hearing (Ketten 2000), although specific data on sensitivity, frequency or intensity discrimination, or localization abilities are lacking. Marine mammals, like all mammals, have typical U-shaped audiograms that begin with relatively low sensitivity (high threshold) at some specified low frequency with increased sensitivity (low threshold) to a species specific optimum followed by a generally steep rise at higher frequencies (high threshold) (Fay 1988).

The majority of blue and fin whales vocalizations are less than 222 Hz (Cummings and Thompson 1971 Thompson *et al*. 1992; Berchok *et al*. 2003a, 2003b; Mellinger and Clarke 2003; Clarke 2004; Rankin *et al.* 2004). Blue whales produce a variety of low-frequency sounds in a

10-100 Hz band (Cummings and Thompson 1971; Edds 1982; Thompson and Friedl 1982; Alling and Payne 1991; McDonald *et al*. 1995; Clark and Fristrup, 1997; Rivers, 1997; Stafford et al., 1998; Stafford et al., 1999; McDonald *et al*. 2001). Off California, the most typical blue whale signals are very long, patterned sequences of tonal infrasonic sounds in the 15-100 Hz range (Aburto *et al*. 1997; Teranishi *et al*. 1997; McDonald et al. 2001; Oleson *et al*. 2005), and are typically infrequently produced by a small subset of males (Calambokidis *et al*. 2004; Oleson et al. 2005).

Fin whales produce a variety of low frequency sounds, primarily in the 15-200 Hz band (Watkins, 1981; Watkins et al. 1987; Edds, 1988; Thompson et al. 1992; McDonald and Fox 1999). The most typical signals are long, patterned sequences of short duration (0.5-2 seconds) infrasonic pulses in the 18-35 Hz range (Patterson and Hamilton 1964; Watkins et al. 1987).

Three sounds are produced by humpback whales: "songs" produced in late fall, winter, and spring by single animals; sounds produced by groups of humpback whales (possibly associated with aggressive behavior among males) on the winter breeding grounds; and sounds produced on the summer feeding grounds. Dominant frequencies of these songs range from 40 Hz to 24 kHz, with components of up to 8 kHz (Thompson et al. 1979; Richardson et al. 1995, Au et al. 2006). Source levels average 155 dB re 1 µPa at 1 m and range from 144 to 174 dB re 1 µPa at 1 m (Thompson et al., 1979). Sounds often associated with possible aggressive behavior by males are quite different from songs, extending from 50 Hz to 10 kHz (or higher), with most energy in components below 3 kHz (Tyack and Whitehead 1983). Sounds are produced less frequently on summer feeding grounds and are at approximately 20-2000 Hz, with median durations of 0.2-0.8 sec and source levels of 175-192 dB re 1 µPa at 1 m (Thompson et al. 1986). Filter-bank models of the humpback whale's ear have been developed from anatomical features of the humpback's ear and optimization techniques (Houser et al. 2001). The results suggest that humpbacks are sensitive to frequencies between 700 Hz and 10 kHz, but best sensitivity is likely to occur between 2 and 6 kHz.

Minke whales produce a variety of sounds, primarily in the 80-5,000 Hz range. In the Northern Hemisphere, sounds recorded include grunts, thumps, and ratchets from 80-850 Hz and pings and clicks from 3-20 kHz (Winn and Perkins 1976; Thompson et al. 1979; Stewart and Leatherwood 1985; Mellinger et al. 2000).

The toothed whales produce a wide variety of sounds, which include species-specific broadband "clicks" with peak energy between 10 and 200 kHz, individually variable "burst pulse" click trains, and constant frequency or frequency-modulated (FM) whistles ranging from 4 to 16 kHz (Wartzok and Ketten 1999). The general consensus is that the tonal vocalizations (whistles) produced by toothed whales play an important role in maintaining contact between dispersed individuals, while broadband clicks are used during echolocation (Wartzok and Ketten 1999). Burst pulses have also been strongly implicated in communication, with some scientists suggesting that they play an important role in agonistic encounters (McCowan and Reiss 1995), while others have proposed that they represent "emotive" signals in a broader sense, possibly representing graded communication signals (Herzing 1996). Sperm whales, however, are known to produce only clicks, which are used for both communication and echolocation (Whitehead 2003). Most of the energy of toothed whales social vocalizations is concentrated near 10 kHz, with source levels for whistles as high as 100-180 dB re 1 µPa at 1 m (Richardson et al. 1995). No odontocete has been shown audiometrically to have acute hearing (<80 dB re 1 µPa) below 500 Hz (DoN 2001). Sperm whales produce clicks, which may be used to echolocate (Mullins et al., 1988), with a frequency range from less than 100 Hz to 30 kHz and source levels up to 230 dB re 1 µPa 1 m or greater (Møhl et al. 2000). There are no specific data on the hearing sensitivity of sperm whales, but immature animals, at least, appear to have medium- and high-frequency hearing abilities similar to the other odontocete species tested (Carder and Ridgway 1990).

Pinnipeds

Sounds produced by pinnipeds include airborne and underwater vocalizations (Richardson et al. 1995). Calls include grunts, barks, and growls, in addition to the more conventional whistles, clicks, and pulses. The majority of pinniped sounds are in the sonic range (20 Hz to 20 kHz) (Ketten 1998; Wartzok and Ketten 1999). In general, phocids are far more vocal underwater than are otariids. Phocid calls are commonly between 100 Hz and 15 kHz, with peak spectra less than 5 kHz, but can range as high as 40 kHz (Ketten 1998; Wartzok and Ketten 1999). There is no evidence that pinnipeds echolocate (Schusterman et al. 2000). Pinniped hearing falls within the range of MFA sonar but to date there is little information on the effect of sonar on pinnipeds. Most of the acoustic behavior of pinnipeds takes place onshore at rookeries or just offshore for species that may hold territories in the water. The northern elephant seal produces loud, low-frequency in-air vocalizations (Bartholomew and Collias 1962). The mean fundamental frequencies are in the range of 147 to 334 Hz for adult males (Le Boeuf and Petrinovich 1974). The mean source level of the male-produced vocalizations during the breeding season is 110 dB re 20 μPa (Sanvito and Galimberti 2003). The harbor seal hears almost equally well in air and underwater (Kastak and Schusterman 1998). Harbor seals hear best at frequencies from 1 to 180 kHz; the peak hearing sensitivity is at 32 kHz in water and 12 kHz in air (Terhune and Turnball 1995; Kastak and Schusterman, 1998; Wolski et al. 2003). The range of maximal sensitivity underwater for the California sea lions is between 1 and 28 kHz (Schusterman et al. 1972). Functional underwater high frequency hearing limits are between 35 and 40 kHz, with peak sensitivities from 15 to 30 kHz (Schusterman et al. 1972).

In comparison with toothed whales, pinnipeds tend to have lower best frequencies, lower high-frequency cutoffs, and poorer sensitivity at the best frequency (Richardson et al. 1995). However, some pinnipeds (especially phocids) may have better sensitivity at low frequencies (<1 kHz) than do toothed whales (Richardson et al. 1995). The pinniped ear appears to have been constrained during its evolution by the necessity of functioning in two acoustically dissimilar media (air and water). The patterns of air and water hearing sensitivity appear to correspond to the patterns of life history of the pinniped species (Kastak and Schusterman 1998). Comparisons of the hearing characteristics of otariids and phocids suggest two types of pinniped ears, with phocids being better adapted for underwater hearing (Richardson et al. 1995; Kastak and Schusterman 1998; Ketten 1998; Wartzok and Ketten 1999). In phocids tested, peak sensitivities ranged between 10 and 30 kHz, with a functional high frequency limit of about 60 kHz (Richardson et al. 1995; Ketten 1998; Wartzok and Ketten 1999).

General reviews of cetacean and pinniped sound production and hearing may be found in Richardson et al. (1995), Edds-Walton (1997), Wartzok and Ketten (1999), and Au et al. (2000), May-Collado et al. (2007). For a discussion of acoustic concepts, terminology, and measurement procedures, as well as underwater sound propagation, Urick (1983) and Richardson et al. (1995) are recommended.

2.2.2 Discussion of Controlled Exposure Experiments

Controlled Exposure Experiments (CEE) are used to determine the short term effects of anthropogenic sound sources on species of concern (Tyack *et al*. 2004; Nowacek *et al*. 2007). Correlation studies have tried to determine sound effects from opportunistic observations of animals in the area of the sound source but the sample sizes are generally small and may take many years to determine if there is an effect or not. In CEEs, the instrumented animals are known and the sound source can be moved to them instead of waiting for the animal to approach the sound source area if they stay in the vicinity of the CEE area. The animal can be instrumented with a radio transmitter to follow its movements or fitted with satellite tag to record its movements and combined with an acoustic recorder to record the received sound level at the animal (Johnson and Tyack 2003). In addition, sensors to record heart rate, swim speed, and oceanographic parameters (e.g. water temperature) can be used to better understand the response and movements of the animals (Miksis et al. 2001). The sound source can be deployed near the instrumented animal and the sound intensity increased in small increments to elicit a response from the focal animal or animals. In addition, an instrumented area with temporary or permanent moored acoustic buoys can be used to track vocalizing animals and the sound source (e.g. navy instrumented ranges such as AUTEC, PMRF and SOAR). A recent behavioral response study (BRS) was conducted on the AUTEC range to study the response of cetaceans to active sonar (NOAA-NMFS 2007).

2.3 MARINE MAMMAL HABITAT AND DISTRIBUTION WITHIN SOUTHERN CALIFORNIA

Marine mammals inhabit most marine environments, from deep ocean canyons to shallow estuarine waters. They are not randomly distributed. Marine mammal distribution is affected by demographic, evolutionary, ecological, habitat-related, and anthropogenic factors (Bowen et al. 2002; Bjørge 2002; Forcada 2002; Stevick et al. 2002).

Movements are often related to feeding or breeding activity (Stevick et al. 2002). A migration is the periodic movement of all, or significant components of an animal population from one habitat to one or more other habitats and back again. Migration is an adaptation that allows an animal to monopolize areas where favorable environmental conditions exist for feeding, breeding, and/or other phases of the animal’s life history. Some baleen whale species, such as humpback whales, make extensive annual migrations to low-latitude mating and calving grounds in the winter and to high-latitude feeding grounds in the summer (Corkeron and Connor 1999). These migrations undoubtedly occur during these seasons due to the presence of highly productive waters and associated cetacean prey species at high latitudes and of warm water temperatures at low latitudes (Corkeron and Connor 1999; Stern 2002). The timing of migration is often a function of age, sex, and reproductive class. Females tend to migrate earlier than males and adults earlier than immature animals (Stevick et al. 2002; Craig et al. 2003). Not all baleen whales, however, migrate. Some individual gray, fin, Bryde’s, minke, and blue whales may stay year-round in a specific area.

Cetacean movements can also reflect the distribution and abundance of prey (Gaskin 1982; Payne et al. 1986; Kenney et al. 1996). Cetacean movements have also been linked to indirect indicators of prey, such as temperature variations, sea-surface chl a concentrations, and features such as bottom depth (Fiedler 2002). Oceanographic conditions such as upwelling zones, eddies, and turbulent mixing can create regionalized zones of enhanced productivity that are translated into zooplankton concentrations, and/or entrain prey as density differences between two different water masses aggregate phytoplankton and zooplankton (Etnoyer et al. 2004). High concentrations of fish and invertebrate larvae along with high rates of primary productivity are associated with shelf break and pelagic frontal features (Roughgarden et al. 1988; Munk et al. 1995). Frontal features in the SOCAL Range Complex and vicinity tend to be ephemeral in space and time, shifting to the north and south by 10 to 1,000 km depending on the season, the year, and the state of the El Niño (Etnoyer et al. 2004).

As noted by MacLeod and Zuur (2005), however, even in the best studied marine mammal species, determining the fundamental reasons behind the linkage between habitat variables and distribution can be problematic, and often requires extensive datasets. For example, though topography might increase primary productivity, and as a result, provide a local increased availability of prey, not every marine mammal species is necessarily concentrated in that area. Additional factors may be involved, such as habitat segregation between other species that share the same ecological niche (MacLeod and Zuur 2005). The degree of similarity in diet between two or more predators that occur in the same habitat will affect the level of competition between these predators. Competition between predators can result in the exclusion of one, or more, of them from a specific habitat. For example, MacLeod et al. (2003) suggested that an example of niche segregation might be that Mesoplodon whales occupy a separate dietary niche from bottlenose whales (Hyperoodon) and Cuvier's beaked whales (Ziphius) though they shared the same distribution. In contrast, Hyperoodon and Ziphius appear to occupy very similar dietary niches, but have geographically segregated distributions, with Hyperoodon occupying cold-temperate to polar waters and Ziphius occupying warm-temperate to tropical waters.

Since most toothed whales do not have the fasting capabilities of the baleen whales, toothed whales probably follow seasonal shifts in preferred prey or are opportunistic feeders, taking advantage of whatever prey happens to be in the area. Likewise, Thode et al. (2000) suggested that blue whales might associate with tidal bores, which are known to concentrate zooplankton.

Long-ranging movements are quite common in pinnipeds; hooded seals and northern elephant seals are both good examples, since they make extensive movements. Pinniped movements depend on the abundance of prey, its energy content, and the seasonality of prey distribution (Forcada 2002). Additionally, the pinniped reproductive cycle mandates that individuals return to land or ice to pup (give birth), nurse, and rear their offspring and molt. Pinnipeds will also haul out for resting, thermoregulation, and to escape predators. As with migrating cetaceans, there are variations in the timing of these movements and in the patterns between age classes (Forcada 2002).

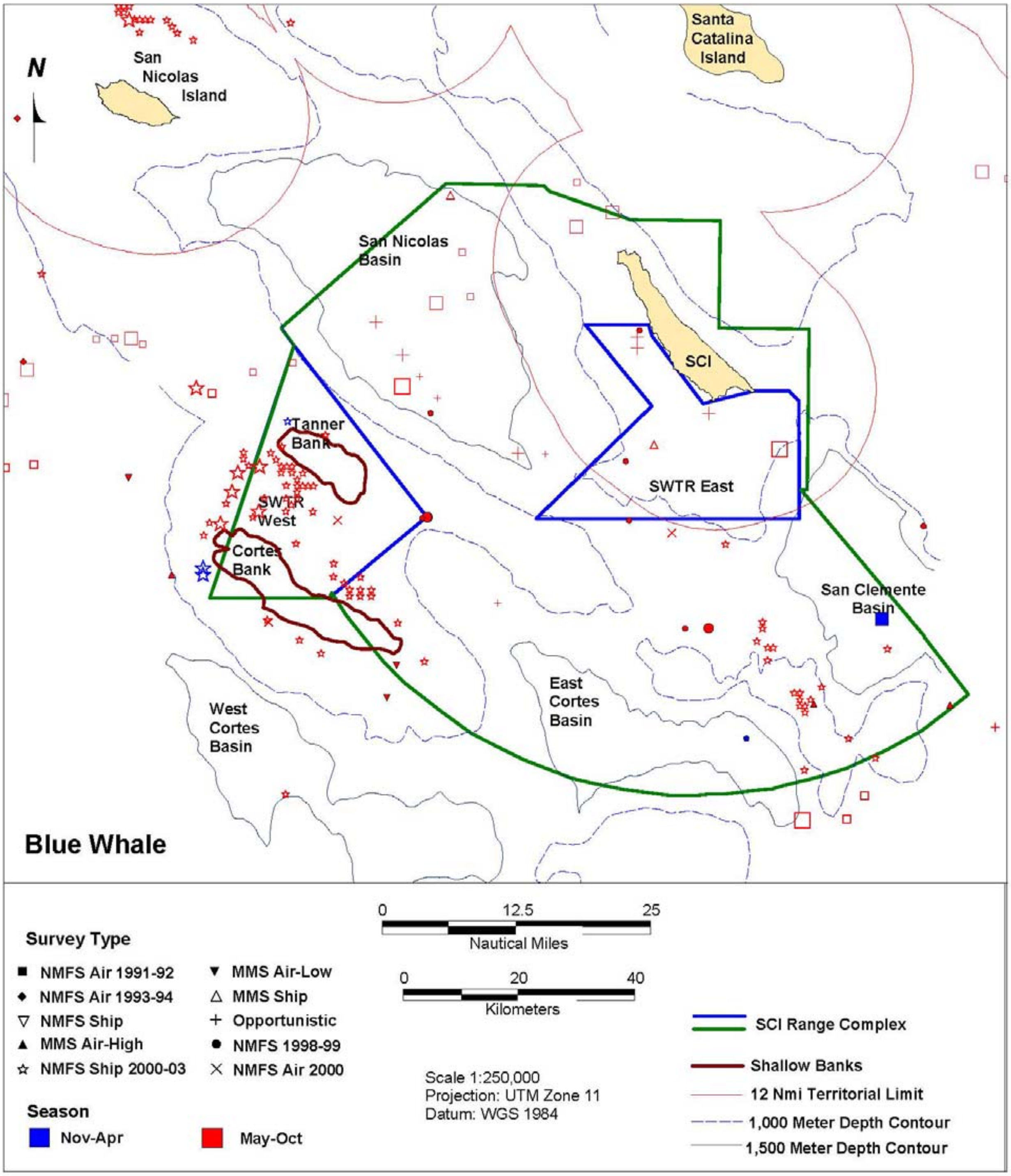
Occurrence of cetaceans outside the area with which they are usually associated may reflect fluctuations in food availability. Some studies have correlated shifts in the distribution of some baleen whale and toothed whale populations with ecological shifts in prey patterns after intense fishing efforts by commercial fisheries in the western North Atlantic (Payne et al. 1986, 1990; Kenney et al. 1996). DeMaster et al. (2001) predicted, based upon current data on human population growth and marine mammal fisheries interactions, that in the future, the most common type of competitive interaction would be ones in which a fishery has an adverse effect on one or more marine mammal populations without necessarily overfishing the target species of the fishery.

Pinniped movements, as noted earlier, are a reflection of both foraging ecology and the need to return to land for the purpose of breeding and molting. Like cetaceans, pinnipeds are often associated with either transient (oceanographic features such as frontal systems) or non-transient, physical features that serve to concentrate prey. Individual seal foraging behavior is probably related to oceanographic features in the water column, such as thermal discontinuities that act to concentrate prey species (Field et al. 2001). McConnell and Fedak (1996) hypothesized that seals out in the open ocean may be influenced by mesoscale frontal systems with locally enhanced prey abundance. Thompson et al. (1991) observed that the spatial and temporal occurrence of feeding harbor seals was in response to fish distribution which also shifts spatially and temporally, with concentrations over trenches and holes more than 10 m deep during daylight hours.

All pinniped species leave the water periodically to haul out on land or ice to molt, sleep, mate, pup, or avoid marine predators (Riedman 1990). The incidence, biological significance, and controlling factors for haul out at other times of the year, when weather is coldest, are essentially unknown (Moulton et al. 2000). For harbor seals, tidal stage has a significant effect on haulout behavior (Schneider and Payne 1983). Human disturbance can affect haulout behavior by causing seals to return to the water, thereby reducing the amount of time mothers spend nursing pups (Moulton et al. 2000; Schneider and Payne 1983).

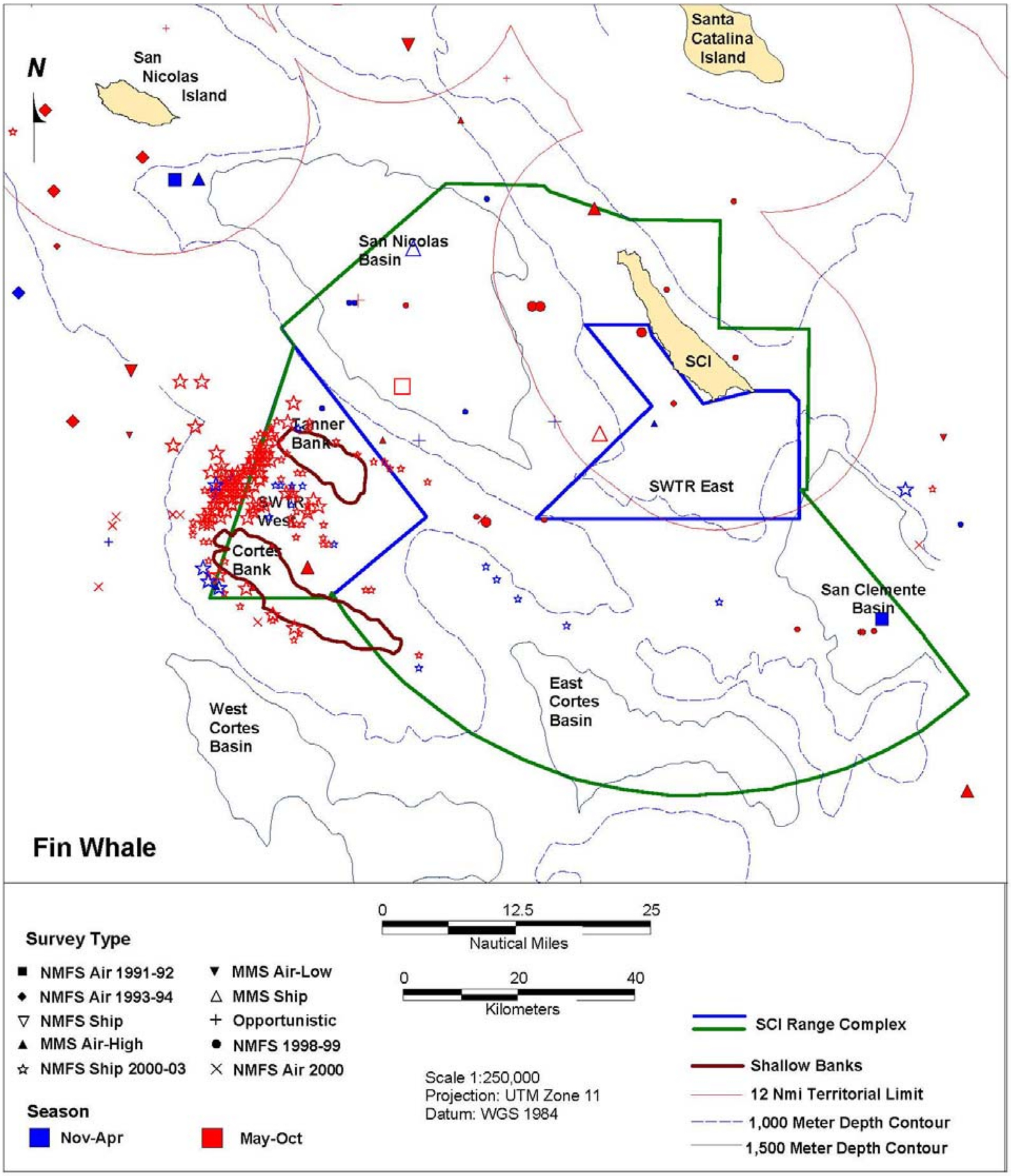
Climatic fluctuations have produced a growing concern about the effects of climate change on marine mammal populations (MacGarvin and Simmonds 1996; IWC 1997; Evans 2002; Würsig et al. 2002). Responses of marine mammals to climate change are difficult to interpret due to the confounding effects of natural responses and human influences. Additionally, the time scale on which marine mammals respond to direct or indirect effects of climate change may be diluted or muted. Large-scale climatic events and long-term temperature change may affect the distribution and abundance of marine mammal species, either impacting them directly or indirectly through alterations of habitat characteristics and distribution or prey availability (Kenney et al. 1996; IWC 1997; Harwood 2001; Greene and Pershing 2004). The impacts on pinnipeds and other marine mammals during the 1982/1983 El Niño event differed from region to region, but generally included a diminished food supply for the species. For example, sea lions in the southern California region were less successful in obtaining sufficient food of good quality, even on more extensive foraging trips (Feldkamp et al. 1991). The loss of food induced by warm waters resulted in nutritionally stressed adult females with pups and lower milk production, leading to a higher mortality rate among sea lion pups and juveniles and lower pup growth rates. This pattern was again evident in the 1997/1998 El Niño event (Hayward 2000). Similar patterns indicative of reduced foraging success and increased nutritional stress are also evident in elephant seals in central California during the cyclic warming periods (Le Boeuf and Crocker 2005). Decreased squid abundance during El Niño events has been attributed to shifts in marine mammal distribution and abundance. For example, short-finned pilot whales virtually disappearing from the Santa Catalina Island area and being replaced by Risso's dolphins (Shane 1994, 1995). In Monterey Bay, following the onset of El Niño 1997/1998, both the diversity and abundance of toothed whales in Monterey Bay increased (Benson et al. 2002). The increase in diversity was caused by an influx of warm-water species coupled with the persistence of temperate species typically found off central California (Benson et al. 2002).

The distribution of each marine mammal species in the applicable parts of Southern California is presented in Figures 2-5- to 2-20, mapped using marine mammal data available through 2003, as described in Section 2.4.



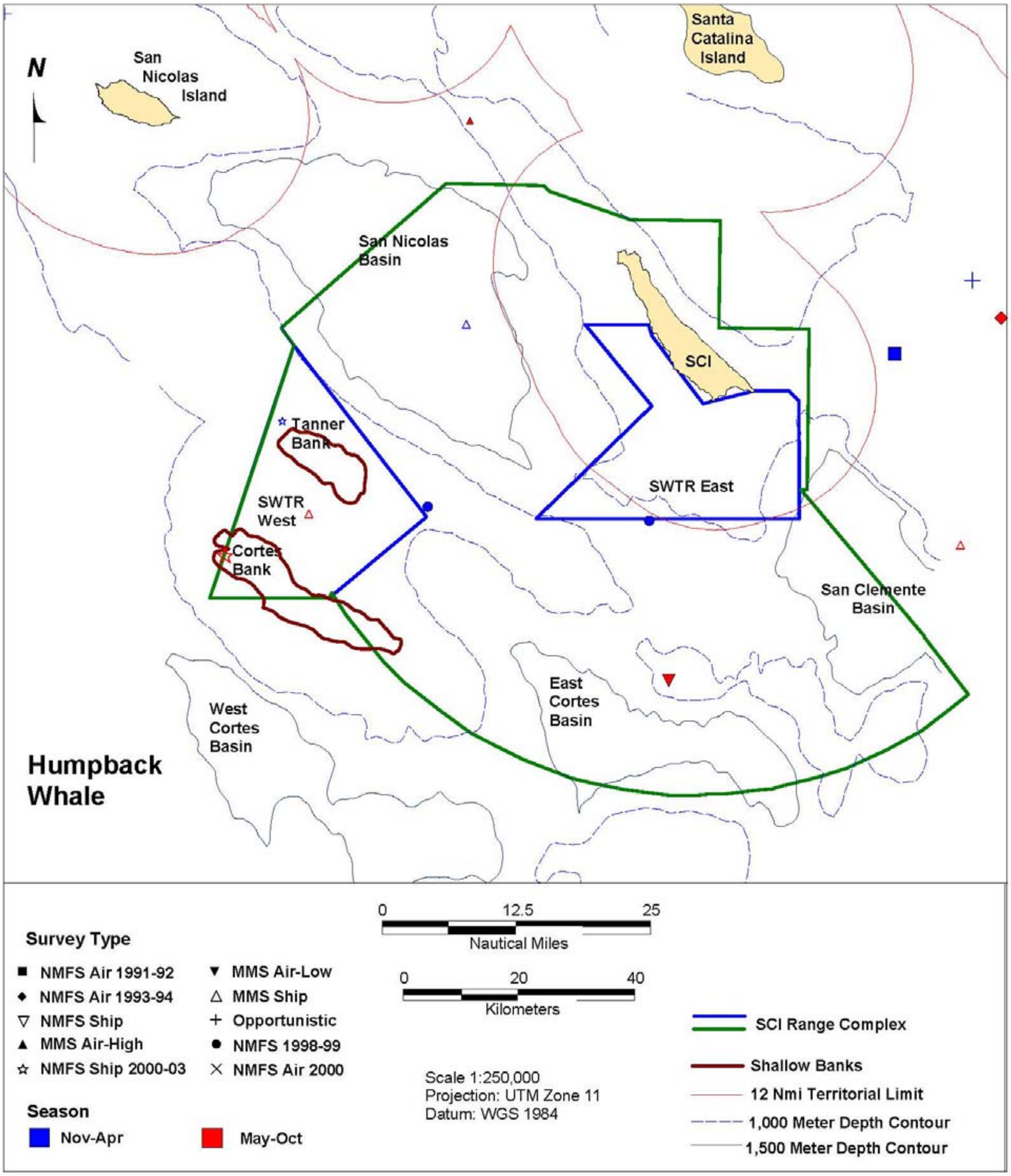
Small symbols are sightings of 1-10 individuals and large symbols are sightings of >10 individuals

Figure 2-5. Sightings of Blue Whales during Cold-water and Warm-water Seasons 1975–2003



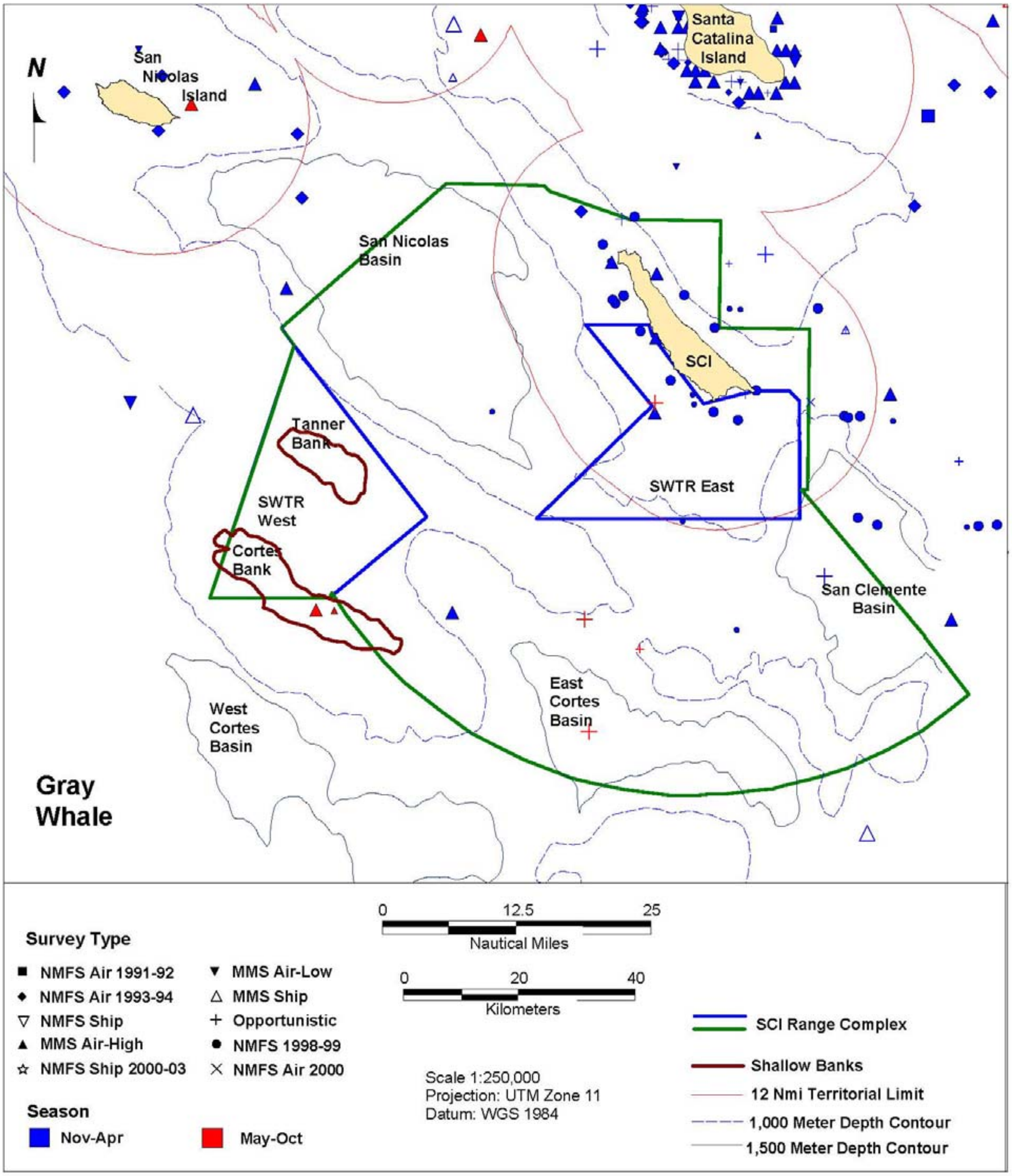
Small symbols are single sightings and large symbols are sightings of >2 individuals.

Figure 2-6. Sightings of Fin Whales during Cold-water and Warm-water Seasons 1975–2003



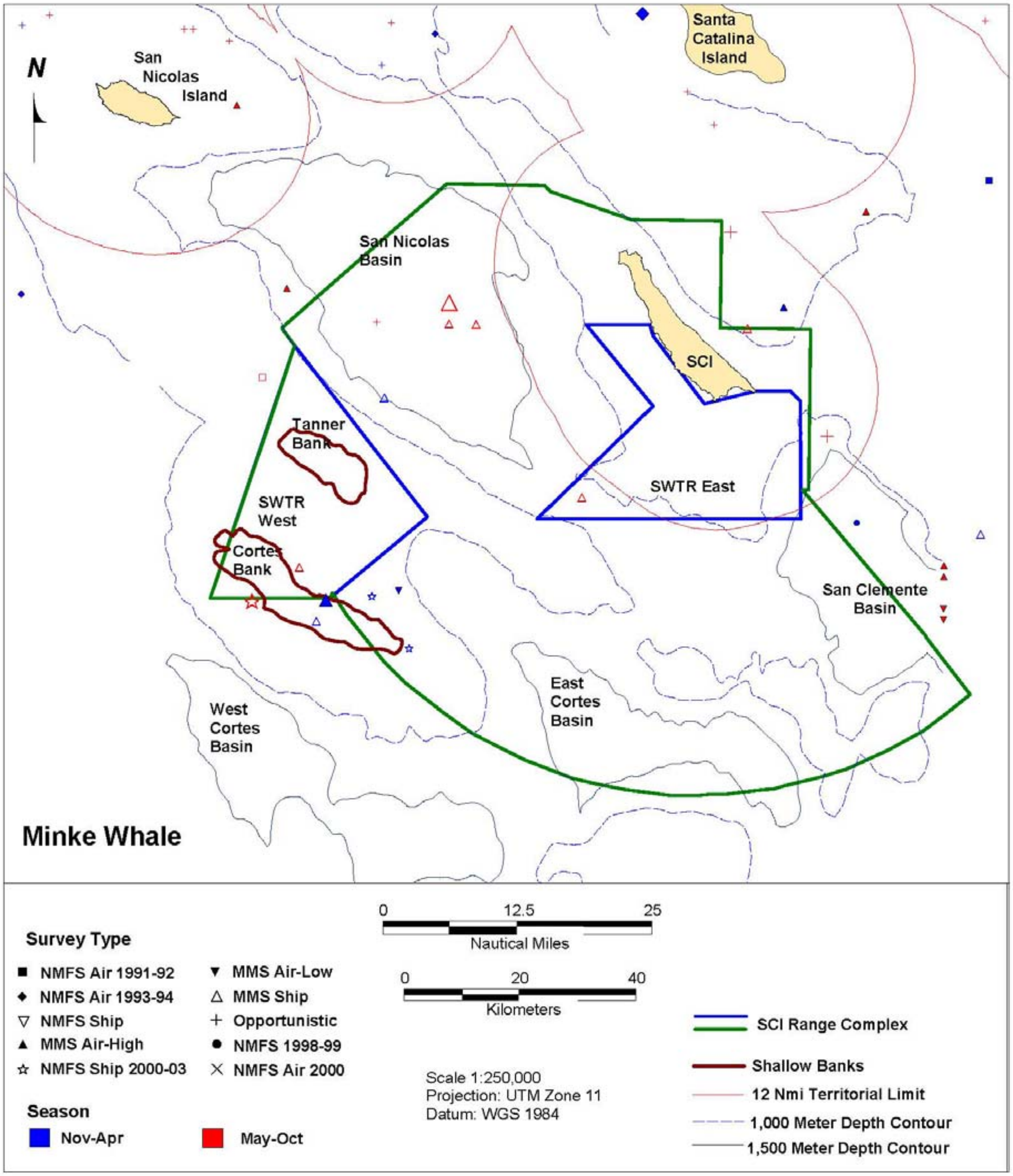
Small symbols are sightings of 1-10 individuals and large symbols are sightings of >10 individuals

Figure 2-7. Sightings of Humpback Whales during Cold-water and Warm-water Seasons 1975–2003



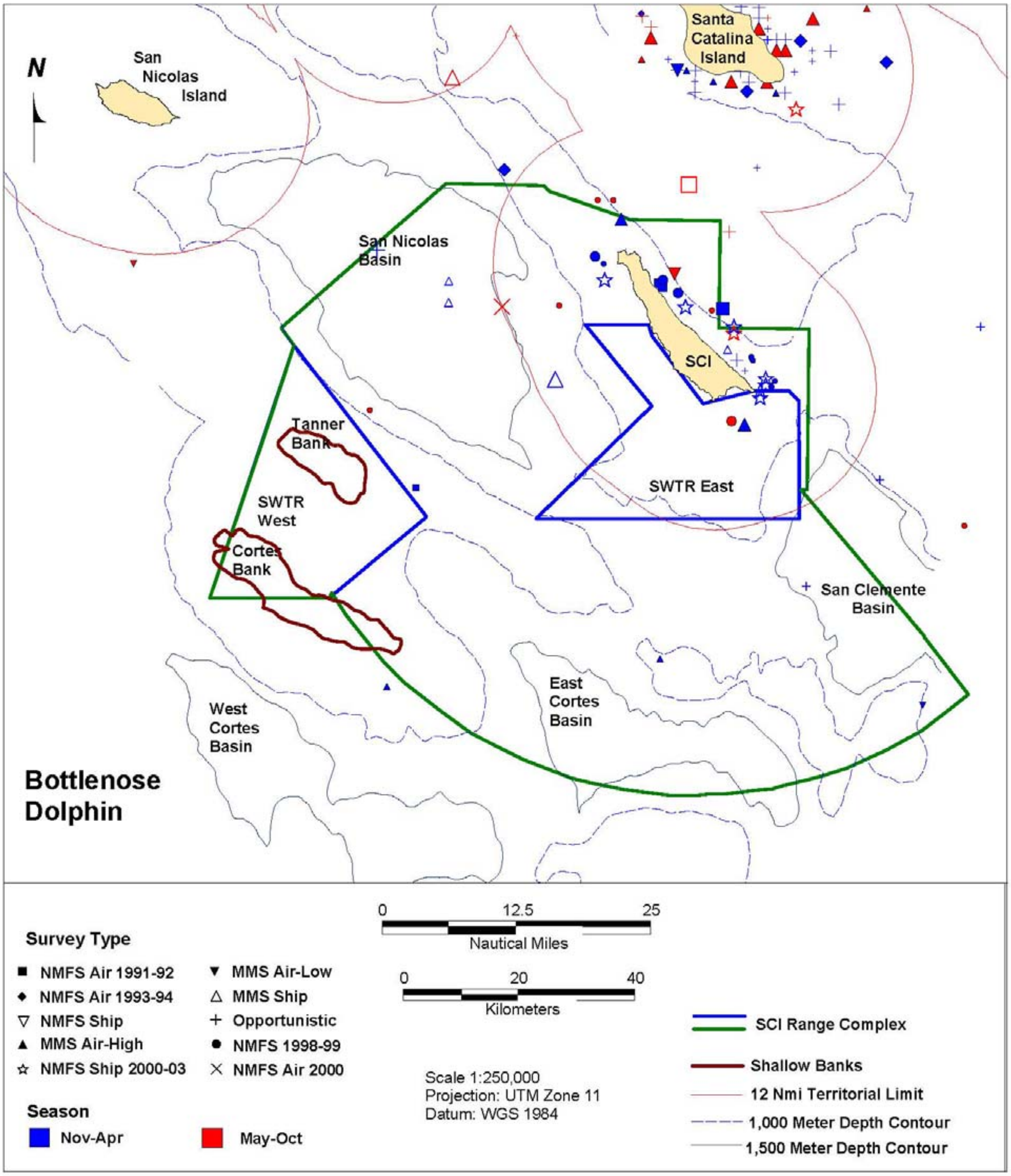
Small symbols are sightings of 1-10 individuals and large symbols are sightings of >10 individuals

Figure 2-8. Sightings of Gray Whales during Cold-water and Warm-water Seasons 1975–2003



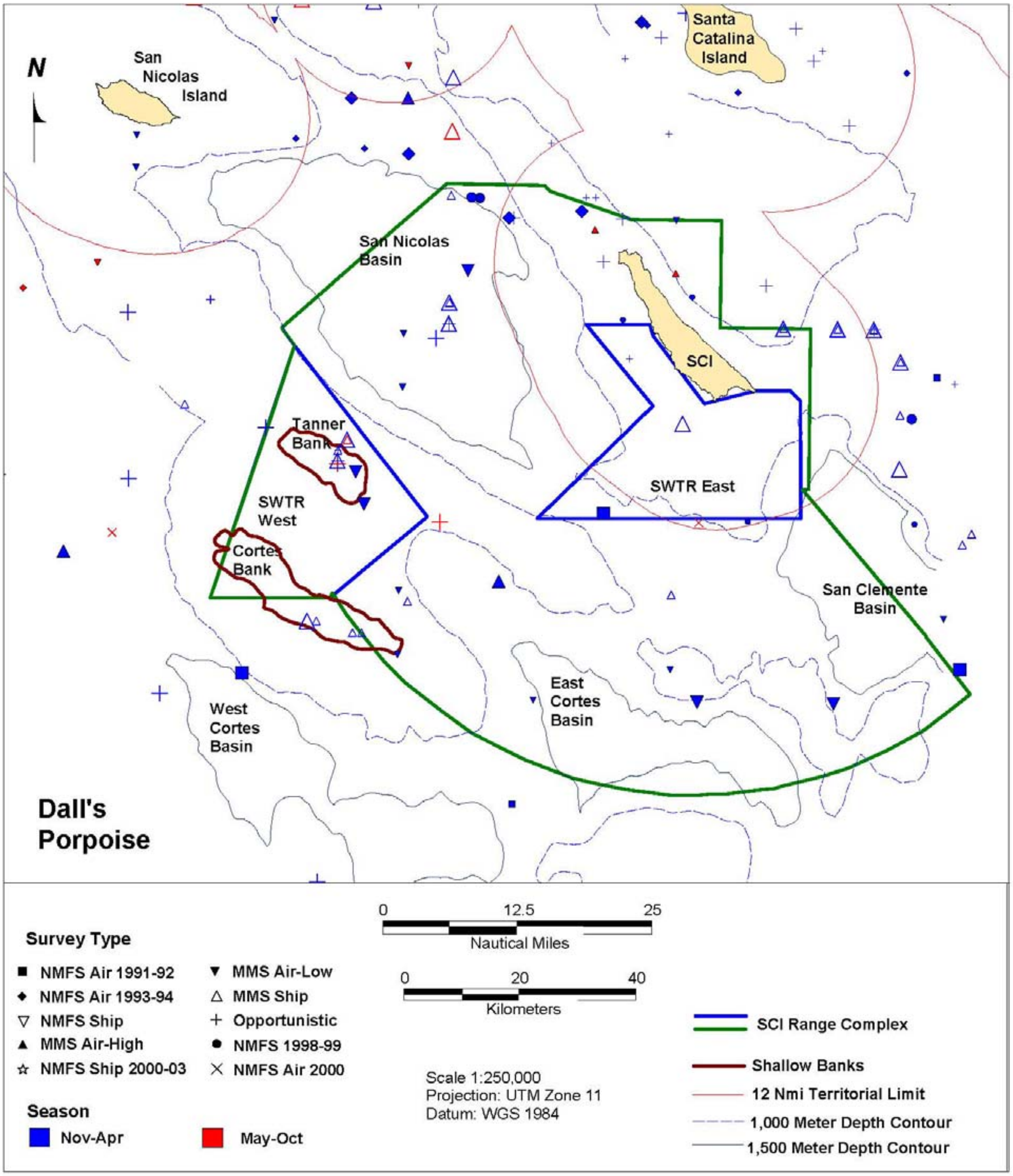
Small symbols are single sightings and large symbols are sightings of >2 individuals.

Figure 2-9. Sightings of Minke Whales during Cold-Water and Warm-Water Seasons 1975–2003



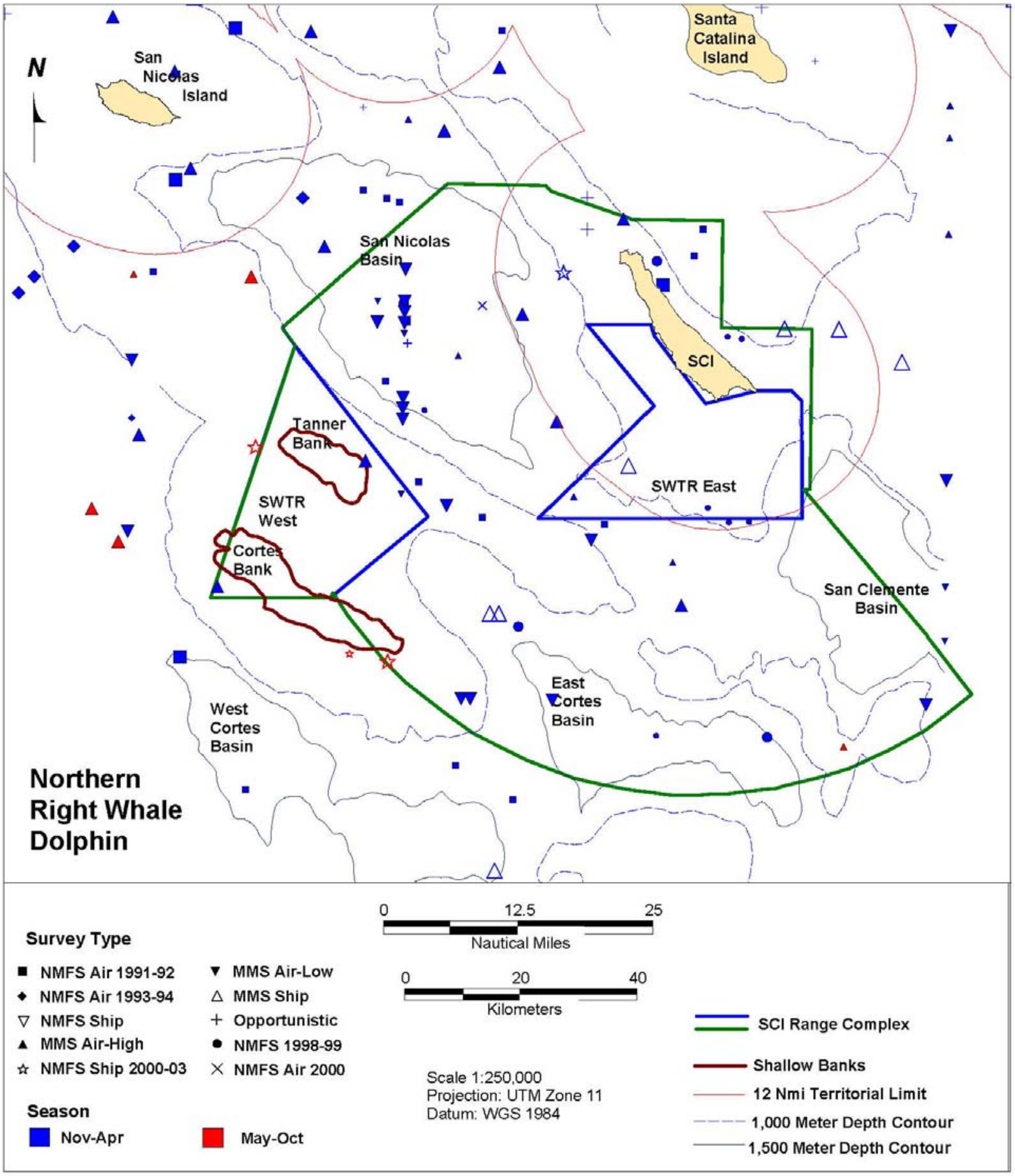
Small symbols are sightings of 1-10 individuals and large symbols are sightings of >10 individuals.

Figure 2-10. Sightings of Bottlenose Dolphins during the Cold-water and Warm-water Seasons 1975–2003



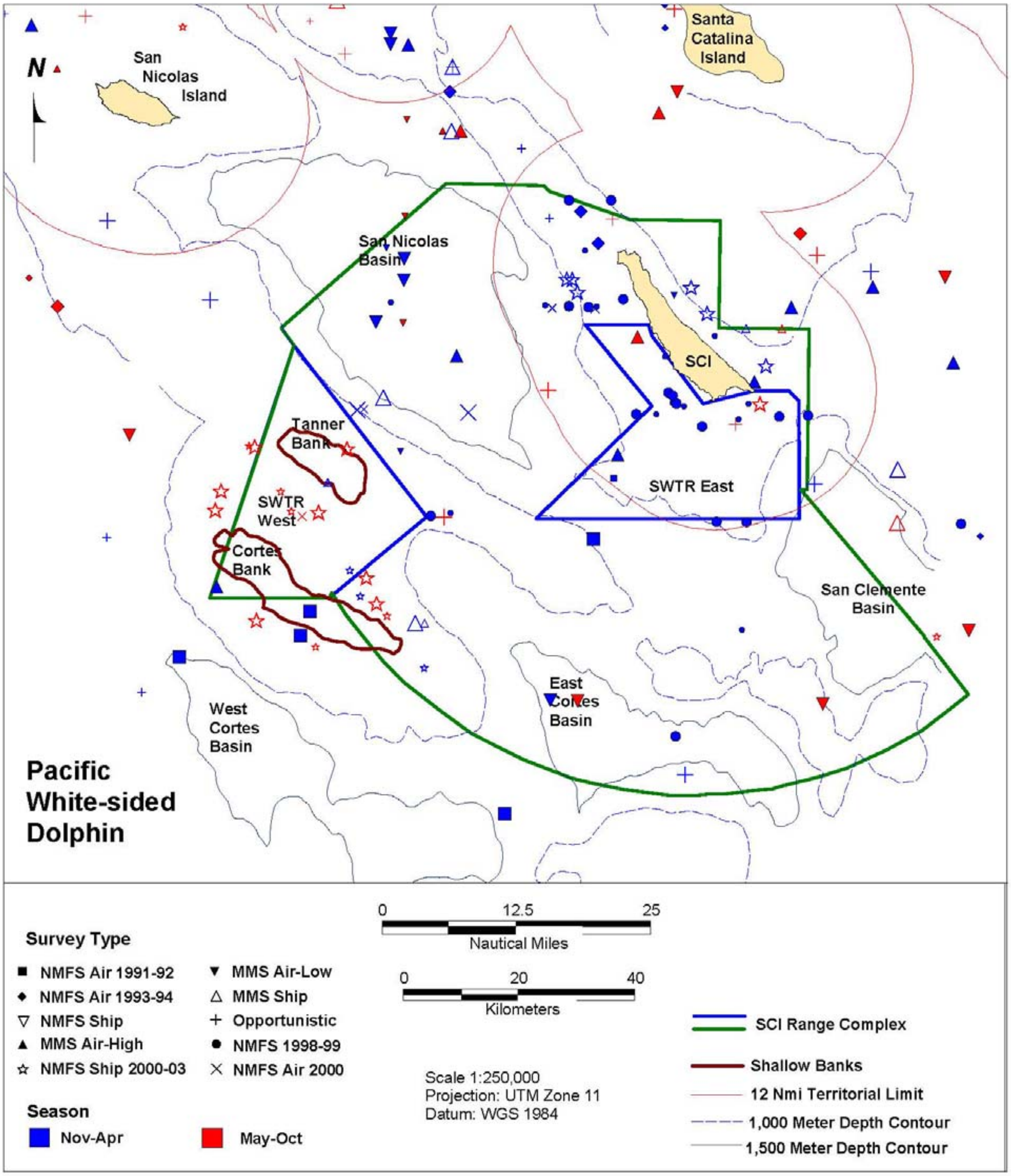
Small symbols are sightings of 1-10 individuals and large symbols are sightings of >10 individuals.

Figure 2-11. Sightings of Dall's Porpoises during the Cold-Water and Warm-Water Seasons 1975–2003



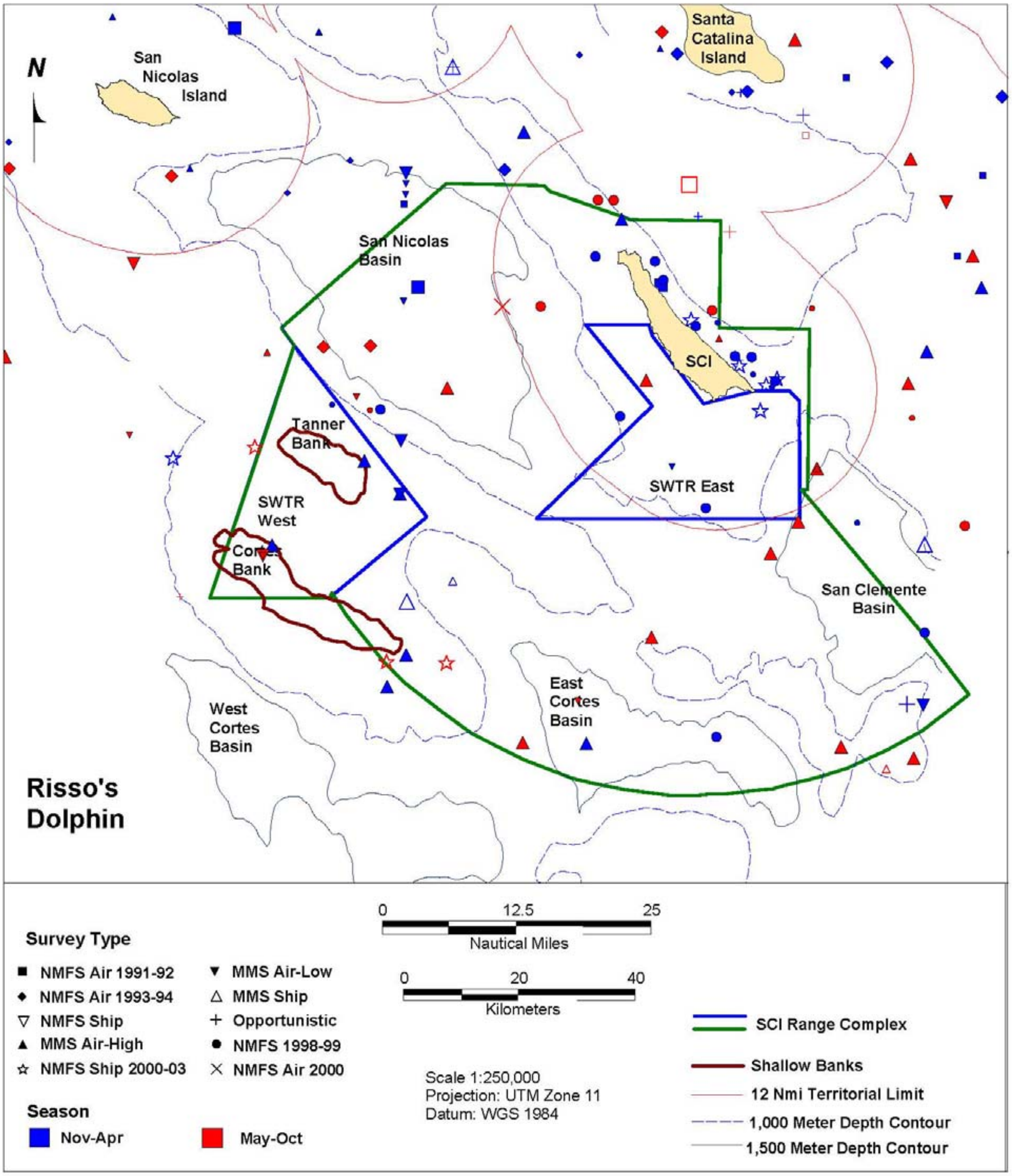
Small symbols are sightings of 1-10 individuals and large symbols are sightings of >10 individuals.

Figure 2-12. Sightings of Northern Right Whale Dolphins during Cold-water and Warm-water Seasons 1975–2003



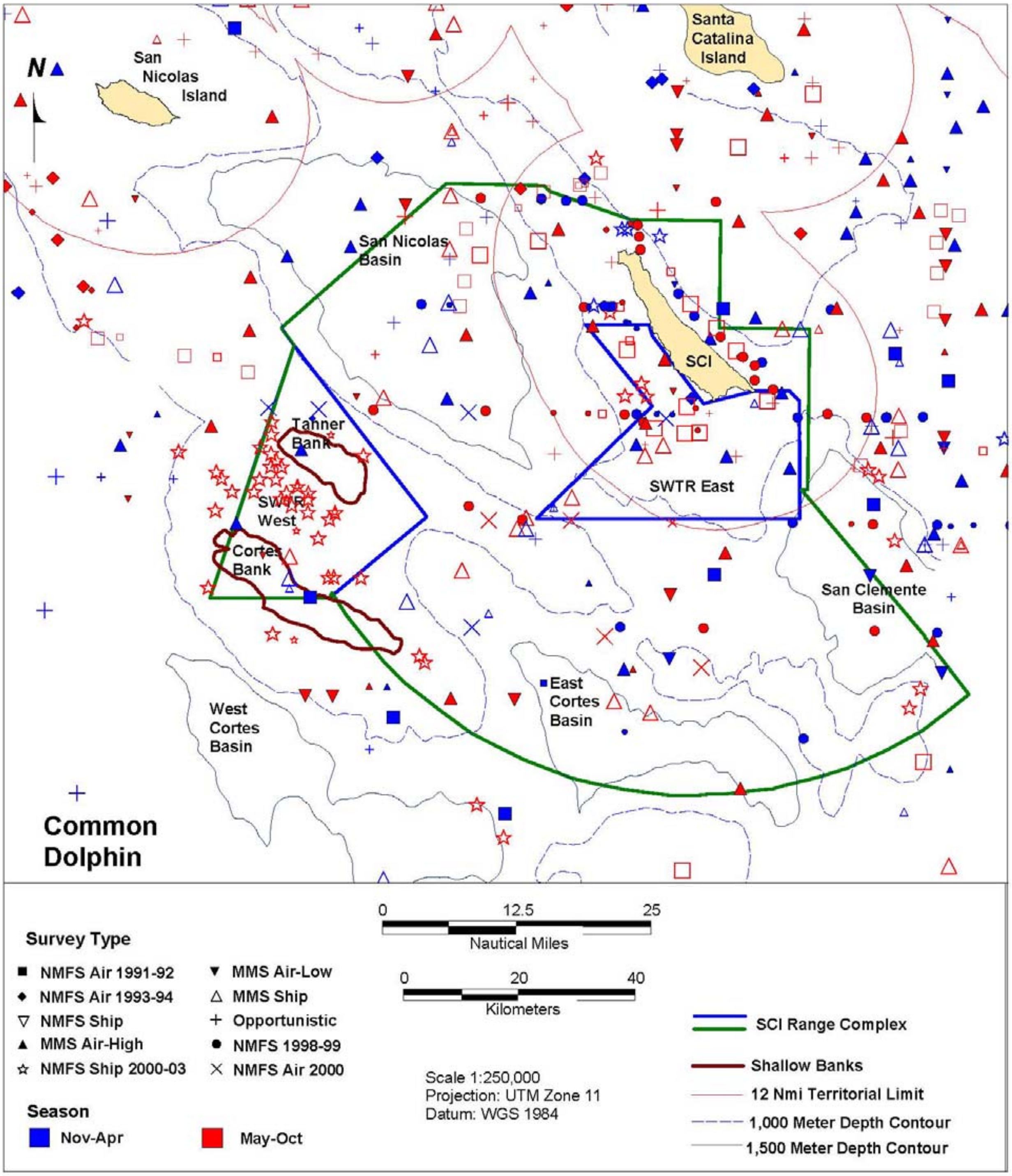
Small symbols are sightings of 1-10 individuals and large symbols are sightings of >10 individuals.

Figure 2-13. Sightings of Pacific White-sided Dolphins during the Cold-water and Warm-water Seasons 1975–2003



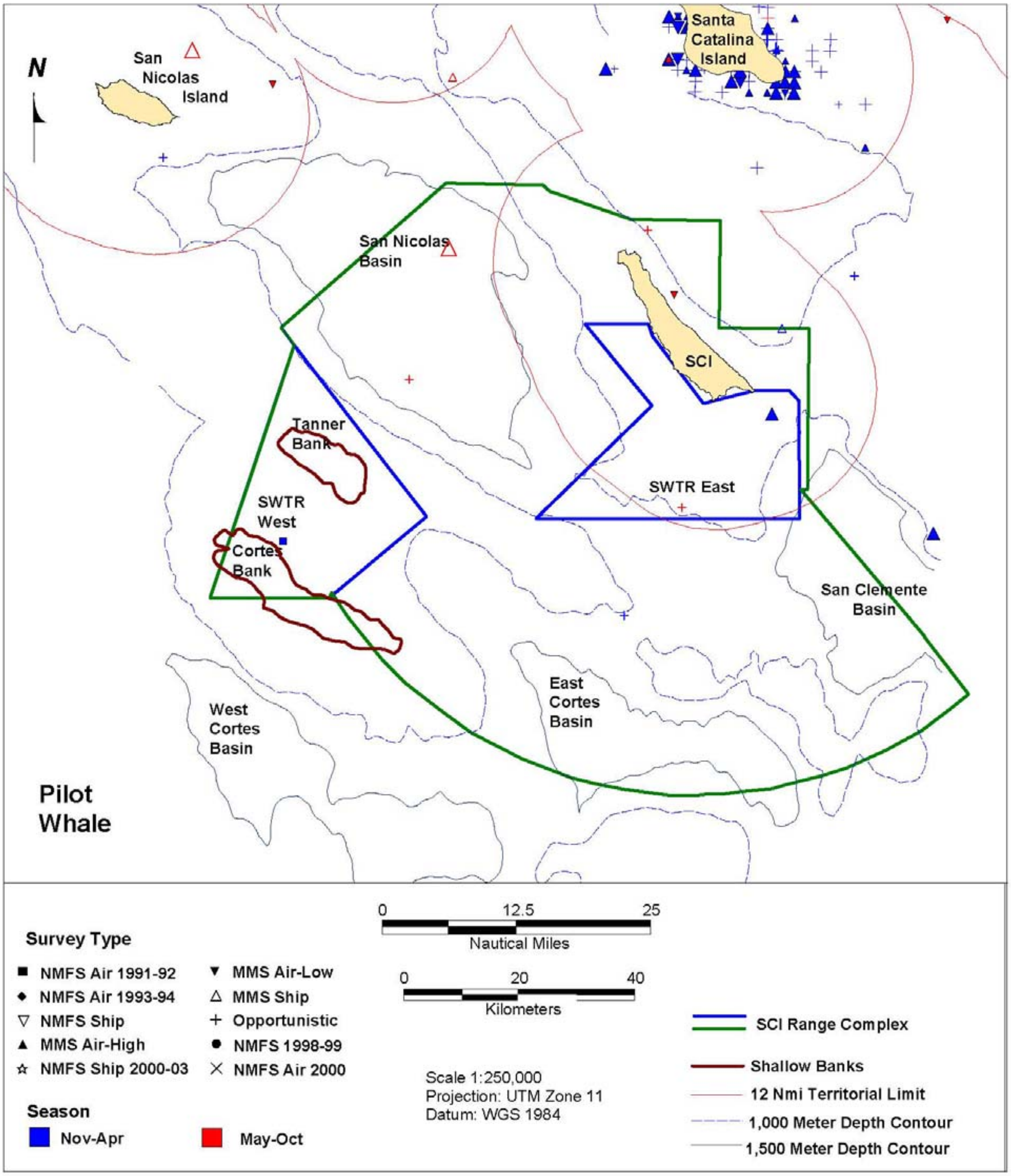
Small symbols are sightings of 1-10 individuals and large symbols are sightings of >10 individuals.

Figure 2-14. Sightings of Risso's Dolphins during the Cold-water and Warm-water Seasons 1975–2003



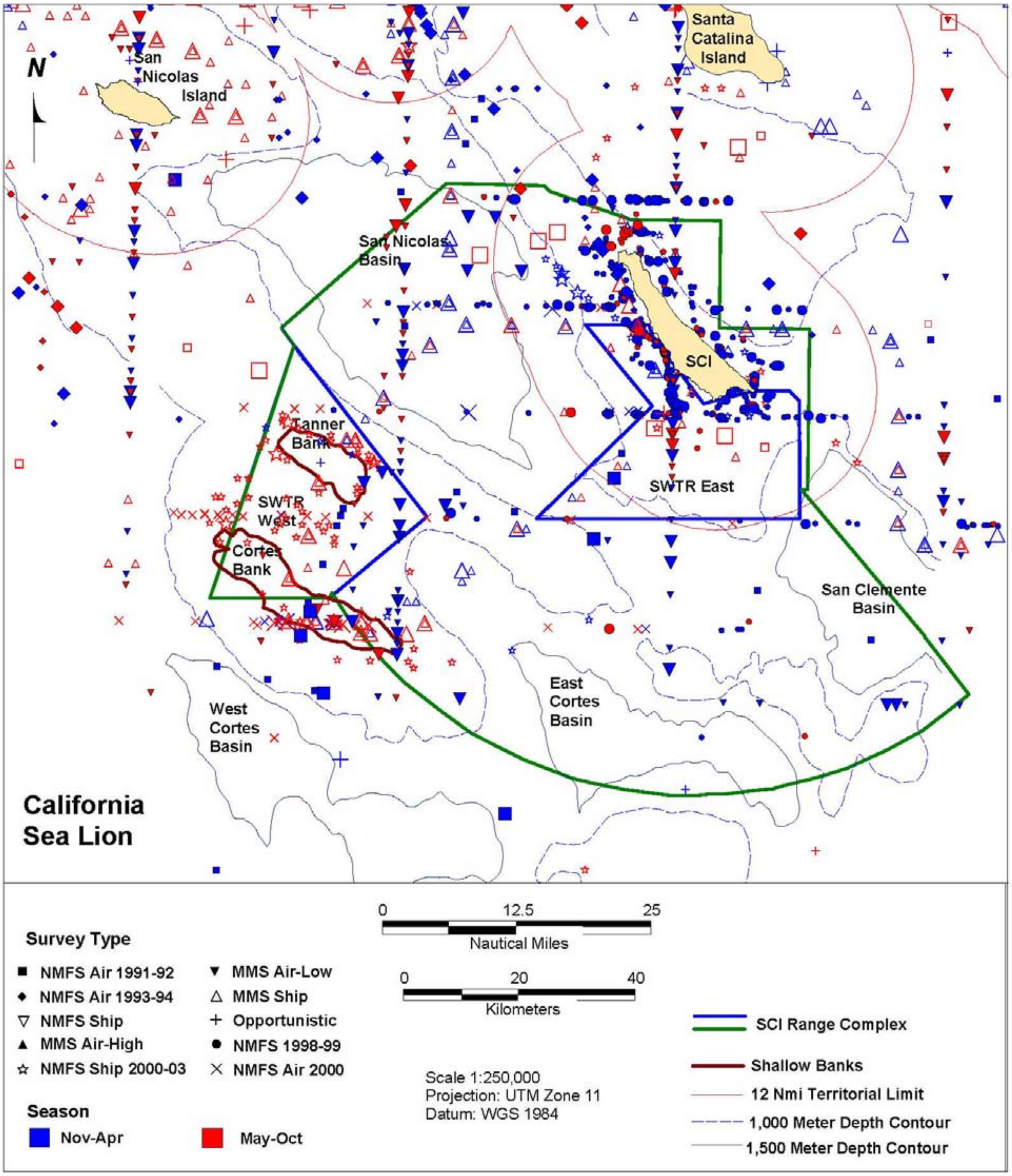
Small symbols are sightings of 1-10 individuals and large symbols are sightings of >10 individuals.

Figure 2-15. Sightings of Common Dolphins during the Cold-water and Warm-water Seasons 1975–2003



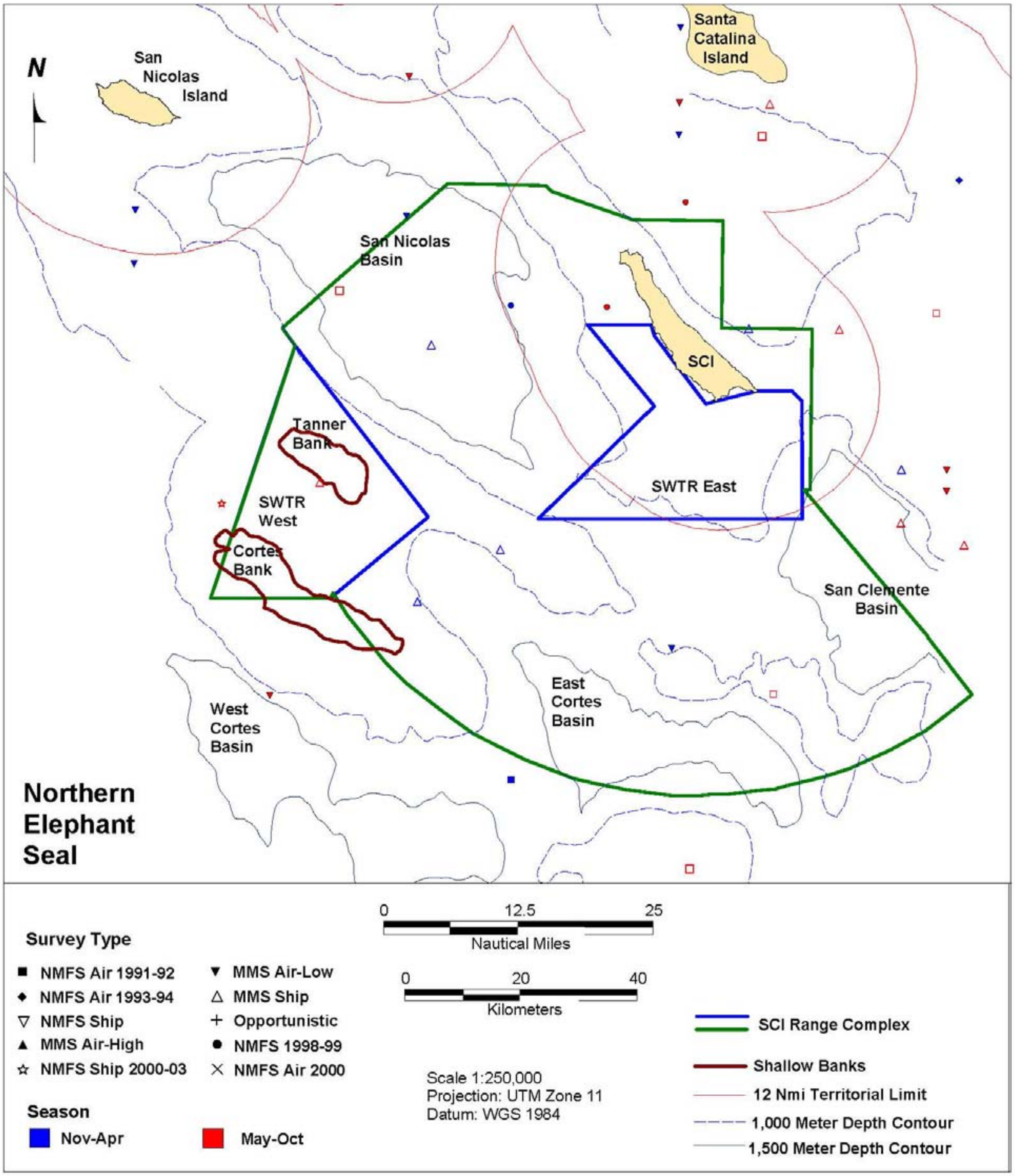
Small symbols are sightings of 1-10 individuals and large symbols are sightings of >10 individuals

Figure 2-16. Sightings Of Short-Finned Pilot Whales During Cold-Water And Warm-Water Seasons 1975–2003



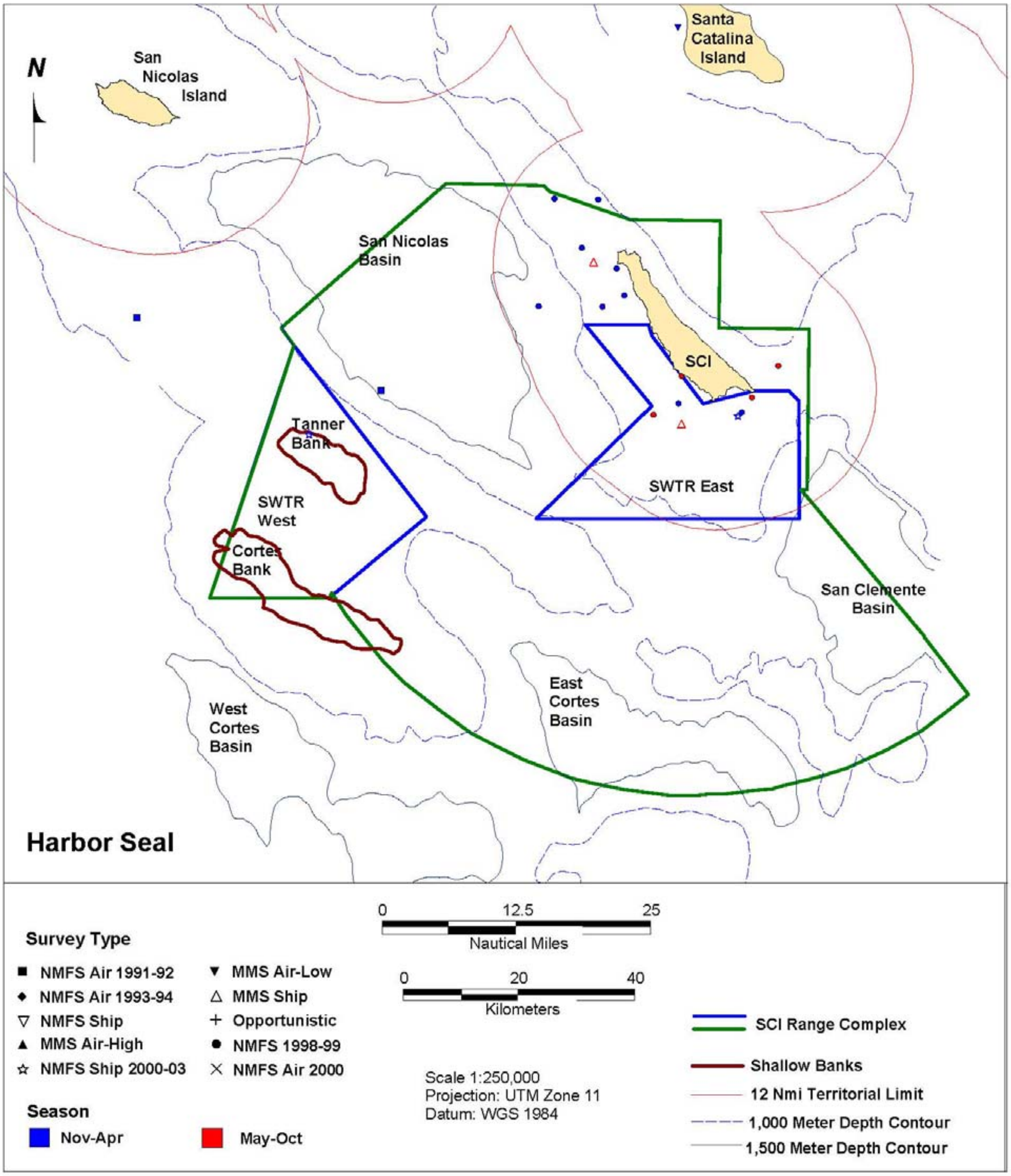
Small symbols are single sightings and large symbols are sightings of >2 individuals

Figure 2-17. Sightings Of California Sea Lions During The Cold-Water And Warm-Water Season 1975–2003



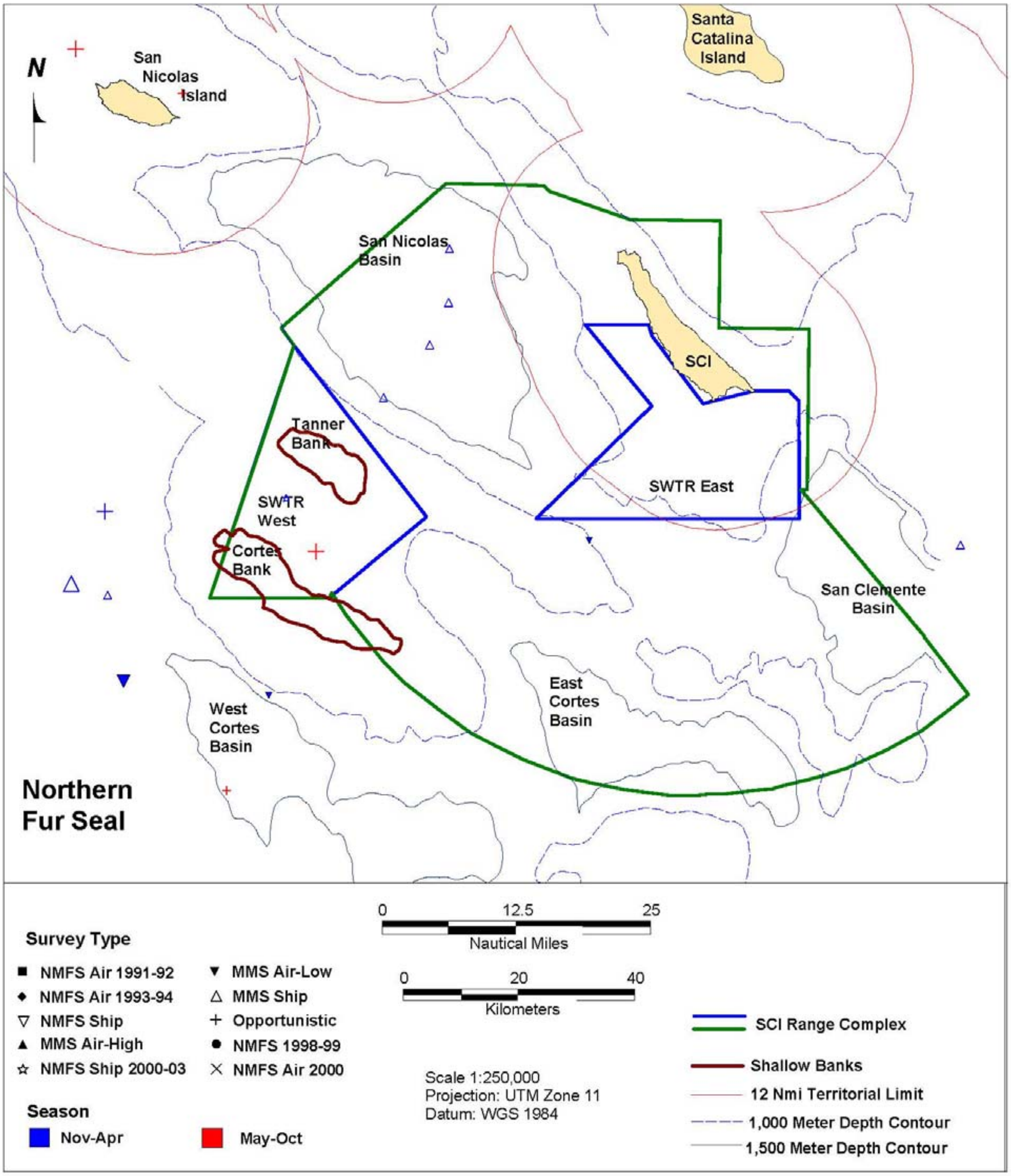
Small symbols are single sightings and large symbols are sightings of >2 individuals.

Figure 2-18. Sightings Of Northern Elephant Seals During Cold-Water And Warm-Water Seasons 1975–2003



Small symbols are single sightings and large symbols are sightings of >2 individuals.

Figure 2-19. Sightings Of Pacific Harbor Seals During Cold-Water And Warm-Water Seasons 1975–2003



Small symbols are single sightings and large symbols are sightings of >2 individuals

Figure 2-20. Sightings of Northern Fur Seals During Cold-Water And Warm-Water Seasons 1975–2003

2.3.1 Marine Mammal Abundance and Density Estimates for Southern California

Marine mammal species occurring off southern California include baleen whales (mysticetes), toothed whales (odontocetes), seals and sea lions (commonly referred to as pinnipeds), and sea otters. Baleen and toothed whales, collectively known as cetaceans, spend their entire lives in the water and spend most of the time (>90% for most species) entirely submerged below the surface. When at the surface, cetacean bodies are almost entirely below the water's surface, with only the blowhole exposed to allow breathing. This makes cetaceans difficult to locate visually and also exposes them to underwater noise, both natural and anthropogenic, essentially 100% of the time because their ears are nearly always below the water's surface. Seals and sea lions (pinnipeds) spend significant amounts of time out of the water during breeding, molting and hauling out periods. In the water, pinnipeds spend varying amounts of time underwater, as some species regularly undertake long, deep dives (e.g., elephant seals) and others are known to rest at the surface in large groups for long amounts of time (e.g., California sea lions). When not actively diving, pinnipeds at the surface often orient their bodies vertically in the water column and often hold their heads above the water surface. Consequently, pinnipeds may not be exposed to underwater sounds to the same extent as cetaceans. Sea otters generally do not spend significant amounts of time on land, but they also often hold their heads above the water's surface, reducing the amount of exposure to underwater noise.

For the purposes of this analysis, we have adopted a conservative approach to underwater noise and marine mammals:

Cetaceans – assume 100% of time is spent underwater and therefore exposed to noise

Pinnipeds – adjust densities to account for time periods spent at breeding areas, haulouts, etc.; but for those animals in the water, assume 100% of time is spent underwater and therefore exposed to noise

Sea otters – assume 100% of time is spent underwater and therefore exposed to underwater noise.

2.3.1.1 Density

The southern California region has been systematically surveyed for several years (1991-1993, 1996, 2001, 2005) by the National Marine Fisheries Service (NMFS), both via aircraft (e.g., Carretta and Forney, 1993) and vessel (e.g., Ferguson and Barlow, 2003; Barlow, 2003; Forney, 2007). Line-transect methods were used to analyze data collected from Southwest Fisheries Science Center (SWFSC) ship surveys in 1991, 1993, 1996, 2001, and 2005 off the U.S. west coast. A new multiple-covariate, line-transect approach (Marques and Buckland, 2003) was used to account for multiple factors that affect the distance at which cetaceans can be seen in different conditions. The most recent vessel survey was conducted in the US Exclusive Economic Zone (EEZ) and out to 300 nm offshore California, Oregon and Washington by NMFS in summer and fall 2005 (Forney, 2007). There has also been regional survey effort in the area, particularly around San Clemente Island and in extreme near shore areas (e.g., Carretta et al., 2000; Carretta, 2003). Consequently there are several density estimates available for most cetacean species in southern California. Compiled densities from vessel surveys conducted since 1986 have been analyzed by NMFS, and were provided as Government Furnished Information (GFI). Density calculation procedures and protocols used by NMFS for this analysis are described in Barlow (2007), Barlow and Forney (2007), and Forney (2007). These density compilations prorate densities of "unidentified" species groups (such as unidentified dolphins, small whales, rorquals, large whales, etc) with densities of identified species, so likely represent the most conservative densities at this time for the southern California region. Densities are presented for warm (May-

October) and cold water (November-April) seasons in water depths >1000 m north of 30°N. Gray whale densities were taken from Carretta et al. (2000), and are applicable for January-April only. Species with rare or extralimital occurrence off southern California are included in the species summaries; however, there are no densities available and they are not included in Table 2-1. The geographic distributions of cetacean species for which densities are available in this area overlap completely with all eight sonar areas (shown in Figure 2-21), so further refinement of densities to sonar areas was not necessary. Area 8, includes all areas outside the previous seven areas that are within the quasi-rectangular region bounded in latitude by 29^{o} N and 34^{o} N, and in longitude by 120^{o} 30' W and 116^{o} 30' W but is not shown on Figure 2-21.

Pinniped at-sea density is not often available because pinniped abundance is obtained via shore counts of animals at known rookeries and haulouts. Therefore, densities of pinnipeds were derived quite differently from those of cetaceans. Several parameters were identified from the literature, including area of stock occurrence, number of animals (which may vary seasonally) and season, and those parameters were then used to calculate density. Once density per "pinniped season" was determined, those values were prorated to fit the warm water (May-October) and cold water (November-April) seasons. Pinniped geographic distributions do not overlap all sonar areas, so density was further refined as the percentage of each sonar area actually overlapped by the species distribution. Determining density in this manner is risky as the parameters used usually contain error (e.g., geographic range is not exactly known and needs to be estimated, abundance estimates usually have large variances) and, as is true of all density estimates, it assumes that animals are always distributed evenly within an area which is likely never true. However, this remains one of the few means available to determine at-sea density for pinnipeds.

Sea otters occur along the central California coast and there is an experimental population of relocated otters at San Nicolas Island.

2.3.1.2 Depth Distribution

There are limited depth distribution data for most marine mammals. This is especially true for cetaceans, as they must be tagged at-sea and by using a tag that either must be implanted in the skin/blubber in some manner or adhere to the skin. There is slightly more data for some pinnipeds, as they can be tagged while on shore during breeding or molting seasons and the tags can be glued to the pelage rather than implanted. There are a few different methodologies/techniques that can be used to determine depth distribution percentages, but by far the most widely used technique currently is the time-depth recorder. These instruments are attached to the animal for a fairly short period of time (several hours to a few days) via a suction cup or glue, and then retrieved immediately after detachment or when the animal returns to the beach. Depth information can also be collected via satellite tags, sonic tags, digital tags, and, for sperm whales, via acoustic tracking of sounds produced by the animal itself.

There are somewhat suitable depth distribution data for a few marine mammal species. Sample sizes are usually extremely small, nearly always fewer than 10 animals total and often only one or two animals. Depth distribution information often must be interpreted from other dive and/or preferred prey characteristics. Depth distributions for species for which no data are available are extrapolated from similar species.

2.3.1.3 Density And Depth Distribution Combined

Density is nearly always reported for an area, e.g., animals/km^2. Analyses of survey results using Distance Sampling techniques include correction factors for animals at the surface but not seen as well as animals below the surface and not seen. Therefore, although the area (e.g., km^2) appears to represent only the surface of the water (two-dimensional), density actually implicitly includes animals anywhere within the water column under that surface area. Density assumes that animals are uniformly distributed within the prescribed area, even though this is likely rarely true. Marine mammals are usually clumped in areas of greater importance, for example, areas of high productivity, lower predation, safe calving, etc. Density can occasionally be calculated for smaller areas that are used regularly by marine mammals, but more often than not there are insufficient data to calculate density for small areas. Therefore, assuming an even distribution within the prescribed area remains the norm.

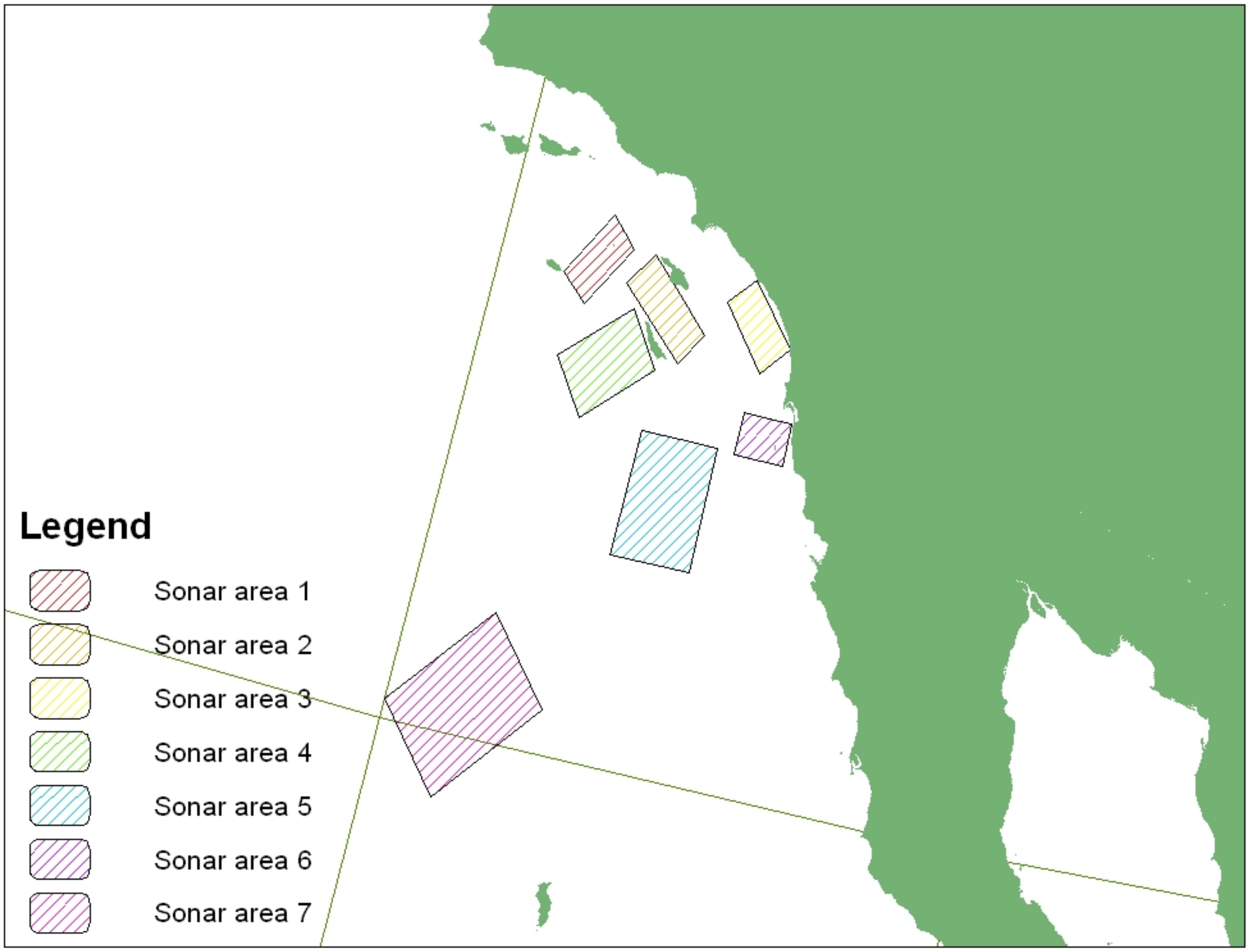


Figure 2-21. Sonar Modeling Areas

Assuming that marine mammals are distributed evenly within the water column is not accurate. The ever-expanding database of marine mammal behavioral and physiological parameters obtained through tagging and other technologies has demonstrated that marine mammals use the water column in various ways, with some species capable of regular deep dives (<800 m) and others regularly diving to <200 m, regardless of the bottom depth. Assuming that all species are evenly distributed from surface to bottom is almost never appropriate and can present a distorted view of marine mammal distribution in any region.

By combining marine mammal density with depth distribution information, a more accurate three-dimensional density estimate is possible. These 3-D estimates allow more accurate modeling of potential marine mammal exposures from specific noise sources. The Marine Resource Assessment (MRA) for the Southern California Operating Area lists 45 marine mammals in the "vicinity" of the Range Complex (Department of the Navy 2005). However, several of the species listed in the MRA are rare or extralimital in southern California waters and do not regularly occur. Only species with regular occurrence and for which density is available are included in Table 2-3.

Table 2-3. Summary of marine mammal densities used for exposure modeling.

Species Name	Warm Season density/km^2	Cold Season density/km^2	Source	Notes
ESA Species				
Blue whale	0.0041222	0.0041222	Barlow (2007)	
Fin whale	0.0024267	0.0008008	Barlow (2007)	
Humpback whale	0.0001613	0.0000984	Barlow (2007)	
Sei whale	0.0000081	0.000005	Barlow (2007)	
Sperm whale	0.0014313	0.0008731	Barlow (2007)	
Guadalupe fur seal	0.007	0.007	Gallo-Reynoso (1994)	Applicable to 100% of the seven sonar areas; unknown % in area 8
California sea otter	0.3	0.3	US Fish and Wildlife Service (2003)	Applicable to 0.06% of sonar area 1 and 0% of areas 2,3,4,5,6,7; unknown % of area 8
MYSTICETES				
Bryde's whale	0.0000081	0.0000081	Barlow (2007)	
Gray whale	0	0.051	Carretta et al. (2000)	Applies to Jan-Apr only
Minke whale	0.0010313	0.0010313	Barlow (2007)	
ODONTOCETES				
Baird's beaked whale	0.0001434	0.0001434	Barlow (2007)	
Bottlenose dolphin	0.0123205	0.0184808	Barlow (2007)	
Cuvier's beaked whale	0.0036883	0.0036883	Barlow (2007)	
Dall's porpoise	0.0016877	0.0081008	Barlow (2007)	
Killer whale	0.0000812	0.0000812	Barlow (2007)	
Long-beaked common dolphin	0.0965747	0.0366984	Barlow (2007)	
Mesoplodonts	0.0011125	0.0011125	Barlow (2007)	
Northern right whale dolphin	0.0056284	0.0270163	Barlow (2007)	
Pacific white-sided dolphin	0.0160748	0.0160748	Barlow (2007)	
Pygmy sperm whale	0.0013785	0.0013785	Barlow (2007)	
Short-finned pilot whale	0.0003315	0.0003315	Barlow (2007)	
Risso's dolphin	0.0180045	0.0540134	Barlow (2007)	
Short-beaked common dolphin	0.8299606	0.315385	Barlow (2007)	
Striped dolphin	0.0175442	0.0107019	Barlow (2007)	
Ziphiid whales	0.0008214	0.0008214	Barlow (2007)	
PINNIPEDS				
Northern elephant seal	0.042	0.025	Caretta et al. (2007); Lowry (2002)	Applicable to 100% of sonar areas 1 and 2, 94% of area 3, 18% of area 4 and 0% of areas 5,6,7; unknown % in area 8
Harbor seal	0.19	0.19	Lowry et al. (2005)	Applicable to 4% of sonar area 1, 20% of area 2, 5% of area 4, and 0% of areas 3,5,6,7; unknown % in area 8
California sea lion	0.605	0.87	Lowry and Maravilla-Chavez (2005)	Applicable to 100% of sonar areas 1,2,3 and 6; 49% of area 4, 62% of area 5 and 0% of area 7; unknown % in area 8
Northern fur seal	0.027	0.027	National Marine Fisheries Service (2006); Carretta et al. (2007)	applicable to 0% of the seven OPAREA sonar areas; unknown % in area 8

Lowry 2002, Lowry et al. (2005), Barlow (2007), and Carretta et al. (2007) are government furnished information from NMFS reports or technical memorandum. Warm season = May – September Cold season = November - April

2.4 CETACEAN STRANDINGS AND THREATS

Strandings can be a single animal or several to hundreds. An event where animals are found out of their normal habitat is considered a stranding even though animals do not necessarily end up beaching (such as the July 2004 Hanalei Mass Stranding Event; Southall et al. 2006). Several hypotheses have been given for the mass strandings which include the impact of shallow beach slopes on odontocete sonar, disease or parasites, geomagnetic anomalies that affect navigation, following a food source in close to shore, avoiding predators, social interactions that cause other cetaceans to come to the aid of stranded animals, and human actions. Generally, inshore species do not strand in large numbers but generally just as a single animal. This may be due to their familiarity with the coastal area whereas pelagic species that are unfamiliar with obstructions or sea bottom tend to strand more often in larger numbers (Woodings 1995). The Navy has studied several stranding events in detail that may have occurred in association with Navy sonar activities. To better understand the causal factors in stranding events that may be associated with Navy sonar activities, the main factors, including bathymetry (i.e. steep drop offs), narrow channels (less than 35 nm), environmental conditions (e.g. surface ducting), and multiple sonar ships (see Section on Stranding Events Associated with Navy Sonar) were compared between the different stranding events.

2.4.1 What is a Stranded Marine Mammal?

When a live or dead marine mammal swims or floats onto shore and becomes “beached” or incapable of returning to sea, the event is termed a “stranding” (Geraci et al., 1999; Perrin and Geraci, 2002; Geraci and Lounsbury, 2005; NMFS, 2007). The legal definition for a stranding within the U.S. is that “a marine mammal is dead and is (i) on a beach or shore of the United States; or (ii) in waters under the jurisdiction of the United States (including any navigable waters); or (B) a marine mammal is alive and is (i) on a beach or shore of the United States and is unable to return to the water; (ii) on a beach or shore of the United States and, although able to return to the water, is in need of apparent medical attention; or (iii) in the waters under the jurisdiction of the United States (including any navigable waters), but is unable to return to its natural habitat under its own power or without assistance.” (16 United States Code [U.S.C.] 1421h).

The majority of animals that strand are dead or moribund (NMFS, 2007). For animals that strand alive, human intervention through medical aid and/or guidance seaward may be required for the animal to return to the sea. If unable to return to sea, rehabilitation at an appropriate facility may be determined as the best opportunity for animal survival. An event where animals are found out of their normal habitat is may be considered a stranding depending on circumstances even though animals do not necessarily end up beaching (Southhall, 2006).

Three general categories can be used to describe strandings: single, mass, and unusual mortality events. The most frequent type of stranding is a single stranding, which involves only one animal (or a mother/calf pair) (NMFS, 2007).

Mass stranding involves two or more marine mammals of the same species other than a mother/calf pair (Wilkinson, 1991), and may span one or more days and range over several miles (Simmonds and Lopez-Jurado, 1991; Frantzis, 1998; Walsh et al., 2001; Freitas, 2004). In North America, only a few species typically strand in large groups of 15 or more and include sperm whales, pilot whales, false killer whales, Atlantic white-sided dolphins, white-beaked dolphins, and rough-toothed dolphins (Odell 1987, Walsh et al. 2001). Some species, such as pilot whales, false-killer whales, and melon-headed whales occasionally strand in groups of 50 to 150 or more (Geraci et al. 1999). All of these normally pelagic off-shore species are highly sociable and usually infrequently encountered in coastal waters. Species that commonly strand in smaller numbers include pygmy killer whales, common dolphins, bottlenose dolphins, Pacific white-sided dolphin Frasier's dolphins, gray whale and humpback whale (West Coast only), harbor porpoise, Cuvier's beaked whales, California sea lions, and harbor seals (Mazzuca et al. 1999, Norman et al. 2004, Geraci and Lounsbury 2005).

Unusual mortality events (UMEs) can be a series of single strandings or mass strandings, or unexpected mortalities (i.e., die-offs) that occur under unusual circumstances (Dierauf and Gulland, 2001; Harwood, 2002; Gulland, 2006; NMFS, 2007). These events may be interrelated: for instance, at-sea die-offs lead to increased stranding frequency over a short period of time, generally within one to two months. As published by the NMFS, revised criteria for defining a UME include include (71 FR 75234, 2006):

(1) A marked increase in the magnitude or a marked change in the nature of morbidity, mortality, or strandings when compared with prior records.

(2) A temporal change in morbidity, mortality, or strandings is occurring.

(3) A spatial change in morbidity, mortality, or strandings is occurring.

(4) The species, age, or sex composition of the affected animals is different than that of animals that are normally affected.

(5) Affected animals exhibit similar or unusual pathologic findings, behavior patterns, clinical signs, or general physical condition (e.g., blubber thickness).

(6) Potentially significant morbidity, mortality, or stranding is observed in species, stocks or populations that are particularly vulnerable (e.g., listed as depleted, threatened or endangered or declining). For example, stranding of three or four right whales may be cause for great concern whereas stranding of a similar number of fin whales may not.

(7) Morbidity is observed concurrent with or as part of an unexplained continual decline of a marine mammal population, stock, or species.

UMEs are usually unexpected, infrequent, and may involve a significant number of marine mammal mortalities. As discussed below, unusual environmental conditions are probably responsible for most UMEs and marine mammal die-offs (Vidal and Gallo-Reynoso, 1996; Geraci et al., 1999; Walsh et al., 2001; Gulland and Hall, 2005).

United States Stranding Response Organization

Stranding events provide scientists and resource managers information not available from limited at-sea surveys, and may be the only way to learn key biological information about certain species such as distribution, seasonal occurrence, and health (Rankin, 1953; Moore et al., 2004; Geraci and Lounsbury, 2005). Necropsies are useful in attempting to determine a reason for the stranding, and are performed on stranded animals when the situation and resources allow.

In 1992, Congress amended the MMPA to establish the Marine Mammal Health and Stranding Response Program (MMHSRP) under authority of the NMFS. The MMHSRP was created out of concern started in the 1980s for marine mammal mortalities, to formalize the response process, and to focus efforts being initiated by numerous local stranding organizations and as a result of public concern.

Major elements of the MMHSRP include (NMFS, 2007):

• National Marine Mammal Stranding Network

• Marine Mammal UME Program

• National Marine Mammal Tissue Bank (NMMTB) and Quality Assurance Program

• Marine Mammal Health Biomonitoring, Research, and Development

• Marine Mammal Disentanglement Network

• John H. Prescott Marine Mammal Rescue Assistance Grant Program (a.k.a. the Prescott Grant Program)

• Information Management and Dissemination.

The United States has a well-organized network in coastal states to respond to marine mammal strandings. Overseen by the NMFS, the National Marine Mammal Stranding Network is comprised of smaller organizations manned by professionals and volunteers from nonprofit organizations, aquaria, universities, and state and local governments trained in stranding response animal health, and diseased investigation. Currently, 141 organizations are authorized by NMFS to respond to marine mammal strandings (National Marine Fisheries Service, 2007o). Through a National Coordinator and six regional coordinators, NMFS authorizes and oversees stranding response activities and provides specialized training for the network.

NMFS Regions and Associated States and Territories

NMFS Northeast Region- ME, NH, MA, RI, CT, NY, NJ, PA, DE, MD, VA

NMFS Southeast Region- NC, SC, GA, FL, AL, MS, LA, TX, PR, VI

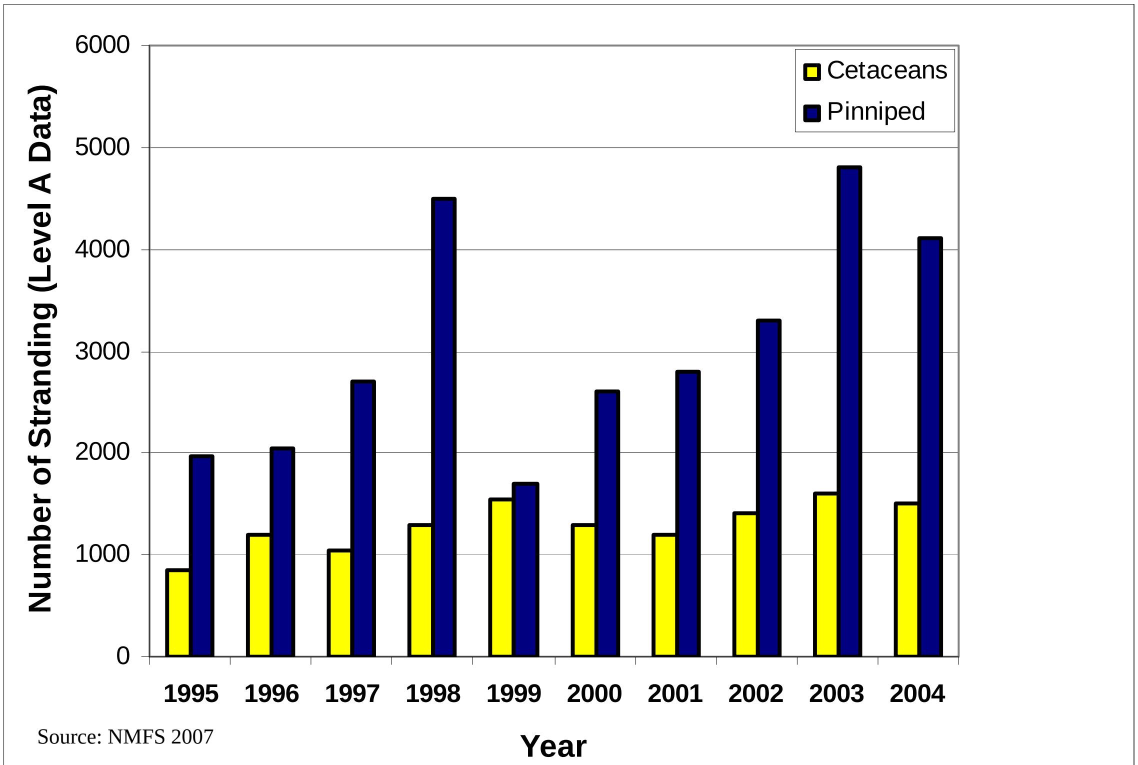
NMFS Southwest Region- CA

NMFS Northwest Region- OR, WA

NMFS Alaska Region- AK

NMFS Pacific Islands Region- HI, Guam, American Samoa, Commonwealth of the Northern Mariana Islands (CNMI)

Stranding reporting and response efforts over time have been inconsistent, although effort and data quality within the U.S. have been improving within the last 20 years (NMFS, 2007). Given the historical inconsistency in response and reporting, however, interpretation of long-term trends in marine mammal stranding is difficult (NMFS, 2007). During the past decade (1995 – 2004), approximately 40,000 stranded marine mammals (about 12,400 are cetaceans) have been reported by the regional stranding networks, averaging 3,600 strandings reported per year (NMFS, 2007). The highest number of strandings were reported between the years 1998 and 2003 (NMFS, 2007). Detailed regional stranding information including most commonly stranded species can be found in Zimmerman (1991), Geraci and Lounsbury (2005), and NMFS (2007).



Source: NMFS 2007

Figure 2-22. United States Annual Cetacean And Pinniped Stranding From 1995-2004.

Table 2-4. Cetacean And Pinniped Stranding Count By NMFS Region 2001-2004.

NMFS Region	# of Cetaceans	# of Pinnipeds
Northeast	1,620	4,050
Southeast	2,830	45
Southwest	12,900	45
Northwest	188	1,430
Alaska	269	348
Pacific Islands	59	10
Four Year Total	17,866	5,928

2.4.1.1 Unusual Mortality Events (UMEs)

Table 2-5 contains a list of documented UMEs within the U.S.

Table 2-5. Documented UMEs within the United States.

Year	Composition	Determination
1993	Harbor seals, Steller sea lions, and California sea lions on the central Washington coast	Human Interaction
1993/1994	Bottlenose dolphins in the Gulf of Mexico	Morbillivirus
1994	Common dolphins in California	Cause not determined
1996	Right whales off Florida/Georgia coast	Evidence of human interactions
1996	Manatees on the west coast of Florida	Brevetoxin
1996	Bottlenose dolphins in Mississippi	Cause not determined
1997	Harbor seals in California	Unknown infectious respiratory disease
1997	Pinnipeds on the Pacific coast	El Niño
1998	California sea lions in central California	Harmful algal bloom; Domoic acid
1999	Harbor porpoises on the East Coast	Determined not to meet criteria for UME because of multiplicity of causes
1999/2000	Bottlenose dolphins in the Panhandle of Florida	Harmful algal bloom is suspected; still under investigation
1999/2000	Gray whales from Alaska to Mexico	Still under investigation
2004	Bottlenose dolphins along the Florida Panhandle	Uncertain, red tide is suspected
2005	Bottlenose dolphins, manatees, sea turtles, and seabirds in west central Florida	Unknown

Source: NMFS 2007c

2.4.2 Threats to Marine Mammals and Potential Causes for Stranding

Reports of marine mammal strandings can be traced back to ancient Greece (Walsh et al., 2001). Like any wildlife population, there are normal background mortality rates that influence marine mammal population dynamics, including starvation, predation, aging, reproductive success, and disease (Geraci et al. 1999; Carretta et al. 2007). Strandings in and of themselves may be reflective of this natural cycle or, more recently, may be the result of anthropogenic sources (i.e., human impacts). Current science suggests that multiple factors, both natural and man-made, may be acting alone or in combination to cause a marine mammal to strand (Geraci et al., 1999; Culik, 2002; Perrin and Geraci, 2002; Hoelzel, 2003; Geraci and Lounsbury, 2005; NRC, 2006). While post-stranding data collection and necropsies of dead animals are attempted in an effort to find a possible cause for the stranding, it is often difficult to pinpoint exactly one factor that can be blamed for any given stranding. An animal suffering from one ailment becomes susceptible to various other influences because of its weakened condition, making it difficult to determine a primary cause. In many stranding cases, scientists never learn the exact reason for the stranding.

Specific potential stranding causes can include both natural and human influenced (anthropogenic) causes listed below and described in the following sections:

Natural Stranding Causes

- Disease
- Natural toxins
- Weather and climatic influences
- Navigation errors
- Social cohesion
- Predation

Human Influenced (Anthropogenic) Stranding Causes

- Fisheries interaction
- Vessel strike
- Pollution and ingestion
- Noise

2.4.2.1 Natural Stranding Causes

Significant natural causes of mortality, die-offs, and stranding discussed below include disease and parasitism; marine neurotoxins from algae; navigation errors that lead to inadvertent stranding; and climatic influences that impact the distribution and abundance of potential food resources (i.e., starvation). Other natural mortality not discussed in detail includes predation by other species such as sharks (Cockcroft et al., 1989; Heithaus, 2001), killer whales (Constantine et al. 1998; Guinet et al. 2000; Pitman et al. 2001), and some species of pinniped (Hiruki et al. 1999; Robinson et al. 1999).

Disease

Like other mammals, marine mammals frequently suffer from a variety of diseases of viral, bacterial, parasitic, and fungal origin (Visser et al. 1991; Dunn et al. 2001; Harwood 2002). Gulland and Hall (2005) provide a more detailed summary of individual and population effects of marine mammal diseases.

Microparasites such as bacteria, viruses, and other microorganisms are commonly found in marine mammal habitats and usually pose little threat to a healthy animal (Geraci et al. 1999). For example, long-finned pilot whales that inhabit the waters off of the northeastern coast of the U.S. are carriers of the morbillivirus, yet have grown resistant to its usually lethal effects (Geraci et al. 1999). Since the 1980s, however, virus infections have been strongly associated with marine mammal die-offs (Domingo et al., 1992; Geraci and Lounsbury, 2005). Morbillivirus is the most significant marine mammal virus and suppresses a host’s immune system, increasing risk of secondary infection (Harwood 2002). A bottlenose dolphin UME in 1993 and 1994 was caused by infectious disease. Die-offs ranged from northwestern Florida to Texas, with an increased number of deaths as it spread (NMFS 2007c). A 2004 UME in Florida was also associated with dolphin morbillivirus (NMFS 2004). Influenza A was responsible for the first reported mass mortality in the U.S., occurring along the coast of New England in 1979-1980 (Geraci et al. 1999; Harwood 2002). Canine distemper virus (a type of morbillivirus) has been responsible for large scale pinniped mortalities and die-offs (Grachev et al. 1989; Kennedy et al., 2000; Gulland and Hall, 2005), while a bacteria, *Leptospira pomona*, is responsible for periodic die-offs in California sea lions about every four years (Gulland et al. 1996; Gulland and Hall 2005). It is difficult to determine whether microparasites commonly act as a primary pathogen, or whether they show up as a secondary infection in an already weakened animal (Geraci et al. 1999). Most marine mammal die-offs from infectious disease in the last 25 years, however, have had viruses associated with them (Simmonds and Mayer 1997; Geraci et al. 1999; Harwood 2002).

Macroparasites are usually large parasitic organisms and include lungworms, trematodes (parasitic flatworms), and protozoans (Geraci and St.Aubin 1987; Geraci et al. 1999). Marine mammals can carry many different types, and have shown a robust tolerance for sizeable infestation unless compromised by illness, injury, or starvation (Morimitsu et al. 1987; Dailey et al. 1991; Geraci et al., 1999). Nasitrema, a usually benign trematode found in the head sinuses of cetaceans (Geraci et al. 1999), can cause brain damage if it migrates (Ridgway and Dailey 1972). As a result, this worm is one of the few directly linked to stranding in the cetaceans (Dailey and Walker 1978; Geraci et al. 1999).

Non-infectious disease, such as congenital bone pathology of the vertebral column (osteomyelitis, spondylosis deformans, and ankylosing spondylitis [AS]), has been described in several species of cetacean (Paterson 1984; Alexander et al. 1989; Kompanje 1995; Sweeny et al. 2005). In humans, bone pathology such as AS, can impair mobility and increase vulnerability to further spinal trauma (Resnick and Niwayama 2002). Bone pathology has been found in cases of single strandings (Paterson 1984; Kompanje 1995), and also in cetaceans prone to mass stranding (Sweeny et al. 2005), possibly acting as a contributing or causal influence in both types of events.

Naturally Occurring Marine Neurotoxins

Some single cell marine algae common in coastal waters, such as dinoflagellates and diatoms, produce toxic compounds that can accumulate (termed bioaccumulation) in the flesh and organs of fish and invertebrates (Geraci et al. 1999; Harwood 2002). Marine mammals become exposed to these compounds when they eat prey contaminated by these naturally produced toxins although expsosure can also occur through inhalation and skin contact (Van Dolah 2005). Figure 2 shows U.S. animal mortalities from 1997-2006 resulting from toxins produced during harmful algal blooms.

In the Gulf of Mexico and mid- to southern Atlantic states, "red tides," a form of harmful algal bloom, are created by a dinoflagellate (*Karenia brevis*). *K. brevis* is found throughout the Gulf of Mexico and sometimes along the Atlantic coast (Van Dolah 2005; NMFS 2007). It produces a neurotoxin known as brevetoxin. Brevetoxin has been associated with several marine mammal UMEs within this area (Geraci 1989; Van Dolah et al. 2003; NMFS 2004; Flewelling et al. 2005; Van Dolah 2005; NMFS 2007). On the U.S. west coast and in the northeast Atlantic, several species of diatoms produce a toxin called domoic acid which has also been linked to marine mammal strandings (Geraci et al. 1999; Van Dolah et al. 2003; Greig et al. 2005; Van Dolah 2005; Brodie et al. 2006; NMFS 2007; Bargu et al. 2008; Goldstein et al. 2008). Other algal toxins associated with marine mammal strandings include saxitoxins and ciguatoxins and are summarized by Van Dolah (2005).

Figure 2-23. Animal Mortalities From Harmful Algal Blooms Within The U.S. From 1997-2006.

Source: Woods Hole Oceanographic Institute (WHO) http://www.whoi.edu/redtide/HABdistribution/HABmap.html

Weather events and climate influences

Severe storms, hurricanes, typhoons, and prolonged temperature extremes may lead to localized marine mammal strandings (Geraci et al., 1999; Walsh et al. 2001). Hurricanes may have been responsible for mass strandings of pygmy killer whales in the British Virgin Islands and Gervais' beaked whales in North Carolina (Mignucci-Giannoni et al. 2000; Norman and Mead 2001). Storms in 1982-1983 along the California coast led to deaths of 2,000 northern elephant seal pups (Le Boeuf and Reiter 1991). Ice movement along southern Newfoundland has forced groups of blue whales and white-beaked dolphins ashore (Sergeant 1982). Seasonal oceanographic conditions in terms of weather, frontal systems, and local currents may also play a role in stranding (Walker et al. 2005).

The effect of large scale climatic changes to the world's oceans and how these changes impact marine mammals and influence strandings is difficult to quantify given the broad spatial and temporal scales involved, and the cryptic movement patterns of marine mammals (Moore 2005; Learmonth et al. 2006). The most immediate, although indirect, effect is decreased prey availability during unusual conditions. This, in turn, results in increased search effort required by marine mammals (Crocker et al. 2006), potential starvation if not successful, and corresponding stranding due directly to starvation or succumbing to disease or predation while in a more weakened, stressed state (Selzer and Payne 1988; Geraci et al. 1999; Moore 2005; Learmonth et al. 2006; Weise et al. 2006).

Two recent papers examined potential influences of climate fluctuation on stranding events in southern Australia, including Tasmania, an area with a history of more than 20 mass stranding since the 1920s (Evans et al. 2005; Bradshaw et al. 2006). These authors note that patterns in animal migration, survival, fecundity, population size, and strandings will revolve around the availability and distribution of food resources. In southern Australia, movement of nutrient-rich waters pushed closer to shore by periodic meridinal winds (occurring about every 12 – 14 years) may be responsible for bringing marine mammals closer to land, thus increasing the probability of stranding (Bradshaw et al. 2006). The papers conclude, however, that while an overarching model can be helpful for providing insight into the prediction of strandings, the particular reasons for each one are likely to be quite varied.

Navigation Error

Geomagnetism- It has been hypothesized that, like some land animals, marine mammals may be able to orient to the Earth's magnetic field as a navigational cue, and that areas of local magnetic anomalies may influence strandings (Bauer et al. 1985; Klinowska 1985; Kirschvink et al. 1986; Klinowska, 1986; Walker et al. 1992; Wartzok and Ketten 1999). In a plot of live stranding positions in Great Britain with magnetic field maps, Klinowska (1985; 1986) observed an association between live stranding positions and magnetic field levels. In all cases, live strandings occurred at locations where magnetic minima, or lows in the magnetic fields, intersect the coastline. Kirschvink et al. (1986) plotted stranding locations on a map of magnetic data for the east coast of the U.S., and were able to develop associations between stranding sites and locations where magnetic minima intersected the coast. The authors concluded that there were highly significant tendencies for cetaceans to beach themselves near these magnetic minima and coastal intersections. The results supported the hypothesis that cetaceans may have a magnetic sensory system similar to other migratory animals, and that marine magnetic topography and patterns may influence long-distance movements (Kirschvink et al. 1986). Walker et al. (1992) examined fin whale swim patterns off the northeastern U.S. continental shelf, and reported that migrating animals aligned with lows in the geometric gradient or intensity. While a similar pattern between magnetic features and marine mammal strandings at New Zealand stranding sites was not seen (Brabyn and Frew, 1994), mass strandings in Hawaii typically were found to occur within a narrow range of magnetic anomalies (Mazzuca et al. 1999).

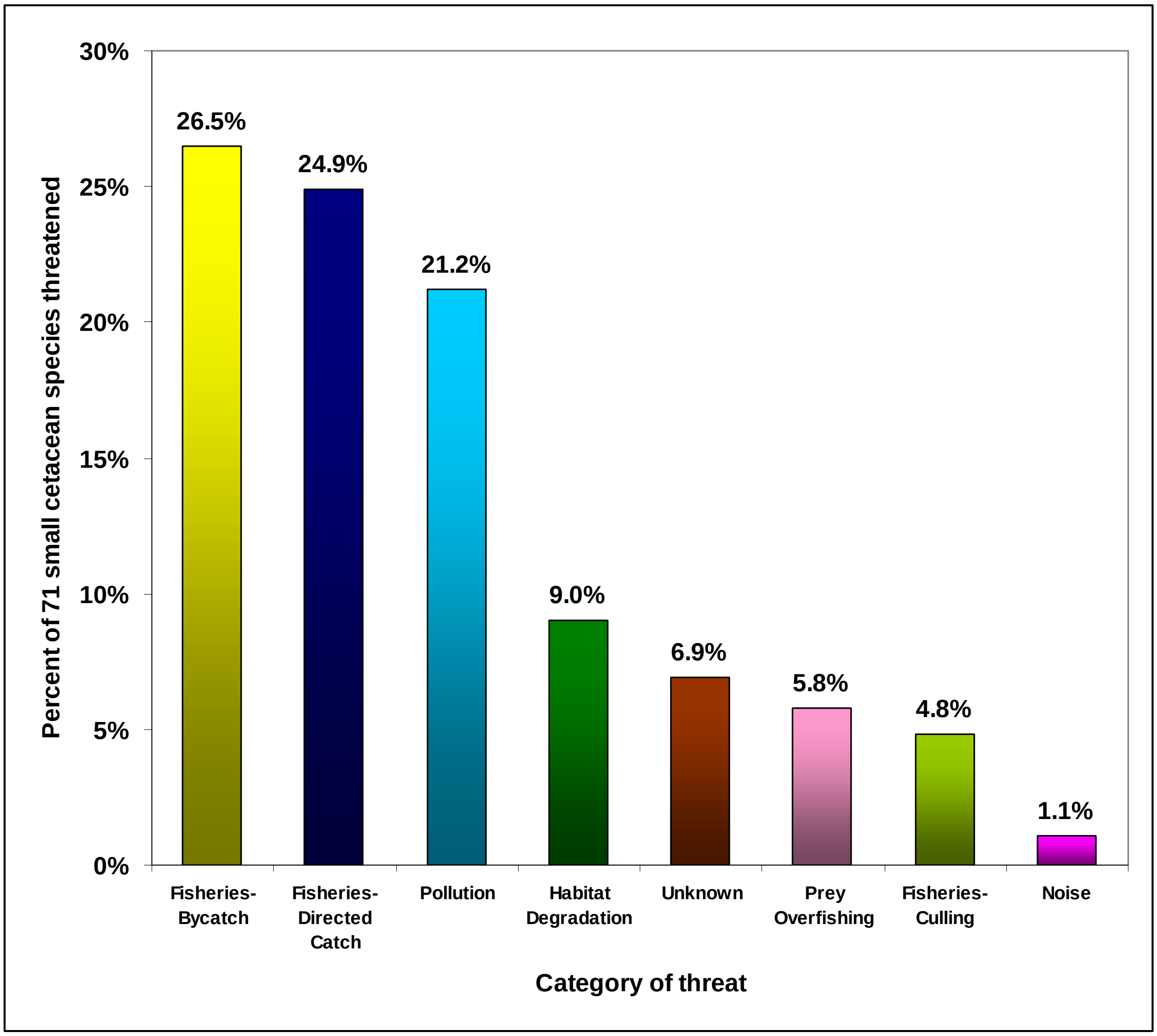
Echolocation Disruption in Shallow Water- Some researchers believe stranding may result from reductions in the effectiveness of echolocation within shallow water, especially with the pelagic species of odontocetes who may be less familiar with coastline (Dudok van Heel 1966; Chambers and James 2005). For an odontocete, echoes from echolocation signals contain important information on the location and identity of underwater objects and the shoreline. The authors postulate that the gradual slope of a beach may present difficulties to the navigational systems of some cetaceans, since it is common for live strandings to occur along beaches with shallow, sandy gradients (Brabyn and McLean 1992; Mazzuca et al. 1999; Maldini et al. 2005; Walker et al. 2005). A contributing factor to echolocation interference in turbulent, shallow water is the presence of microbubbles from the interaction of wind, breaking waves, and currents. Additionally, ocean water near the shoreline can have an increased turbidity (e.g., floating sand or silt, particulate plant matter, etc.) due to the run-off of fresh water into the ocean, either from rainfall or from freshwater outflows (e.g., rivers and creeks). Collectively, these factors can reduce and scatter the sound energy within echolocation signals and reduce the perceptibility of returning echoes of interest.

Social cohesion

Many pelagic species such as sperm whale, pilot whales, melon-head whales, and false killer whales, and some dolphins occur in large groups with strong social bonds between individuals. When one or more animals strand due to any number of causative events, then the entire pod may follow suit out of social cohesion (Geraci et al. 1999; Conner 2000; Perrin and Geraci 2002; NMFS 2007).

2.4.2.2 Anthropogenic Stranding Causes and Potential Risks

With the exception of historic whaling in the 19th and early part of the 20th century, over the past few decades there has been an increase in marine mammal mortalities associated with a variety of human activities (Geraci et al. 1999; NMFS 2007). These include fisheries interactions (bycatch and directed catch), pollution (marine debris, toxic compounds), habitat modification (degradation, prey reduction), direct trauma (vessel strikes, gunshots), and noise. Figure 2-24- shows potential worldwide risk to small toothed cetaceans by source.



(Source: Culik 2002)

Figure 2-24. Human Threats to World Wide Small Cetacean Populations

Fisheries Interaction: By-Catch, Directed Catch, and Entanglement

The incidental catch of marine mammals in commercial fisheries is a significant threat to the survival and recovery of many populations of marine mammals (Geraci et al.,1999; Baird 2002; Culik 2002; Carretta et al. 2004; Geraci and Lounsbury 2005; NMFS 2007). Interactions with fisheries and entanglement in discarded or lost gear continue to be a major factor in marine mammal deaths worldwide (Geraci et al. 1999; Nieri et al. 1999; Geraci and Lounsbury 2005; Read et al. 2006; Zeeber et al. 2006). For instance, baleen whales and pinnipeds have been found entangled in nets, ropes, monofilament line, and other fishing gear that has been discarded out at sea (Geraci et al. 1999; Campagna et al. 2007).

Bycatch- Bycatch is the catching of non-target species within a given fishing operation and can include non-commercially used invertebrates, fish, sea turtles, birds, and marine mammals (NRC 2006). Read et al. (2006) attempted to estimate the magnitude of marine mammal bycatch in U.S. and global fisheries. Data on marine mammal bycatch within the United States was obtained from fisheries observer programs, reports of entangled stranded animals, and fishery logbooks, and was then extrapolated to estimate global bycatch by using the ratio of U.S. fishing vessels to the total number of vessels within the world's fleet (Read et al. 2006). Within U.S. fisheries, between 1990 and 1999 the mean annual bycatch of marine mammals was 6,215 animals, with a standard error of +/- 448 (Read et al. 2006). Eight-four percent of cetacean bycatch occurred in gill-net fisheries, with dolphins and porpoises constituting most of the cetacean bycatch (Read et al. 2006). Over the decade there was a 40 percent decline in marine mammal bycatch, which was significantly lower from 1995-1999 than it was from 1990-1994 (Read et al. 2006). Read et al. (2006) suggests that this is primarily due to effective conservation measures that were implemented during this time period.

Read et al. (2006) then extrapolated this data for the same time period and calculated an annual estimate of 653,365 of marine mammals globally, with most of the world's bycatch occurring in gill-net fisheries. With global marine mammal bycatch likely to be in the hundreds of thousands every year, bycatch in fisheries will be the single greatest threat to many marine mammal populations around the world (Read et al. 2006).

Entanglement- Entanglement in active fishing gear is a major cause of death or severe injury among the endangered whales in the action area. Entangled marine mammals may die as a result of drowning, escape with pieces of gear still attached to their bodies, or manage to be set free either of their own accord or by fishermen. Many large whales carry off gear after becoming entangled (Read et al. 2006). Many times when a marine mammal swims off with gear attached, the end result can be fatal. The gear may be become too cumbersome for the animal, or it can be wrapped around a crucial body part and tighten over time. Stranded marine mammals frequently exhibit signs of previous fishery interaction, such as scarring or gear attached to their bodies, and the cause of death for many stranded marine mammals is often attributed to such interactions (Baird and Gorgone 2005). Because marine mammals that die or are injured in fisheries may not wash ashore and not all animals that do wash ashore exhibit clear signs of interactions, stranding data probably underestimate fishery-related mortality and serious injury (NMFS 2005a)

From 1993 through 2003, 1,105 harbor porpoises were reported stranded from Maine to North Carolina, many of which had cuts and body damage suggestive of net entanglement (NMFS 2005e). In 1999 it was possible to determine that the cause of death for 38 of the stranded porpoises was from fishery interactions, with one additional animal having been mutilated (right flipper and fluke cut off) (NMFS 2005e). In 2000, one stranded porpoise was found with monofilament line wrapped around its body (NMFS 2005e). In 2003, nine stranded harbor porpoises were attributed to fishery interactions, with an additional three mutilated animals (NMFS 2005e). An estimated 78 baleen whales were killed annually in the offshore southern

California/Oregon drift gillnet fishery during the 1980s (Heyning and Lewis 1990). From 1998-2005, based on observer records, five fin whales (CA/OR/WA stock), 12 humpback whales (ENP stock), and six sperm whales (CA/OR/WA stock) were either seriously injured or killed in fisheries off the mainland west coast of the U.S. (California Marine Mammal Stranding Network Database 2006).

Ship Strike

Vessel strikes to marine mammals are another cause of mortality and stranding (Laist et al. 2001; Geraci and Lounsbury 2005; de Stephanis and Urquiola, 2006). An animal at the surface could be struck directly by a vessel, a surfacing animal could hit the bottom of a vessel, or an animal just below the surface could be cut by a vessel's propeller. The severity of injuries typically depends on the size and speed of the vessel (Knowlton and Kraus 2001; Laist et al. 2001; Vanderlaan and Taggart 2007).

An examination of all known ship strikes from all shipping sources (civilian and military) indicates vessel speed is a principal factor in whether a vessel strike results in death (Knowlton and Kraus 2001; Laist et al. 2001, Jensen and Silber 2003; Vanderlaan and Taggart 2007). In assessing records in which vessel speed was known, Laist et al. (2001) found a direct relationship between the occurrence of a whale strike and the speed of the vessel involved in the collision. The authors concluded that most deaths occurred when a vessel was traveling in excess of 13 knots although most vessels do travel greater than 15 kts. Jensen and Silber (2003) detailed 292 records of known or probable ship strikes of all large whale species from 1975 to 2002. Of these, vessel speed at the time of collision was reported for 58 cases. Of these cases, 39 (or 67%) resulted in serious injury or death (19 or 33% resulted in serious injury as determined by blood in the water, propeller gashes or severed tailstock, and fractured skull, jaw, vertebrae, hemorrhaging, massive bruising or other injuries noted during necropsy and 20 or 35% resulted in death). Operating speeds of vessels that struck various species of large whales ranged from 2 to 51 knots. The majority (79%) of these strikes occurred at speeds of 13 knots or greater. The average speed that resulted in serious injury or death was 18.6 knots. Pace and Silber (2005) found that the probability of death or serious injury increased rapidly with increasing vessel speed. Specifically, the predicted probability of serious injury or death increased from 45 percent to 75 % as vessel speed increased from 10 to 14 knots, and exceeded 90% at 17 knots. Higher speeds during collisions result in greater force of impact, but higher speeds also appear to increase the chance of severe injuries or death by pulling whales toward the vessel. Computer simulation modeling showed that hydrodynamic forces pulling whales toward the vessel hull increase with increasing speed (Clyne 1999, Knowlton et al. 1995).

The growth in civilian commercial ports and associated commercial vessel traffic is a result in the globalization of trade. The Final Report of the NOAA International Symposium on "Shipping Noise and Marine Mammals: A Forum for Science, Management, and Technology" stated that the worldwide commercial fleet has grown from approximately 30,000 vessels in 1950 to over 85,000 vessels in 1998 (NRC, 2003; Southall, 2005). Between 1950 and 1998, the U.S. flagged fleet declined from approximately 25,000 to less than 15,000 and currently represents only a small portion of the world fleet. From 1985 to 1999, world seaborne trade doubled to 5 billion tons and currently includes 90 percent of the total world trade, with container shipping movements representing the largest volume of seaborne trade. It is unknown how international shipping volumes and densities will continue to grow. However, current statistics support the prediction that the international shipping fleet will continue to grow at the current rate or at greater rates in the future. Shipping densities in specific areas and trends in routing and vessel design are as, or more, significant than the total number of vessels. Densities along existing coastal routes are expected to increase both domestically and internationally. New routes are also expected to develop as new ports are opened and existing ports are expanded. Vessel propulsion systems are also advancing toward faster ships operating in higher sea states for lower operating costs; and container ships are expected to become larger along certain routes (Southall 2005).

While there are reports and statistics of whales struck by vessels in U.S. waters, the magnitude of the risks of commercial ship traffic poses to marine mammal populations is difficult to quantify or estimate. In addition, there is limited information on vessel strike interactions between ships and marine mammals outside of U.S. waters (de Stephanis and Urquiola 2006). Laist et al. (2001) concluded that ship collisions may have a negligible effect on most marine mammal populations in general, except for regional based small populations where the significance of low numbers of collisions would be greater given smaller populations or populations segments.

U.S. Navy vessel traffic is a small fraction of the overall U.S. commercial and fishing vessel traffic. While U.S. Navy vessel movements may contribute to the ship strike threat, given the lookout and mitigation measures adopted by the U.S. Navy, probability of vessel strikes is greatly reduced. Furthermore, actions to avoid close interaction of U.S. Navy ships and marine mammals and sea turtles, such as maneuvering to keep away from any observed marine mammal and sea turtle are part of existing at-sea protocols and standard operating procedures. Navy ships have up to three or more dedicated and trained lookouts as well as two to three bridge watchstanders during at-sea movements who would be searching for any whales, sea turtles, or other obstacles on the water surface. Such lookouts are expected to further reduce the chances of a collision.

Commercial and Private Marine Mammal Viewing

In addition to vessel operations, private and commercial vessels engaged in marine mammal watching also have the potential to impact marine mammals in Southern California. NMFS has promulgated regulations at 50 CFR 224.103, which provide specific prohibitions regarding wildlife viewing activities. In addition, NMFS launched an education and outreach campaign to provide commercial operators and the general public with responsible marine mammal viewing guidelines. In January 2002, NMFS also published an official policy on human interactions with wild marine mammals which states that: “NOAA Fisheries cannot support, condone, approve or authorize activities that involve closely approaching, interacting or attempting to interact with whales, dolphins, porpoises, seals, or sea lions in the wild. This includes attempting to swim, pet, touch or elicit a reaction from the animals.”

Although considered by many to be a non-consumptive use of marine mammals with economic, recreational, educational, and scientific benefits, marine mammal watching is not without potential negative impacts. One concern is that animals become more vulnerable to vessel strikes once they habituate to vessel traffic (Swingle et al. 1993; Wiley et al. 1995). Another concern is that preferred habitats may become abandoned if disturbance levels are too high. A whale’s behavioral response to whale watching vessels depends on the distance of the vessel from the whale, vessel speed, vessel direction, vessel noise, and the number of vessels (Amaral and Carlson 2005; Au and Green 2000; Cockeron 1995; Erbe 2002; Felix 2001; Magalhaes et al. 2002; Richter et al. 2003; Schedat et al. 2004; Simmonds 2005; Watkins 1986; Williams et al. 2002). The whale’s responses changed with these different variables and, in some circumstances, the whales did not respond to the vessels, but in other circumstances, whales changed their vocalizations surface time, swimming speed, swimming angle or direction, respiration rates, dive times, feeding behavior, and social interactions. In addition to the information on whale watching, there is also direct evidence of pinniped haul out site (Pacific harbor seals) abandonment because of human disturbance at Strawberry Spit in San Francisco Bay (Allen 1991).

Ingestion of Plastic Objects and Other Marine Debris And Toxic Pollution Exposure

For many marine mammals, debris in the marine environment is a great hazard and can be harmful to wildlife. Not only is debris a hazard because of possible entanglement, animals may mistake plastics and other debris for food (NMFS, 2007g). There are certain species of cetaceans, along with Florida manatees, that are more likely to eat trash, especially plastics, which is usually fatal for the animal (Geraci et al. 1999).

Between 1990 through October 1998, 215 pygmy sperm whales stranded along the U.S. Atlantic coast from New York through the Florida Keys (NMFS 2005a). Remains of plastic bags and other debris were found in the stomachs of 13 of these animals (NMFS 2005a). During the same time period, 46 dwarf sperm whale strandings occurred along the U.S. Atlantic coastline between Massachusetts and the Florida Keys (NMFS 2005d). In 1987 a pair of latex examination gloves was retrieved from the stomach of a stranded dwarf sperm whale (NMFS 2005d). 125 pygmy sperm whales were reported stranded from 1999 – 2003 between Maine and Puerto Rico; in one pygmy sperm whale found stranded in 2002, red plastic debris was found in the stomach along with squid beaks (NMFS 2005a).

Sperm whales have been known to ingest plastic debris, such as plastic bags (Evans et al. 2003; Whitehead 2003). While this has led to mortality, the scale to which this is affecting sperm whale populations is unknown, but Whitehead (2003) suspects it is not substantial at this time.

High concentrations of potentially toxic substances within marine mammals along with an increase in new diseases have been documented in recent years. Scientists have begun to consider the possibility of a link between pollutants and marine mammal mortality events. NMFS takes part in a marine mammal bio-monitoring program not only to help assess the health and contaminant loads of marine mammals, but also to assist in determining anthropogenic impacts on marine mammals, marine food chains and marine ecosystem health. Using strandings and bycatch animals, the program provides tissue/serum archiving, samples for analyses, disease monitoring and reporting, and additional response during disease investigations (NMFS 2007).

The impacts of these activities are difficult to measure. However, some researchers have correlated contaminant exposure to possible adverse health effects in marine mammals. Contaminants such as organochlorines do not tend to accumulate in significant amounts in invertebrates, but do accumulate in fish and fish-eating animals. Thus, contaminant levels in planktivorous mysticetes have been reported to be one to two orders of magnitude lower compared to piscivorous odontocetes (Borell 1993; O'Shea and Brownell 1994; O'Hara and Rice 1996; O'Hara et al. 1999).

The manmade chemical PCB (polychlorinated biphenyl), and the pesticide DDT (dichlorodiphyenyltrichloroethane), are both considered persistent organic pollutants that are currently banned in the United States for their harmful effects in wildlife and humans (NMFS, 2007c). Despite having been banned for decades, the levels of these compounds are still high in marine mammal tissue samples taken along U.S. coasts (NMFS, 2007c). Both compounds are long-lasting, reside in marine mammal fat tissues (especially in the blubber), and can be toxic causing effects such as reproductive impairment and immunosuppression (NMFS, 2007c).

Both long-finned and short-finned pilot whales have a tendency to mass strand throughout their range. Short-finned pilot whales have been reported as stranded as far north as Rhode Island, and long-finned pilot whales as far south as South Carolina (NMFS 2005b). For U.S. east coast stranding records, both species are lumped together and there is rarely a distinction between the two because of uncertainty in species identification (NMFS 2005b). Since 1980 within the Northeast region alone, between 2 and 120 pilot whales have stranded annually either individually or in groups (NMFS 2005b). Between 1999 and 2003 from Maine to Florida, 126 pilot whales were reported to be stranded, including a mass stranding of 11 animals in 2000 and another mass stranding of 57 animals in 2002, both along the Massachusetts coast (NMFS 2005b).

It is unclear how much of a role human activities play in these pilot whale strandings, and toxic poisoning may be a potential human-caused source of mortality for pilot whales (NMFS 2005b). Moderate levels of PCBs and chlorinated pesticides (such as DDT, DDE, and dieldrin) have been found in pilot whale blubber (NMFS 2005b). Bioaccumulation levels have been found to be more similar in whales from the same stranding event than from animals of the same age or sex (NMFS 2005b). Numerous studies have measured high levels of toxic metals (mercury, lead, and cadmium), selenium, and PCBs in pilot whales in the Faroe Islands (NMFS 2005b). Population effects resulting from such high contamination levels are currently unknown (NMFS 2005b).

Habitat contamination and degradation may also play a role in marine mammal mortality and strandings. Some events caused by man have direct and obvious effects on marine mammals, such as oil spills (Geraci et al. 1999). But in most cases, effects of contamination will more than likely be indirect in nature, such as effects on prey species availability, or by increasing disease susceptibility (Geraci et al. 1999).

U.S. Navy vessel operation between ports and exercise locations has the potential for release of small amounts of pollutant discharges into the water column. U.S. Navy vessels are not a typical source, however, of either pathogens or other contaminants with bioaccumulation potential such as pesticides and PCBs. Furthermore, any vessel discharges such as bilgewater and deck runoff associated with the vessels would be in accordance with international and U.S. requirements for eliminating or minimizing discharges of oil, garbage, and other substances, and not likely to contribute significant changes to ocean water quality.

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U.S. Navy vessel operation between ports and exercise locations has the potential for release of small amounts of pollutant discharges into the water column. U.S. Navy vessels are not a typical source, however, of either pathogens or other contaminants with bioaccumulation potential such as pesticides and PCBs. Furthermore, any vessel discharges such as bilgewater and deck runoff associated with the vessels would be in accordance with international and U.S. requirements for eliminating or minimizing discharges of oil, garbage, and other substances, and not likely to contribute significant changes to ocean water quality.

Deep Water Ambient Noise

Urick (1983) provided a discussion of the ambient noise spectrum expected in the deep ocean. Shipping, seismic activity, and weather, are the primary causes of deep-water ambient noise. The ambient noise frequency spectrum can be predicted fairly accurately for most deep-water areas based primarily on known shipping traffic density and wind state (wind speed, Beaufort wind force, or sea state) (Urick 1983). For example, for frequencies between 100 and 500 Hz, Urick (1983) estimated the average deep water ambient noise spectra to be 73 to 80 dB for areas of heavy shipping traffic and high sea states, and 46 to 58 dB for light shipping and calm seas.

Shallow Water Ambient Noise

In contrast to deep water, ambient noise levels in shallow waters (i.e., coastal areas, bays, harbors, etc.) are subject to wide variations in level and frequency depending on time and location. The primary sources of noise include distant shipping and industrial activities, wind and waves, marine animals (Urick 1983). At any give time and place, the ambient noise is a mixture of all of these noise variables. In addition, sound propagation is also affected by the variable shallow water conditions, including the depth, bottom slope, and type of bottom. Where the bottom is reflective, the sounds levels tend to be higher, then when the bottom is absorptive.

Noise from Aircraft and Vessel Movement

Surface shipping is the most widespread source of anthropogenic, low frequency (0 to 1,000 Hz) noise in the oceans and may contribute to over 75% of all human sound in the sea (Simmonds and Hutchinson 1996, ICES 2005b). Ross (1976) has estimated that between 1950 and 1975, shipping had caused a rise in ambient noise levels of 10 dB. He predicted that this would increase by another 5 dB by the beginning of the 21st century. The National Resource Council (1997) estimated that the background ocean noise level at 100 Hz has been increasing by about 1.5 dB per decade since the advent of propeller-driven ships. Michel et al. (2001) suggested an association between long-term exposure to low frequency sounds from shipping and an increased incidence of marine mammal mortalities caused by collisions with ships.

Airborne sound from a low-flying helicopter or airplane may be heard by marine mammals and turtles while at the surface or underwater. Due to the transient nature of sounds from aircraft involved in at-sea operations, such sounds would not likely cause physical effects but have the potential to affect behaviors. Responses by mammals and turtles could include hasty dives or turns, or decreased foraging (Soto et al., 2006). Whales may also slap the water with flukes or flippers, swim away from the aircraft track.

Sound emitted from large vessels, particularly in the course of transit, is the principal source of noise in the ocean today, primarily due to the properties of sound emitted by civilian cargo vessels (Richardson et al., 1995; Arveson and Vendittis, 2000). Ship propulsion and electricity generation engines, engine gearing, compressors, bilge and ballast pumps, as well as hydrodynamic flow surrounding a ship's hull and any hull protrusions contribute to a large vessels' noise emission into the marine environment. Prop-driven vessels also generate noise through cavitation, which accounts much of the noise emitted by a large vessel depending on its travel speed. Military vessels underway or involved in naval operations or exercises, also introduce anthropogenic noise into the marine environment. Noise emitted by large vessels can be characterized as low-frequency, continuous, and tonal. The sound pressure levels at the vessel will vary according to speed, burden, capacity and length (Richardson et al. 1995; Arveson and Vendittis, 2000). Vessels ranging from 135 to 337 meters generate peak source sound levels from 169- 200 dB between 8 Hz and 430 Hz, although Arveson and Vendittis (2000) documented components of higher frequencies (10-30 kHz) as a function of newer merchant ship engines and faster transit speeds.

Whales have variable responses to vessel presence or approaches, ranging from apparent tolerance to diving away from a vessel. Unfortunately, it is not always possible to determine whether the whales are responding to the vessel itself or the noise generated by the engine and cavitation around the propeller. Apart from some disruption of behavior, an animal may be unable to hear other sounds in the environment due to masking by the noise from the vessel. Any masking of environmental sounds or conspecific sounds is expected to be temporary, as noise dissipates with a vessel transit through an area. Any masking of environmental sounds or conspecific sounds is expected to be temporary, as noise dissipates with a vessel transit through an area.

Vessel noise primarily raises concerns for masking of environmental and conspecific cues. However, exposure to vessel noise of sufficient intensity and/or duration can also result in temporary or permanent loss of sensitivity at a given frequency range, referred to as temporary or permanent threshold shifts (TTS or PTS). Threshold shifts are assumed to be possible in marine mammal species as a result of prolonged exposure to large vessel traffic noise due to its intensity, broad geographic range of effectiveness, and constancy.

Collectively, significant cumulative exposure to individuals, groups, or populations can occur if they exhibit site fidelity to a particular area; for example, whales that seasonally travel to a regular area to forage or breed may be more vulnerable to noise from large vessels compared to transiting whales. Any permanent threshold shift in a marine animal's hearing capability, especially at particular frequencies for which it can normally hear best, can impair its ability to perceive threats, including ships. Whales have variable responses to vessel presence or approaches, ranging from apparent tolerance to diving away from a vessel. It is not possible to determine whether the whales are responding to the vessel itself or the noise generated by the engine and cavitation around the propeller. Apart from some disruption of behavior, an animal may be unable to hear other sounds in the environment due to masking by the noise from the vessel.

Most observations of behavioral responses of marine mammals to human generated sounds have been limited to short-term behavioral responses, which included the cessation of feeding, resting, or social interactions. Nowacek et al. (2007) provide a detailed summary of cetacean response to underwater noise.

Given the sound propagation of low frequency sounds, a large vessel in this sound range can be heard 139-463 kilometers away (Ross 1976 in Polefka 2004). U.S. Navy vessels, however, have incorporated significant underwater ship quieting technology to reduce their acoustic signature (as compared to a similarly-sized vessel) in order to reduce their vulnerability to detection by enemy passive acoustics (Southall, 2005). Therefore, the potential for TTS or PTS from U.S. Navy vessel and aircraft movement is extremely low given that the exercises and training events are transitory in time, with vessels moving over large area of the ocean. A marine mammal or sea turtle is unlikely to be exposed long enough at high levels for TTS or PTS to occur. Any masking of environmental sounds or conspecific sounds is expected to be temporary, as noise dissipates with a U.S. Navy vessel transiting through an area. If behavioral disruptions result from the presence of aircraft or vessels, it is expected to be temporary. Animals are expected to resume their migration, feeding, or other behaviors without any threat to their survival or reproduction. However, if an animal is aware of a vessel and dives or swims away, it may successfully avoid being struck.

Stranding Events Associated with Navy Sonar

There are two classes of sonars employed by the U.S. Navy: active sonars and passive sonars. Most active military sonars operate in a limited number of areas, and are most likely not a significant contributor to a comprehensive global ocean noise budget (ICES 2005b).

The effects of mid-frequency active naval sonar on marine wildlife have not been studied as extensively as the effects of air-guns used in seismic surveys (Madsen et al. 2006; Stone and Tasker 2006; Wilson et al. 2006; Palka and Johnson 2007; Parente et al. 2007). Maybaum (1989,

1993) observed changes in behavior of humpbacks during playback tapes of the M-1002 system (using 203 dB re 1 µPa-m for study); specifically, a decrease in respiration, submergence, and aerial behavior rates; and an increase in speed of travel and track linearity. Direct comparison of Maybaum's results, however, with U.S Navy mid-frequency active sonar are difficult to make. Maybaum's signal source, the commercial M-1002, is not similar to how naval mid-frequency sonar operates. In addition, behavioral responses were observed during playbacks of a control tape, (i.e. a tape with no sound signal) so interpretation of Maybaum's results are inconclusive.

Research by Nowacek, et al. (2004) on North Atlantic right whales using a whale alerting signal designed to alert whales to human presence suggests that received sound levels of only 133 to 148 pressure level (decibel [dB] re 1 microPascals [µPa]) for the duration of the sound exposure may disrupt feeding behavior. The authors did note, however, that within minutes of cessation of the source, a return to normal behavior would be expected. Direct comparison of the Nowacek et al. (2004) sound source to MFA sonar, however, is not possible given the radically different nature of the two sources. Nowacek et al.'s source was a series of non-sonar like sounds designed to purposely alert the whale, lasting several minutes, and covering a broad frequency band. Direct differences between Nowacek et al. (2004) and MFA sonar is summarized below from Nowacek et al. (2004) and Nowacek et al. (2007):

(1) Signal duration: Time difference between the two signals is significant, 18-minute signal used by Nowacek et al. verses < 1-sec for MFA sonar.

(2) Frequency modulation: Nowacek et al. contained three distinct signals containing frequency modulated sounds:

> 1st - alternating 1-sec pure tone at 500 and 850 Hz
>
> 2nd - 2-sec logarithmic down-sweep from 4500 to 500 Hz
>
> 3rd - pair of low-high (1500 and 2000 Hz) sine wave tones amplitude modulated at 120 Hz

(3) Signal to noise ratio: Nowacek et al.'s signal maximized signal to noise ratio so that it would be distinct from ambient noise and resist masking.

(4) Signal acoustic characteristics: Nowacek et al.'s signal comprised of disharmonic signals spanning northern right whales' estimated hearing range.

Given these differences, therefore, the exact cause of apparent right whale behavior noted by the authors can not be attributed to any one component since the source was such a mix of signal types.

The effects of naval sonars on marine wildlife have not been studied as extensively as have the effects of airguns used in seismic surveys (Nowacek et al. 2007). In the Caribbean, sperm whales were observed to interrupt their activities by stopping echolocation and leaving the area in the presence of underwater sounds surmised to have originated from submarine sonar signals (Watkins and Schevill 1975; Watkins et al. 1985). The authors did not report receive levels from these exposures, and also got a similar reaction from artificial noise they generated by banging on their boat hull. It was unclear if the sperm whales were reacting to the sonar signal itself or to a potentially new unknown sound in general. Madsen et al. (2006) tagged and monitored eight sperm whales in the Gulf of Mexico exposed to seismic airgun surveys. Sound sources were from approximately 2 to 7 nm (4 to 13 km) away from the whales and based on multipath propagation RLs were as high as 162 dB re 1 uPa with energy content greatest between 0.3 to 3.0 kHz. Sperm whales engaged in foraging dives continued the foraging dives throughout exposures to these seismic pulses. In the Caribbean Sea, sperm whales avoided exposure to mid-frequency submarine sonar pulses, in the range 1000 Hz to 10,000 Hz (IWC 2005). Sperm whales have also moved out of areas after the start of air gun seismic testing (Davis et al. 1995). In contrast, during playback experiments off the Canary Islands, André et al. (1997) reported that foraging sperm whales exposed to a 10 kHz pulsed signal did not exhibit any general avoidance reactions.

The Navy sponsored tests of the effects of low-frequency active (LFA) sonar source, between 100 Hz and 1000 Hz, on blue, fin, and humpback whales. The tests demonstrated that whales exposed to sound levels up to 155 dB did not exhibit significant disturbance reactions, though there was evidence that humpback whales altered their vocalization patterns in reaction to the noise. Given that the source level of the Navy's LFA is reported to be in excess of 215 dB, the possibility exists that animals in the wild may be exposed to sound levels much higher than 155 dB.

Acoustic exposures have been demonstrated to kill marine mammals, result in physical trauma, and injury (Ketten 2005). Animals in or near an intense noise source can die from profound injuries related to shock wave or blast effects. Acoustic exposures can also result in noise induced hearing loss that is a function of the interactions of three factors: sensitivity, intensity, and frequency. Loss of sensitivity is referred to as a threshold shift; the extent and duration of a threshold shift depends on a combination of several acoustic features and is specific to particular species (TTS or PTS, depending on how the frequency, intensity and duration of the exposure combine to produce damage). In addition to direct physiological effects, noise exposures can impair an animal's sensory abilities (masking) or result in behavioral responses such as aversion or attraction (see Section 3.19).

Acoustic exposures can also result in the death of an animal by impairing its foraging, ability to detect predators or communicate, or by increasing stress, and disrupting important physiological events. Whales have moved away from their feeding and mating grounds (Bryant *et al*. 1984; Morton and Symnods 2002; Weller et al. 2002), moved away from their migration route (Richardson et al. 1995), and have changed their calls due to noise (Miller et al. 2000). Acoustic exposures such as MFA sonar tend to be infrequent and short in duration, and therefore effects are likely indirect and to be short lived. In situations such as the alteration of gray whale migration routes in response to shipping and whale watching boats, those acoustic exposures were chronic over several years (Moore and Clarke 2002). This was also true of the effect of seismic survey airguns (daily for 39 days) on the use of feeding areas by gray whales in the western North Pacific although whales began returning to the feeding area witin one day of the end of the exposure (Weller et al. 2002).

Below are evaluations of the general information available on the variety of ways in which cetaceans and pinnipeds have been reported to respond to sound, generally, and mid-frequency sonar, in particular.

The Navy is very concerned and thoroughly investigates each marine mammal stranding to better understand the events surrounding strandings (Norman 2006). Strandings can be a single animal or several to hundreds. An event where animals are found out of their normal habitat is considered a stranding even though animals do not necessarily end up beaching (such as the July 2004 Hanalei Mass Stranding Event; Southall et al. 2006). Several hypotheses have been given for the mass strandings which include the impact of shallow beach slopes on odontocete sonar, disease or parasites, geomagnetic anomalies that affect navigation, following a food source in close to shore, avoiding predators, social interactions that cause other cetaceans to come to the aid of stranded animals, and human actions. Generally, inshore species do not strand in large numbers but generally just as a single animal. This may be due to their familiarity with the coastal area whereas pelagic species that are unfamiliar with obstructions or sea bottom tend to strand more often in larger numbers (Woodings 1995). The Navy has studied several stranding events in detail that may have occurred in association with Navy sonar activities. To better understand the causal factors in stranding events that may be associated with Navy sonar activities, the main factors, including bathymetry (i.e. steep drop offs), narrow channels (less than 35 nm), environmental conditions (e.g. surface ducting), and multiple sonar ships were compared between the different stranding events.

When a marine mammal swims or floats onto shore and becomes "beached" or stuck in shallow water, it is considered a "stranding" (MMPA section 410 (16 USC section 1421g;NMFS, 2007a). NMFS explains that "a cetacean is considered stranded when it is on the beach, dead or alive, or in need of medical attention while free-swimming in U.S. waters. A pinniped is considered to be stranded either when dead or when in distress on the beach and not displaying normal haul-out behavior" (NMFS 2007b).

Over the past three decades, several "mass stranding" events [strandings involving two or more individuals of the same species (excluding a single cow-calf pair) and at times, individuals from different species] that have occurred over the past two decades have been associated with naval operations, seismic surveys, and other anthropogenic activities that introduce sound into the marine environment (Canary Islands, Greece, Vieques, U.S. Virgin Islands, Madeira Islands, Haro Strait, Washington State, Alaska, Hawaii, North Carolina).

Information was collected on mass stranding events (events in which two or more cetaceans stranded) that have occurred and for which reports are available, from the past 40 years. Any causal agents that have been associated with those stranding events were also identified (Table 2-5). Major range events undergo name changes over the years, however, the equivalent of COMPTUEX and JTFEX have been conducted in southern California since 1934. Training involving sonar has been conducted since World War II and sonar systems described in the SOCAL EIS/OEIS since the 1970's (Jane's 2005).

2.4.3 Stranding Analysis

Over the past two decades, several mass stranding events involving beaked whales have been documented. While beaked whale strandings have been reported since the 1800s (Geraci and Lounsbury 1993; Cox et al. 2006; Podesta et al. 2006), several mass strandings since have been associated with naval operations that may have included mid-frequency sonar (Simmonds and Lopez-Jurado 1991; Frantzis 1998; Jepson et al. 2003; Cox et al. 2006). As Cox et al. (2006) concludes, the state of science can not yet determine if a sound source such as mid-frequency sonar alone causes beaked whale strandings, or if other factors (acoustic, biological, or environmental) must co-occur in conjunction with a sound source.

A review of historical data (mostly anecdotal) maintained by the Marine Mammal Program in the National Museum of Natural History, Smithsonian Institution reports 49 beaked whale mass stranding events between 1838 and 1999. The largest beaked whale mass stranding occurred in the 1870s in New Zealand when 28 Gray's beaked whales (*Mesoplodon grayi*) stranded. Blainsville's beaked whale (*Mesoplodon densirostris*) strandings are rare, and records show that they were involved in one mass stranding in 1989 in the Canary Islands. Cuvier's beaked whales (*Ziphius cavirostris*) are the most frequently reported beaked whale to strand, with at least 19 stranding events from 1804 through 2000 (DoC and DoN 2001; Smithsonian Institution 2000).

The discussion below centers on those worldwide stranding events that may have some association with naval operations, and global strandings that the U.S. Navy feels are either inconclusive or can not be associated with naval operations.

2.4.3.1 Naval Association

In the following sections, specific stranding events that have been putatively linked to potential sonar operations are discussed. Of note, these events represent a small overall number of animals over an 11 year period (40 animals) and not all worldwide beaked whale strandings can be linked to naval activity (ICES 2005a; 2005b; Podesta et al. 2006). Four of the five events occurred during NATO exercises or events where U.S. Navy presence was limited (Greece, Portugal, Spain). One of the five events involved only U.S. Navy ships (Bahamas).

Beaked whale stranding events associated with potential naval operations.

1996 May	Greece (NATO)
2000 March	Bahamas (US)
2000 May	Portugal, Madeira Islands (NATO/US)
2002 September	Spain, Canary Islands (NATO/US)
2006 January	Spain, Mediterranean Sea coast (NATO/US)

Case Studies of Stranding Events (coincidental with or implicated with naval sonar)

1996 Greece Beaked Whale Mass Stranding (May 12 – 13, 1996)

Description: Twelve Cuvier's beaked whales (*Ziphius cavirostris*) stranded along a 38.2-kilometer strand of the coast of the Kyparissiakos Gulf on May 12 and 13, 1996 (Frantzis, 1998). From May 11 through May 15, the NATO research vessel Alliance was conducting sonar tests with signals of 600 Hz and 3 kHz and root-mean-squared (rms) sound pressure levels (SPL) of 228 and 226 dB re: 1μPa, respectively (D'Amico and Verboom 1998; D'Spain et al. 2006). The timing and the location of the testing encompassed the time and location of the whale strandings (Frantzis 1998).

Findings: Partial necropsies of eight of the animals were performed, including external assessments and the sampling of stomach contents. No abnormalities attributable to acoustic exposure were observed, but the stomach contents indicated that the whales were feeding on cephalods soon before the stranding event. No unusual environmental events before or during the stranding event could be identified (Frantzis 1998).

Conclusions: The timing and spatial characteristics of this stranding event were atypical of stranding in Cuvier's beaked whale, particularly in this region of the world. No natural phenomenon that might contribute to the stranding event coincided in time with the mass stranding. Because of the rarity of mass strandings in the Greek Ionian Sea, the probability that the sonar tests and stranding coincided in time and location, while being independent of each other, was estimated as being extremely low (Frantzis 1998). However, because information for the necropsies was incomplete and inconclusive, the cause of the stranding cannot be precisely determined.

2000 Bahamas Marine Mammal Mass Stranding (March 15-16, 2000)

Description: Seventeen marine mammals comprised of Cuvier's beaked whales, Blainville's beaked whales (*Mesoplodon densirostris*), minke whale (*Balaenoptera acutorostrata*), and one spotted dolphin (*Stenella frontalis*), stranded along the Northeast and Northwest Providence Channels of the Bahamas Islands on March 15-16, 2000 (Evans and England 2001). The strandings occurred over a 36-hour period and coincided with U.S. Navy use of mid-frequency active sonar within the channel. Navy ships were involved in tactical sonar exercises for approximately 16 hours on March 15. The ships, which operated the AN/SQS-53C and AN/SQS-56, moved through the channel while emitting sonar pings approximately every 24 seconds. The timing of pings was staggered between ships and average source levels of pings varied from a nominal 235 dB SPL (AN/SQS-53C) to 223 dB SPL (AN/SQS-56). The center frequency of pings was 3.3 kHz and 6.8 to 8.2 kHz, respectively.

Seven of the animals that stranded died, while ten animals were returned to the water alive. The animals known to have died included five Cuvier's beaked whales, one Blainville's beaked whale, and the single spotted dolphin. Six necropsies were performed and three of the six necropsied whales (one Cuvier's beaked whale, one Blainville's beaked whale, and the spotted dolphin) were fresh enough to permit identification of pathologies by computerized tomography (CT). Tissues from the remaining three animals were in a state of advanced decomposition at the time of inspection.

Findings: The spotted dolphin demonstrated poor body condition and evidence of a systemic debilitating disease. In addition, since the dolphin stranding site was isolated from the acoustic activities of Navy ships, it was determined that the dolphin stranding was unrelated to the presence of Navy active sonar.

All five necropsied beaked whales were in good body condition and did not show any signs of external trauma or disease. In the two best preserved whale specimens, hemorrhage was associated with the brain and hearing structures. Specifically, subarachnoid hemorrhage within the temporal region of the brain and intracochlear hemorrhages were noted. Similar findings of bloody effusions around the ears of two other moderately decomposed whales were consistent with the same observations in the freshest animals. In addition, three of the whales had small hemorrhages in their acoustic fats, which are fat bodies used in sound production and reception (i.e., fats of the lower jaw and the melon). The best-preserved whale demonstrated acute hemorrhage within the kidney, inflammation of the lung and lymph nodes, and congestion and mild hemorrhage in multiple other organs. Other findings were consistent with stresses and injuries associated with the stranding process. These consisted of external scrapes, pulmonary edema and congestion.

Conclusions: The post-mortem analyses of stranded beaked whales lead to the conclusion that the immediate cause of death resulted from overheating, cardiovascular collapse and stresses associated with being stranded on land. However, the presence of subarachnoid and intracochlear hemorrhages were believed to have occurred prior to stranding and were hypothesized as being related to an acoustic event. Passive acoustic monitoring records demonstrated that no large scale acoustic activity besides the Navy sonar exercise occurred in the times surrounding the stranding event. The mechanism by which sonar could have caused the observed traumas or caused the animals to strand was undetermined. The spotted dolphin was in overall poor condition for examination, but showed indications of long-term disease. No analysis of baleen whales (minke whale) was conducted. Baleen whale stranding events have not been associated with either low-frequency or mid-frequency sonar use (ICES 2005a, 2005b).

2000 Madeira Island, Portugal Beaked Whale Strandings (May 10 – 14, 2000)

Description: Three Cuvier's beaked whales stranded on two islands in the Madeira Archipelago, Portugal, from May 10 – 14, 2000 (Cox et al. 2006). A joint NATO amphibious training exercise, named "Linked Seas 2000," which involved participants from 17 countries, took place in Portugal during May 2 – 15, 2000. The timing and location of the exercises overlapped with that of the stranding incident.

Findings: Two of the three whales were necropsied. Two heads were taken to be examined. One head was intact and examined grossly and by CT; the other was only grossly examined because it was partially flensed and had been seared from an attempt to dispose of the whale by fire (Ketten 2005).

No blunt trauma was observed in any of the whales. Consistent with prior CT scans of beaked whales stranded in the Bahamas 2000 incident, one whale demonstrated subarachnoid and peribullar hemorrhage and blood within one of the brain ventricles. Post-cranially, the freshest whale demonstrated renal congestion and hemorrhage, which was also consistent with findings in the freshest specimens in the Bahamas incident.

Conclusions: The pattern of injury to the brain and auditory system were similar to those observed in the Bahamas strandings, as were the kidney lesions and hemorrhage and congestion in the lungs (Ketten 2005). The similarities in pathology and stranding patterns between these two events suggested a similar causative mechanism. Although the details about whether or how sonar was used during "Linked Seas 2000" is unknown, the presence of naval activity within the region at the time of the strandings suggested a possible relationship to Navy activity.

2002 Canary Islands Beaked Whale Mass Stranding (24 September 2002)

Description: On September 24, 2002, 14 beaked whales stranded on Fuerteventura and Lanzaote Islands in the Canary Islands (Jepson et al. 2003). Seven of the 14 whales died on the beach and the 7 were returned to the ocean. Four beaked whales were found stranded dead over the next three days either on the coast or floating offshore (Fernández et al. 2005). At the time of the strandings, an international naval exercise (Neo-Tapon 2002) that involved numerous surface warships and several submarines was being conducted off the coast of the Canary Islands. Tactical mid-frequency active sonar was utilized during the exercises, and strandings began within hours of the onset of the use of mid-frequency sonar (Fernández et al. 2005).

Findings: Eight Cuvier's beaked whales, one Blainville's beaked whale, and on Gervais' beaked whale were necropsied; six of them within 12 hours of stranding (Fernández et al. 2005). The stomachs of the whales contained fresh and undigested prey contents. No pathogenic bacteria were isolated from the whales, although parasites were found in the kidneys of all of the animals. The head and neck lymph nodes were congested and hemorrhages were noted in multiple tissues and organs, including the kidney, brain, ears, and jaws. Widespread fat emboli were found throughout the carcasses, but no evidence of blunt trauma was observed in the whales. In addition, the parenchyma of several organs contained macroscopic intravascular bubbles and lesions, putatively associated with nitrogen off-gassing.

Conclusions: The association of NATO mid-frequency sonar use close in space and time to the beaked whale strandings, and the similarity between this stranding event and previous beaked whale mass strandings coincident with sonar use, suggests that a similar scenario and causative mechanism of stranding may be shared between the events. Beaked whales stranded in this event demonstrated brain and auditory system injuries, hemorrhages, and congestion in multiple organs, similar to the pathological findings of the Bahamas and Madeira stranding events. In addition, the necropsy results of Canary Islands stranding event lead to the hypothesis that the presence of disseminated and widespread gas bubbles and fat emboli were indicative of nitrogen bubble formation, similar to what might be expected in decompression sickness (Jepson et al. 2003; Fernández et al. 2005). Whereas gas emboli would develop from the nitrogen gas, fat emboli would enter the blood stream from ruptured fat cells (presumably where nitrogen bubble formation occurs) or through the coalescence of lipid bodies within the blood stream.

The possibility that the gas and fat emboli found by Fernández et al. (2005) was due to nitrogen bubble formation has been hypothesized to be related to either direct activation of the bubble by sonar signals or to a behavioral response in which the beaked whales flee to the surface following sonar exposure. The first hypothesis is related to rectified diffusion (Crum and Mao 1996), the process of increasing the size of a bubble by exposing it to a sound field. This process is facilitated if the environment in which the ensonified bubbles exist is supersaturated with gas. Repetitive diving by marine mammals can cause the blood and some tissues to accumulate gas to a greater degree than is supported by the surrounding environmental pressure (Ridgway and Howard 1979). Deeper and longer dives of some marine mammals, such as those conducted by beaked whales, are theoretically predicted to induce greater levels of supersaturation (Houser et al. 2001). If rectified diffusion were possible in marine mammals exposed to high-level sound, conditions of tissue supersaturation could theoretically speed the rate and increase the size of bubble growth. Subsequent effects due to tissue trauma and emboli would presumably mirror those observed in humans suffering from decompression sickness. It is unlikely that the short duration of sonar pings would be long enough to drive bubble growth to any substantial size, if such a phenomenon occurs. However, an alternative but related hypothesis has also been suggested: stable bubbles could be destabilized by high-level sound exposures such that bubble growth then occurs through static diffusion of gas out of the tissues. In such a scenario the marine mammal would need to be in a gas-supersaturated state for a long enough period of time for bubbles to become of a problematic size. The second hypothesis speculates that rapid ascent to the surface following exposure to a startling sound might produce tissue gas saturation sufficient for the evolution of nitrogen bubbles (Jepson et al. 2003; Fernández et al. 2005). In this scenario, the rate of ascent would need to be sufficiently rapid to compromise behavioral or physiological protections against nitrogen bubble formation. Tyack et al. (2006) showed that beaked whales often make rapid ascents from deep dives suggesting that it is unlikely that beaked whales would suffer from decompression sickness. Zimmer and Tyack (2007) speculated that if repetitive shallow dives that are used by beaked whales to avoid a predator or a sound source, they could accumulate high levels of nitrogen because they would be above the depth of lung collapse (above about 210 ft) and could lead to decompression sickness. There is no evidence that beaked whales dive in this manner in response to predators or sound sources and other marine mammals such as Antarctic and Galapagos fur seals, and pantropical spotted dolphins make repetitive shallow dives with no apparent decompression sickness (Kooyman and Trillmich, 1984; Kooyman et al., 1984; Baird et al., 2001).

Although theoretical predictions suggest the possibility for acoustically mediated bubble growth, there is considerable disagreement among scientists as to its likelihood (Piantadosi and Thalmann 2004). Sound exposure levels predicted to cause in vivo bubble formation within diving cetaceans have not been evaluated and are suspected as needing to be very high (Evans 2002; Crum et al. 2005). Moore and Early (2004) reported that in analysis of sperm whale bones spanning 111 years, gas embolism symptoms were observed indicating that sperm whales may be susceptible to decompression sickness due to natural diving behavior. Further, although it has been argued that traumas from recent beaked whale strandings are consistent with gas emboli and bubble-induced tissue separations (Jepson et al. 2003), there is no conclusive evidence supporting this hypothesis and there is concern that at least some of the pathological findings (e.g., bubble emboli) are artifacts of the necropsy. Currently, stranding networks in the United States have agreed to adopt a set of necropsy guidelines to determine, in part, the possibility and frequency with which bubble emboli can be introduced into marine mammals during necropsy procedures (Arruda et al. 2007).

2006 Spain, Gulf of Vera Beaked Whale Mass Stranding (26-27 January 2006)

Description: The Spanish Cetacean Society reported an atypical mass stranding of four beaked whales that occurred January 26 to 28, 2006, on the southeast coast of Spain near Mojacar (Gulf of Vera) in the Western Mediterranean Sea. According to the report, two of the whales were discovered the evening of January 26 and were found to be still alive. Two other whales were discovered during the day on January 27, but had already died. A following report stated that the first three animals were located near the town of Mojacar and were examined by a team from the University of Las Palmas de Gran Canarias, with the help of the stranding network of Ecologistas en Acción Almería-PROMAR and others from the Spanish Cetacean Society. The fourth animal was found dead on the afternoon of May 27, a few kilometers north of the first three animals.

From January 25-26, 2006, a NATO surface ship group (seven ships including one U.S. ship under NATO operational command) conducted active sonar training against a Spanish submarine within 50 nm of the stranding site.

Findings: Veterinary pathologists necropsied the two male and two female beaked whales (*Z. cavirostris*).

Conclusions: According to the pathologists, a likely cause of this type of beaked whale mass stranding event may have been anthropogenic acoustic activities. However, no detailed pathological results confirming this supposition have been published to date, and no positive acoustic link was established as a direct cause of the stranding.

Even though no causal link can be made between the stranding event and naval exercises, certain conditions may have existed in the exercise area that, in their aggregate, may have contributed to the marine mammal strandings (Freitas 2004):

- Operations were conducted in areas of at least 1000 meters in depth near a shoreline where there is a rapid change in bathymetry on the order of 1000 – 6000 meters occurring a cross a relatively short horizontal distance (Freitas 2004).

- Multiple ships, in this instance, five MFA sonar equipped vessels, were operating in the same area over extended periods of time (20 hours) in close proximity.

- Exercises took place in an area surrounded by landmasses, or in an embayment. Operations involving multiple ships employing mid-frequency active sonar near land may produce sound directed towards a channel or embayment that may cut off the lines of egress for marine mammals (Freitas 2004)

2.4.3.2 Other Global Stranding Discussions

In the following sections, stranding events that have been linked to U.S. Navy activity in popular press are presented. As detailed in the individual case study conclusions, the U.S. Navy believes there is enough evidence available to refute allegations of impacts from mid-frequency sonar, or at least indicate that a substantial degree of uncertainty in time and space that preclude a meaningful scientific conclusion.

Case Studies of Stranding Events

2003 Washington State Harbor Porpoise Strandings (May 2 – June 2 2003)

Description: At 1040 hours on May 5, 2003, the USS SHOUP began the use of mid-frequency tactical active sonar as part of a naval exercise. At 1420, the USS SHOUP entered the Haro Strait and terminated active sonar use at 1438, thus limiting active sonar use within the strait to less than 20 minutes. Between May 2 and June 2, 2003, approximately 16 strandings involving 15 harbor porpoises (*Phocoena phocoena*) and one Dall's porpoise (*Phocoenoides dalli*) were reported to the Northwest Marine Mammal Stranding Network. A comprehensive review of all strandings and the events involving USS SHOUP on 5 May 2003 were presented in U.S. Department of Navy (2004). Given that the USS SHOUP was known to have operated sonar in the strait on May 5, and that supposed behavioral reactions of killer whales (*Orcinus orca*) had been putatively linked to these sonar operations (NMFS Office of Protected Resources, 2005), the NMFS undertook an analysis of whether sonar caused the strandings of the harbor porpoises.

Whole carcasses of ten of harbor porpoises and the head of an additional porpoise were collected for analysis. Necropsies were performed on ten of the harbor porpoises and six whole carcasses and two heads were selected for CT imaging. Gross examination, histopathology, age determination, blubber analysis, and various other analyses were conducted on each of the carcasses (Norman et al. 2004).

Findings: Post-mortem findings and analysis details are found in Norman et al. (2004). All of the carcasses suffered from some degree of freeze-thaw artifact that hampered gross and histological evaluations. At the time of necropsy, three of the porpoises were moderately fresh, whereas the remainder of the carcasses was considered to have moderate to advanced decomposition. None of the 11 harbor porpoises demonstrated signs of acoustic trauma. In contrast, a putative cause of death was determined for 5 of the porpoises; 2 animals had blunt trauma injuries and 3 animals had indication of disease processes (fibrous peritonitis, salmonellosis, and necrotizing pneumonia). A cause of death could not be determined in the remaining animals, which is consistent with expected percentage of marine mammal necropsies conducted within the northwest region. It is important to note, however, that these determinations were based only on the evidence from the necropsy so as not to be biased with regard to determinations of the potential presence or absence of acoustic trauma. The result was that other potential causal factors, such as one animal (Specimen 33NWR05005) found tangled in a fishing net, was unknown to the investigators in their determination regarding the likely cause of death.

Conclusions: The NMFS concluded from a retrospective analysis of stranding events that the number of harbor porpoise stranding events in the approximate month surrounding the USS SHOUP use of sonar was higher than expected based on annual strandings of harbor porpoises (Norman et al. 2004). In this regard, it is important to note that the number of strandings in the May-June timeframe in 2003 was also higher for the outer coast indicating a much wider phenemona than use of sonar by USS SHOUP in Puget Sound for one day in May. The conclusion by NMFS that the number of strandings in 2003 was higher is also different from that of The Whale Museum, which has documented and responded to harbor porpoise strandings since 1980 (Osborne 2003). According to The Whale Museum, the number of strandings as of May 15, 2003, was consistent with what was expected based on historical stranding records and was less than that occurring in certain years. For example, since 1992 the San Juan Stranding Network has documented an average of 5.8 porpoise strandings per year. In 1997 there were 12 strandings in the San Juan Islands with more than 30 strandings throughout the general Puget Sound area. Disregarding the discrepancy in the historical rate of porpoise strandings and its relation to the USS SHOUP, NMFS acknowledged that the intense level of media attention focused on the strandings likely resulted in an increased reporting effort by the public over that which is normally observed (Norman et al. 2004). NMFS also noted in its report that the “sample size is too small and biased to infer a specific relationship with respect to sonar usage and subsequent strandings.”

Seven of the porpoises collected and analyzed died prior to SHOUP departing to sea on May 5, 2003. Of these seven, one, discovered on May 5, 2003, was in a state of moderate decomposition, indicating it died before May 5; the cause of death was determined to be due, most likely, to salmonella septicemia. Another porpoise, discovered at Port Angeles on May 6, 2003, was in a state of moderate decomposition, indicating that this porpoise also died prior to May 5. One stranded harbor porpoise discovered fresh on May 6 is the only animal that could potentially be linked in time to the USS SHOUP’s May 5 active sonar use. Necropsy results for this porpoise found no evidence of acoustic trauma. The remaining eight strandings were discovered one to three weeks after the USS SHOUP’s May 5 transit of the Haro Strait, making it difficult to causally link the sonar activities of the USS SHOUP to the timing of the strandings. Two of the eight porpoises died from blunt trauma injury and a third suffered from parasitic infestation, which possibly contributed to its death (Norman et al. 2004). For the remaining five porpoises, NMFS was unable to identify the causes of death.

The speculative association of the harbor porpoise strandings to the use of sonar by the USS SHOUP is inconsistent with prior stranding events linked to the use of mid-frequency sonar. Specifically, in prior events, the stranding of whales occurred over a short period of time (less than 36 hours), stranded individuals were spatially co-located, traumas in stranded animals were consistent between events, and active sonar was known or suspected to be in use. Although mid-frequency active sonar was used by the USS SHOUP, the distribution of harbor porpoise strandings by location and with respect to time surrounding the event do not support the suggestion that mid-frequency active sonar was a cause of harbor porpoise strandings. Rather, a complete lack of evidence of any acoustic trauma within the harbor porpoises, and the identification of probable causes of stranding or death in several animals, further supports the conclusion that harbor porpoise strandings were unrelated to the sonar activities of the USS SHOUP.

Additional allegations regarding USS SHOUP use of sonar having caused behavioral effects to Dall's porpoise, orca, and a minke whale also arose in association with this event (see U.S. Department of Navy 2004 for a complete discussion).

Dall's porpoise: Information regarding the observation of Dall's porpoise on 5 May 2003 came from the operator of a whale watch boat at an unspecified location. This operator reported the Dall's porpose were seen "going north" when the SHOUP was estimated by him to be 10 miles away. Potential reasons for the Dall's movement include the pursuit of prey, the presence of harassing resident orca or predatory transient orca, vessel disturbance from one of many whale watch vessels, or multiple other unknowable reasons including the use of sonar by USS SHOUP. In short, there was nothing unusual in the observed behavior of the Dall's porpoise on 5 May 2003 and no way to assess if the otherwise normal behavior was in reaction to the use of sonar by USS SHOUP, any other potential causal factor, or a combination of factors.

Orca: Observer opinions regarding orca J-Pod behaviors on 5 May 2003 were inconsistent, ranging from the orca being "at ease with the sound" or "resting" to their being "annoyed." One witness reported observing "low rates of surface active behavior" on behalf of the orca J-Pod, which is in conflict with that of another observer who reported variable surface activity, tail slapping and spyhopping. Witnesses also expressed the opinion that the behaviors displayed by the orca on 5 May 2003 were "extremely unusual," although those same behaviors are observed and reported regularly on the Orca Network Website, are behaviors listed in general references as being part of the normal repertoire of orca behaviors. Given the contradictory nature of the reports on the observed behavior of the J-Pod orca, it is impossible to determine if any unusual behaviors were present. In short, there is no way to assess if any unusual behaviors were present or if present they were in reaction to vessel disturbance from one of many nearby whale watch vessels, use of sonar by USS SHOUP, any other potential causal factor, or a combination of factors.

Minke whale: A minke whale was reported porpoising in Haro Strait on 5 May 2003, which is a rarely observed behavior. The cause of this behavior is indeterminate given multiple potential causal factors including but not limited to the presence of predatory Transient orca, possible interaction with whale watch boats, other vessels, or SHOUP's use of sonar. The behavior of the minke whale was the only unusual behavior clearly present on 5 May 2003, however, no way to given the existing information if the unusual behavior observed was in reaction to the use of sonar by USS SHOUP, any other potential causal factor, or a combination of factors.

2004 Hawai'i Melon-Headed Whale Mass Stranding (July 3-4 2004)

Description: The majority of the following information is taken from the NMFS report on the stranding event (Southall et al. 2006) but is inclusive of additional and new information not presented in the NMFS report. On the morning of July 3, 2004, between 150-200 melon-headed whales (*Peponocephala electra*) entered Hanalei Bay, Kauai. Individuals attending a canoe blessing ceremony observed the animals entering the bay at approximately 7:00 a.m. The whales were reported entering the bay in a "wave as if they were chasing fish" (Braun 2006). At 6:45 a.m. on July 3, 2004, approximately 25 nm north of Hanalei Bay, active sonar was tested briefly prior to the start of an anti-submarine warfare exercise.

The whales stopped in the southwest portion of the bay, grouping tightly, and displayed spy-hopping and tail-slapping behavior. As people went into the water among the whales, the pod separated into as many as four groups, with individual animals moving among the clusters. This continued through most of the day, with the animals slowly moving south and then southeast within the bay. By about 3 p.m., police arrived and kept people from interacting with the animals. The Navy believes that the abnormal behavior by the whales during this time is likely the result of people and boats in the water with the whales rather than the result of sonar activities taking place 25 or more miles off the coast. At 4:45 p.m. on July 3, 2004, the RIMPAC Battle Watch Captain received a call from a National Marine Fisheries representative in Honolulu, Hawaii, reporting the sighting of as many as 200 melon-headed whales in Hanalei Bay. At 4:47 p.m. the Battle Watch Captain directed all ships in the area to cease active sonar transmissions.

At 7:20 p.m. on July 3, 2004, the whales were observed in a tight single pod 75 yards from the southeast side of the bay. The pod was circling in a group and displayed frequent tail slapping and whistle vocalizations and some spy hopping. No predators were observed in the bay and no animals were reported as having fresh injuries. The pod stayed in the bay through the night of July 3, 2004. On the morning of July 4, 2004, the whales were observed to still be in the bay and collected in a tight group. A decision was made at that time to attempt to herd the animals out of the bay. A 700-to-800-foot rope was constructed by weaving together beach morning glory vines. This vine rope was tied between two canoes and with the assistance of 30 to 40 kayaks, was used to herd the animals out of the bay. By approximately 11:30 a.m. on July 4, 2004, the pod was coaxed out of the bay.

A single neonate melon-headed whale was observed in the bay on the afternoon of July 4, after the whale pod had left the bay. The following morning on July 5, 2004, the neonate was found stranded on Lumahai Beach. It was pushed back into the water but was found stranded dead between 9 and 10 a.m. near the Hanalei pier. NMFS collected the carcass and had it shipped to California for necropsy, tissue collection, and diagnostic imaging.

Following the stranding event, NMFS undertook an investigation of possible causative factors of the stranding. This analysis included available information on environmental factors, biological factors, and an analysis of the potential for sonar involvement. The latter analysis included vessels that utilized mid-frequency active sonar on the afternoon and evening of July 2. These vessels were to the southeast of Kauai, on the opposite side of the island from Hanalei Bay.

Findings: NMFS concluded from the acoustic analysis that the melon-headed whales would have had to have been on the southeast side of Kauai on July 2 to have been exposed to sonar from naval vessels on that day (Southall et al. 2006). There was no indication whether the animals were in that region or whether they were elsewhere on July 2. NMFS concluded that the animals would have had to swim from 1.4-4.0 m/s for 6.5 to 17.5 hours after sonar transmissions ceased to reach Hanalei Bay by 7:00 a.m. on July 3. Sound transmissions by ships to the north of Hanalei Bay on July 3 were produced as part of exercises between 6:45 a.m. and 4:47 p.m.

Propagation analysis conducted by the 3rd Fleet estimated that the level of sound from these transmissions at the mouth of Hanalei Bay could have ranged from 138-149 dB re: 1 μPa.

NMFS was unable to determine any environmental factors (e.g., harmful algal blooms, weather conditions) that may have contributed to the stranding. However, additional analysis by Navy investigators found that a full moon occurred the evening before the stranding and was coupled with a squid run (Mobley 2007). One of the first observations of the whales entering the bay reported the pod came into the bay in a line "as if chasing fish" (Braun, 2005). . In addition, a group of 500-700 melon-headed whales were observed to come close to shore and interact with humans in Sasanhaya Bay, Rota, on the same morning as the whales entered Hanalei Bay (Jefferson et al. 2006). Previous records further indicated that, though the entrance of melon-headed whales into the shallows is rare, it is not unprecedented. A pod of melon-headed whales entered Hilo Bay in the 1870s in a manner similar to that which occurred at Hanalei Bay in 2004.

The necropsy of the melon-headed whale calf suggested that the animal died from a lack of nutrition, possibly following separation from its mother. The calf was estimated to be approximately one week old. Although the calf appeared not to have eaten for some time, it was not possible to determine whether the calf had ever nursed after it was born. The calf showed no signs of blunt trauma or viral disease and had no indications of acoustic injury.

Conclusions: Although it is not impossible, it is unlikely that the sound level from the sonar caused the melon-headed whales to enter Hanalei Bay. This conclusion is based on a number of factors:

1. The speculation that the whales may have been exposed to sonar the day before and then fled to the Hanalei Bay is not supported by reasonable expectation of animal behavior and swim speeds. The flight response of the animals would have had to persist for many hours following the cessation of sonar transmissions. Such responses have not been observed in marine mammals and no documentation of such persistent flight response after the cessation of a frightening stimulus has been observed in other mammals. The swim speeds, though feasible for the species, are highly unlikely to be maintained for the durations proposed, particularly since the pod was a mixed group containing both adults and neonates. Whereas adults may maintain a swim speed of 4.0 m/s for some time, it is improbable that a neonate could achieve the same for a period of many hours.

2. The area between the islands of Oahu and Kauai and the PMRF training range have been used in RIMPAC exercises for more than 20 years, and are used year-round for ASW training using mid frequency active sonar. Melon-headed whales inhabiting the waters around Kauai are likely not naive to the sound of sonar and there has never been another stranding event associated in time with ASW training at Kauai or in the Hawaiian Islands. Similarly, the waters surrounding Hawaii contain an abundance of marine mammals, many of which would have been exposed to the same sonar operations that were speculated to have affected the melon-headed whales. No other strandings were reported coincident with the RIMPAC exercises. This leaves it uncertain as to why melon-headed whales, and no other species of marine mammal, would respond to the sonar exposure by stranding.

3. At the nominal swim speed for melon-headed whales, the whales had to be within 1.5 to 2 nm of Hanalei Bay before sonar was activated on July 3. The whales were not in their open ocean habitat but had to be close to shore at 6:45 a.m. when the sonar was activated to have been observed inside Hanalei Bay from the beach by 7:00 a.m (Hanalei Bay is very large area). This observation suggests that other potential factors could be causative of the stranding event (see below).

4. The simultaneous movement of 500-700 melon-headed whales and Risso's dolphins into Sasanhaya Bay, Rota, in the Northern Marianas Islands on the same morning as the 2004 Hanalei stranding (Jefferson et al. 2006) suggests that there may be a common factor which prompted the melon-headed whales to approach the shoreline. A full moon occurred the evening before the stranding and a run of squid was reported concomitant with the lunar activity (Mobley et al. 2007). Thus, it is possible that the melon-headed whales were capitalizing on a lunar event that provided an opportunity for relatively easy prey capture (Mobley et al. 2007). A report of a pod entering Hilo Bay in the 1870s indicates that on at least one other occasion, melon-headed whales entered a bay in a manner similar to the occurrence at Hanalei Bay in July 2004. Thus, although melon-headed whales entering shallow embayments may be an infrequent event, and every such event might be considered anomalous, there is precedent for the occurrence.

5. The received noise sound levels at the bay were estimated to range from roughly 95 – 149 dB re: 1 μPa. Received levels as a function of time of day have not been reported, so it is not possible to determine when the presumed highest levels would have occurred and for how long. However, received levels in the upper range would have been audible by human participants in the bay. The statement by one interviewee that he heard "pings" that lasted an hour and that they were loud enough to hurt his ears is unreliable. Received levels necessary to cause pain over the duration stated would have been observed by most individuals in the water with the animals. No other such reports were obtained from people interacting with the animals in the water.

Although NMFS concluded that sonar use was a "plausible, if not likely, contributing factor in what may have been a confluence of events (Southall et al. 2006)," this conclusion was based primarily on the basis that there was an absence of any other compelling explanation. The authors of the NMFS report on the incident were unaware, at the time of publication, of the simultaneous event in Rota. In light of the simultaneous Rota event, the Hanalei stranding does not appear as anomalous as initially presented and the speculation that sonar was a causative factor is weakened. The Hanalei Bay incident does not share the characteristics observed with other mass strandings of whales coincident with sonar activity (e.g., specific traumas, species composition, etc.). In addition, the inability to conclusively link or exclude the impact of other environmental factors makes a causal link between sonar and the melon-headed whale strandings highly speculative at best.

1980- 2004 Beaked Whale Strandings in Japan (Brownell et al. 2004)

Description: Brownell et al. (2004) compare the historical occurrence of beaked whale strandings in Japan (where there are U.S. Naval bases), with strandings in New Zealand (which lacks a U.S. Naval base) and concluded the higher number of strandings in Japan may be related to the presence of the US. Navy vessels using mid-frequency sonar. While the dates for the strandings were well documented, the authors of the study did not attempt to correlate the dates of any navy activities or exercises with the dates of the strandings.

To fully investigate the allegation made by Brownell et al. (2004), the Center for Naval Analysis (CNA) in an internal Navy report, looked at the past U.S. Naval exercise schedules from 1980 to 2004 for the water around Japan in comparison to the dates for the strandings provided by Brownell et al. (2004). None of the strandings occurred during or soon (within weeks) after any U.S. Navy exercises. While the CNA analysis began by investigating the probabilistic nature of any co-occurrences, the strandings and sonar use were not correlated by time. Given there there there was no instance of co-occurrence in over 20 years of stranding data, it can be reasonably postulated that sonar use in Japan waters by U.S. Navy vessels did not lead to any of the strandings documented by Brownell et al. (2004).

2004 Alaska Beaked Whale Strandings (7-16 June 2004)

Description: In the timeframe between 17 June and 19 July 2004, five beaked whales were discovered at various locations along 1,600 miles of the Alaskan coastline and one was found floating (dead) at sea. Because the Navy exercise Alaska Shield/Northern Edge 2004 occurred within the approximate timeframe of these strandings, it has been alleged that sonar may have been the probable cause of these strandings.

The Alaska Shield/Northern Edge 2004 exercise consisted of a vessel tracking event followed by a vessel boarding search and seizure event. There was no ASW component to the exercise, no use of mid-frequency sonar, and no use of explosives in the water. There were no events in the Alaska Shield/Northern Edge exercise that could have caused in any of the strandings over this 33 day period covering 1,600 miles of coastline.

2005 North Carolina Marine Mammal Mass Stranding Event (January 15-16, 2005)

Description: On January 15 and 16, 2005, 36 marine mammals consisting of 33 short-finned pilot whales, 1 minke whale, and 2 dwarf sperm whales stranded alive on the beaches of North Carolina (Hohn et al., 2006a). The animals were scattered across a 111-km area from Cape Hatteras northward. Because of the live stranding of multiple species, the event was classified as a UME. It is the only stranding on record for the region in which multiple offshore species were observed to strand within a two- to three-day period

The U.S. Navy indicated that from January 12-14 some unit level training with mid-frequency active sonar was conducted by vessels that were 93 to 185 km from Oregon Inlet. An expeditionary strike group was also conducting exercises to the southeast, but the closest point of active sonar transmission to the inlet was 650 km away. The unit level operations were not unusual for the area or time of year and the vessels were not involved in antisubmarine warfare exercises. Marine mammal observers on board the vessels did not detect any marine mammals during the period of unit level training. No sonar transmissions were made on January 15-16.

The National Weather Service reported that a severe weather event moved through North Carolina on January 13 and 14. The event was caused by an intense cold front that moved into an unusually warm and moist air mass that had been persisting across the eastern United States for about a week. The weather caused flooding in the western part of the state, considerable wind damage in central regions of the state, and at least three tornadoes that were reported in the north central part of the state. Severe, sustained (one to four days) winter storms are common for this region.

Over a two-day period (January 16-17), two dwarf sperm whales, 27 pilot whales, and the minke whale were necropsied and tissue samples collected. Twenty-five of the stranded cetacean heads were examined; two pilot whale heads and the heads of the dwarf sperm whales were analyzed by CT.

Findings: The pilot whales and dwarf sperm whale were not emaciated, but the minke whale, which was believed to be a dependent calf, was emaciated. Many of the animals were on the beach for an extended period of time prior to necropsy and sampling, and many of the biochemical abnormalities noted in the animals were suspected of being related to the stranding and prolonged time on land. Lesions were observed in all of the organs, but there was no consistency across species. Musculoskeletal disease was observed in two pilot whales and cardiovascular disease was observed in one dwarf sperm whale and one pilot whale. Parasites were a common finding in the pilot whales and dwarf sperm whales but were considered consistent with the expected parasite load for wild odontocetes. None of the animals exhibited traumas similar to those observed in prior stranding events associated with mid-frequency sonar activity. Specifically, there was an absence of auditory system trauma and no evidence of distributed and widespread bubble lesions or fat emboli, as was previously observed (Fernández et al., 2005).

Sonar transmissions prior to the strandings were limited in nature and did not share the concentration identified in previous events associated with mid-frequency active sonar use (Evans and England, 2001). The operational/environmental conditions were also dissimilar (e.g., no constrictive channel and a limited number of ships and sonar transmissions). NMFS noted that environmental conditions were favorable for a shift from up-welling to down-welling conditions, which could have contributed to the event. However, other severe storm conditions existed in the days surrounding the strandings and the impact of these weather conditions on at-sea conditions is unknown. No harmful algal blooms were noted along the coastline.

Conclusions: All of the species involved in this stranding event are known to occasionally strand in this region. Although the cause of the stranding could not be determined, several whales had preexisting conditions that could have contributed to the stranding. Cause of death for many of the whales was likely due to the physiological stresses associated with being stranded. A consistent suite of injuries across species, which was consistent with prior strandings where sonar exposure is expected to be a causative mechanism, was not observed.

NMFS was unable to determine any causative role that sonar may have played in the stranding event. The acoustic modeling performed, as in the Hanalei Bay incident, was hampered by uncertainty regarding the location of the animals at the time of sonar transmissions. However, as in the Hanalei Bay incident, the response of the animals following the cessation of transmissions would imply a flight response that persisted for many hours after the sound source was no longer operational. In contrast, the presence of a severe weather event passing through North Carolina during January 13 and 14 is a possible, if not likely, contributing factor to the North Carolina UME of January 15. Hurricanes may have been responsible for mass strandings of pygmy killer whales in the British Virgin Islands and Gervais' beaked whales in North Carolina (Mignucci-Giannoni et al. 2000; Norman and Mead 2001).

2.4.3.3 Causal Associations for Stranding Events

Several stranding events have been associated with Navy sonar activities but relatively few of the total stranding events that have been recorded occurred spatially or temporally with Navy sonar activities. While sonar may be a contributing factor under certain rare conditions, the presence of sonar it is not a necessary condition for stranding events to occur.

A review of past stranding events associated with sonar suggest that the potential factors that may contribute to a stranding event are steep bathymetry changes, narrow channels, multiple sonar ships, surface ducting and the presence of beaked whales that may be more susceptible to sonar exposures. The most important factors appear to be the presence of a narrow channel (e.g. Bahamas and Madeira Island, Portugal) that may prevent animals from avoiding sonar exposure and multiple sonar ships within that channel. There are no narrow channels (less than 35 nm wide and 10 nm in length) in the SOCAL Range Complex and the ships would be spread out over a wider area allowing animals to move away from sonar activities if they choose. In addition, beaked whales may not be more susceptible to sonar but may favor habitats that are more conducive to sonar effects.

There have been no mass strandings in Southern California waters are attributed to Navy sonar. Given the large military presence and private and commercial vessel traffic in the Southern California waters, it is likely that a mass stranding event would be detected. Therefore, it is unlikely that the conditions that may have contributed to past stranding events involving Navy sonar would be present in the SOCAL Range Complex.

2.4.3.4 California Stranding Patterns

While major range events undergo name changes over the years, the equivalent of COMPTUEX and JTFEX have been conducted in Southern California, specifically SCIRC, since 1934. Sonar training activities have been conducted since World War II, and sonar systems assessed in the COMPTUEX/JTFEX EA/OEA (U.S. Navy 2006a) have been used since the 1970's (J. Marshall U.S. Navy, pers. comm.). Between 1982-2005, eight blue whales, 14 fin whales, seven humpback whales, two sperm whales, zero sei whales, and 12 Guadalupe fur seals (California Marine Mammal Stranding Network Database 2006), were reported as stranded in California. Known strandings also occurred in all months with no significant temporal trend (California Marine Mammal Stranding Network Database 2006). Beaked whales have also stranded in Southern California, however they were not considered mass stranding events nor were they correlated with sonar. Eleven beaked whales stranded between 1982-2005 from San Diego to Santa Barbara County [specifically, Blainville’s, Hubb’s (*M. carhubbsi*), Cuvier’s, and Stejneger’s (*M. stejnegeri*)] (California Marine Mammal Stranding Network Database 2006).

2.4.4 Stranding Section Conclusions

Marine mammal strandings have been a historic and ongoing occurrence attributed to a variety of causes. Over the last fifty years, increased awareness and reporting has lead to more information about species effected and raised concerns about anthropogenic sources of stranding. While there has been some marine mammal mortalities potentially associated with mid-frequency sonar effects to a small number of species (primarily limited numbers of certain species of beaked whales), the significance and actual causative reason for any impacts is still subject to continued investigation.

By comparison and as described previously, potential impacts to all species of cetaceans worldwide from fishery related mortality can be orders of magnitude more significant (100,000s of animals vice 10s of animals) (Culik, 2002; ICES, 2005b; Read et al., 2006). This does not negate the influence of any mortality or additional stressor to small, regionalized sub-populations which may be at greater risk from human related mortalities (fishing, vessel strike, sound) than populations with larger oceanic level distribution or migrations. ICES (2005a) noted, however, that taken in context of marine mammal populations in general, sonar is not major threat, or significant portion of the overall ocean noise budget.

In conclusion, a constructive framework and continued research based on sound scientific principles is needed in order to avoid speculation as to stranding causes, and to further our understanding of potential effects or lack of effects from military mid-frequency sonar (Bradshaw et al., 2005; ICES 2005b; Barlow and Gisiner, 2006; Cox et al. 2006).

3 ASSESSING ENVIRONMENTAL CONSEQUENCES

When analyzing the results of the sonar and underwater detonation exposure modeling to provide an estimate of effects, it is important to understand that there are limitations to the ecological data used in the model, and that the model results must be interpreted within the context of a given species' ecology.

3.1 ANALYTICAL FRAMEWORK FOR ASSESSING MARINE MAMMAL RESPONSE TO ACTIVE SONAR

As summarized by the National Academies of Science (NAS), the possibility that human-generated sound could harm marine mammals or significantly interfere with their "normal" activities is an issue of increasing concern (National Research Council [NRC] 2005). This section of the appendix for the EIS/OEIS evaluates the potential for the specific Navy acoustic sources used in the SOCAL Range Complex to result in harassment of marine mammals.

Marine mammals respond to various types of man-made sounds introduced in the ocean environment. Responses are typically subtle and can include shorter surfacings, shorter dives, fewer blows per surfacing, longer intervals between blows (breaths), ceasing or increasing vocalizations, shortening or lengthening vocalizations, and changing frequency or intensity of vocalizations (NRC 2005). However, it is not known how these responses relate to significant effects (e.g., long-term effects or population consequences) (NRC 2005). Assessing whether a sound may disturb or injure a marine mammal involves understanding the characteristics of the acoustic sources, the marine mammals that may be present in the vicinity of the sound, and the effects that sound may have on the physiology and behavior of those marine mammals. Although it is known that sound is important for marine mammal communication, navigation and foraging (NAS 2003; NRC 2005), there are many unknowns in assessing the effects and significance of marine mammals responses to sound exposures. For this reason, the Navy enlisted the expertise of National Marine Fisheries Service (NMFS) as the cooperating agency. Their input assisted the Navy in developing a conceptual analytical framework for evaluating what sound levels marine mammals might receive as a result of Navy training actions in SOCAL Range Complex, whether marine mammals might respond to these exposures, and whether that response might have a mode of action on the biology or ecology of marine mammals such that the response should be considered a potential harassment. From this framework of evaluating the potential for harassment incidents to occur, an assessment of whether acoustic sources might impact populations, stocks or species of marine mammals can be conducted.

The conceptual analytical framework (Figure 3-1) presents an overview of how the mid-frequency active sonar sources used during training are assessed to evaluate the potential for marine mammals to be exposed to an acoustic source, the potential for that exposure to result in a physiological effect or behavioral response by an animal, and the assessment of whether that response may result in a consequence that constitutes harassment in accordance with MMPA definitions.

The first step in the conceptual model is to estimate the potential for marine mammals to be exposed to a Navy acoustic source. Three questions are answered in this "acoustic modeling" step:

1. What action will occur? This requires identification of all acoustic sources that would be used in the exercises and the specific outputs of those sources. This information is provided in Chapter 3.

2. Where and when will the action occur? The place and season of the action are important to determine which marine mammal species are likely to be present. Species occurrence and

density data (Section 2.1 and 2.2 are used to determine the subset of marine mammals that may be present when an acoustic source is operational.

3. Predict the underwater acoustic environment that would be encountered. The acoustic environment here refers to environmental factors that influence the propagation of underwater sound. Acoustic parameters influenced by the place, season, and time are described in Section 4.2.

4. How many marine mammals are predicted to be exposed to sound from the acoustic sources? Sound propagation models are used to predict the received exposure level from an acoustic source, and these are coupled with species distribution and density data to estimate the accumulated received energy and maximum sound pressure level that might be received at a level that could be considered as potential harassment. Section 4 describes the acoustic modeling and Section 6.3 present the number of exposure incidents predicted by the modeling.

The next steps in the analytical framework evaluate whether the sound exposures predicted by the acoustic model might cause a response in a marine mammal, and if that response might be considered harassment of the animal. Harassment includes the concepts of potential injury (Level A Harassment) and behavioral disturbance (Level B harassment). The response assessment portion of the analytical framework examines the following question:

1. Which potential acoustic exposures might result in harassment of marine mammals?

The predicted acoustic exposures are first considered within the context of the species biology (e.g., can a marine mammal detect the sound, and is that mammal likely to respond to that sound?). Next, if a response is predicted, is that response potentially 'harassment' in accordance with MMPA harassment definitions? For example, if a response to the acoustic exposure has a mode of action that results in a consequence for an individual, such as interruption of feeding, that response or repeated occurrence of that response could be considered "abandonment or significant alteration of natural behavioral patterns," and therefore the exposure(s) would cause Level B harassment.

The following flow chart (Figure 3-1) is a representation of the general analytical framework utilized in applying the specific thresholds discussed in this section. The framework presented in the flow chart is organized from left to right and is compartmentalized according to the phenomena that occur within each. These include the physics of sound propagation (Physics), the potential physiological processes associated with sound exposure (Physiology), the potential behavioral processes that might be affected as a function of sound exposure (Behavior), and the immediate effects these changes may have on functions the animal is engaged in at the time of exposure (Life Function – Proximate). These compartmentalized effects are extended to longer term life functions (Life Function – Ultimate) and into population and species effects. Throughout the flow chart, dotted and solid lines are used to connect related events. Solid lines designate those effects that "will" happen; dotted lines designate those that "might" happen but must be considered (including those hypothesized to occur but for which there is no direct evidence).

Section 3.2 reviews the regulatory framework and premises for the Navy/NMFS marine mammal response analytical framework. Section 3.3 present the analysis by species/stock, presenting relevant information about the species biology and ecology to provide a context for assessing whether modeled exposures might result in incidental harassment. The potential for harassment incidents is then considered within the context of the affected marine mammal population, stock or species to assess potential population viability. Particular focus on recruitment and survival are provided to analyze whether the effects of the action can be considered to have negligible impact on species or stocks.

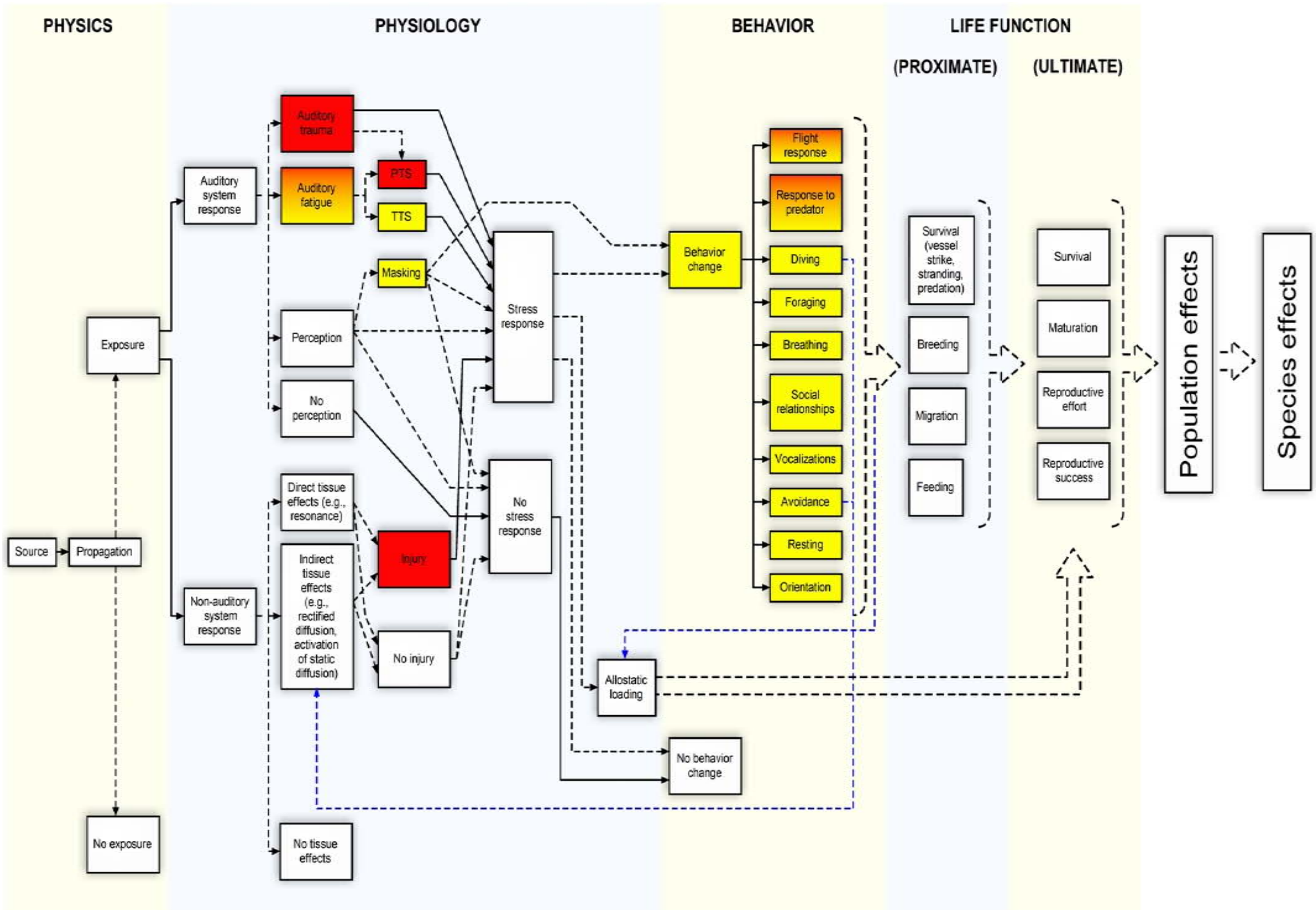

Figure 3-1. Conceptual model for assessing the effects of mid-frequency sonar exposures on marine mammals.

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Some boxes contained within the flow chart are colored according to how they relate to the definitions of harassment under the Marine Mammal Protection Act (MMPA). Red boxes correspond to events that are injurious. By prior ruling and usage, these events would be considered as Level A harassment under the MMPA. Yellow boxes correspond to events that have the potential to qualify as Level B harassment under the MMPA. Based on prior ruling, the specific instance of TTS is considered as Level B harassment. Boxes that are shaded from red to yellow have the potential for injury and behavioral disturbance. The analytical framework outlined within the flow chart acknowledges that physiological responses must always precede behavioral responses (i.e., there can be no behavioral response without first some physiological effect of the sound) and an organization where each functional block only occurs once and all relevant inputs/outputs flow to/from a single instance.

Physiology

Potential impacts to the auditory system are assessed by considering the characteristics of the received sound (e.g., amplitude, frequency, duration) and the sensitivity of the exposed animals. Some of these assessments can be numerically based (e.g., TTS, permanent threshold shift [PTS], perception). Others will be necessarily qualitative, due to lack of information, or will need to be extrapolated from other species for which information exists. Potential physiological responses to the sound exposure are ranked in descending order, with the most severe impact (auditory trauma) occurring at the top and the least severe impact occurring at the bottom (the sound is not perceived).

1. Auditory trauma represents direct mechanical injury to hearing related structures, including tympanic membrane rupture, disarticulation of the middle ear ossicles, and trauma to the inner ear structures such as the organ of Corti and the associated hair cells. Auditory trauma is always injurious but could be temporary and not result in PTS. Auditory trauma is always assumed to result in a stress response.

2. Auditory fatigue refers to a loss of hearing sensitivity after sound stimulation. The loss of sensitivity persists after, sometimes long after, the cessation of the sound. The mechanisms responsible for auditory fatigue differ from auditory trauma and would primarily consist of metabolic exhaustion of the hair cells and cochlear tissues. The features of the exposure (e.g., amplitude, frequency, duration, temporal pattern) and the individual animal’s susceptibility would determine the severity of fatigue and whether the effects were temporary (TTS) or permanent (PTS). Auditory fatigue (PTS or TTS) is always assumed to result in a stress response.

3. Sounds with sufficient amplitude and duration to be detected among the background ambient noise are considered to be perceived. This category includes sounds from the threshold of audibility through the normal dynamic range of hearing (i.e., not capable of producing fatigue). To determine whether an animal perceives the sound, the received level, frequency, and duration of the sound are compared to what is known of the species’ hearing sensitivity.

Since audible sounds may interfere with an animal’s ability to detect other sounds at the same time, perceived sounds have the potential to result in auditory masking. Unlike auditory fatigue, which always results in a stress response because the sensory tissues are being stimulated beyond their normal physiological range, masking may or may not result in a stress response, depending on the degree and duration of the masking effect. Masking may also result in a unique circumstance where an animal’s ability to detect other sounds is compromised without the animal’s knowledge. This could conceivably result in sensory impairment and subsequent behavior change; in this case, the change in behavior is the *lack of a response* that would normally be made if sensory impairment did not occur. For this reason, masking also may lead directly to behavior change without first causing a stress response.

The features of perceived sound (e.g., amplitude, duration, temporal pattern) are also used to judge whether the sound exposure is capable of producing a stress response. Factors to consider in this decision include the probability of the animal being naïve or experienced with the sound (i.e., what are the known/unknown consequences of the exposure).

The received level is not of sufficient amplitude, frequency, and duration to be perceptible by the animal. By extension, this does not result in a stress response (not perceived).

Potential impacts to tissues other than those related to the auditory system are assessed by considering the characteristics of the sound (e.g., amplitude, frequency, duration) and the known or estimated response characteristics of nonauditory tissues. Some of these assessments can be numerically based (e.g., exposure required for rectified diffusion). Others will be necessarily qualitative, due to lack of information. Each of the potential responses may or may not result in a stress response.

1. Direct tissue effects – Direct tissue responses to sound stimulation may range from tissue shearing (injury) to mechanical vibration with no resulting injury. Any tissue injury would produce a stress response, whereas noninjurious stimulation may or may not.

2. Indirect tissue effects – Based on the amplitude, frequency, and duration of the sound, it must be assessed whether exposure is sufficient to indirectly affect tissues. For example, the hypothesis that rectified diffusion occurs is based on the idea that bubbles that naturally exist in biological tissues can be stimulated to grow by an acoustic field. Under this hypothesis, one of three things could happen: (1) bubbles grow to the extent that tissue hemorrhage occurs (injury); (2) bubbles develop to the extent that a complement immune response is triggered or nervous tissue is subjected to enough localized pressure that pain or dysfunction occurs (a stress response without injury); or (3) the bubbles are cleared by the lung without negative consequence to the animal. The probability of rectified diffusion, or any other indirect tissue effect, will necessarily be based on what is known about the specific process involved. No tissue effects – The received sound is insufficient to cause either direct mechanical) or indirect effects to tissues. No stress response occurs.

The Stress Response

The acoustic source is considered a potential stressor if, by its action on the animal, via auditory or nonauditory means, it may produce a stress response in the animal. The term "stress" has taken on an ambiguous meaning in the scientific literature, but with respect to Figure 3-1 and the later discussions of allostasis and allostatic loading, the stress response will refer to an increase in energetic expenditure that results from exposure to the stressor and which is predominantly characterized by either the stimulation of the sympathetic nervous system (SNS) or the hypothalamic-pituitary-adrenal (HPA) axis (Reeder and Kramer 2005). The SNS response to a stressor is immediate and acute and is characterized by the release of the catecholamine neurohormones norepinephrine and epinephrine (i.e., adrenaline). These hormones produce elevations in the heart and respiration rate, increase awareness, and increase the availability of glucose and lipids for energy. The HPA response is ultimately defined by increases in the secretion of the glucocorticoid steroid hormones, predominantly cortisol in mammals. The amount of increase in circulating glucocorticoids above baseline may be an indicator of the overall severity of a stress response (Hennessy et al. 1979). Each component of the stress response is variable in time; e.g., adrenalines are released nearly immediately and are used or cleared by the system quickly, whereas cortisol levels may take long periods of time to return to baseline.

The presence and magnitude of a stress response in an animal depends on a number of factors. These include the animal's life history stage (e.g., neonate, juvenile, adult), the environmental conditions, reproductive or developmental state, and experience with the stressor. Not only will these factors be subject to individual variation, but they will also vary within an individual over time. In considering potential stress responses of marine mammals to acoustic stressors, each of these should be considered. For example, is the acoustic stressor in an area where animals engage in breeding activity? Are animals in the region resident and likely to have experience with the stressor (i.e., repeated exposures)? Is the region a foraging ground or are the animals passing through as transients? What is the ratio of young (naïve) to old (experienced) animals in the population? It is unlikely that all such questions can be answered from empirical data; however, they should be addressed in any qualitative assessment of a potential stress response as based on the available literature.

The stress response may or may not result in a behavioral change**,** depending on the characteristics of the exposed animal. However, provided a stress response occurs, we assume that some contribution is made to the animal's allostatic load. Allostasis is the ability of an animal to maintain stability through change by adjusting its physiology in response to both predictable and unpredictable events (McEwen and Wingfield 2003). The same hormones associated with the stress response vary naturally throughout an animal's life, providing support for particular life history events (e.g., pregnancy) and predictable environmental conditions (e.g., seasonal changes). The allostatic load is the cumulative cost of allostasis incurred by an animal and is generally characterized with respect to an animal's energetic expenditure. Perturbations to an animal that may occur with the presence of a stressor, either biological (e.g., predator) or anthropogenic (e.g., construction), can contribute to the allostatic load (Wingfield, 2003). Additional costs are cumulative and additions to the allostatic load over time may contribute to reductions in the probability of achieving ultimate life history functions (e.g., survival, maturation, reproductive effort and success) by producing pathophysiological states. The contribution to the allostatic load from a stressor requires estimating the magnitude and duration of the stress response, as well as any secondary contributions that might result from a change in behavior.

If the acoustic source does not produce tissue effects, is not perceived by the animal, or does not produce a stress response by any other means, Figure 3-1 assumes that the exposure does not contribute to the allostatic load. Additionally, without a stress response or auditory masking, it is assumed that there can be no behavioral change. Conversely, any immediate effect of exposure that produces an injury (i.e., red boxes on the flow chart in Figure 3-1) is assumed to also produce a stress response and contribute to the allostatic load.

Behavior

Acute stress responses may or may not cause a behavioral reaction. However, all changes in behavior are expected to result from an acute stress response. This expectation is based on the idea that some sort of physiological trigger must exist to change any behavior that is already being performed. The exception to this rule is the case of masking. The presence of a masking sound may not produce a stress response, but may interfere with the animal's ability to detect and discriminate biologically relevant signals. The inability to detect and discriminate biologically relevant signals hinders the potential for normal behavioral responses to auditory cues and is thus considered a behavioral change.

Numerous behavioral changes can occur as a result of stress response, and Figure 3-1 lists only those that might be considered the most common types of response for a marine animal. For each potential behavioral change, the magnitude in the change and the severity of the response needs to be estimated. Certain conditions, such as stampeding (i.e., flight response) or a response to a predator, might have a probability of resulting in injury. For example, a flight response, if significant enough, could produce a stranding event. Under the MMPA, such an event would be considered a Level A harassment. Each altered behavior may also have the potential to disrupt biologically significant events (e.g., breeding or nursing) and may need to be qualified as Level B harassment. All behavioral disruptions have the potential to contribute to the allostatic load. This secondary potential is signified by the feedback from the collective behaviors to allostatic loading.

Special considerations are given to the potential for avoidance and disrupted diving patterns. Due to past incidents of beaked whale strandings associated with sonar operations, feedback paths are provided between avoidance and diving and indirect tissue effects. This feedback accounts for the hypothesis that variations in diving behavior and/or avoidance responses can possibly result in nitrogen tissue supersaturation and nitrogen off-gassing, possibly to the point of deleterious vascular bubble formation. Although hypothetical in nature, the potential process is currently popular and hotly debated.

Life Function

Proximate Life Functions

Proximate life history functions are the functions that the animal is engaged in at the time of acoustic exposure. The disruption of these functions, and the magnitude of the disruption, is something that must be considered in determining how the ultimate life history functions are affected. Consideration of the magnitude of the effect to each of the proximate life history functions is dependent upon the life stage of the animal. For example, an animal on a breeding ground which is sexually immature will suffer relatively little consequence to disruption ofbreeding behavior when compared to an actively displaying adult of prime reproductive age.

Ultimate Life Functions

The ultimate life functions are those that enable an animal to contribute to the population (or stock, or species, etc.). The impact to ultimate life functions will depend on the nature and magnitude of the perturbation to proximate life history functions. Depending on the severity of the response to the stressor, acute perturbations may have nominal to profound impacts on ultimate life functions. For example, unit-level use of sonar by a vessel transiting through an area that is utilized for foraging, but not for breeding, may disrupt feeding by exposed animals for a brief period of time. Because of the brevity of the perturbation, the impact to ultimate life functions may be negligible. By contrast, weekly training over a period of years may have a more substantial impact because the stressor is chronic. Assessment of the magnitude of the stress response from the chronic perturbation would require an understanding of how and whether animals acclimate to a specific, repeated stressor and whether chronic elevations in the stress response (e.g., cortisol levels) produce fitness deficits.

The proximate life functions are loosely ordered in decreasing severity of impact. Mortality (survival) has an immediate effect, in that no future reproductive success is feasible and there is no further addition to the population resulting from reproduction. Severe injuries may also lead to reduced survivorship (longevity) and prolonged alterations in behavior. The latter may further affect an animal's overall reproductive success and reproductive effort. Disruptions of breeding have an immediate impact on reproductive effort and may impact reproductive success. The magnitude of the effect will depend on the duration of the disruption and the type of behavior change that was provoked. Disruptions to feeding and migration can affect all of the ultimate life functions; however, the impacts to reproductive effort and success are not likely to be as severe or immediate as those incurred by mortality and breeding disruptions.

3.2 REGULATORY FRAMEWORK

The MMPA prohibits the unauthorized harassment of marine mammals, and provides the regulatory processes for authorization for any such harassment that might occur incidental to an otherwise lawful activity.

The model for estimating potential acoustic effects from SOCAL Range Complex anti-submarine warfare (ASW) training activities on cetacean species makes use of the methodology that was developed in cooperation with the National Oceanic and Atmospheric Administration (NOAA) for the Navy's Draft Overseas Environmental Impact Statement/Environmental Impact Statement, Undersea Warfare Training Range (OEIS/EIS) (DON, 2005). Via response comment letter to Undersea Warfare Training Range (USWTR) received from NMFS dated January 30, 2006, NMFS concurred with the use of Energy Flux Density Level (EL) for the determination of physiological effects to marine mammals. Therefore, this methodology is used to estimate the annual exposure of marine mammals that may be considered Level A harassment or Level B harassment as a result of temporary, recoverable physiological effects.

In addition, the approach for estimating potential acoustic effects from training activities on marine mammal makes use of the comments received on previous Navy NEPA documents. NMFS and others who commented recommended the use of an alternate methodology to evaluate when sound exposures might result in behavioral effects without corresponding physiological effects. As a result of these comments, this analysis uses a dose function approach to evaluate the potential for behavioral effects. The dose-function is further explained in Section 3.18.

A number of Navy actions and NOAA rulings have helped to qualify possible events deemed as "harassment" under the MMPA. As stated previously, "harassment" under the MMPA includes both potential injury (Level A), and disruptions of natural behavioral patterns to a point where they are abandoned or significantly altered (Level B). NMFS also includes mortality as a possible outcome to consider in addition to Level A and Level B harassment. The acoustic effects analysis and exposure calculations are based on the following premises:

- Harassment that may result from Navy operations described in the SOCAL Range Complex EIS/OEIS is unintentional and incidental to those operations.

- This SOCAL Range Complex EIS/OEIS request uses an unambiguous definition of injury as defined in the RIMPAC OEA (DON 2006) and in previous rulings (NOAA 2001; 2002a): injury occurs when any biological tissue is destroyed or lost as a result of the action.

- Behavioral disruption might result in subsequent injury and injury may cause a subsequent behavioral disruption, so Level A and Level B (defined below) harassment categories can overlap and are not necessarily mutually exclusive. However, consistant with prior ruling (NOAA 2001; 2006b), this SOCAL Range Complex EIS/OEIS request assumes that Level A and B do not overlap so as to preclude circular definitions of harassment.

- An individual animal predicted to experience simultaneous multiple injuries, multiple disruptions, or both, is counted as a single take (see NOAA 2001; 2006b). An animal whose behavior is disrupted by an injury has already been counted as a Level A harassment and will not also be counted as a Level B harassment. Based on the consideration of two different acoustic modeling methodologies to assess the potential for sound exposures that might result in behavioral disturbance, it is possible that an animal could simultaneously experience multiple disruptions (e.g., a temporary threshold shift and a resultant stress response), may be counted as multiple Level B harassment incidents (i.e., a potential overlap of 5 percent). Although this approach overestimates the potential for behavioral disturbance incidents, it is considered conservative because the actual incidents of disturbance are expected to be much lower.

- The acoustic effects analysis is based on primary exposures only. Secondary, or indirect, effects, such as susceptibility to predation following injury and injury resulting from disrupted behavior, while possible, can only be reliably predicted in circumstances where the responses have been well documented. Consideration of secondary effects would result in much Level A harassment being considered Level B harassment, and vice versa, since much injury (Level A harassment) has the potential to disrupt behavior (Level B harassment), and much temporary physiological or behavioral disruption (Level B) could be conjectured to have the potential for injury (Level A). Consideration of secondary effects would lead to circular definitions of harassment.

3.3 INTEGRATION OF REGULATORY AND BIOLOGICAL FRAMEWORKS

This section presents a biological framework within which potential effects can be categorized and then related to the existing regulatory framework of injury (Level A) and behavioral disruption (Level B). The information presented in Sections 3.4 and 3.5 is used to develop specific numerical exposure thresholds and dose function exposure estimations. Exposure thresholds are combined with sound propagation models and species distribution data to estimate the potential exposures, as presented in Section 4.2.3.

3.4 PHYSIOLOGICAL AND BEHAVIORAL EFFECTS

Sound exposure may affect multiple biological traits of a marine animal; however, the MMPA as amended directs which traits should be used when determining effects. Effects that address injury are considered Level A harassment under MMPA. Effects that address behavioral disruption are considered Level B harassment under MMPA.

The biological framework proposed here is structured according to potential physiological and behavioral effects resulting from sound exposure. The range of effects may then be assessed to determine which qualify as injury or behavioral disturbance under MMPA regulations Physiology and behavior are chosen over other biological traits because:

- They are consistent with regulatory statements defining harassment by injury and harassment by disturbance.
- They are components of other biological traits that may be relevant.
- They are a more sensitive and immediate indicator of effect.

For example, ecology is not used as the basis of the framework because the ecology of an animal is dependent on the interaction of an animal with the environment. The animal's interaction with the environment is driven both by its physiological function and its behavior, and an ecological impact may not be observable over short periods of observation. Ecological information is considered in the analysis of the effects of individual species (see Section 3.3 and 3.4).

A "physiological effect" is defined here as one in which the "normal" physiological function of the animal is altered in response to sound exposure. Physiological function is any of a collection of processes ranging from biochemical reactions to mechanical interaction and operation of organs and tissues within an animal. A physiological effect may range from the most significant of impacts (i.e., mortality and serious injury) to lesser effects that would define the lower end of the physiological impact range, such as the non-injurious distortion of auditory tissues. This latter physiological effect is important to the integration of the biological and regulatory frameworks and will receive additional attention in later sections.

A "behavioral effect" is one in which the "normal" behavior or patterns of behavior of an animal are overtly disrupted in response to an acoustic exposure. Examples of behaviors of concern can be derived from the harassment definitions in the MMPA and the ESA.

In this EIS/OEIS the term "normal" is used to qualify distinctions between physiological and behavioral effects. Its use follows the convention of normal daily variation in physiological and behavioral function without the influence of anthropogenic acoustic sources. As a result, this EIS/OEIS uses the following definitions:

- A physiological effect is a variation in an animal's respiratory, endocrine, hormonal, circulatory, neurological, or reproductive activity and processes, beyond the animal's normal range of variability, in response to human activity or to an exposure to a stimulus such as active sonar.

- A behavioral effect is a variation in the pattern of an animal's breathing, feeding, resting, migratory, intraspecific behavior (such as reproduction, mating, territorial, rearing, and agonistic behavior), and interspecific beyond the animal's normal pattern of variability in response to human activity or to an exposure to a stimulus such as active sonar.

The definitions of physiological effect and behavioral effect used within this document should not be confused with more global definitions applied to the field of biology or to existing Federal law. It is reasonable to expect some physiological effects to result in subsequent behavioral effects. For example, a marine mammal that suffers a severe injury may be expected to alter diving or foraging to the degree that its variation in these behaviors is outside that which is considered normal for the species. If a physiological effect is accompanied by a behavioral effect, the overall effect is characterized as a physiological effect; physiological effects take precedence over behavioral effects with regard to their ordering. This approach provides the most conservative ordering of effects with respect to severity, provides a rational approach to dealing with the overlap of the definitions, and avoids circular arguments.

The severity of physiological effects generally decreases with decreasing sound exposure and/or increasing distance from the sound source. The same generalization does not consistently hold for behavioral effects because they do not depend solely on the received sound level. Behavioral responses also depend on an animal's learned responses, innate response tendencies, motivational state, the pattern of the sound exposure, and the context in which the sound is presented. However, to provide a tractable approach to predicting acoustic effects that is relevant to the terms of behavioral disruption described in the MMPA, it is assumed here that the severities of behavioral effects also decrease with decreasing sound exposure and/or increasing distance from the sound source. Figure 3-2 shows the relationship between severity of effects, source distance, and exposure level, as defined in this EIS/OEIS.

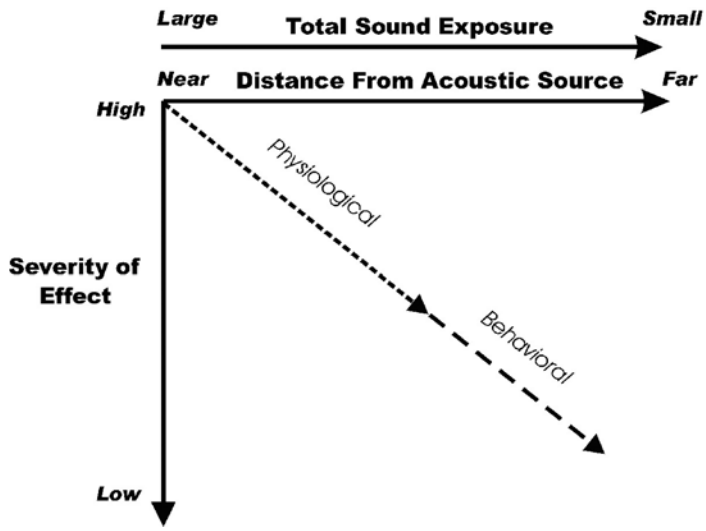


Figure 3-2. Relationship Between Severity of Effects, Source Distance, and Exposure Level.

3.5 MMPA LEVEL A AND LEVEL B HARASSMENT

Categorizing potential effects as either physiological or behavioral effects allows them to be related to the harassment definitions. For military readiness activities, Level A harassment includes any act that injures or has the significant potential to injure a marine mammal or marine mammal stock in the wild. Injury, as defined in the SOCAL Range Complex EIS/OEIS and previous regulatory rulings (NOAA 2001; 2002a), is the destruction or loss of biological tissue. The destruction or loss of biological tissue will result in an alteration of physiological function that exceeds the normal daily physiological variation of the intact tissue. For example, increased localized histamine production, edema, production of scar tissue, activation of clotting factors, white blood cell response, etc., may be expected following injury. Therefore, this EIS/OEIS assumes that all injury is qualified as a physiological effect and, to be consistent with prior actions and rulings (NOAA 2001), all injuries (slight to severe) are considered Level A harassment.

Public Law 108-136 (2004) amended the MMPA definitions of Level B harassment for military readiness activities, which applies to this action. For military readiness activities, Level B harassment is defined as “any act that disturbs or is likely to disturb a marine mammal or marine mammal stock by causing disruption of natural behavioral patterns including, but not limited to, migration, surfacing, nursing, breeding, feeding, or sheltering to a point where such behaviors are abandoned or significantly altered.” Unlike Level A harassment, which is solely associated with physiological effects, both physiological and behavioral effects may cause Level B harassment.

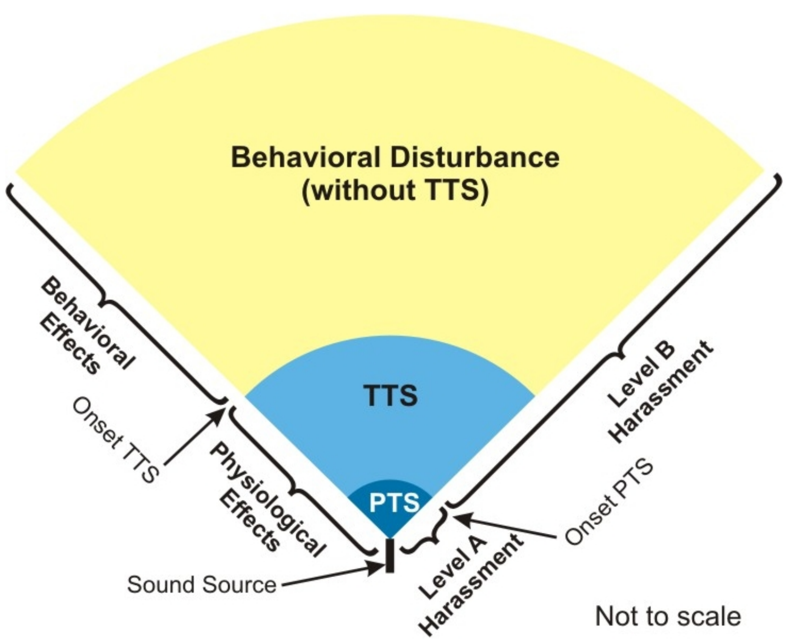
For example, some physiological effects can occur that are non-injurious but that can potentially disrupt the behavior of a marine mammal. These include temporary distortions in sensory tissue that alter physiological function, but that are fully recoverable without the requirement for tissue replacement or regeneration. For example, an animal that experiences a temporary reduction in hearing sensitivity suffers no injury to its auditory system, but may not perceive some sounds due to the reduction in sensitivity. As a result, the animal may not respond to sounds that would normally produce a behavioral reaction. This lack of response qualifies as a temporary disruption of normal behavioral patterns – the animal is impeded from responding in a normal manner to an acoustic stimulus.

The harassment status of slight behavior disruption has been addressed in workshops, previous actions, and rulings (NOAA 2001; DON 2001a). The conclusion is that a momentary behavioral reaction of an animal to a brief, time-isolated acoustic event does not qualify as Level B harassment. A more general conclusion, that Level B harassment occurs only when there is "a potential for a significant behavioral change or response in a biologically important behavior or activity," is found in recent rulings (NOAA, 2002a). Public Law 108-136 (2004) amended the definition of Level B harassment for military readiness activities, which applies to this action. For military readiness activities, Level B harassment is defined as "any act that disturbs or is likely to disturb a marine mammal or marine mammal stock by causing disruption of natural behavioral patterns…to a point where such behaviors are abandoned or significantly altered."

Although the temporary lack of response discussed above may not result in abandonment or significant alteration of natural behavioral patterns, the acoustic effect inputs used in the acoustic model assume that temporary hearing impairment (slight to severe) is considered Level B harassment. Although modes of action are appropriately considered, as outlined in Figure 3-2, the conservative assumption used here is to consider all hearing impairment as harassment. As a result, the actual incidental harassment of marine mammals associated with this action may be less than predicted via the analytical framework.

3.6 MMPA Exposure Zones

Two acoustic modeling approaches are used to account for both physiological and behavioral effects to marine mammals. This subsection of harassment zones is specific to the modeling of total energy (EL), described in more detail in Section 4.2. When using a threshold of accumulated energy (EL) the volumes of ocean in which Level A and Level B harassment are predicted to occur are described as exposure zones. As a conservative estimate, all marine mammals predicted to be in a zone are considered exposed to accumulated sound levels that may result in harassment within the applicable Level A or Level B harassment categories. Figure 3-3- illustrates harassment zones extending from a hypothetical, directional sound source.



This figure is for illustrative purposes only and does not represent the sizes or shapes of the actual exposure zones.

Figure 3-3. Exposure Zones Extending from a Hypothetical, Directional Sound Source.

The Level A exposure zone extends from the source out to the distance and exposure at which the slightest amount of injury is predicted to occur. The acoustic exposure that produces the slightest degree of injury is therefore the threshold value defining the outermost limit of the Level A exposure zone. Use of the threshold associated with the onset of slight injury as the most distant point and least injurious exposure takes account of all more serious injuries by inclusion within the Level A harassment zone. The threshold used to define the outer limit of the Level A exposure zone is given in Figure 3-3.

The Level B exposure zone begins just beyond the point of slightest injury and extends outward from that point to include all animals that may possibly experience Level B harassment. Physiological effects extend beyond the range of slightest injury to a point where slight temporary distortion of the most sensitive tissue occurs, but without destruction or loss of that tissue (such as occurs with inner ear hair cells subjected to temporary threshold shift). The animals predicted to be in this zone are assumed to experience Level B harassment by virtue of temporary impairment of sensory function (altered physiological function) that can disrupt behavior. The criterion and threshold used to define the outer limit of the Level B exposure zone for the on-set of certain physiological effects are given in Figure 3-3. Due to the Level B exposure zone developed using accumulated energy, there is a partial overlap with the consideration of potential behavioral disturbance assessed using the dose function, which is a received sound pressure level, described in Section 3.19. This overlap is considered conservative in that it may ‘double-count’ potential exposures, and ensures both physiological and behavioral effects are sufficiently considered.

3.6.1 Auditory Tissues as Indicators of Physiological Effects

Exposure to continuous-type sound may cause a variety of physiological effects in mammals. For example, exposure to very high sound levels may affect the function of the visual system, vestibular system, and internal organs (Ward 1997). Exposure to high-intensity, continuous- type sounds of sufficient duration may cause injury to the lungs and intestines (e.g., Dalecki et al. 2002). Sudden, intense sounds may elicit a “startle” response and may be followed by an orienting reflex (Ward 1997; Jansen 1998). The primary physiological effects of sound, however, are on the auditory system (Ward 1997).

The mammalian auditory system consists of the outer ear, middle ear, inner ear, and central nervous system. Sound waves are transmitted through the middle ears to fluids within the inner ear except cetaceans. The inner ear contains delicate electromechanical hair cells that convert the fluid motions into neural impulses that are sent to the brain. The hair cells within the inner ear are the most vulnerable to over-stimulation by sound exposure (Yost 1994).

Very high sound levels may rupture the eardrum or damage the small bones in the middle ear (Yost 1994). Lower level exposures of sufficient duration may cause permanent or temporary hearing loss; such an effect is called a noise-induced threshold shift, or simply a threshold shift (TS) (Miller 1974). A TS may be either permanent, in which case it is called a permanent threshold shift (PTS), or temporary, in which case it is called a temporary threshold shift (TTS). Still lower levels of sound may result in auditory masking (described in Section 3.19), which may interfere with an animal’s ability to hear other concurrent sounds.

Because the tissues of the ear appear to be the most susceptible to the physiological effects of sound and TSs tend to occur at lower exposures than other more serious auditory effects, PTS and TTS are used here as the biological indicators of physiological effects. TTS is the first indication of physiological non-injurious change and is not physical injury. The remainder of this section is, therefore, focused on TSs, including PTSs and TTSs. Since masking (without a resulting TS) is not associated with abnormal physiological function, it is not considered a physiological effect in this EIS/OEIS, but rather a potential behavioral effect. Descriptions of other potential physiological effects, including acoustically mediated bubble growth and air cavity resonance, are described in the Section 3.19.

3.7 NOISE-INDUCED THRESHOLD SHIFTS

The amount of TS depends on the amplitude, duration, frequency, and temporal pattern of the sound exposure. Threshold shifts will generally increase with the amplitude and duration of sound exposure. For continuous sounds, exposures of equal energy will lead to approximately equal effects (Ward 1997). For intermittent sounds, less TS will occur than from a continuous exposure with the same energy (some recovery will occur between exposures) (Kryter et al. 1966; Ward 1997).

The magnitude of a TS normally decreases with the amount of time post-exposure (Miller 1974). The amount of TS just after exposure is called the initial TS. If the TS eventually returns to zero (the threshold returns to the pre-exposure value), the TS is a TTS. Since the amount of TTS depends on the time post-exposure, it is common to use a subscript to indicate the time in minutes after exposure (Quaranta et al. 1998). For example, TTS2 means a TTS measured two minutes after exposure. If the TS does not return to zero but leaves some finite amount of TS, then that remaining TS is a PTS. The distinction between PTS and TTS is based on whether there is a complete recovery of a TS following a sound exposure. Figure 3-4 shows two hypothetical TSs: one that completely recovers, a TTS, and one that does not completely recover, leaving some PTS.

3.8 PTS, TTS, AND EXPOSURE ZONES

PTS is non-recoverable and, by definition, must result from the destruction of tissues within the auditory system. PTS therefore qualifies as an injury and is classified as Level A harassment under the wording of the MMPA. In the SOCAL Range Complex, the smallest amount of PTS (onset- PTS) is taken to be the indicator for the smallest degree of injury that can be measured. The acoustic exposure associated with onset-PTS is used to define the outer limit of the Level A exposure zone.

TTS is recoverable and, as in recent rulings (NOAA 2001; 2002a), is considered to result from the temporary, non-injurious distortion of hearing-related tissues. In the SOCAL Range Complex, the smallest measurable amount of TTS (onset-TTS) is taken as the best indicator for slight temporary sensory impairment. Because it is considered non-injurious, the acoustic exposure associated with onset-TTS is used to define the outer limit of the portion of the Level B exposure zone attributable to physiological effects. This follows from the concept that hearing loss potentially affects an animal's ability to react normally to the sounds around it. Therefore, in the SOCAL Range Complex, the potential for TTS is considered as a Level B harassment that is mediated by physiological effects on the auditory system.

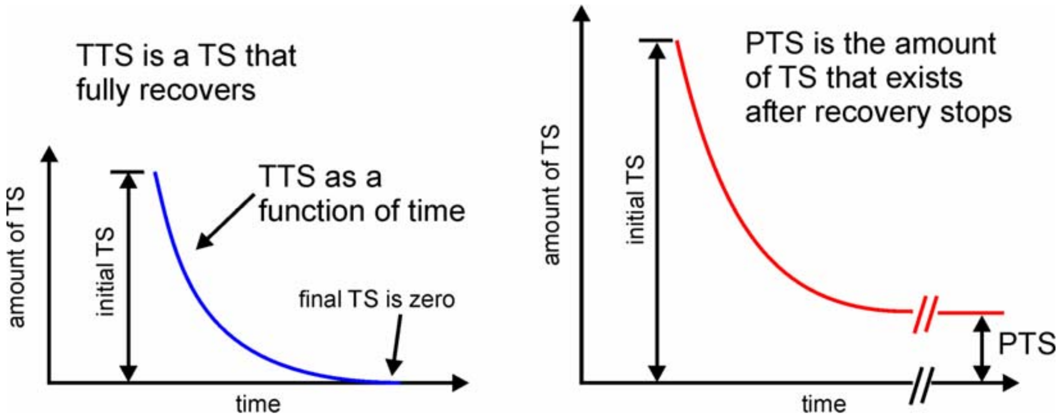


Figure 3-4. Hypothetical Temporary and Permanent Threshold Shifts

3.9 CRITERIA AND THRESHOLDS FOR PHYSIOLOGICAL EFFECTS (SENSORY IMPAIRMENT)

This section presents the effect criteria and thresholds for physiological effects of sound leading to injury and behavioral disturbance as a result of sensory impairment. Section 3.4 identified the tissues of the ear as being the most susceptible to physiological effects of underwater sound. PTS and TTS were determined to be the most appropriate biological indicators of physiological effects that equate to the onset of injury (Level A harassment) and behavioral disturbance (Level B harassment), respectively. This Section is, therefore, focused on criteria and thresholds to predict PTS and TTS in marine mammals.

Marine mammal ears are functionally and structurally similar to terrestrial mammal ears; however, there are important differences (Ketten 1998). The most appropriate information from which to develop PTS/TTS criteria for marine mammals would be experimental measurements of PTS and TTS from marine mammal species of interest. TTS data exist for several marine mammal species and may be used to develop meaningful TTS criteria and thresholds. Because of the ethical issues presented, PTS data do not exist for marine mammals and are unlikely to be obtained. Therefore, PTS criteria must be extrapolated using TTS criteria and estimates of the relationship between TTS and PTS.

This section begins with a review of the existing marine mammal TTS data. The review is followed by a discussion of the relationship between TTS and PTS. The specific criteria and thresholds for TTS and PTS used in this EIS/OEIS are then presented. This is followed by discussions of sound energy flux density level (EL), the relationship between EL and sound pressure level (SPL), and the use of SPL and EL in previous environmental compliance documents.

3.9.1 Energy Flux Density Level and Sound Pressure Level

Energy Flux Density Level (EL) is measure of the sound energy flow per unit area expressed in dB. EL is stated in dB re 1 µPa^2-s for underwater sound and dB re (20 µPa)^2-s for airborne sound.

Sound Pressure Level (SPL) is a measure of the root-mean square, or "effective," sound pressure in decibels. SPL is expressed in dB re 1 µPa for underwater sound and dB re 20 µPa for airborne sound.

3.10 TTS IN MARINE MAMMALS

A number of investigators have measured TTS in marine mammals. These studies measured hearing thresholds in trained marine mammals before and after exposure to intense sounds. Some of the more important data obtained from these studies are onset-TTS levels – exposure levels sufficient to cause a just-measurable amount of TTS, often defined as 6 dB of TTS (for example, Schlundt et al. 2000). The existing cetacean and pinniped underwater TTS data are summarized in the following bullets.

- Schlundt et al. (2000) reported the results of TTS experiments conducted with bottlenose dolphins and white whales exposed to 1-second tones. This paper also includes a reanalysis of preliminary TTS data released in a technical report by Ridgway et al. (1997). At frequencies of 3, 10, and 20 kHz, SPLs necessary to induce measurable amounts (6 dB or more) of TTS were between 192 and 201 dB re 1 µPa (EL = 192 to 201 dB re 1 µPa^2-s). The mean exposure SPL and EL for onset-TTS were 195 dB re 1 µPa and 195 dB re 1 µPa^2-s, respectively. The sound exposure stimuli (tones) and relatively large number of test subjects (five dolphins and two white whales) make the Schlundt et al. (2000) data the most directly relevant TTS information for the scenarios described in the SOCAL Range Complex EIS/OEIS.

- Finneran et al. (2001, 2003, 2005) described TTS experiments conducted with bottlenose dolphins exposed to 3-kHz tones with durations of 1, 2, 4, and 8 seconds. Small amounts of TTS (3 to 6 dB) were observed in one dolphin after exposure to ELs between 190 and 204 dB re 1 µPa^2-s. These results were consistent with the data of Schlundt et al. (2000) and showed that the Schlundt et al. (2000) data were not significantly affected by the masking sound used. These results also confirmed that, for tones with different durations, the amount of TTS is best correlated with the exposure EL rather than the exposure SPL.

- Finneran et al. (2007) conducted TTS experiments with bottlenose dolphins exposed to intensed 20 kHz fatiquing tone. Behavioral and auditory evoked potentials (using sinusoidal amplitude modulated tones creating auditory steady state response [AASR]) were used to measure TTS. The fatiguing tone was either 16 (mean = 193 re 1µPa, SD = 0.8) or 64 seconds (185-186 re 1µPa) in duration. TTS ranged from 19-33db from behavioral measurements and 40-45dB from ASSR measurements.

- Nachtigall et al. (2003) measured TTS in a bottlenose dolphin exposed to octave-band sound centered at 7.5 kHz. Nachtigall et al. (2003a) reported TTSs of about 11 dB measured 10 to 15 minutes after exposure to 30 to 50 minutes of sound with SPL 179 dB re 1 µPa (EL about 213 dB re µPa^2-s). No TTS was observed after exposure to the same sound at 165 and 171 dB re 1 µPa. Nachtigall et al. (2003b) reported TTSs of around 4 to 8 dB 5 minutes after exposure to 30 to 50 minutes of sound with SPL 160 dB re 1 µPa (EL about 193 to 195 dB re 1 µPa^2-s). The difference in results was attributed to faster post-exposure threshold measurement—TTS may have recovered before being detected by Nachtigall et al. (2003a). These studies showed that, for long-duration exposures, lower sound pressures are required to induce TTS than are required for short-duration tones. These data also confirmed that, for the cetaceans studied, EL is the most appropriate predictor for onset-TTS.

- Finneran et al. (2000, 2002) conducted TTS experiments with dolphins and white whales exposed to impulsive sounds similar to those produced by distant underwater explosions and seismic water guns. These studies showed that, for very short-duration impulsive sounds, higher sound pressures were required to induce TTS than for longer-duration tones.

- Kastak et al. (1999, 2005) conducted TTS experiments with three species of pinnipeds, California sea lion, northern elephant seal and a Pacific harbor seal, exposed to continuous underwater sounds at levels of 80 and 95 dB Sensation Level (referenced to the animal's absolute auditory threshold at the center frequency) at 2.5 and 3.5 kHz for up to 50 minutes. Mean TTS shifts of up to 12.2 dB occurred with the harbor seals showing the largest shift of 28.1 dB. Increasing the sound duration had a greater effect on TTS than increasing the sound level from 80 to 95 dB.

Figure 3-5 shows the existing TTS data for cetaceans (dolphins and white whales). Individual exposures are shown in terms of SPL versus exposure duration (upper panel) and EL versus exposure duration (lower panel). Exposures that produced TTS are shown as filled symbols. Exposures that did not produce TTS are represented by open symbols. The squares and triangles represent impulsive test results from Finneran et al. 2000 and 2002, respectively. The circles show the 3-, 10-, and 20-kHz data from Schlundt et al. (2000) and the results of Finneran et al. (2003). The inverted triangle represents data from Nachtigall et al. (2003b).

Figure 3-5 illustrates that the effects of the different sound exposures depend on the SPL and duration. As the duration decreases, higher SPLs are required to cause TTS. In contrast, the ELs required for TTS do not show the same type of variation with exposure duration.

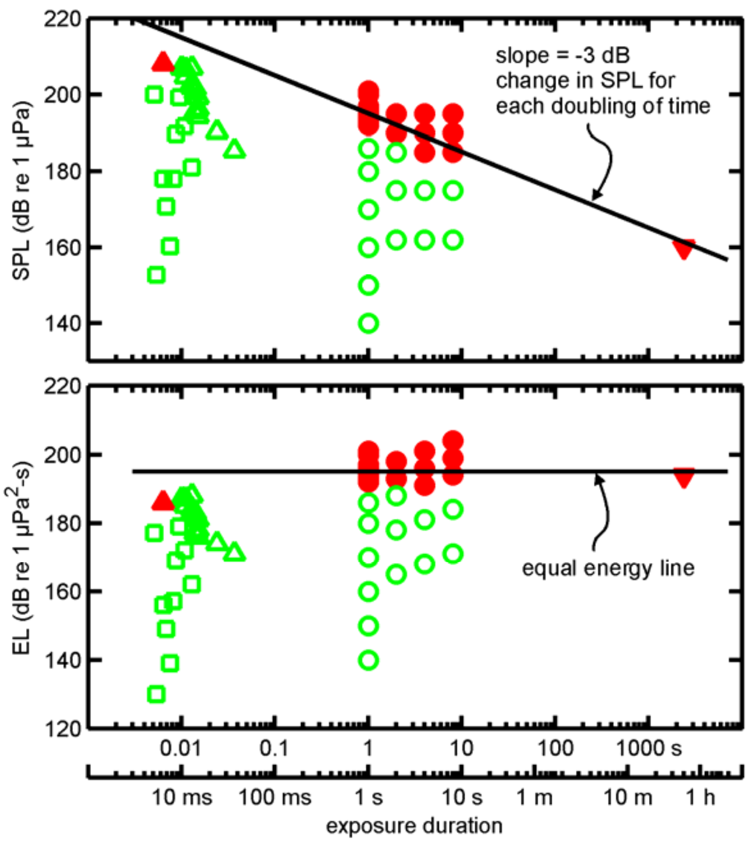


Figure 3-5. Existing TTS Data for Cetaceans.

Legend: Filled symbol: Exposure that produced TTS, Open symbol: Exposure that did not produce TTS, Squares: Impulsive test results from Finneran et al., 2000, Triangles: Impulsive test results from Finneran et al., 2002, Circles: 3, 10, and 20-kHz data from Schlundt et al. (2000) and results of Finneran et al. (2003), and Inverted triangle: Data from Nachtigall et al., 2003b.

The solid line in the upper panel of Figure 3-5 has a slope of -3 dB per doubling of time. This line passes through the point where the SPL is 195 dB re 1 µPa and the exposure duration is 1 second. Since EL = SPL + 10log10 (duration), doubling the duration increases the EL by 3 dB. Subtracting 3 dB from the SPL decreases the EL by 3 dB. The line with a slope of -3 dB per doubling of time, therefore, represents an equal energy line – all points on the line have the same EL, which is, in this case, 195 dB re 1 µPa^2-s. This line appears in the lower panel as a horizontal line at 195 dB re 1 µPa^2-s. The equal energy line at 195 dB re 1 µPa^2-s fits the tonal and sound data (the non-impulsive data) very well, despite differences in exposure duration, SPL, experimental methods, and subjects.

In summary, the existing cetacean TTS data show that, for the species studied and sounds (non-impulsive) of interest, the following is true:

- The growth and recovery of TTS are analogous to those in land mammals. This means that, as in land mammals, cetacean TSs depend on the amplitude, duration, frequency content, and temporal pattern of the sound exposure. Threshold shifts will generally increase with the amplitude and duration of sound exposure. For continuous sounds, exposures of equal energy will lead to approximately equal effects (Ward 1997). For intermittent sounds, less TS will occur than from a continuous exposure with the same energy (some recovery will occur between exposures) (Kryter et al. 1965; Ward 1997).

- SPL by itself is not a good predictor of onset-TTS, since the amount of TTS depends on both SPL and duration.

- Exposure EL is correlated with the amount of TTS and is a good predictor for onset-TTS for single, continuous exposures with different durations. This agrees with human TTS data presented by Ward et al. (1958, 1959).

- An energy flux density level of 195 dB re 1 µPa^2-s is the most appropriate predictor for onset-TTS from a single, continuous exposure.

Relationship between TTS and PTS

Since marine mammal PTS data do not exist, onset-PTS levels for these animals must be estimated using TTS data and relationships between TTS and PTS. Much of the early human TTS work was directed towards relating TTS2 after 8 hours of sound exposure to the amount of PTS that would exist after years of similar daily exposures (e.g., Kryter et al. 1966). Although it is now acknowledged that susceptibility to PTS cannot be reliably predicted from TTS measurements, TTS data do provide insight into the amount of TS that may be induced without a PTS. Experimental studies of the growth of TTS may also be used to relate changes in exposure level to changes in the amount of TTS induced. Onset-PTS exposure levels may therefore be predicted by:

- Estimating the largest amount of TTS that may be induced without PTS. Exposures causing a TS greater than this value are assumed to cause PTS.

- Estimating the additional exposure, above the onset-TTS exposure, necessary to reach the maximum allowable amount of TTS that, again, may be induced without PTS. This is equivalent to estimating the growth rate of TTS – how much additional TTS is produced by an increase in exposure level.

Experimentally induced TTSs, from short duration sounds (1-8 seconds) in the range of 3.5-20 kHz, in marine mammals have generally been limited to around 2 to 10 dB, well below TSs that result in some PTS. Experiments with terrestrial mammals have used much larger TSs and provide more guidance on how high a TS may rise before some PTS results. Early human TTS studies reported complete recovery of TTSs as high as 50 dB after exposure to broadband sound (Ward, 1960; Ward et al. 1958, 1959). Ward et al. (1959) also reported slower recovery times when TTS2 approached and exceeded 50 dB, suggesting that 50 dB of TTS2 may represent a "critical" TTS. Miller et al. (1963) found PTS in cats after exposures that were only slightly longer in duration than those causing 40 dB of TTS. Kryter et al. (1966) stated: "A TTS2 that approaches or exceeds 40 dB can be taken as a signal that danger to hearing is imminent." These data indicate that TSs up to 40 to 50 dB may be induced without PTS, and that 40 dB is a reasonable upper limit for TS to prevent PTS.

The small amounts of TTS produced in marine mammal studies also limit the applicability of these data to estimates of the growth rate of TTS. Fortunately, data do exist for the growth of TTS in terrestrial mammals. For moderate exposure durations (a few minutes to hours), TTS2 varies with the logarithm of exposure time (Ward et al. 1958, 1959; Quaranta et al. 1998). For shorter exposure durations the growth of TTS with exposure time appears to be less rapid (Miller 1974; Keeler 1976). For very long-duration exposures, increasing the exposure time may fail to produce any additional TTS, a condition known as asymptotic threshold shift (Saunders et al. 1977; Mills et al. 1979).

Ward et al. (1958, 1959) provided detailed information on the growth of TTS in humans. Ward et al. presented the amount of TTS measured after exposure to specific SPLs and durations of broadband sound. Since the relationship between EL, SPL, and duration is known, these same data could be presented in terms of the amount of TTS produced by exposures with different ELs.

Figure 3-6 shows results from Ward et al. (1958, 1959) plotted as the amount of TTS2 versus the exposure EL. The data in Figure 6-6(a) are from broadband (75 Hz to 10 kHz) sound exposures with durations of 12 to 102 minutes (Ward et al. 1958). The symbols represent mean TTS2 for 13 individuals exposed to continuous sound. The solid line is a linear regression fit to all but the two data points at the lowest exposure EL. The experimental data are fit well by the regression line (R2 = 0.95). These data are important for two reasons: (1) they confirm that the amount of TTS is correlated with the exposure EL; and (2) the slope of the line allows one to estimate the in additional amount of TTS produced by an increase in exposure. For example, the slope of the line in Figure 3-6(a) is approximately 1.5 dB TTS2 per dB of EL. This means that each additional dB of EL produces 1.5 dB of additional TTS2.

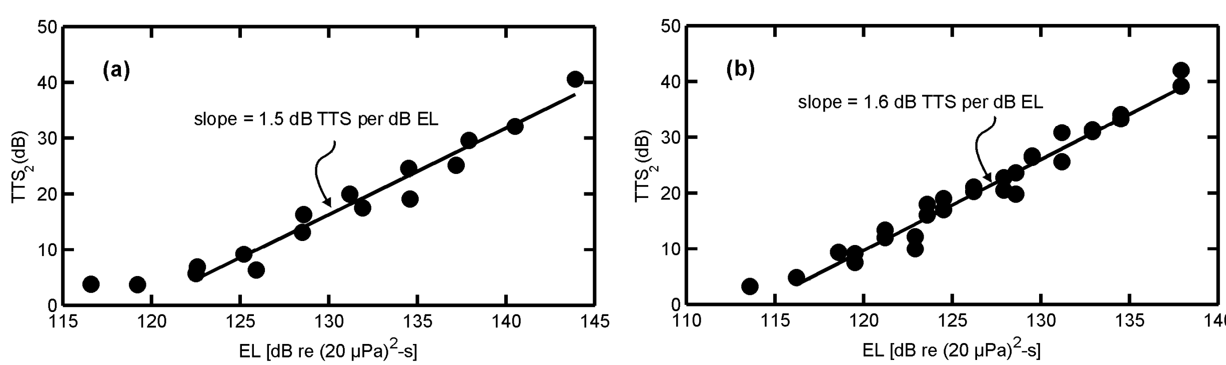


Figure 3-6. Growth of TTS versus the Exposure EL (from Ward et al. [1958, 1959])

The data in Figure 3-6(b) are from octave-band sound exposures (2.4 to 4.8 kHz) with durations of 12 to 102 minutes (Ward et al. 1959). The symbols represent mean TTS for 13 individuals exposed to continuous sound. The linear regression was fit to all but the two data points at the lowest exposure EL. The results are similar to those shown in Figure 3-6(a). The slope of the regression line fit to the mean TTS data was 1.6 dB TTS2/dB EL. A similar procedure was carried out for the remaining data from Ward et al. (1959), with comparable results. Regression lines fit to the TTS versus EL data had slopes ranging from 0.76 to 1.6 dB TTS2/dB EL, depending on the frequencies of the sound exposure and hearing test.

An estimate of 1.6 dB TTS2 per dB increase in exposure EL is the upper range of values from Ward et al. (1958, 1959) and gives the most conservative estimate – it predicts a larger amount of

TTS from the same exposure compared to the lines with smaller slopes. The difference between onset-TTS (6 dB) and the upper limit of TTS before PTS (40 dB) is 34 dB. To move from onset-TTS to onset-PTS, therefore, requires an increase in EL of 34 dB divided by 1.6 dB/dB, or approximately 21 dB. An estimate of 20 dB between exposures sufficient to cause onset-TTS and those capable of causing onset-PTS is a reasonable approximation.

To summarize:

- In the absence of marine mammal PTS data, onset-PTS exposure levels may be estimated from marine mammal TTS data and PTS/TTS relationships observed in terrestrial mammals. This involves:

- Estimating the largest amount of TTS that may be induced without PTS. Exposures causing a TS greater than this value are assumed to cause PTS.

- Estimating the growth rate of TTS – how much additional TTS is produced by an increase in exposure level.

- A variety of terrestrial mammal data sources point toward 40 dB as a reasonable estimate of the largest amount of TS that may be induced without PTS. A conservative is that continuous-type exposures producing TSs of 40 dB or more always result in some amount of PTS.

- Data from Ward et al. (1958, 1959) reveal a linear relationship between TTS2 and exposure EL. A value of 1.6 dB TTS2 per dB increase in EL is a conservative estimate of how much additional TTS is produced by an increase in exposure level for continuous- type sounds.

- There is a 34 dB TS difference between onset-TTS (6 dB) and onset-PTS (40 dB). The additional exposure above onset-TTS that is required to reach PTS is therefore 34 dB divided by 1.6 dB/dB, or approximately 21 dB.

- Exposures with ELs 20 dB above those producing TTS may be assumed to produce a PTS. This number is used as a conservative simplification of the 21 dB number derived above.

For this specified action, sound exposure thresholds for modeling TTS and PTS exposures are as presented in Table 3-1.

Cetaceans predicted to receive a sound exposure with EL of 215 dB re 1 µPa^2-s or greater are assumed to experience PTS and are counted as Level A harassment. Cetaceans predicted to receive a sound exposure with EL greater than or equal to 195 dB re 1 µPa^2-s but less than 215 dB re 1 µPa^2-s are assumed to experience TTS and are counted as Level B harassment.

The TTS and PTS thresholds for pinnipeds vary with species. A threshold of 206 dB re 1 µPa^2-s for TTS and 226 dB re 1 µPa^2-s for PTS is used for otariids. Northern elephant seals are similar to otariids and use thresholds of TTS = 204 dB re 1 µPa^2-s, PTS = 224 dB re 1 µPa^2-s. A lower threshold is used for harbor seals (TTS = 183 dB re 1 µPa^2-s, PTS = 203 dB re 1 µPa^2-s).

Table 3-1. Summary of the Physiological Effects Thresholds for TTS and PTS for Cetaceans and Pinnipeds.

Physiological Effects			
Animal	**Criteria**	**Threshold (re 1µPa^2-s)**	**MMPA Effect**
Cetacean	TTS PTS	195 215	Level B Harassment Level A Harassment
Pinnipeds			
Northern Elephant Seal	TTS PTS	204 224	Level B Harassment Level A Harassment
Pacific Harbor Seal	TTS PTS	183 203	Level B Harassment Level A Harassment
California Sea Lion	TTS PTS	206 226	Level B Harassment Level A Harassment
Guadalupe Fur Seal	TTS PTS	206 226	Level B Harassment Level A Harassment
Northern Fur Seal	TTS PTS	206 226	Level B Harassment Level A Harassment

3.11 DERIVATION OF EFFECT THRESHOLD

Cetacean Threshold

The TTS threshold is primarily based on the cetacean TTS data from Schlundt et al. (2000). Since these tests used short-duration tones similar to sonar pings, they are the most directly relevant data. The mean exposure EL required to produce onset-TTS in these tests was 195 dB re 1 µPa^2-s. This result is corroborated by the short-duration tone data of Finneran et al. (2001, 2003, 2005, 2003) and the long-duration sound data from Nachtigall et al. (2003a, b). Together, these data demonstrate that TTS in cetaceans is correlated with the received EL and that onset-TTS exposures are fit well by an equal-energy line passing through 195 dB re 1 µPa^2-s.

The PTS threshold is based on a 20 dB increase in exposure EL over that required for onset-TTS. The 20 dB value is based on estimates from terrestrial mammal data of PTS occurring at 40 dB or more of TS, and on TS growth occurring at a rate of 1.6 dB/dB increase in exposure EL. This is conservative because: (1) 40 dB of TS is actually an upper limit for TTS used to approximate onset-PTS, and (2) the 1.6 dB/dB growth rate is the highest observed in the data from Ward et al. (1958, 1959).

Pinniped Threshold

The TTS threshold for pinnipeds is based on TTS data from Kastak et al. (1999; 2005). Although their data is from continuous noise rather than short duration tones, pinniped TTS can be extrapolated using equal energy curves. Continuous sound at a lower intensity level can produce TTS similar to short duration but higher intensity sounds such as sonar pings.

3.12 USE OF EL FOR PHYSIOLOGICAL EFFECT THRESHOLDS

Effect thresholds are expressed in terms of total received EL. Energy flux density is a measure of the flow of sound energy through an area. Marine and terrestrial mammal data show that, for continuous-type sounds of interest, TTS and PTS are more closely related to the energy in the sound exposure than to the exposure SPL.

The EL for each individual ping is calculated from the following equation:

EL = SPL + 10log10(duration)

The EL includes both the ping SPL and duration. Longer-duration pings and/or higher-SPL pings will have a higher EL.

If an animal is exposed to multiple pings, the energy flux density in each individual ping is summed to calculate the total EL. Since mammalian TS data show less effect from intermittent exposures compared to continuous exposures with the same energy (Ward, 1997), basing the effect thresholds on the total received EL is a conservative approach for treating multiple pings; in reality, some recovery will occur between pings and lessen the effect of a particular exposure.

Therefore, estimates are conservative because recovery is not taken into account – intermittent exposures are considered comparable to continuous exposures.

The total EL depends on the SPL, duration, and number of pings received. The TTS and PTS thresholds do not imply any specific SPL, duration, or number of pings. The SPL and duration of each received ping are used to calculate the total EL and determine whether the received EL meets or exceeds the effect thresholds. For example, the TTS threshold would be reached through any of the following exposures:

- A single ping with SPL = 195 dB re 1 µPa and duration = 1 second.
- A single ping with SPL = 192 dB re 1 µPa and duration = 2 seconds.
- Two pings with SPL = 192 dB re 1 µPa and duration = 1 second.
- Two pings with SPL = 189 dB re 1 µPa and duration = 2 seconds.

Comparison to Surveillance Towed Array Sensor System Low Frequency (SURTASS LFA) Active Risk Functions

The physiological effect thresholds described in this EIS/OEIS should not be confused with criteria and thresholds used for the Navy's Surveillance Towed Array Sensor System Low Frequency Active (SURTASS LFA) sonar. SURTASS LFA features pings lasting many tens of seconds. The sonars of concern within the SOCAL Range Complex emit pings lasting a few seconds at most. SURTASS LFA risk functions were expressed in terms of the received "single ping equivalent" SPL. Physiological effect thresholds in this EIS/OEIS are expressed in terms of the total received EL. The SURTASS LFA risk function parameters cannot be directly compared to the effect thresholds used in this the SOCAL Range Complex EIS/OEIS. Comparisons must take into account the differences in ping duration, number of pings received, and method of accumulating effects over multiple pings.

3.13 PREVIOUS USE OF EL FOR PHYSIOLOGICAL EFFECTS

Energy measures have been used as a part of dual criteria for cetacean auditory effects in shock trials, which only involve impulsive-type sounds (DON 1997, 2001a). These actions used 192 dB re 1 µPa^2-s as a reference point to derive a TTS threshold in terms of EL. A second TTS threshold, based on peak pressure, was also used. If either threshold was exceeded, effect was assumed.

The 192 dB re 1 µPa^2-s reference point differs from the threshold of 195 dB re 1 µPa^2-s used in this SOCAL Range Complex EIS/OEIS. The 192 dB re 1 µPa^2-s value was based on the minimum observed by Ridgway et al. (1997) and Schlundt et al. (2000) during TTS measurements with bottlenose dolphins exposed to 1-second tones. At the time, no impulsive test data for marine mammals were available and the 1-second tonal data were considered to be the best available. The minimum value of the observed range of 192 to 201 dB re 1 µPa^2-s was used to protect against misinterpretation of the sparse data set available. The 192 dB re 1 µPa^2-s value was reduced to 182 dB re 1 µPa^2-s to accommodate the potential effects of pressure peaks in impulsive waveforms.

The additional data now available for onset-TTS in small cetaceans confirm the original range of values and increase confidence in it (Finneran et al. 2001, 2003; Nachtigall et al. 2003a, 2003b). The SOCAL Range Complex EIS/OEIS, therefore, uses the more complete data available and the mean value of the entire Schlundt et al. (2000) data set (195 dB re 1 µPa^2-s), instead of the minimum of 192 dB re 1 µPa^2-s. From the standpoint of statistical sampling and prediction theory, the mean is the most appropriate predictor—the "best unbiased estimator"—of the EL at which onset-TTS should occur; predicting the number of exposures in future actions relies (in part) on using the EL at which onset-TTS will most likely occur. When that EL is applied over many pings in each of many sonar exercises, that value will provide the most accurate prediction of the actual number of exposures by onset-TTS over all of those exercises. Use of the minimum value would overestimate the number of exposures because many animals counted would not have experienced onset-TTS. Further, there is no logical limiting minimum value of the distribution that would be obtained from continued successive testing. Continued testing and use of the minimum would produce more and more erroneous estimates.

3.14 CRITERIA AND THRESHOLDS FOR BEHAVIORAL EFFECTS

Section 3.4 categorized the potential effects of sound into physiological effects and behavioral effects. Criteria and thresholds for physiological effects are discussed in Section 3.4. This Section presents the effect criterion and threshold for behavioral effects of sound leading to behavioral disturbance without accompanying physiological effects. Since TTS is used as the biological indicator for a physiological effect leading to behavioral disturbance, the behavioral effects discussed in this section may be thought of as behavioral disturbance occurring at exposure levels below those causing TTS.

A large body of research on terrestrial animal and human response to airborne sound exists, but results from those studies are not readily extendible to the development of effect criteria and thresholds for marine mammals. For example, "annoyance" is one of several criteria used to define impact to humans from exposure to industrial sound sources. Comparable criteria cannot be developed for marine mammals because there is no acceptable method for determining whether a non-verbal animal is annoyed. Further, differences in hearing thresholds, dynamic range of the ear, and the typical exposure patterns of interest (e.g., human data tend to focus on 8-hour-long exposures) make extrapolation of human sound exposure standards inappropriate.

Behavioral observations of marine mammals exposed to anthropogenic sound sources exist, however, there are few observations and no controlled measurements of behavioral disruption of cetaceans caused by sound sources with frequencies, waveforms, durations, and repetition rates comparable to those employed by the tactical sonars to be used in the SOCAL Range Complex. At the present time there is no consensus on how to account for behavioral effects on marine mammals exposed to continuous-type sounds (NRC 2003).

3.15 HISTORY OF ASSESSING POTENTIAL HARASSMENT FROM BEHAVIORAL EFFECTS

The science of understanding the effects of sound on marine mammals is dynamic, and the Navy is committed to the use of the best available science for evaluating potential effects from training and testing activities. Navy LOA requests for USWTR mid-frequency active sonar training relied on behavioral observations of trained cetaceans exposed to intense underwater sound under controlled circumstances to develop a criterion and threshold for behavioral effects of sound based on energy flux density. These data are described in detail in Schlundt et al. (2000) and Finneran and Schlundt (2004). These data represented the best available data at the time those activities were proposed because they are based on controlled, tonal sound exposures within the tactical sonar frequency range and because the species studied are closely related to the majority of animals expected to be located within the proposed action area. The USWTR Draft EIS/OEIS provided analysis to the 190 dB re 1 μPa^2-s, which Navy believed to most accurately reflect scientifically-derived behavioral reactions from sound sources that are most similar to mid-frequency sonars. A full discussion of the scientific data and use of those data to derive the 190 dB re 1 μPa^2-s threshold is presented in the RIMPAC overseas environmental assessment (OEA) (DON 2006).

As described above, behavioral observations of trained cetaceans exposed to intense underwater sound under controlled circumstances are an important data set in evaluating and developing a criterion and threshold for behavioral effects of sound. These behavioral response data are an important foundation for the scientific basis of the Navy's prior threshold of onset behavioral effects because of the: (1) finer control over acoustic conditions; (2) greater quality and confidence in recorded sound exposures; and (3) the exposure stimuli closely match those of interest for the mid-frequency active sonar used proposed in SOCAL Range Complex. Since no comparable controlled exposure data for wild animals exist, or are likely to be obtained in the near-term, the relationship between the behavioral results reported by Finneran and Schlundt (2004) and wild animals is not known. Although experienced, trained subjects may tolerate higher sound levels than inexperienced animals; it is also possible that prior experiences and resultant expectations may have made some trained subjects less tolerant of sound exposures. However, in response to USWTR comments, potential differences between trained subjects and wild animals were considered by the Navy in conjunction with NMFS in the Navy's application for harassment authorization for RIMPAC 2006. At that time, NMFS recommended the Navy include analysis of this threshold based on NMFS' evaluation of behavioral observations of marine mammals under controlled conditions, plus NMFS' interpretation of two additional studies on reactions to vessel sound (Nowacek et al. 2004) and analysis for the U.S.S. SHOUP event (NMFS 2005). For that exercise, a conservative threshold for effect was derived compared to the regulatory definition of harassment, and the Navy agreed to the use of the 173 dB re 1 μPa^2-s threshold for the RIMPAC incidental harassment authorization (IHA) request.

Rationale for using energy flux density for evaluation of behavioral effects included:

- EL effect exposures account for both the exposure SPL and duration into account. Both SPL and duration of exposure affect behavioral responses to sound, so a behavioral effect threshold based on EL accounts for exposure duration.

- EL takes into account the effects of multiple pings. Effect thresholds based on SPL predict the same effect regardless of the number of received sounds. Previous actions using SPL-based criteria included implicit methods to account for multiple pings, such as the single-ping equivalent used in the surveillance towed array sensor system low frequency active (SURTASS LFA) (DON 2001b).

- EL allows a rational ordering of behavioral effects with physiological effects. The effect thresholds for physiological effects are stated in terms of EL because experimental data described above showed that the observed effects (TTS and PTS) are correlated best with the sound energy, not the SPL. Using EL for behavioral effects allows the behavioral and physiological effects to be placed on a single exposure scale, with behavioral effects occurring at lower exposures than physiological effects.

Subsequent to issuance of the RIMPAC IHA, additional public comments were received and considered. Based on this input, the Navy continued to coordinate with NMFS to determine whether an alternate approach to energy flux density could be used to evaluate when a marine mammal may behaviorally be affected by mid-frequency sonar sound exposures. Coordination between the Navy and NMFS produced the adoption of dose function for evaluation of behavioral effects. The dose function approach for evaluating behavioral effects is described in below, and fully considers the controlled, tonal sound exposure data in addition to comments received from the regulatory, scientific and the public regarding concerns with the use of EL for evaluating the effects of sound on wild animals.

3.16 RISK FUNCTION METHODOLOGY

Based on available evidence, marine animals are likely to exhibit any of a suite of potential behavioral responses or combinations of behavioral responses upon exposure to sonar transmissions. Potential behavioral responses include, but are not limited to: avoiding exposure or continued exposure; behavioral disturbance (including distress or disruption of social or foraging activity); habituation to the sound; becoming sensitized to the sound; or not responding to the sound.

Existing studies of behavioral effects of human-made sounds in marine environments remain inconclusive, partly because many of those studies have lacked adequate controls, applied only to certain kinds of exposures (which are often different from the exposures being analyzed in the study), and had limited ability to detect behavioral changes that may be significant to the biology of the animals that were being observed. These studies are further complicated by the wide variety of behavioral responses marine mammals exhibit and the fact that those responses can vary significantly by species, individuals, and the context of an exposure. In some circumstances, some individuals will continue normal behavioral activities in the presence of high levels of human-made noise. In other circumstances, the same individual or other individuals may avoid an acoustic source at much lower received levels (Richardson et al., 1995; Wartzok et al., 2003). These differences within and between individuals appear to result from a complex interaction of experience, motivation, and learning that are difficult to quantify and predict..

The National Marine Fisheries Service (NMFS) and other commentators recommended the use of an alternate methodology to evaluate when sound exposures might result in behavioral effects without corresponding physiological effects. Therefore, the Navy and NMFS have developed the Risk-Function approach to estimate potential behavioral effects from mid frequency active sonar. The behavioral response exposures presented in this chapter were estimated using the risk function methodology described below.

3.16.1 Applying the Risk Function Methodology

To assess the potential effects on marine mammals associated with active sonar used during training activities, the Navy together with NMFS, as a first step, investigated a series of mathematical models and methodologies that estimate the number of times individuals of the different species of marine mammals might be exposed to MFA sonar at different received levels. The Navy effects analyses assumed that the potential consequences of exposure to MFA sonar on individual animals would be a function of the received sound pressure level (decibels re 1 micropascal [dB re 1 µPa]). These analyses assume that MFA sonar poses no risk, that is, does not constitute harassment to marine mammals if they are exposed to sound pressure levels from the MFA sonar below a certain basement value.

The second step of the assessment procedure requires the Navy and NMFS to identify how marine mammals are likely to respond when they are exposed to active sonar. Marine mammals can experience a variety of responses to sound including sensory impairment (permanent and temporary threshold shifts and acoustic masking), physiological responses (particular stress responses), behavioral responses, social responses that might result in reducing the fitness of individual marine mammals and social responses that would not result in reducing the fitness of individual marine mammals.

Previously, the Navy and NMFS have used acoustic thresholds to identify the number of marine mammals that might experience hearing losses (temporary or permanent) or behavioral harassment upon being exposed to MFA sonar (see Figure 3.9.3, left panel). These acoustic thresholds have been represented by either sound exposure level (related to sound energy, abbreviated as SEL), sound pressure level (SPL), or other metrics such as peak pressure level and acoustic impulse (not considered for sonar in this DEIS/DOEIS). The general approach has been to apply these threshold functions so that a marine mammal is counted as behaviorally harassed or experiencing hearing loss when exposed to received sound levels above a certain threshold and not counted as behaviorally harassed or experiencing hearing loss when exposed to received levels below that threshold. For example, previous Navy EISs, environmental assessments, MMPA take authorization requests, and the MMPA incidental harassment authorization (IHA) for the Navy's 2006 Rim-of-the Pacific (RIMPAC) Major Exercise (FR 71.38710-38712, 2006) used 173 dB re 1 μPa^2-second (sec) as the energy threshold level (i.e., SEL) for Level B behavioral harassment for cetaceans. If the transmitted sonar accumulated energy received by a whale was above 195 dB re 1 μPa^2-sec, then the animal was considered to have experienced a temporary loss in the sensitivity of its hearing. The left panel in Figure 3-7 illustrates a typical step-function or threshold that might also relate a sonar exposure to the probability of a response. As this figure illustrates, past Navy/NMFS acoustic thresholds assumed that every marine mammal above a particular received level (for example, to the right of the red vertical line in the figure) would exhibit identical responses to a sonar exposure. This assumed that the responses of marine mammals would not be affected by differences in acoustic conditions; differences between species and populations: differences in gender, age, reproductive status, or social behavior; or the prior experience of the individuals.

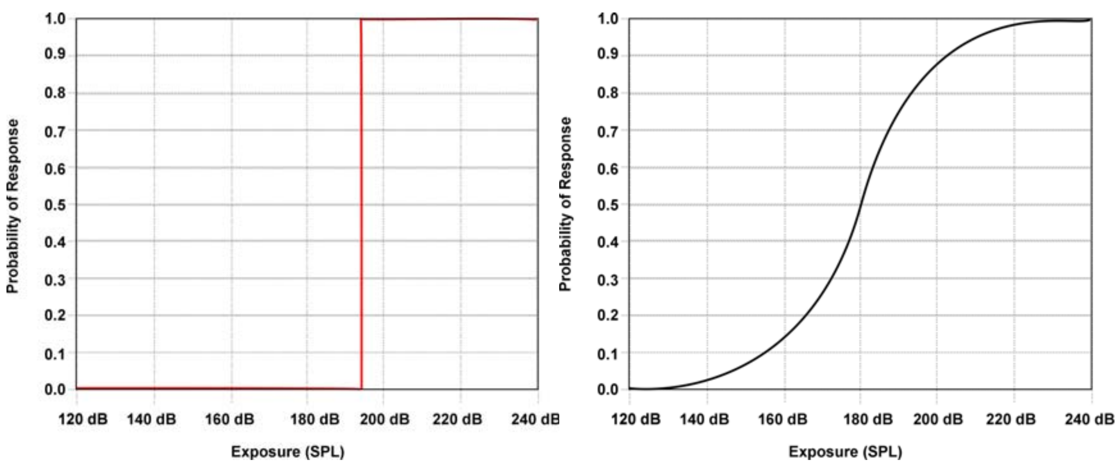


Figure 3-7. Typical Step Function (left) and Typical Risk Contimuum Function (right)

In this figure, for the typical step function (left panel) the probability of a response is depicted on the y-axis and received exposure on the x-axis. The right panel illustrates a typical risk continuum-function using the same axes. SPL is "Sound Pressure Level" in decibels referenced to 1 μPa root mean square (rms).

Both the Navy and NMFS agree that the studies of marine mammals in the wild and in experimental settings do not support these assumptions—different species of marine mammals and different individuals of the same species respond differently to sonar exposure. Additionally, there are specific geographic/bathymetric conditions that dictate the response of marine mammals to sonar that suggest that different populations may respond differently to sonar exposure. Further, studies of animal physiology suggest that gender, age, reproductive status, and social behavior, among other variables, probably affect how marine mammals respond to sonar exposures (Wartzok et al. 2003; Southall et al. 2007).

Over the past several years, the Navy and NMFS have worked on developing an MFA sonar acoustic risk function to replace the acoustic thresholds used in the past to estimate the probability of marine mammals being behaviorally harassed by received levels of MFA sonar. The Navy and NMFS will continue to use acoustic thresholds to estimate temporary or permanent threshold shifts using SEL as the appropriate metric. Unlike acoustic thresholds, acoustic risk continuum functions (which are also called "exposure-response functions," "dose-response functions," or "stress-response functions" in other risk assessment contexts) assume that the probability of a response depends first on the "dose" (in this case, the received level of sound) and that the probability of a response increases as the "dose" increases. It is important to note that the probabilities associated with acoustic risk functions do not represent an individual's probability of responding. Rather, the probabilities identify the proportion of an exposed population that is likely to respond to an exposure.

The right panel in Figure 3-7 illustrates a typical acoustic risk function that might relate an exposure, as received SPL in dB re 1 μPa, to the probability of a response. As the exposure receive level increases in this figure, the probability of a response increases as well but the relationship between an exposure and a response is "linear" only in the center of the curve (that is, unit increases in exposure would produce unit increases in the probability of a response only in the center of a risk function curve). In the "tails" of an acoustic risk function curve, unit increases in exposure produce smaller increases in the probability of a response. Based on observations of various animals, including humans, the relationship represented by an acoustic risk function is a more robust predictor of the probable behavioral responses of marine mammals to sonar and other acoustic sources.

The Navy and NMFS have previously used the acoustic risk function to estimate the probable responses of marine mammals to acoustic exposures for other training and research programs. Examples of previous application include the Navy Final EISs on the SURTASS LFA sonar (DoN 2001); the North Pacific Acoustic Laboratory experiments conducted off the Island of Kauai (Office of Naval Research, 2001), and the Supplemental EIS for SURTASS LFA sonar (DoN 2007a).

The Navy and NMFS used two metrics to estimate the number of marine mammals that could be subject to Level B harassment (behavioral harassment and TTS) as defined by the MMPA, during training exercises. The agencies used acoustic risk functions with the metric of received SPL (dB re 1 μPa) to estimate the number of marine mammals that might be at risk for MMPA Level B behavioral harassment as a result of being exposed to MFA sonar. The agencies will continue to use acoustic thresholds ("step-functions") with the metric of SEL (dB re 1 μPa^2-s) to estimate the number of marine mammals that might be "taken" through sensory impairment (i.e., Level A – PTS and Level B – TTS) as a result of being exposed to MFA sonar.

Although the Navy has not used acoustic risk functions in previous MFA sonar assessments of the potential effects of MFA sonar on marine mammals, risk functions are not new concepts for risk assessments. Common elements are contained in the process used for developing criteria for air, water, radiation, and ambient noise and for assessing the effects of sources of air, water, and noise pollution. The Environmental Protection Agency (EPA) uses dose-functions to develop water quality criteria and to regulate pesticide applications (U.S. EPA 1998); the Nuclear Regulatory Commission (NRC) uses dose-functions to estimate the consequences of radiation exposures (see NRC 1997 and 10 Code of Federal Regulations [C.F.R] § 20.1201); the Centers for Disease Control and Prevention (CDCP) and the Food and Drug Administration (FDA) use dose-functions as part of their assessment methods (for example, see CDCP 2003, U.S. FDA 2001); and the Occupational Safety and Health Administration (OSHA) uses dose-functions to assess the potential effects of noise and chemicals in occupational environments on the health of people working in those environments (for examples, see FR 61:56746-56856, 1996; FR 71:10099-10385, 2006).

3.16.2 Risk Function Adapted from Feller (1968)

The particular acoustic risk function developed by the Navy and NMFS estimates the probability of behavioral responses that NMFS would classify as harassment for the purposes of the MMPA given exposure to specific received levels of MFA sonar. The mathematical function is derived from a solution in Feller (1968) as defined in the SURTASS LFA Sonar Final OEIS/EIS (DoN 2001), and relied on in the Supplemental SURTASS LFA Sonar EIS (DoN 2007a) for the probability of MFA sonar risk for MMPA Level B behavioral harassment with input parameters modified by NMFS for MFA sonar for mysticetes, odontocetes, and pinnipeds.

In order to represent a probability of risk, the function should have a value near zero at very low exposures, and a value near one for very high exposures. One class of functions that satisfies this criterion is cumulative probability distributions, a type of cumulative distribution function. In selecting a particular functional expression for risk, several criteria were identified:

- The function must use parameters to focus discussion on areas of uncertainty;
- The function should contain a limited number of parameters;
- The function should be capable of accurately fitting experimental data; and
- The function should be reasonably convenient for algebraic manipulations.

As described in DoN(2001), the mathematical function below is adapted from a solution in Feller (1968).

$$R = \frac{1 - \left(\frac{L-B}{K}\right)^{-A}}{1 - \left(\frac{L-B}{K}\right)^{-2A}}$$

Where: R = risk (0 – 1.0);

L = Received Level (RL) in dB;

B = basement RL in dB; (120 dB);

K = the RL increment above basement in dB at which there is 50 percent risk;

A = risk transition sharpness parameter (10) (explained in 3.1.5.3).

In order to use this function, the values of the three parameters (B, K, and A) need to be established. The values used in this DEIS/DOEIS analysis are based on three sources of data: TTS experiments conducted at SSC and documented in Finneran, et al. (2001, 2003, and 2005; Finneran and Schlundt 2004); reconstruction of sound fields produced by the USS SHOUP associated with the behavioral responses of killer whales observed in Haro Strait and documented in Department of Commerce NMFS (2005); DoN (2004); and Fromm (2004a, 2004b); and observations of the behavioral response of North Atlantic right whales exposed to alert stimuli containing mid-frequency components documented in Nowacek et al. (2004). The input parameters, as defined by NMFS, are based on very limited data that represent the best available science at this time.

3.16.3 Data Sources Used for Risk Function

There is widespread consensus that cetacean response to MFA sound signals needs to be better defined using controlled experiments. Navy is contributing to an ongoing behavioral response study in the Bahamas that is anticipated to provide some initial information on beaked whales, the species identified as the most sensitive to MFA sonar. NMFS is leading this international effort with scientists from various academic institutions and research organizations to conduct studies on how marine mammals respond to underwater sound exposures.

Until additional data is available, NMFS and the Navy have determined that the following three data sets are most applicable for the direct use in developing risk function parameters for MFA/HFA sonar. These data sets represent the only known data that specifically relate altered behavioral responses to exposure to MFA sound sources.

Data from SSC's Controlled Experiments: Most of the observations of the behavioral responses of toothed whales resulted from a series of controlled experiments, designed as acoustic experiments rather than behavioral experiments, on bottlenose dolphins and beluga whales conducted by researchers at SSC's facility in San Diego, California (Finneran et al. 2001, 2003, 2005; Finneran and Schlundt 2004; Schlundt et al. 2000). In experimental trials with marine mammals trained to perform tasks when prompted, scientists evaluated whether the marine mammals performed these tasks when exposed to mid-frequency tones. Altered behavior during experimental trials usually involved refusal of animals to return to the site of the sound stimulus. This refusal included what appeared to be deliberate attempts to avoid a sound exposure or to avoid the location of the exposure site during subsequent tests (Schlundt et al. 2000, Finneran et al. 2002). Bottlenose dolphins exposed to 1-sec intense tones exhibited short-term changes in behavior above received sound levels of 178 to 193 dB re 1 μPa rms, and beluga whales did so at received levels of 180 to 196 dB and above.

Finneran and Schlundt (2004) examined behavioral observations recorded by the trainers or test coordinators during the Schlundt et al. (2000) and Finneran et al. (2001, 2003, 2005) experiments featuring 1-second (sec) tones. These included observations from 193 exposure sessions (fatiguing stimulus level > 141 dB re 1μPa) conducted by Schlundt et al. (2000) and 21 exposure sessions conducted by Finneran et al. (2001, 2003, 2005). The observations were made during exposures to sound sources at 0.4 kHz, 3 kHz, 10 kHz, 20 kHz, and 75 kHz. The TTS experiments that supported Finneran and Schlundt (2004) are further explained below:

- Schlundt et al. (2000) provided a detailed summary of the behavioral responses of trained marine mammals during TTS tests conducted at SSC San Diego with 1-sec tones. Schlundt et al. (2000) reported eight individual TTS experiments. Fatiguing stimuli durations were 1-sec; exposure frequencies were 0.4 kHz, 3 kHz, 10 kHz, 20 kHz and 75 kHz. The experiments were conducted in San Diego Bay. Because of the variable ambient noise in the bay, low-level broadband masking noise was used to keep hearing thresholds consistent despite fluctuations in the ambient noise. Schlundt et al. (2000)

reported that "behavioral alterations," or deviations from the behaviors the animals being tested had been trained to exhibit, occurred as the animals were exposed to increasing fatiguing stimulus levels.

- Finneran et al. (2001, 2003, 2005) conducted TTS experiments using tones at 3 kHz. The test method was similar to that of Schlundt et al. (2000) except the tests were conducted in a pool with very low ambient noise level (below 50 dB re 1 μPa/hertz [Hz]), and no masking noise was used. Two separate experiments were conducted using 1-sec tones. In the first, fatiguing sound levels were increased from 160 to 201 dB SPL. In the second experiment, fatiguing sound levels between 180 and 200 dB re 1 μPa were randomly presented.

<u>Data from Studies of Baleen (Mysticetes) Whale Responses</u>: The only mysticete data available resulted from a field experiments in which baleen whales (mysticetes) were exposed to a range frequency sound sources from 500 Hz to 4500 Hz (Nowacek et al. 2004). An alert stimulus, with a mid-frequency component, was the only portion of the study used to support the risk function input parameters.

- Nowacek et al. (2004) documented observations of the behavioral response of North Atlantic right whales exposed to alert stimuli containing mid-frequency components. To assess risk factors involved in ship strikes, a multi-sensor acoustic tag was used to measure the responses of whales to passing ships and experimentally tested their responses to controlled sound exposures, which included recordings of ship noise, the social sounds of conspecifics and a signal designed to alert the whales. The alert signal was 18-minutes of exposure consisting of three 2-minute signals played sequentially three times over. The three signals had a 60 percent duty cycle and consisted of: (1) alternating 1-sec pure tones at 500 Hz and 850 Hz; (2) a 2-sec logarithmic down-sweep from 4,500 Hz to 500 Hz; and (3) a pair of low (1,500 Hz)-high (2,000 Hz) sine wave tones amplitude modulated at 120 Hz and each 1-sec long. The purposes of the alert signal were (a) to provoke an action from the whales via the auditory system with disharmonic signals that cover the whales estimated hearing range; (b) to maximize the signal to noise ratio (obtain the largest difference between background noise) and c) to provide localization cues for the whale. Five out of six whales reacted to the signal designed to elicit such behavior. Maximum received levels ranged from 133 to 148 dB re 1μPa.

<u>Observations of Killer Whales in Haro Strait in the Wild</u>: In May 2003, killer whales (*Orcinus orca*) were observed exhibiting behavioral responses while the USS SHOUP was engaged in MFA sonar operations in the Haro Strait in the vicinity of Puget Sound, Washington. Although these observations were made in an uncontrolled environment, the sound field that may have been associated with the sonar operations had to be estimated, and the behavioral observations were reported for groups of whales, not individual whales, the observations associated with the USS SHOUP provide the only data set available of the behavioral responses of wild, non-captive animal upon exposure to the AN/SQS-53 MFA sonar.

- NMFS (2005), DoN (2004), and Fromm (2004a, 2004b) documented reconstruction of sound fields produced by the USS SHOUP associated with the behavioral response of killer whales observed in Haro Strait. Observations from this reconstruction included an approximate closest approach time which was correlated to a reconstructed estimate of received level at an approximate whale location (which ranged from 150 to 180 dB), with a mean value of 169.3 dB.

3.16.4 Limitations of the Risk Function Data Sources

There are significant limitations and challenges to any risk function derived to estimate the probability of marine mammal behavioral responses; these are largely attributable to sparse data. Ultimately there should be multiple functions for different marine mammal taxonomic groups, but the current data are insufficient to support them. The goal is unquestionably that risk functions be based on empirical measurement.

The risk function presented here is based on three data sets that NMFS and Navy have determined are the best available science at this time. The Navy and NMFS acknowledge each of these data sets has limitations. However, this risk function, if informed by the limited available data relevant to the MFA sonar application, has the advantages of simplicity and the fact that there is precedent for its application and foundation in marine mammal research.

While NMFS considers all data sets as being weighted equally in the development of the risk function, the Navy believes the SSC San Diego data is the most rigorous and applicable for the following reasons:

- The data represents the only source of information where the researchers had complete control over and ability to quantify the noise exposure conditions.
- The altered behaviors were identifiable due to long term observations of the animals.
- The fatiguing noise consisted of tonal exposures with limited frequencies contained in the MFA sonar bandwidth.

However, the Navy and NMFS do agree that the following are limitations associated with the three data sets used as the basis of the risk function:

- The three data sets represent the responses of only four species: trained bottlenose dolphins and beluga whales, North Atlantic right whales in the wild and killer whales in the wild.
- None of the three data sets represent experiments designed for behavioral observations of animals exposed to MFA sonar.
- The behavioral responses of marine mammals that were observed in the wild (observations of killer whales in Haro Strait) are based on an estimated received level of sound exposure; they do not take into consideration (due to minimal or no supporting data):
    - Potential relationships between acoustic exposures and specific behavioral activities (e.g., feeding, reproduction, changes in diving behavior, etc.), variables such as bathymetry, or acoustic waveguides; or
    - Differences in individuals, populations, or species, or the prior experiences, reproductive state, hearing sensitivity, or age of the marine mammal.

<u>SSC San Diego Trained Bottlenose Dolphins and Beluga Data Set:</u>

- The animals were trained animals in captivity; therefore, they may be more or less sensitive than cetaceans found in the wild (Domjan, 1998).
- The tests were designed to measure TTS, not behavior.

- Because the tests were designed to measure TTS, the animals were exposed to much higher levels of sound than the baseline risk function (only two of the total 193 observations were at levels below 160 dB re 1 μPa^2-s).
- The animals were not exposed in the open ocean but in a shallow bay or pool.

North Atlantic Right Whales in the Wild Data Set:

- The observations of behavioral response were from exposure to alert stimuli that contained mid-frequency components but was not similar to a MFA sonar ping. The alert signal was 18 minutes of exposure consisting of three 2-minute signals played sequentially three times over. The three signals had a 60 percent duty cycle and consisted of: (1) alternating 1-sec pure tones at 500 Hz and 850 Hz; (2) a 2-sec logarithmic down-sweep from 4,500 Hz to 500 Hz; and (3) a pair of low (1,500 Hz)-high (2,000 Hz) sine wave tones amplitude modulated at 120 Hz and each 1-sec long. This 18-minute alert stimuli is in contrast to the average 1-sec ping every 30 sec in a comparatively very narrow frequency band used by military sonar.
- The purpose of the alert signal was, in part, to provoke an action from the whales through an auditory stimulus.

Killer Whales in the Wild Data Set:

- The observations of behavioral harassment were complicated by the fact that there were other sources of harassment in the vicinity (other vessels and their interaction with the animals during the observation).
- The observations were anecdotal and inconsistent. There were no controls during the observation period, with no way to assess the relative magnitude of the any observed response as opposed to baseline conditions.

3.16.5 Input Parameters for the Risk Function

The values of B, K, and A need to be specified in order to utilize the risk function defined in Section 3.9.7.4.2. The risk continuum function approximates the dose-response function in a manner analogous to pharmacological risk assessment (DoN 2001, Appendix A). In this case, the risk function is combined with the distribution of sound exposure levels to estimate aggregate impact on an exposed population.

3.16.5.1 Basement Value for Risk—The B Parameter

The B parameter defines the basement value for risk, below which the risk is so low that calculations are impractical. This 120 dB level is taken as the estimate received level (RL) below which the risk of significant change in a biologically important behavior approaches zero for the MFA sonar risk assessment. This level is based on a broad overview of the levels at which multiple species have been reported responding to a variety of sound sources, both mid-frequency and other, was recommended by the scientists, and has been used in other publications. The Navy recognizes that for actual risk of changes in behavior to be zero, the signal-to-noise ratio of the animal must also be zero. However, the present convention of ending the risk calculation at 120 dB for MFA sonar has a negligible impact on the subsequent calculations, because the risk function does not attain appreciable values at received levels that low.

3.16.5.2 The K Parameter

NMFS and the Navy used the mean of the following values to define the midpoint of the function: (1) the mean of the lowest received levels (185.3 dB) at which individuals responded with altered behavior to 3 kHz tones in the SSC data set; (2) the estimated mean received level value of 169.3 dB produced by the reconstruction of the USS SHOUP incident in which killer whales exposed to MFA sonar (range modeled possible received levels: 150 to 180 dB); and (3) the mean of the 5 maximum received levels at which Nowacek et al. (2004) observed significantly altered responses of right whales to the alert stimuli than to the control (no input signal) is 139.2 dB SPL. The arithmetic mean of these three mean values is 165 dB SPL. The value of K is the difference between the value of B (120 dB SPL) and the 50 percent value of 165 dB SPL; therefore, K=45.

3.16.5.3 Risk Transition—The A Parameter

The A parameter controls how rapidly risk transitions from low to high values with increasing receive level. As A increases, the slope of the risk function increases. For very large values of A, the risk function can approximate a threshold response or step function. NMFS has recommended that Navy use A=10 as the value for odontocetes, and pinnipeds (Figure 3.1.5.3-1) (NMFS 2008). This is the same value of A that was used for the SURTASS LFA sonar analysis. As stated in the SURTASS LFA Sonar Final OEIS/EIS (DoN 2001), the value of A=10 produces a curve that has a more gradual transition than the curves developed by the analyses of migratory gray whale studies (Malme et al., 1984). The choice of a more gradual slope than the empirical data was consistent with other decisions for the SURTASS LFA Sonar Final OEIS/EIS to make conservative assumptions when extrapolating from other data sets (see Subchapter 1.43 and Appendix D of the SURTASS LFA Sonar EIS [NMFS 2008]).

Based on NMFS' direction, the Navy will use a value of A=8 for mysticetes to allow for greater consideration of potential harassment at the lower received levels based on Nowacek et al., 2004 (Figure 3.1.5.3-2) (NMFS 2008).

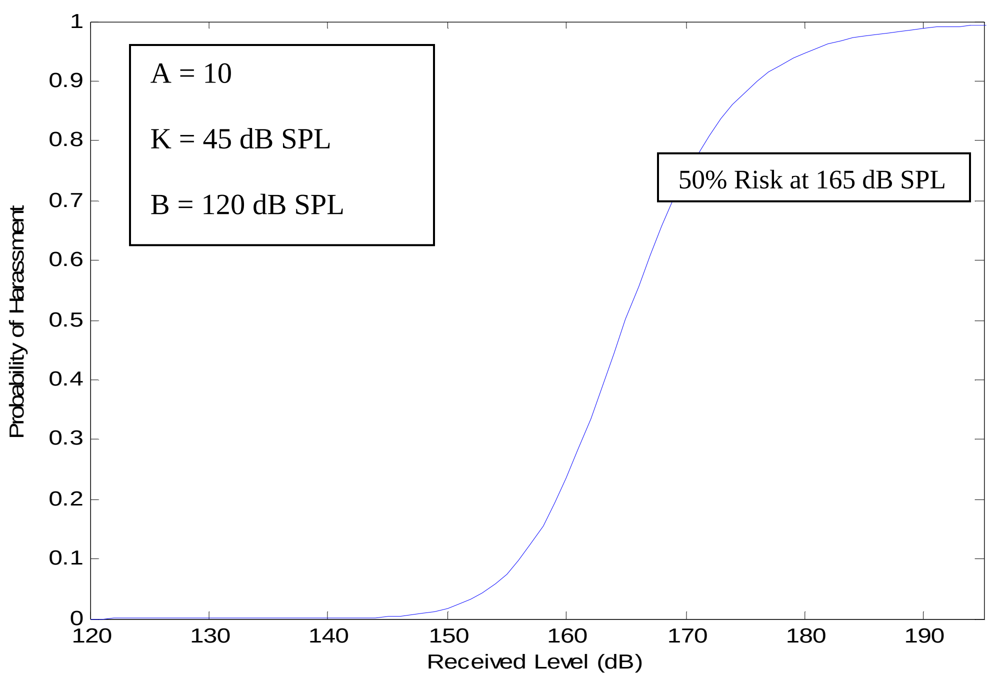


Figure 3-8. Risk Function Curve for Odontocetes (Toothed Whales) and Pinnipeds

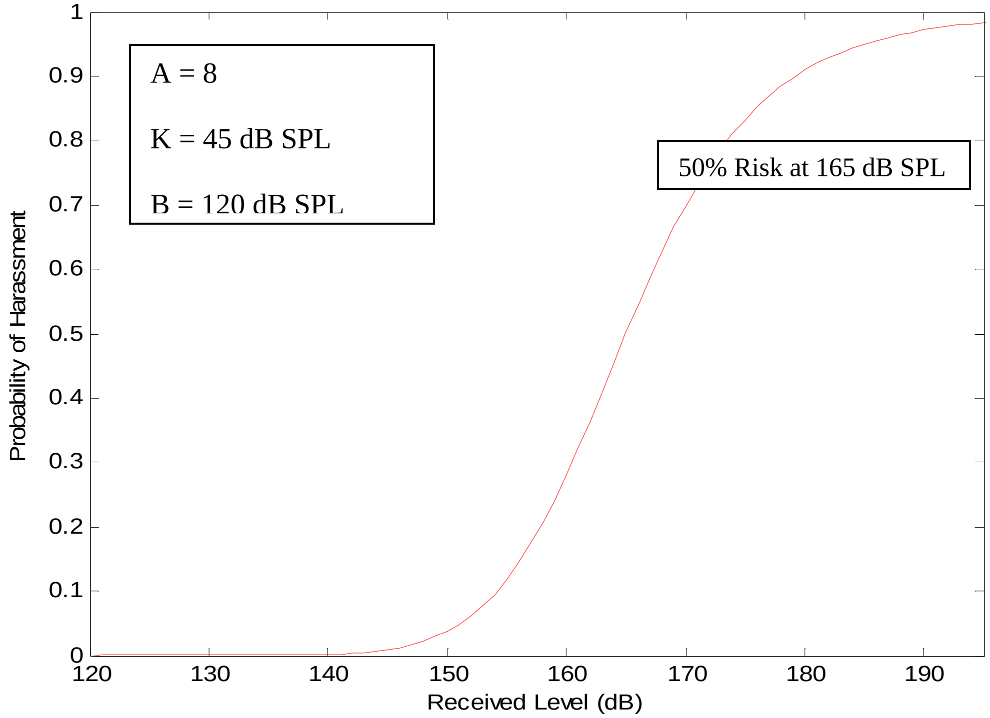


Figure 3-9. Risk Function Curve for Mysticetes (Baleen Whales)

3.16.6 Application of the Risk Function and Current Regulatory Scheme

The risk function is used to estimate the percentage of an exposed population that is likely to exhibit behaviors that would qualify as harassment (as that term is defined by the MMPA applicable to military readiness activities, such as the Navy's testing and training with mid- and high-frequency active sonar) at a given received level of sound. For example, at 165 dB SPL (dB re: 1µPa rms), the risk (or probability) of harassment is defined according to this function as 50 percent, and Navy/NMFS applies that by estimating that 50 percent of the individuals exposed at that received level are likely to respond by exhibiting behavior that NMFS would classify as behavioral harassment. The risk function is not applied to individual animals, only to exposed populations.

The data used to produce the risk function were compiled from four species that had been exposed to sound sources in a variety of different circumstances. As a result, the risk function represents a general relationship between acoustic exposures and behavioral responses that is then applied to specific circumstances. That is, the risk function represents a relationship that is deemed to be generally true, based on the limited, best-available science, but may not be true in specific circumstances. In particular, the risk function, as currently derived, treats the received level as the only variable that is relevant to a marine mammal's behavioral response. However, we know that many other variables—the marine mammal's gender, age, and prior experience; the activity it is engaged in during an exposure event, its distance from a sound source, the number of sound sources, and whether the sound sources are approaching or moving away from the animal—can be critically important in determining whether and how a marine mammal will respond to a sound source (Southall et al. 2007). The data that are currently available do not allow for incorporation of these other variables in the current risk functions; however, the risk function represents the best use of the data that are available.

As more specific and applicable data become available, NMFS can use these data to modify the outputs generated by the risk function to make them more realistic (and ultimately, data may exist to justify the use of additional, alternate, or multi-variate functions). As mentioned above, it is known that the distance from the sound source and whether it is perceived as approaching or moving away can affect the way an animal responds to a sound (Wartzok et al. 2003). Though there are data showing marine mammal responses to sound sources at that *received level*, NMFS does not currently have any data that describe the response of marine mammals to sounds at that *distance* (or to other contextual aspects of the exposure, such as the presence of higher frequency harmonics), much less data that compare responses to similar sound levels at varying distances. However, if data were to become available that suggested animals were less likely to respond (in a manner NMFS would classify as harassment) to certain levels beyond certain distances, or that they were more likely to respond at certain closer distances, Navy will re-evaluate the risk function to try to incorporate any additional variables into the "take" estimates.

Last, pursuant to the MMPA, an applicant is required to estimate the number of animals that will be "taken" by their activities. This estimate informs the analysis that NMFS must perform to determine whether the activity will have a "negligible impact" on the species or stock. Level B (behavioral) harassment occurs at the level of the individual(s) and does not assume any resulting population-level consequences, though there are known avenues through which behavioral disturbance of individuals can result in population-level effects. Alternately, a negligible impact finding is based on the lack of likely adverse effects to annual rates of recruitment or survival (i.e., population-level effects). An estimate of the number of Level B harassment takes, alone, is not enough information on which to base an impact determination. In addition to considering estimates of the number of marine mammals that might be "taken" through harassment, NMFS must consider other factors, such as the nature of any responses (their intensity, duration, etc.), the context of any responses (critical reproductive time or location, migration, etc.), or any of the other variables mentioned in the first paragraph (if known), as well as the number and nature of estimated Level A takes, the number of estimated mortalities, and effects on habitat. For example, in the case of sonar usage in the SOCAL Range Complex, a portion of the animals that are likely to be "taken" through behavioral harassment are expected to be exposed at relatively low received levels (120-140 dB SPL) where the significance of those responses would be reduced because of the distance (25-65 nm) from a sound source. Alternatively, only a relatively very small portion (<5%) of the animals that are expected to be "taken" through behavioral harassment are expected to occur when animals are exposed to higher received levels, such as the onset of TTS (195 dB re 1 μPa^2-s) or higher. Since the modeling does not take into account the reduction of effects resulting from the Navy's standard mitigation, approximately 25% of all exposures are modeled as having occurred within the 1,000 yard mitigation safety zone where procedures are in place to reduce the received level of animals within this zone. Generally speaking, Navy and NMFS anticipate more severe effects from takes resulting from exposure to higher received levels (though this is in no way a strictly linear relationship throughout species, individuals, or circumstances) and less severe effects from takes resulting from exposure to lower received levels.

It is worth noting that Navy and NMFS would expect an animal exposed to the levels at the bottom of the risk function to exhibit behavioral responses that are less likely to adversely affect the longevity, survival, or reproductive success of the animals that might be exposed, based on received level, and the fact that the exposures will occur in the absence of some of the other contextual variables that would likely be associated with increased severity of effects, such as the proximity of the sound source(s) or the proximity of other vessels, aircraft, submarines, etc.

maneuvering in the vicinity of the exercise. NMFS will consider all available information (other variables, etc.), but all else being equal, takes that result from exposure to lower received levels and at greater distances from the exercises would be less likely to contribute to population level effects.

3.16.7 Navy Protocols For Acoustic Modeling Analysis of Marine Mammal Exposures

For this DEIS/DOEIS, the acoustic modeling results include additional analysis to account for the model's overestimation of potential effects. Specifically, the model overestimated effects because:

- Acoustic footprints for sonar sources near land are not reduced to account for the land mass where marine mammals would not occur..
- Acoustic footprints for sonar sources were added independently and, therefore, did not account for overlap they would have with other sonar systems used during the same active sonar activity. As a consequence, the area of the total acoustic footprint was larger than the actual acoustic footprint when multiple ships are operating together.
- Acoustic exposures do not reflect implementation of mitigation measures, such as reducing sonar source levels when marine mammals are present.
- Marine mammal densities were averaged across specific active sonar activity areas and, therefore, are evenly distributed without consideration for animal grouping or patchiness.
- Acoustic modeling did not account for limitations of the NMFS-defined refresh rate of 24 hours. This time period represents the amount of time in which individual marine mammals can be harasses no more than once.

Table 3-2 provides a summary of the modeling protocols used in the analysis for this DEIS/OEIS.

Table 3-2. Navy Protocols Providing for Modeling Quantification of Marine Mammal Exposures

Historical Data	Sonar Positional Reporting System (SPORTS)	Annual active sonar usage data will be obtained from the SPORTS database to determine the number of active sonar hours and the geographic location of those hours for modeling purposes.
Acoustic Parameters	AN/SQS-53 and AN/SQS-56	Model the AN/SQS-53 and the AN/SQS-56 active sonar sources separately to account for the differences in source level, frequency, and exposure effects.
	Submarine Sonar	Submarine active sonar use will be included in effects analysis calculations using the SPORTS database.
Post Modeling Analysis	Land Shadow	For sound sources within the acoustic footprint of land, subtract the land area from the marine mammal exposure calculation.
	Multiple Ships	Correction factors will be used to address overestimates of exposures to marine mammals resulting from multiple counting when there are more than one ship operating in the same vicinity.
	Multiple Exposures	The following refresh rates for SOCAL Range Complex training events will be included to account for multiple exposures: • Unit-level Training, Coordinated Events, and Maintenance – 4 hours • Integrated Anti-submarine Warfare (ASW) Course- – 16 hours • Major Exercises / Major Range Events– 12 hours • Sustainment Training Exercises – 12 hours.

3.17 OTHER EFFECTS CONSIDERED

3.18 STRESS

A possible stressor for marine mammals exposed to sound, including mid-frequency active sonar, is the effect on health and physiological stress (Review by Fair and Becker 2000). A stimulus may cause a number of behavioral and physiological responses such as an elevated heart rate, increases in endocrine and neurological function, and decreased immune function, particularly if the animal perceives the stimulus as life threatening (Seyle 1950; Moberg 2000; Sapolsky *et al*. 2005). The primary response to the stressor is to move away to avoid continued exposure. Next, the animal's physiological response to a stressor is to engage the autonomic nervous system with the classic "fight or flight" response. This includes changes in the cardiovascular system (increased heart rate), the gastrointestinal system (decrease digestion), the exocrine glands (increased hormone output), and the adrenal glands (increased nor-epinephrine). These physiological and hormonal responses are short lived and may not have significant long-term effects on an animal's health or fitness. Generally these short term responses are not detrimental to the animal except when the health of the animal is already compromised by disease, starvation or parasites; or the animal is chronically exposed to a stressor.

Exposure to chronic or high intensity sound sources can cause physiological stress. Acoustic exposures and physiological responses have been shown to cause stress responses (elevated respiration and increased heart rates) in humans (Jansen 1998). Jones (1998) reported on reductions in human performance when faced with acute, repetitive exposures to acoustic disturbance. Trimper et al. (1998) reported on the physiological stress responses of osprey to low-level aircraft noise. Krausman et al. (2004) reported on the auditory (TTS) and physiology stress responses of Sonoran pronghorn antelope to military overflights. Smith et al. (2004a, 2004b) recorded sound-induced physiological stress responses in a hearing-specialist fish that was associated with TTS. Welch and Welch (1970) reported physiological and behavioral stress responses that accompanied damage to the inner ears of fish and several mammals.

Most of these responses to sound sources or other stimuli have been studied extensively in terrestrial animals but are much more difficult to determine in marine mammals. Increases in heart rate are common reaction to acoustic disturbance in marine mammals (Miksis *et al*. 2001) as are small increases in the hormones norepinephrine, epinephrine, and dopamine (Romano *et al*. 2002; 2004). Increases in cortical steroids are more difficult to determine because blood collection procedures will also cause stress (Romano *et al*. 2002; 2004). A recent study, Chase Encirclement Stress Studies (CHESS), was conducted by NMFS on chronic stress effects in small odontocetes affected by the eastern tropical Pacific (ETP) tuna fishery (Forney et al. 2002). Analysis was conducted on blood constituents, immune function, reproductive parameters, heart rate and body temperature of small odontocetes that had been pursued and encircled by tuna fishing boats. Some effects were noted, including lower pregnancy rates, increases in norepinephrine, dopamine, ACTH and cortisol levels, heart lesions and an increase in fin and surface temperature when chased for over 75 minutes but with no change in core body temperature (Forney et al. 2002). These stress effects in small cetaceans that were actively pursued (sometimes for over 75 minutes) were relatively small and difficult to discern. It is unlikely that marine mammals exposed to mid-frequency active sonar would be exposed at long as the cetaceans in the CHESS study and would not be pursued by the Navy ships, therefore stress effects would be minimal from the short term exposure to sonar.

3.18.1 Acoustically Mediated Bubble Growth

One suggested cause of injury to marine mammals is by rectified diffusion (Crum and Mao 1996) the process of increasing the size of a bubble by exposing it to a sound field. This process is facilitated if the environment in which the ensonified bubbles exist is supersaturated with a gas, such as nitrogen which makes up approximately 78 percent of air (remainder of air is about 21 percent oxygen with some carbon dioxide). Repetitive diving by marine mammals can cause the blood and some tissues to accumulate gas to a greater degree than is supported by the surrounding environmental pressure (Ridgway and Howard 1979). Deeper and longer dives of some marine mammals (for example, beaked whales) are theoretically predicted to induce greater super saturation (Houser et al. 2001). Conversely, studies have shown that marine mammal lung structure (both pinnipeds and cetaceans) facilitates collapse of the lungs at depths deeper than approximately 162 ft (Kooyman et al. 1970). Collapse of the lungs would force air in to the non-air exchanging areas of the lungs (in to the bronchioles away from the alveoli) thus significantly decreasing nitrogen diffusion in to the body. Deep diving pinnipeds such as the northern elephant and Weddell seals (*Leptonychotes weddellii*) typically exhale before long deep dives, further reducing air volume in the lungs (Kooyman et al. 1970). If rectified diffusion were possible in marine mammals exposed to high-level sound, conditions of tissue super saturation could theoretically speed the rate and increase the size of bubble growth. Subsequent effects due to tissue trauma and emboli would presumably mirror those observed in humans suffering from decompression sickness.

It is unlikely that the short duration of sonar pings would be long enough to drive bubble growth to any substantial size, if such a phenomenon occurs. However, an alternative but related hypothesis has also been suggested. Stable bubbles could be destabilized by high-level sound exposures such that bubble growth then occurs through static diffusion of gas out of the tissues. In such a scenario the marine mammal would need to be in a gas-supersaturated state for a long enough period of time and exposed to a continuous sound source for bubbles to become of a problematic size.

3.18.2 DecompressionSickness

Another hypothesis suggests that rapid ascent to the surface following exposure to a startling sound might produce tissue gas saturation sufficient for the evolution of nitrogen bubbles (Jepson et al. 2003). In this scenario, the rate of ascent would need to be sufficiently rapid to compromise behavioral or physiological protections against nitrogen bubble formation. Cox et al. (2006), with experts in the field of marine mammal behavior, diving, physiology, respiration physiology, pathology, anatomy, and bio-acoustics considered this to be a plausible hypothesis but requires further investigation. Conversely Fahlman et al. (2006) suggested that diving bradycardia (reduction in heart rate and circulation to the tissues), lung collapse and slow ascent rates would reduce nitrogen uptake and thus reduce the risk of decompression sickness by 50 percent in models of marine mammals. Recent information on the diving profiles of Cuvier's and Blaineville's beaked whales in Hawaii (Baird et al. 2006) and in the Ligurian Sea in Italy (Tyack et al. 2006b) showed that while these species do dive deeply (regularly exceed depths of 2,624 ft) and for long periods (48-68 minutes), they have significantly slower ascent rates than descent rates. This fits well with Fahlman et al. (2006) model of deep and long duration divers that would have slower ascent rates to reduce nitrogen saturation and reduce the risk of decompression sickness. Therefore, if nitrogen saturation remains low, then a rapid ascent in response to sonar should not cause decompression sickness. Currently it is not known if beaked whales do rapidly ascend in response to sonar or other disturbances. It may be that deep diving animals would be better protected diving to depth to avoid predators, such as killer whales, rather than ascending to the surface where they may be more susceptible to predators.

Although theoretical predictions suggest the possibility for acoustically mediated bubble growth, there is considerable disagreement among scientists as to its likelihood (Piantadosi and Thalmann 2004; Evans and Miller 2003). To date, ELs predicted to cause in vivo bubble formation within diving cetaceans have not been evaluated (NOAA 2002b). Further, although it has been argued that traumas from recent beaked whale strandings are consistent with gas emboli and bubble-induced tissue separations (Jepson et al. 2003), there is no conclusive evidence of this and complicating factors associated with introduction of gas in to the venous system during necropsy. Because evidence supporting it is debatable, no marine mammals addressed in this EIS/OEIS are given special treatment due to the possibility for acoustically mediated bubble growth. Beaked whales are, however, assessed differently from other species to account for factors that may have contributed to prior beaked whale strandings as set out in the previous section.

3.18.3 Resonance

Another suggested cause of injury in marine mammals is air cavity resonance due to sonar exposure. Resonance is a phenomenon that exists when an object is vibrated at a frequency near its natural frequency of vibration—the particular frequency at which the object vibrates most readily. The size and geometry of an air cavity determine the frequency at which the cavity will resonate. Displacement of the cavity boundaries during resonance has been suggested as a cause of injury. Large displacements have the potential to tear tissues that surround the air space (for example, lung tissue).

Understanding resonant frequencies and the susceptibility of marine mammal air cavities to resonance is important in determining whether certain sonars have the potential to affect different cavities in different species. In 2002, NMFS convened a panel of government and private scientists to address this issue (NOAA 2002b). They modeled and evaluated the likelihood that Navy mid-frequency active sonar caused resonance effects in beaked whales that eventually led to their stranding (DOC and DON 2001). The conclusions of that group were that resonance in air-filled structures the frequencies at which resonance were predicted to occur were below the frequencies utilized by the sonar systems employed. Furthermore, air cavity vibrations due to the resonance effect were not considered to be of sufficient amplitude to cause tissue damage.

3.18.4 Likelihood of Prolonged Exposure

The proposed ASW activities within the SOCAL Range Complex would not result in prolonged exposure because the vessels are constantly moving, and the flow of the activity in the SOCAL Range Complex when ASW training occurs reduces the potential for prolonged exposure. The implementation of the mitigation measures described in Section 5 would further reduce the likelihood of any prolonged exposure.

3.18.5 Likelihood of Masking

Natural and artificial sounds can disrupt behavior by masking, or interfering with an animal's ability to hear other sounds. Masking occurs when the receipt of a sound is interfered with by a second sound at similar frequencies and at similar or higher levels. If the second sound were artificial, it could be potentially harassing if it disrupted hearing-related behavior such as communications or echolocation. It is important to distinguish TTS and PTS, which persist after the sound exposure, from masking, which occurs during the sound exposure.

Historically, principal masking concerns have been with prevailing background sound levels from natural and manmade sources (for example, Richardson et al. 1995). Dominant examples of the latter are the accumulated sound from merchant ships and sound of seismic surveys. Both cover a wide frequency band and are long in duration.

The proposed SOCAL Range Complex ASW areas are away from harbors but may include heavily traveled shipping lanes, although shipping lanes are a small portion of the overall range complex. The loudest mid-frequency underwater sounds in the Proposed Action area are those produced by hull-mounted mid-frequency active tactical sonar. The sonar signals are likely within the audible range of most cetaceans, but are very limited in the temporal and frequency domains. In particular, the pulse lengths are short, the duty cycle low, the total number of hours of operation per year small, and these hull-mounted mid-frequency active tactical sonars transmit within a narrow band of frequencies (typically less than one-third octave).

For the reasons outlined above, the chance of sonar operations causing masking effects is considered negligible.

3.18.6 Long-Term Effects

Navy activities are conducted in the same general areas throughout the SOCAL Range Complex, so marine mammal populations could be exposed to repeated activities over time. However, as described earlier, short-term non-injurious sound exposure levels predicted to cause TTS or temporary behavioral disruptions qualify as Level B harassment. Application of this criterion assumes an effect even though it is highly unlikely that all behavioral disruptions or instances of TTS will result in long term significant impacts.

Long-term monitoring programs for the SOCAL Range Complex are being developed by the Navy to assess population trends and responses of marine mammals to Navy activities. Short-term monitoring programs for exercises (e.g., undersea warfare exercise (USWEX)) are being developed to assess mitigation measures and responses of marine mammals to Navy activities.

3.19 APPLICATION OF EXPOSURE THRESHOLDS TO OTHER SPECIES

Mysticetes

Information on auditory function in mysticetes is extremely lacking. Sensitivity to low-frequency sound by baleen whales has been inferred from observed vocalization frequencies, observed reactions to playback of sounds, and anatomical analyses of the auditory system. Baleen whales are estimated to hear from 15 Hz to 20 kHz, with good sensitivity from 20 Hz to 2 kHz (Ketten 1998). Filter-bank models of the humpback whale's ear have been developed from anatomical features of the humpback's ear and optimization techniques (Houser et al. 2001). The results suggest that humpbacks are sensitive to frequencies between 40 Hz and 16 kHz, but best sensitivity is likely to occur between 100 Hz and 8 kHz. However, absolute sensitivity has not been modeled for any baleen whale species. Furthermore, there is no indication of what sorts of sound exposure produce threshold shifts in these animals.

The criteria and thresholds for PTS and TTS developed for odontocetes for this activity are also used for mysticetes. This generalization is based on the assumption that the empirical data at hand are representative of both groups until data collection on mysticete species shows otherwise. For the frequencies of interest for this action, there is no evidence that the total amount of energy required to induce onset-TTS and onset-PTS in mysticetes is different than that required for odontocetes.

Beaked Whales

Recent beaked whale strandings have prompted inquiry into the relationship between high-amplitude continuous-type sound and the cause of those strandings. For example, in the stranding in the Bahamas in 2000, the Navy mid-frequency sonar was identified as the only contributory cause that could have lead to the stranding. The Bahamas exercise entailed multiple ships using mid-frequency sonar during transit of a long constricted channel. The Navy participated in an extensive investigation of the stranding with the NMFS. The "Joint Interim Report, Bahamas Marine Mammal Stranding Event of 15-16 March 2000" concluded that the variables to be considered in managing future risk from tactical mid-range sonar were "sound propagation characteristics (in this case a surface duct), unusual underwater bathymetry, intensive use of multiple sonar units, a constricted channel with limited egress avenues, and the presence of beaked whales that appear to be sensitive to the frequencies produced by these sonars." (DOC and DON 2001).

The Navy analyzed the known range of operational, biological, and environmental factors involved in the Bahamas stranding and focused on the interplay of these factors to reduce risks to beaked whales from ASW training operations. Mitigation measures based on the Bahamas investigation are presented in Chapter 5. The confluence of these factors do not occur in the SOCAL Range Complex. Although beaked whales are visually and acoustically detected in areas where sonar use routinely takes place, there has not been a stranding of beaked whales in the SOCAL Range Complex associated with the 30-year use history of the present sonar systems.

This history would suggest that the simple exposure of beaked whales to sonar is not enough to cause beaked whales to strand. Brownell et al (2004), have suggested that the high number of beaked whale strandings in Japan between 1980 and 2004 may be related to U.S. Navy sonar use in those waters given the presence of U.S. Naval Bases and exercises off Japan. The Center for Naval Analysis compiled the history of naval exercises taking place off Japan and found there to be no correlation in time for any of the stranding events presented in Brownell et al (2004). Like the situation in California, there are clearly beaked whales present in the waters off Japan (as evidenced by the strandings) however, there is no correlation in time to strandings and sonar use. Sonar did not causing the strandings provided by Brownell et al. (2004) and more importantly, this suggests sonar use in the presence of beaked whales over two decades has not resulted in strandings related to sonar use.

As suggested by the known presence of beaked whales in waters sonar use has historically taken place, it is likely that beaked whales have been occasionally exposed to sonar during the last 30 years of sonar use in Southern California and yet there is no indication of any adverse impact on beaked whales from exposure to sonar in Californian waters. Therefore, the continued use of sonar in the SOCAL Range Complex is not likely to result in effects to beaked whales.

3.19.1 Explosive Source Criteria

The criterion for mortality for marine mammals used in the CHURCHILL FEIS (DON, 2001) is "onset of severe lung injury." This is conservative in that it corresponds to a 1 percent chance of mortal injury, and yet any animal experiencing onset severe lung injury is counted as a lethal exposure.

- The threshold is stated in terms of the Goertner (1982) modified positive impulse with value "indexed to 31 psi-ms.'" Since the Goertner approach depends on propagation, source/animal depths, and animal mass in a complex way, the actual impulse value corresponding to the 31-psi-ms index is a complicated calculation. Again, to be conservative, CHURCHILL used the mass of a calf dolphin (at 12.2 kg), so that the threshold index is 30.5 psi-ms (Table 3.3).

Two criteria are used for injury: onset of slight lung hemorrhage and 50 percent eardrum rupture (tympanic membrane [TM] rupture). These criteria are considered indicative of the onset of injury (Table 3.3).

- The threshold for onset of slight lung injury is calculated for a small animal (a dolphin calf weighing 27 lb), and is given in terms of the "Goertner modified positive impulse," indexed to 13 psi-ms in the (DON, 2001a). This threshold is conservative since the positive impulse needed to cause injury is proportional to animal mass, and therefore, larger animals require a higher impulse to cause the onset of injury.

- The threshold for TM rupture corresponds to a 50 percent rate of rupture (i.e., 50 percent of animals exposed to the level are expected to suffer TM rupture); this is stated in terms of an EL value of 205 dB re 1 μPa^2-s. The criterion reflects the fact that TM rupture is not necessarily a serious or life-threatening injury, but is a useful index of possible injury that is well correlated with measures of permanent hearing impairment (e.g., Ketten, 1998 indicates a 30 percent incidence of permanent threshold shift [PTS] at the same threshold).

Two criteria are considered for non-injurious harassment temporary threshold shift (TTS), which is a temporary, recoverable, loss of hearing sensitivity (NMFS 2001; DON 2001a).

- The first criterion for TTS is 182 dB re 1 μPa^2-s maximum EL level in any 1/3-octave band at frequencies >100 hertz (Hz).

- A second criterion for estimating TTS threshold has also been developed. A threshold of 12 pounds per square inch (psi) peak pressure was developed for 10,000 pound charges as part of the CHURCHILL Final EIS (DON 2001a, [FR70/160, 19 Aug 05; FR 71/226, 24 Nov 06]). It was introduced to provide a more conservative safety zone for TTS when the explosive or the animal approaches the sea surface (for which case the explosive energy is reduced but the peak pressure is not). Navy policy is to use a 23 psi criterion for explosive charges less than 2,000 lb and the 12 psi criterion for explosive charges larger than 2,000 lb. This is below the level of onset of TTS for an odontocete (Finneran *et al*. 2002). All explosives modeled for the SOCAL Range Complex EIS/OEIS are less than 1,500 lbs.

Table 3-3. Effects Analysis Criteria for Underwater Detonations for Explosives < 2000 lbs Net Explosive Weight. Based on CHURCHILL FEIS (DON 2001) and Eglin Air Force Base IHA (NMFS 2005h) and LOA (NMFS 2006a).

	Criterion	Metric	Threshold	Comments	Source
Mortality & Injury	**Mortality** Onset of extensive lung hemorrhage	**Shock Wave** Goertner modified positive impulse	30.5 psi-msec	All marine mammals (dolphin calf)	Goertner 1982
	Slight Injury Onset of slight lung hemorrhage	**Shock Wave** Goertner modified positive impulse	13.0 psi-msec	All marine mammals (dolphin calf)	Goertner 1982
	Slight Injury 50% TM Rupture	**Shock Wave** Energy Flux Density (EFD) for *any single exposure*	205 dB re:1μPa^2-sec	All marine mammals	DoN 2001
Harassment	**Temporary Auditory Effects** TTS	**Noise Exposure** greatest EFD in any 1/3-octave band *over all exposures*	182 dB re:1μPa^2-sec	For odontocetes greatest EFD for frequencies ≥100 Hz and for mysticetes ≥10 Hz	NMFS 2005, NMFS 2006a
	Temporary Auditory Effects TTS	**Noise Exposure** Peak Pressure for *any single exposure*	23 psi-msec	All marine mammals	DoN 2001
	Behavioral Modification	**Noise Exposure** greatest EFD in any 1/3-octave band *over all exposures*	177 dB re:1μPa^2-sec	For odontocetes greatest EFD for frequencies ≥100 Hz and for mysticetes ≥10 Hz	NMFS

Notes:

Goertner, J.F. 1982. Prediction of underwater explosion safe ranges for sea mammals. Naval Surface Weapons Center, White Oak Laboratory, Silver Spring, MD. NSWC/WOL TR-82-188. 25 pp.

DoN. 2001. USS Churchill Shock Trail FEIS- February 2001. Department of the Navy.

NMFS. 2005. Notice of Issuance of an Incidental Harassment Authorization, Incidental to Conducting the Precisions Strike Weapon (PSW) Testing and Training by Eglin Air Force Base in the Gulf of Mexico. Federal Register,70(160):48675-48691.

NMFS. 2006. Incidental Takes of Marine Mammals Incidental to Specified Activities; Naval Explosive Ordnance Disposal School Training Operations at Eglin Air Force Base, Florida, National Oceanic and Atmospheric Administration, National Marine Fisheries Service. Federal Register 71(199):60693-60697

NMFS. Briefed to NMFS for VAST-IMPASS; U.S. Air Force uses 176 dB for permit applications at Eglin Gulf Test and Training Range (EGTTR)

3.19.2 Shallow Water Underwater Detonations (Offshore of San Clemente Island)

Navy Special Warfare (NSW) incorporates VSW, bottom-laid explosives training into Basic Underwater Demolition/School (BUD/S) and Maritime Operations (MAROPs) training curriculums. Personnel training include small, single underwater explosive charges at Northwest Harbor (Figure 3-10) and Horse Beach Cove (Figure 3-11), and multiple charges at Northwest Harbor on San Clemente Island (SCI).

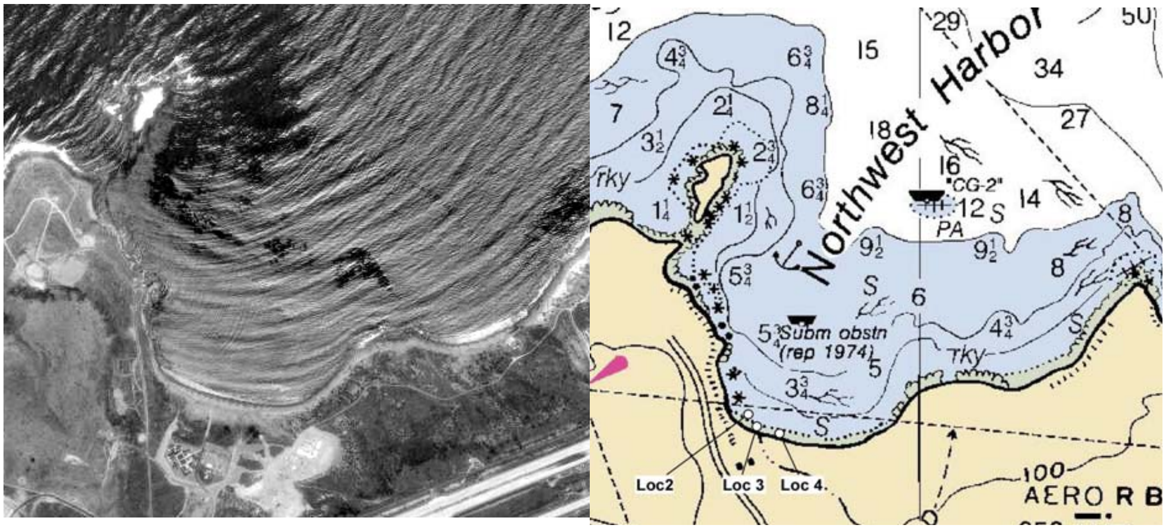


Figure 3-10. San Clemente Island, Northwest Harbor Aerial Photo and Chart Depths in fathoms at mean lower low water

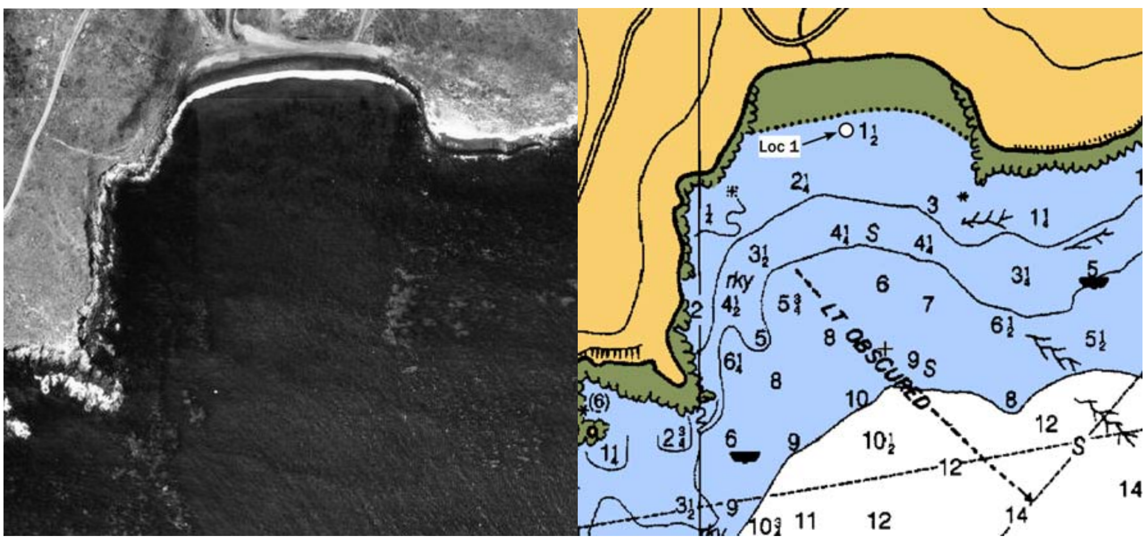


Figure 3-11. San Clemente Island, Horse Beach Cove, Aerial Photo and Chart Depths in fathoms at mean lower low water

These exercises are the culmination of theoretical and practical instruction for successive groups of Navy Special Warfare (NSW) personnel-in-training. The exercises are essential in that they provide NSW personnel with hands-on experience with the design, deployment, and detonation of underwater clearance devices of the general type and size that they are required to understand and utilize. The specific explosive elements and their arrangements have been selected to include the widest range of features, so that a trained operator can competently use similar forms or configurations as objectives require. That is, the explosive configurations used in the training exercises are not necessarily those that would be used in actual operations.

There are three underwater explosive exercises conducted in Northwest Harbor: the single charge (SC) exercise, the multiple-charge obstacle loading (OL) exercise, and the multiple-charge mat-weave (MW) exercise. Only SC exercises are conducted at Horse Beach Cove. Single charges of up to 20 lbs of C4 high-explosive are detonated in near-shore waters of 5 to 20 feet depth at Northwest Harbor and of 10-12 ft depth at Horse Beach Cove.

OL exercise is conducted up to 7 times a year at Northwest Harbor (Figure 3-12). The obstacles used in training are 8, 1 m^2 concrete blocks on the bottom in about 15 ft of water. They are arranged in an elongated pattern parallel to the shoreline. Onto each obstacle are attached 2 haversack charges of C4 explosive weighing 20 lbs each that is equivalent to about 27 lbs of TNT. All haversacks of all obstacles are cross-connected by detonation cord to effect coordinated detonation of C4.

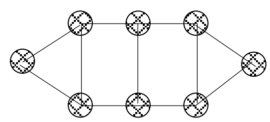


Figure 3-12. Obstacle Pattern

MW exercise is conducted up to 7 times a year at Northwest Harbor (Figure 3-11). Two MW devices or mats are used in training, and involves the detonation of two lattices of line-charge explosive in quick succession. Each mat is a square lattice arrangement of 2.75-in diameter line-charge high explosive with 10, 25-ft long segments arranged in a 5 x 5 cross-hatch pattern and tied together at their intersections (Figure 3-12 Square Mats). Each of the 10 line charges contains 50 lbs of PBX composite-explosive that is equivalent to about 67 lbs of TNT. The two 500-lb mats are placed side-by-side on the bottom at a depth of about 5 ft just off the shoreline. The explosive within each mat is detonated simultaneously – at the speed of the explosive – and the two mats are detonated sequentially with a time-separation of about 500 ms. By design, a mat directs a large proportion of its explosive force vertically – i e., down into the substrate and, incidentally, up into the air. MW exercises occur at the location labeled “Loc 3” on the chart in Figure 2 of the main text.

All scheduling, safety regulation enforcement, explosive handling, and explosive detonations are carried out by qualified NSW training personnel.

Mitigation Considerations and Precedence: The unusual physical topographies, the low numbers of protected species and the training routines at both sites combine with the unusual pressure-wave propagation characteristics of the Northwest Harbor, where multiple charges are used, to allow exceptionally reliable and effective mitigation procedures. Each of those characteristics will be described, but the exceptional reliability of visual detection of protected species at these sites allows for complete mitigation within a radius that extends out to the distance at which only the lowest degree of temporary auditory threshold shift (onset-TTS) would be expected to occur. That is, the procedures to be described will mitigate the potential for Level-A harassment by injury and Level-B harassment associated with TTS by not detonating explosives while protected species are in the area associated with those effects. That approach and the analysis used in this DEIS for underwater explosive effects on marine mammals and turtles are based on the criteria established in the FEIS for shock trial of the USS Winston S. Churchill (DoN, 2001) and the associated regulatory ruling (66 FR 22450, May 4, 2001). From those precedents, the distance at which onset-TTS, a Level-B harassment, would be expected to occur is taken be the greater of the distances at which either the peak-pressure has fallen to 12 psi or the energy in the 3^{rd} octave-band of highest energy has fallen to 182 dB re 1 $\mu Pa^2 \cdot$sec. For mysticetes, only energy occurring above 10 Hz was considered in the energy estimates and for odontocetes, only energy occurring above 100 Hz was considered.

Given effective mitigation to the distance associated with onset-TTS, more severe impacts – e. g., greater TTS and Level-A harassment by injury - and their associated pressure-wave metrics are not analyzed or described in this DEIS. Additionally, as in the cited precedence, detonations in the SC, OL, and MW exercises occur infrequently and are isolated in time from one another so that resultant behavioral disturbance or disruption, other than that caused by TTS, does not reach the degree associated with Level-B harassment. While the OL and MW exercises usually take place on separate days over a two-day period, they may occur several hours apart on the same day. There is an average of almost 2 months between successive occurrences of this pair of exercises.

As separate criteria for carnivora (sea lions) and chelonia (turtles) have not been established, the dual criterion for odontocetes is taken, as in the cited precedence, to be protective of those groups.

Recent suggested revisions to the cited precedence for large deep-water explosions are described below.

Topographic, Water, and Bottom Conditions: The locations of the training ranges at Northwest Harbor and Horse Beach Cove, when combined with existing training procedures, provide for reliable visual detection of protected species. Training is conducted in daylight hours in sea-states of 2 or less and the mitigation zones are always clearly visible from the shore. Unlike typical circular mitigation zones, pressure-wave propagation from the detonations and thus, the mitigation zones, are restricted to a relatively small area due to the confining sides of the harbor and cove. Those limiting sides shape each zone into a wedge shape of about 90 degrees from the point of detonations and less than that when viewed from the shore observer's position - i. e., both sites have narrow fields-of-search with visual angles less than 90 degrees. Additionally, both sites have beaches that slope up from the waterline with elevated on-shore positions that provide stable, unmoving elevated heights-of-eye for complete binocular-aided observation of the detonation areas and sea surface beyond 2000 ft seaward of the detonation locations. At both sites, visual observation from the shore is augmented by the observations of a safety boat operator moving through and beyond the mitigation area. Thus, marine mammals and turtles are easily detected when at the surface in the mitigation zone.

The shallow depths of the mitigation zones maximize the probability of animals being on the surface - re typical mitigation scenarios - and thus, the probability of their visual detection as well. Both wedge-shaped mitigation zones extend out from detonations in VSW depths of only 10-20 ft – the MW detonation is at an extremely shallow depth of 5 ft - and are no more than 50–60 ft in depth at their farthest extents. That is, the average depths of the zones are only about 30-35 ft and the highest blast pressures occur in the shallowest parts of the ranges near the charge locations where animal presence is most obvious. When combined with the low number of animals typically in these zones – described below - the few animals in or transiting through these shallow areas are not diving deeply or for extended periods of time as is typically assumed in mitigation areas over deeper water. For comparison, a typical at-sea mitigation zone over deep water has a circular surface area. There, point-charges in the upper column would have a hemispheric or cylindrical volume-of-effect - depending on charge-size and bottom-depth - with a circular surface visual-mitigation area of radius equal to the maximum horizontal extent of either the hemisphere or cylinder. The present wedge-shaped zones in VSW of similar radius have only

25% of that surface area over shallow volumes less than 1% as large as deeper-water hemispheric or cylindrical volumes. Thus, in the present relatively shallow volumes, marine animals will be at the surface much more frequently and, as a result, detected much more readily than in deeper water zones. Given these VSW characteristics, the percent detection or detection effectiveness for various species that are usually associated with deeper at-sea zones and other methods of observation do not apply nor do the detection probabilities associated with assessment surveys over deep water from ships or planes such as those described by Buckland et al. (1993) or Barlow (1995).

Bottom and water-column conditions also influence pressure-wave propagation. A study conducted during actual exercises at Naval Amphibious Base (NAB), Coronado, CA and Northwest Harbor during 2002 and 2003 (NSWC/Anteon Corp., Inc.; 2005) revealed considerable differences in pressure-wave propagation between the two sites - differences that are attributable to the different bottom and water-column conditions at those sites.

The NAB range is composed of clean sand along an open coast with, presumably, a hard substrate wherein propagation comes close to matching propagation-model predictions. At Horse Beach Cove, the bottom around the detonation location (Figure 3-11) and seaward has not been studied but, it appears to be composed of clean sands with some dense kelp extending out along the eastern side of the mitigation zone. As such, the pressure-wave propagation at Horse Beach Cove will be assumed to be similar to that of NAB along its main seaward axis – i. e., a line, roughly perpendicular to the shoreline that extends seaward from the detonation location.

The Northwest Harbor range, on the other hand, has heavily eroded hills on its West and South sides and is not subject to strong lateral wave-generated coastal currents suggesting a softer, silt-like substrate despite the clean sand on and near the beach. Additionally, moderate subsurface vegetation is distributed unevenly on the shore approaches. Beginning about 2200 ft offshore, dense surface-visible kelp occurs over considerable distances seaward along the main seaward axis and begins closer to the shore on either side of the main axis. In those conditions, blast pressures and energies, measured at various distances from the detonation, are substantially less than model predictions that assume a clean hard bottom.

The distribution of surface-visible kelp in Northwest Harbor varies due to storm-wave damage and recovery in different seasons but, subsurface kelp is, likely, present in the lower water column in most parts of the inner and outer harbor throughout the year. A depth sounder, that reported vegetation height and bottom depth, was deployed along a line from the SC exercise location 4 (Fig. 1, Chart) seaward. Bottom vegetation began about 300 ft seaward and moderate vegetation was found in the bottom 3rd of the water column out to about 600 ft seaward. Between 600 and 1000 ft seaward, vegetation was present that reached 2/3 of the way up to the surface. None of this vegetation was visible at the surface or when looking down from the surface. A similar examination of the water column along a line seaward of OL and MW locations 2 and 3 (Fig. 1, Chart) – not far to the west of the first line - indicated little or no vegetation out to about 1000 ft but, it is likely that subsurface kelp began at about that distance. Similar substantial attenuation of pressure-waves was observed out to 1000 ft along both of these axes indicating that the attenuation is not due solely to kelp in the column. However, such vegetation also deposits layers of organic matter over time just below the bottom and that could, along with a soft deeper substrate, contribute to the overall attenuation effects on propagation at Northwest Harbor.

In any case, some combination of vegetation and substrate create an acoustic sink-like condition that substantially attenuates the pressure waves created by near-shore detonations before they reach the inner limits of the denser surface-visible kelp at about 2200 ft. Additional relevant details of the study are given below in the description of pressure-wave propagation.

Finally, both Northwest Harbor and Horse Beach Cove are shallow bays that open to the ocean. These Bays undergo substantial, frequent water exchange with the ocean as a result of tidal volume flux and coastal circulation patterns. Water mixing within Northwest Harbor is substantial as evidenced by the absence of thermal and salinity layering in the sound velocity measurements that were made there. The same conditions likely exist at Horse Beach Cove as well. The water mixing within the bays that reduces layering effects also facilitates the rapid dilution of explosive by-products and the water exchange with the ocean transports those by-products from the sites and furthers their dilution.

Protected Species: Mysticetes and large odontocetes are rarely, if ever, present in the outer areas of Northwest Harbor that have dense kelp growth throughout the year and are not known to appear shoreward of the inner edge of the surface-visible kelp. Similarly, they are not known to appear in the shallow approaches to Horse Beach Cove. Were they to approach either area, even at considerable distance beyond the mitigation zones to be described, they would be immediately obvious to the shore or safety-boat observers. Neither Horse Beach Cove nor Northwest Harbor is known to be a preferred feeding site for small marine mammals and turtles are not known to feed in, nest near, or frequent either site. Thus, the principle concern is for protection of small odontocetes (dolphins, porpoises and small whales), carnivora (sea lions), and chelonia (turtles) that only occasionally visit these sites. It follows that the mitigation zones, to be described, are determined by estimates of the propagated peak-pressure and energy in the 3rd octave-band of highest energy above 100 Hz – i. e., in the range of hearing of small odontocetes.

Pressure-Wave Propagation in VSW: Measurements of the propagated pressures in live-fire tests during SC exercises at NAB and during SC, OL, and MW exercises at Northwest Harbor were conducted in 2002 and 2003 as part of a study to evaluate underwater explosive propagation models in very shallow water (VSW) (NSWC/Anteon Corp., Inc.; 2005). Details of the procedures, results, and conclusions may be found in that report. Results and conclusions relevant to the proposed action are described in this DEIS. The measurements made in those tests provide an in-place characterization of pressure propagation for all three training exercises as they are actually conducted at Northwest Harbor and a guide to expected explosive pressure propagation at Horse Beach Cove. That is, actual measurements, as opposed to model predictions, are used as the basis for determining mitigation ranges in the SC, OL, and MW exercises at Northwest Harbor. For the SC exercises in Horse Beach Cove, mitigation ranges are determined from the predictions of an explosive propagation model that, conservatively, assumes an unbounded homogeneous medium.

The propagation of pressure waves was found to be substantially different between Northwest Harbor and NAB – a clean hard sand range. For example, in SC exercises, measurements of propagated peak-peak pressures at about 1000 ft for 15 lb charges detonated in 15 ft of water – on and 2 ft off the bottom at both sites - produced peak-pressures that were only about ¼ as large at Northwest Harbor as those at NAB. Energies measured at similar distances for these same shots did not show substantial differences between sites. However, at Northwest Harbor, there was added extraneous noise in the recording system that added to the sums of energies calculated from that data (NSWC/Anteon Corp. Inc. 2005). That is, the actual energies in the water at Northwest Harbor were, likely, less than those at NAB.

The position of single charges - on and 2 ft off the bottom - had similar effects on propagated peak-pressures at both sites. That is, off-bottom positions produced consistently higher peak-pressures than on-bottom positions as measured at about 200, 500, and 1000 ft distances. Off-bottom 15 lb charges in 15 ft of water produced between 43 – 67 % greater peak-pressures than on-bottom charges. In an extremely shallow depth of 6 ft, the off-bottom placement of a 15 lb charge produced about 94% greater peak-pressure than a similar on-bottom charge as measured at about 190 ft distance. The SC exercises in the proposed action only use on-bottom positions and the MW exercise at Northwest Harbor uses on-bottom charge placement in about 5 ft of water (NSWC/Anteon Corp. Inc. 2005).

The data from both sites also show a trend that is not typically seen in explosions occurring in deeper water with the charges in the upper portion of the water column. For most of the SC detonations and both the OL and MW detonations, the deeper measuring gages at distance showed lower peak-pressures and energies. Usually, the highest pressures and energies are measured at the deepest depths due to bottom-reflected pressure waves, refraction etc. In the case of the multiple-explosive OL exercise, the deepest gages were at 79 and 66% of the water depth at about 800 and 1800 ft distances, respectively. These gages measured about half the peak-pressure and less than half of the total energy between 100 Hz and 40 KHz than were recorded by the gages in the upper half of the column. In the MW exercise, the effect was not seen at about 1000 ft distance, but a similar trend was seen at about 2300 ft. While the data are suggestive of a general trend for VSW detonations and VSW propagation, the deepest gages in many cases did not extend down close enough to the bottom and thus, such a general conclusion cannot be drawn (NSWC/Anteon Corp. Inc.; 2005).

Measurements made during the OL and MW exercises demonstrated an important finding with regard to multiple-charge detonations. In those exercises, the propagated pressure-waves are substantially smaller than would be expected for single charges with weights equal to the aggregate weights of the individual charges. Aggregation of multiple charge-weights is often done in the absence of empirical data or applicable models. Further, the differences are much greater than can be accounted for by the sound attenuating properties of Northwest Harbor. For the OL exercise with 16, 20-lb charges of C4, measurements at about 800 ft distance show received peak-pressures less than would be expected from a single 20-lb charge of C4. It was concluded that the OL detonations are too small, too fast, too far apart, and too separated in time for their propagated pressure waves to overlap – i. e., to sum with - each other to any substantial degree. Further, the essentially random distribution of charges on the eight obstacles make the obtained results representative of propagated pressure-waves in past and future OL exercises at that site. For the MW exercise, the measured peak-pressures at about 1000 ft were those that would be expected from only a few pounds of TNT at that distance. In the MW exercise, the complicated geometry of long linear charges, arranged in a lattice, provides an explanation for the obtained results – results that also are representative of past and future MW exercises. Details of these results and conclusions may be found in the Discussion section of Appendix E in NSWC/Anteon Corp., Inc. (2005).

Mitigation Zones at Northwest Harbor and Horse Beach Cove: Measurements during SC exercises at Northwest Harbor produced empirical data for more accurately determining mitigation zones for SC exercises there. Previously, a broader zone has been used for SC exercises. The peak-pressures (unfiltered) and energies – between 100 Hz and 41 KHz - in 3rd octave-bands of highest energies were measured seaward of a 15 lb single charge of C4 lying on the bottom in 15 ft of water. These values were measured during - and are representative of - CS exercises conducted there (NSWC/Anteon Report 2005, Shot 5236, Table 4, Figure 17). At about 1000 ft seaward, the peak-pressure varied from only 2-4 psi (unfiltered) at different depths and the energies between 100 Hz and 41 KHz in the 3rd octave-bands of highest energies varied from about 174-182 dB re 1 $\mu Pa^2 \cdot sec$ at different depths. As explained in the NSWC/Anteon Report (2005), these energy values contain extraneous noise added into the values. That is, the stated energy values are more than the actual energy in the water. A 20 lb single charge of C4 would be expected to have about 2 psi more peak-pressure and about 2 dB more energy at that distance. From these measurements, the range at which the criterion for onset-TTS would be expected to occur in small odontocetes and thus, the mitigation range for SC exercises with charge-weights of

20 lbs or less of C4 on the bottom at Northwest Harbor, is determined to be 1100 ft from the detonation site.

The mitigation range for SC exercises at Horse Beach Cove is determined from model predictions. As the pressure-wave propagation at Horse Beach Cove was not measured, it is considered to be equivalent to NAB's clean hard sand bottom - a conservative assumption. Predictions made by the Reflection and Refraction in Multi-Layered Ocean/Ocean Bottoms with Shear Wave Effects (REFMS) model were found to be unstable across the distances considered under the conditions of VSW with bottom or near bottom charge placement, reflective bottom, and a non-refractive water column – i. e., equal sound velocity at all depths - (NSWC/Anteon Corp. Inc.; 2005; Results and Discussion – Model Validation). The source of instability in the REFMS predictions is due, most likely, to the VSW where the ratio of depth to range is very small – a known problem for the REFMS predictive ray-tracing but, refraction and placement conditions may contribute as well. REFMS was developed for large explosives in deep water and has been validated there, but is in need of added development for reliable application in VSW conditions. The peak-pressures and 3rd octave-band energies for the minimum refraction and maximum reflection VSW bottom at NAB were just as well predicted by a simpler model that assumes "iso-velocity" throughout the column and with no boundaries – conservative assumptions. In iso-velocity conditions, peak pressure follows a power law over distance as do the dominant frequency and energy at that frequency. Predictions of that iso-velocity model for detonations in an unbounded (equivalent to an off-bottom charge), homogeneous medium or a free acoustic field appear in Figure 3-13.

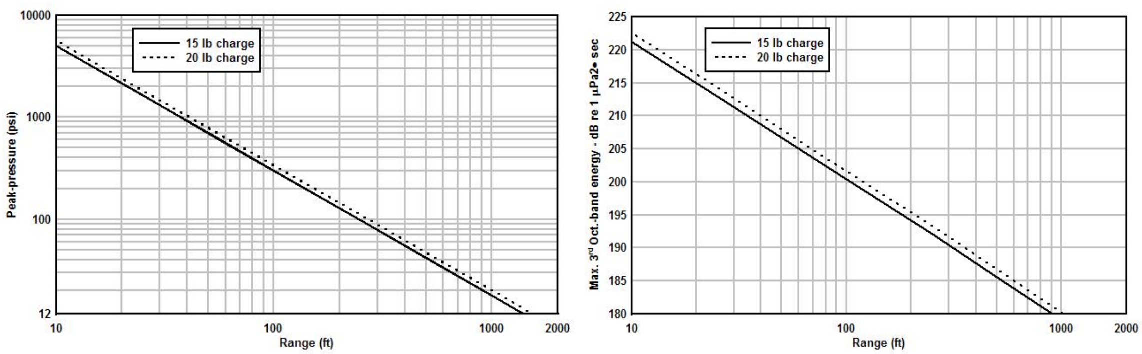


Figure 3-13. Iso-velocity predictions of peak pressure and energy in the 3rd octave-band of highest energy above 100 Hz as a function of range for 15 and 20 lb charges of C4 explosive.

From Figure 3-13, it is determined that the mitigation range for SC exercises with charge-weights of 20 lbs or less of C4 on the bottom at Horse Beach Cove is determined to be 1300 ft from the detonation site.

The mitigation range for the OL and MW exercises at Northwest Harbor are determined from empirical data collected during actual exercises (NSWC/Anteon Corp., Inc.; 2005; Appendix E). In both exercises, high peak-pressures and long signal durations were expected at the farthest range, so amplifier gains were reduced and recording periods were lengthened, accordingly. However, in the OL exercise, peak-pressures of only 4-10 psi (unfiltered) were recorded at three different water depths at 1779 ft distance along the main seaward axis. In the MW exercise, peak-pressures of only 3-5 psi (unfiltered) were recorded at three different depths at 2332 ft distance. In both exercises, the relatively high extraneous noise level in the recording – mentioned above - and unexpectedly low received signal pressure produced a low signal-to-noise ratio that, when coupled with the longer recording and integration periods, prevented accurate calculations of 3rd octave-band energies. That is, noise spikes above 100 Hz could influence the calculation of individual octave-band energies. Instead, the data were band-pass filtered – with a low cutoff of 100 Hz to accommodate small odontocete hearing sensitivity and a high cutoff of 40 KHz to remove extraneous noise above that frequency – and total energies, instead of 3rd octave-band energies, were reported. Thus, in the OL exercise, total energies of 181-187 dB re 1 μPa^2 ·sec were recorded at the three different water depths at 1779 ft distance. In the MW exercise, total energies of 180-185 dB re 1 μPa^2 ·sec were recorded at different depths at 2332 ft distance.

In addition to energy in the water, these total energy values incorporate some noise that remained in the pass-band after filtering. These totals can be related to maximum 3rd octave-band energies by comparison with results obtained in the SC exercises. In two SC exercises with bottom charges, one at NAB and one at Northwest Harbor, the total energy and the energy in the 3rd octave band of highest energy were considered for each pressure gage in both exercises. The mean difference, across all gages, between total energy and maximum 3rd octave-band energy was 6.6 dB with a standard deviation of 2.0 dB. That is, the total energies given above indicate that the probable maximum 3rd octave band energy was at or below the onset-TTS energy criterion at 1780 ft distance in the OL exercise and below that criterion at 2332 ft distance for the MW exercise. Considering the added noise, the actual energies – total and probable maximum 3rd octave-band - were somewhat less. Thus, it is determined that the mitigation range for OL and MW exercises with charge-types and charge-weights described at Northwest Harbor is determined to be 2000 ft from the detonation site.

The total energy values, described above for these exercises, are not comparable with recently suggested revisions to the impulse criteria for onset-TTS resulting from exposure to very large single charges in very deep water. That suggested criterion uses a peak-pressure of 23 psi as a "limiting" value and 183 dB re 1 μPa^2 ·sec received, C-weighted energy flux density level. C-weighting has somewhat different filter characteristics than band-pass filtering and, for "mid-frequency" cetacea, the C-weighting has low and high-frequency cutoffs of 150 Hz and 160 KHz. For perspective, a mid-depth pressure gage at 1779 ft distance in the OL exercise recorded 9 psi peak-pressure and 187 dB re 1 μPa^2 ·sec total energy with 100 Hz and 40 KHz band-pass filtering. Using band-pass filtering between 150 Hz and 40 KHz as a conservative approximation to mid-frequency C-weighting – with 40 KHz used to remove high frequency noise as before - that gage's total energy at 1780 ft distance would be 183 dB re 1 μPa^2 ·sec. That value would include additional noise in the pass-band as before. Beyond that perspective, there are substantial differences between the very deep water, large charge scenario of the suggested revised criteria and the present one with its single and multiple relatively small explosives laid on the bottom in very shallow water. Different blast conditions, configurations, and charge-weight produce substantially different waveforms at a distance and therefore, likely differ considerably in their effects on auditory tissue. For these reasons, the previously described dual-criterion is used in this DEIS. It is the dual-criterion previously used in DON (2001) and approved in CFR (2001).

4 MODELING ACOUSTIC AND EXPLOSIVE EFFECTS

The methodology for analyzing potential impacts from sonar and explosives is presented in in this section, which defines the model process in detail, describes how the impact threshold derived from Navy-NMFS consultations are derived, and discusses relative potential impact based on species biology.

The Navy acoustic exposure model process uses a number of inter-related software tools to assess potential exposure of marine mammals to Navy generated underwater sound including sonar and explosions. For sonar, these tools estimate potential impact volumes and areas over a range of thresholds for sonar specific operating modes. Results are based upon extensive pre-computations over the range of acoustic environments that might be encountered in the operating area.

The process includes four steps used to calculate potential exposures:

- Identify unique acoustic environments that encompass the operating area. Parameters include depth and seafloor geography, bottom characteristics and sediment type, wind and surface roughness, sound velocity profile, surface duct, sound channel, and convergence zones.

- Compute transmission loss (TL) data appropriate for each sensor type in each of these acoustic environments. Propagation can be complex depending on a number of environmental parameters listed in step one, as well as sonar operating parameters such as directivity, source level, ping rate, and ping length, and for explosives the amount of explosive material detonated. The Navy standard CASS-GRAB acoustic propagation model is used to resolve these complexities for underwater propagation prediction.

- Use that TL to estimate the total sound energy received at each point in the acoustic environment.

- Apply this energy to predicted animal density for that area to estimate potential acoustic exposure, with animals distributed in 3-D based on best available science on animal dive profiles.

Modeling of the effects of mid-frequency sonar and underwater detonations was conducted using methods described in the following sections.

The primary potential impact to marine mammals from underwater acoustics is Level B harassment from noise. For explosions, in the absence of any mitigation or monitoring measures, there is a very small chance that a marine mammal could be injured or killed when exposed to the energy generated from an explosive force on the sea floor. Analysis of noise impacts to cetaceans is based on criteria and thresholds initially presented in U.S. Navy Environmental Impact Statements for ship shock trials of the Seawolf submarine and the Winston Churchill (DDG 81), and subsequently adopted by NMFS.

Non-lethal injurious impacts (Level A Harassment) are defined in those documents as tympanic membrane (TM) rupture and the onset of slight lung injury. The threshold for Level A Harassment corresponds to a 50-percent rate of TM rupture, which can be stated in terms of an energy flux density (EFD) value of 205 dB re 1 μPa^2-s. TM rupture is well-correlated with permanent hearing impairment. Ketten (1998) indicates a 30-percent incidence of permanent threshold shift (PTS) at the same threshold.

The criteria for onset of slight lung injury were established using partial impulse because the impulse of an underwater blast wave was the parameter that governed damage during a study using mammals, not peak pressure or energy (Yelverton 1981). Goertner (1982) determined a way to calculate impulse values for injury at greater depths, known as the Goertner "modified" impulse pressure. Those values are valid only near the surface because as hydrostatic pressure increases with depth, organs like the lung, filled with air, compress. Therefore the "modified" impulse pressure thresholds vary from the shallow depth starting point as a function of depth.

The shallow depth starting points for calculation of the "modified" impulse pressures are mass-dependent values derived from empirical data for underwater blast injury (Yelverton 1981). During the calculations, the lowest impulse and body mass for which slight, and then extensive, lung injury found during a previous study (Yelverton et al 1973) were used to determine the positive impulse that may cause lung injury. The Goertner model is sensitive to mammal weight; such that smaller masses have lower thresholds for positive impulse so injury and harassment will be predicted at greater distances from the source for them. Impulse thresholds of 13.0 and 31.0 psi-msec, found to cause slight and extensive injury in a dolphin calf, were used as thresholds in the analysis contained in this document.

Level B (non-injurious) Harassment includes temporary (auditory) threshold shift (TTS), a slight, recoverable loss of hearing sensitivity. One criterion used for TTS is 182 dB re 1 µPa^2-s maximum EFD level in any 1/3-octave band above 100 Hz for toothed whales (e.g., dolphins). A second criterion, 23 psi, has recently been established by NMFS to provide a more conservative range for TTS when the explosive or animal approaches the sea surface, in which case explosive energy is reduced, but the peak pressure is 1 µPa^2-s is not. NMFS applies the more conservative of these two. Table A-1 lists the thresholds for explosives.

Table 4-1. Explosive Source Thresholds

Threshold Type (Explosives)	Threshold Level
Level A – 50% Eardrum rupture (peak one-third octave energy)	205 dB
Temporary Threshold Shift (TTS) (peak one-third octave energy)	182 dB
Temporary Threshold Shift (TTS) (peak pressure)	23 psi
Level A – Slight lung injury (positive impulse)	13 psi-ms
Fatality – 1% Mortal lung injury (positive impulse)	31 psi-ms

For non-explosive sound sources, Level B Harassment includes behavioral modifications resulting from repeated noise exposures (below TTS) to the same animals over a relatively short period of time. Cetaceans exposed to ELs of 195 dB re 1 µPa^2-s up to 215 dB re 1 µPa^2-s are assumed to experience TTS. At 215 dB re 1 µPa^2-s, cetaceans are assumed to experience PTS. Unlike cetaceans, the TTS and PTS thresholds used for pinnipeds vary with species. Otariids have thresholds of 206 dB re 1 µPa^2-s for TTS and 226 dB re 1 µPa^2-s for PTS. Northern elephant seals are similar to otariids (TTS = 204 dB re 1 µPa^2-s, PTS = 224 dB re 1 µPa^2-s) but are lower for harbor seals (TTS = 183 dB re 1 µPa^2-s, PTS = 203 dB re 1 µPa^2-s).

A certain proportion of marine mammals are expected to experience behavioral disturbance at different received sound pressure levels and are counted as Level B harassment exposures. The details of this “sub-TTS” theory and calculation are described in the Dose Response section. Table 4-2 lists the thresholds for sonar.

Table 4-2. Sonar Source Thresholds For Cetaceans and Pinnipeds

Physiological Effects			
Animal	**Criteria**	**Threshold (re 1µPa^2-s)**	**MMPA Effect**
Cetacean	TTS PTS	195 215	Level B Harassment Level A Harassment
Pinnipeds			
Northern Elephant Seal	TTS PTS	204 224	Level B Harassment Level A Harassment
Pacific Harbor Seal	TTS PTS	183 203	Level B Harassment Level A Harassment
California Sea Lion	TTS PTS	206 226	Level B Harassment Level A Harassment
Guadalupe Fur Seal	TTS PTS	226 206	Level B Harassment Level A Harassment
Northern Fur Seal	TTS PTS	206 226	Level B Harassment Level A Harassment

The sound sources will be located in an area that is inhabited by species listed as threatened or endangered under the Endangered Species Act (ESA, 16 USC §§ 1531-1543). Operation of the sound sources, that is, transmission of acoustic signals in the water column, could potentially cause harm or harassment to listed species.

"Harm" defined under ESA regulations is "…an act which actually kills or injures…" (50 CFR 222.102) listed species. "Harassment" is an "intentional or negligent act or omission which creates the likelihood of injury to wildlife by annoying it to such an extent as to significantly disrupt normal behavioral patterns which include, but are not limited to, breeding, feeding, or sheltering" (50 CFR 17.3).

Level A harassment criteria and thresholds under MMPA are appropriate to apply as "harm" criteria and thresholds under ESA. Analysis that predicts Level A harassment under MMPA will occur as a result of the proposed action would correspond to harm to listed species under ESA. Level B harassment criteria and thresholds under MMPA are appropriate to apply as harassment criteria and thresholds under ESA.

If a federal agency determines that its proposed action "may affect" a listed species, it is required to consult, either formally or informally, with the appropriate regulator. There is no permit issuance under ESA, rather consultation among the cognizant federal agencies under § 7 of the ESA. Such consultations would likely be concluded favorably, subject to requirements that the activity will not appreciably reduce the likelihood of the species' survival and recovery and impacts are minimized and mitigated. The Navy will initiate formal interagency consultation by submitting a Biological Assessment to NMFS, detailing the proposed action's potential effects on listed species and their designated critical habitats. Consultation would conclude with NMFS' issuance of a Biological Opinion that addresses the issues of whether the project can be expected to jeopardize the continued existence of listed species or result in the destruction or adverse modification of critical habitat.

4.1 ACOUSTIC SOURCES

The Southern California (SOCAL) acoustic sources are categorized as either broadband (producing sound over a wide frequency band) or narrowband (producing sound over a frequency band that that is small in comparison to the center frequency). In general, the narrowband sources in this exercise are ASW sonars and the broadband sources are explosives. This delineation of source types has a couple of implications. First, the transmission loss used to determine the impact ranges of narrowband ASW sonars can be adequately characterized by model estimates at a single frequency. Broadband explosives, on the other hand, produce significant acoustic energy across several frequency decades of bandwidth. Propagation loss is sufficiently sensitive to frequency as to require model estimates at several frequencies over such a wide band.

Second, the types of sources have different sets of harassment metrics and thresholds. Energy metrics are defined for both types. However, explosives are impulsive sources that produce a shock wave that dictates additional pressure-related metrics (peak pressure and positive impulse). Detailed descriptions of both types of sources are provided in the following subsections.

4.1.1 Sonars

To estimate impacts from mid- and high-frequency sonar, five types of narrowband sonars representative of those used in operations in the SOCAL Range Complex were modeled. Exposure estimates are calculated for each sonar according to the manner in which it operates. For example, the SQS-53C is a hull-mounted, surface ship sonar that operates for many hours at a time, so it is most useful to calculate and report SQS-53C exposures per hour of operation. The SQS-56C is a hull-mounted, surface ship sonar (not as powerfull as the SQS-53C) that operates for many hours at a time, so it is most useful to calculate and report SQS-56C exposures per hour of operation. The AQS-22 is a helicopter-deployed sonar, which is lowered into the water, pings a number of times, and then moves to a new location. For the AQS-22, it is most helpful to calculate and report exposures per dip. Table 4-3 presents the deploying platform, frequency class, and the reporting metric for each sonar.

Table 4-3. Active Sonars Employed in SOCAL Range

Sonar	Description	Frequency Class	Exposures Reported
MK-48	Torpedo sonar	High frequency	Per torpedo
AN/SQS-53C	Surface ship sonar	Mid-frequency	Per hour
AN/SQS-56C	Surface ship sonar	Mid-frequency	Per hour
AN/SSQ-62	Sonobuoy sonar	Mid-frequency	Per sonobuoy
AN/AQS-22	Helicopter-dipping sonar	Mid-frequency	Per dip

Note that MK-48 source described here is the active pinger on the torpedo; the explosive source of the detonating torpedo is described in the next subsection.

The acoustic modeling that is necessary to support the exposure estimates for each of these sonars relies upon a generalized description of the manner of the sonar's operating modes. This description includes the following:

- "Effective" energy source level – The total energy across the band of the source, scaled by the pulse length (10 $\log_{10}$ [pulse length]), and corrected for source beam width so that it reflects the energy in the direction of the main lobe. The beam pattern correction consists of two terms:
  - Horizontal directivity correction: 10 $\log_{10}$ (360 / horizontal beam width)
  - Vertical directivity correction: 10 $\log_{10}$ (2 / [sin(θ_1) – sin(θ_2)]), where θ_1 and θ_2 are the 3-dB down points on the main lobe.
- Source depth – Depth of the source in meters.
- Nominal frequency – Typically the center band of the source emission. These are frequencies that have been reported in open literature and are used to avoid classification issues. Differences between these nominal values and actual source frequencies are small enough to be of little consequence to the output impact volumes.
- Source directivity – The source beam is modeled as the product of a horizontal beam pattern and a vertical beam pattern. Two parameters define the horizontal beam pattern:
  - Horizontal beam width – Width of the source beam (degrees) in the horizontal plane (assumed constant for all horizontal steer directions).
  - Horizontal steer direction – Direction in the horizontal in which the beam is steered relative to the direction in which the platform is heading

  The horizontal beam is rectangular with constant response across the width of the beam and with flat, 20-dB down sidelobes. (Note that steer directions ϕ, $-\phi$, $180^o - \phi$, and $180^o + \phi$ all produce equal impact volumes.)

  Similarly, two parameters define the vertical beam pattern:
  - Vertical beam width – Width of the source beam (degrees) in the vertical plane measured at the 3-dB down point. (The width is that of the beam steered towards broadside and not the width of the beam at the specified vertical steer direction.)
  - Vertical steer direction – Direction in the vertical plane that the beam is steered relative to the horizontal (upward looking angles are positive).

  To avoid sharp transitions that a rectangular beam might introduce, the power response at vertical angle θ is

  $$\max \{ \sin^2 [n(\theta_s - \theta)] / [n \sin (\theta_s - \theta)]^2, \ 0.01 \}$$

  where $n = 180^o / \theta_w$ is the number of half-wavelength-spaced elements in a line array that produces a main lobe with a beam width of θ_w. θ_s is the vertical beam steer direction.
- Ping spacing – Distance between pings. For most sources this is generally just the product of the speed of advance of the platform and the repetition rate of the sonar. Animal motion is generally of no consequence as long as the source motion is greater than the speed of the animal (nominally, three knots). For stationary (or nearly stationary) sources, the "average" speed of the animal is used in place of the platform speed. The attendant assumption is that the animals are all moving in the same constant direction.

These parameters are defined for each of the active sonars (including two operating modes for the 53C) in Table 4-4.

Table 4-4. Source Description of SOCAL Mid- and High-Frequency Active Sonars

Sonar	Source Depth	Center Freq	Source Level	Emission Spacing	Vertical Directivity	Horizontal Directivity
MK-48	27 m	20 kHz	230 dB	144 m	Omni	Omni
AN/SQS-53C Search Mode	7 m	3.5 kHz	235 dB	154 m	Omni	240^{o} Forward-looking
AN/SQS-53C Kingfisher Mode	7 m	3.5 kHz	236 dB	4.6 m	20^{o} Width 42^{o} D/E	120^{o} Forward-looking
SQS-56C	27 m	6.8 to 8.2 kHz	225 dB	128.6 m	13^{o}	30^{o}
AN/SSQ-62	27 m	8 kHz	201 dB	450 m	Omni	Omni
AN/AQS-22	27 m	4.1 kHz	217 dB	15 m	Omni	Omni

4.1.2 Explosives

Explosives detonated underwater introduce loud, impulsive, broadband sounds into the marine environment. Three source parameters influence the effect of an explosive: the weight of the explosive warhead, the type of explosive material, and the detonation depth. The net explosive weight (or NEW) accounts for the first two parameters. The NEW of an explosive is the weight of only the explosive material in a given round, referenced to the explosive power of TNT.

The detonation depth of an explosive is particularly important due to a propagation effect known as surface-image interference increasingly. For sources located near the sea surface, a distinct interference pattern arises from the coherent sum of the two paths that differ only by a single reflection from the pressure-release surface. As the source depth and/or the source frequency decreases, these two paths increasingly, destructively interfere with each other, reaching total cancellation at the surface (barring surface-reflection scattering loss). For the SOCAL Range there are two types of explosive sources: demolition charges and munitions (Mk-48 torpedo, Maverick and Harpoon missiles, Mk-82 and Mk-83 bombs, 5” rounds and 76 mm rounds). Demolition charges are typically modeled as detonating near the middle of the water column. The Mk-48 detonates immediately below the hull of its target (nominally 50 feet). A source depth of two meters is used for bombs and missiles that do not strike their target. For the gunnery rounds, a source depth of one foot is used. The NEW for these sources are as follows:

- Demolition charge – 20 pounds,
- Mk-48 – 851 pounds,
- Maverick – 78.5 pounds,
- Harpoon – 448 pounds,
- Mk-82 – 238 pounds,
- Mk-83 – 574 pounds,
- 5” rounds – 9.54 pounds, and
- 76 mm rounds – 1.6 pounds.

The exposures expected to result from these sources are computed on a per in-water explosive basis. The cumulative effect of a series of explosives can often be derived by simple addition if the detonations are spaced widely in time or space, allowing for sufficient animal movements as to ensure a different population of animals is considered for each detonation.

The cases in which simple addition of the exposures estimates may not be appropriate are addressed by the modeling of a "representative" sinking exercise (SINKEX). In a SINKEX, a decommissioned surface ship is towed to a specified deep-water location and there used as a target for a variety of weapons. Although no two SINKEXs are ever the same, a representative case derived from past exercises is described in the *Programmatic SINKEX Overseas Environmental Assessment (March 2006)* for the Western North Atlantic.

In a SINKEX, weapons are typically fired in order of decreasing range from the source with weapons fired until the target is sunk. A torpedo is used after all munitions have been expended if the target is still afloat. Since the target may sink at any time during the exercise, the actual number of weapons used can vary widely. In the representative case, however, all of the ordnances are assumed expended; this represents the worst case of maximum exposure.

The sequence of weapons firing for the representative SINKEX is described in Table 4-5. Guided weapons are nearly 100% accurate and are modeled as hitting the target (that is, no underwater acoustic effect) in all but two cases: (1) the Maverick is modeled as a miss to represent the occasional miss, and (2) the MK-48 torpedo intentionally detonates in the water column immediately below the hull of the target. Unguided weapons are more frequently off-target and are modeled according to the statistical hit/miss ratios. Note that these hit/miss ratios are artificially low in order to demonstrate a worst-case scenario; they should not be taken as indicative of weapon or platform reliability.

Table 4-5. Representative SINKEX Weapons Firing Sequence

Time (Local)	Event Description
0900	Range Control Officer receives reports that the exercise area is clear of non-participant ship traffic, marine mammals, and sea turtles.
0909	Hellfire missile fired, hits target.
0915	2 HARM missiles fired, both hit target (5 minutes apart).
0930	1 Penguin missile fired, hits target.
0940	3 Maverick missiles fired, 2 hit target, 1 misses (5 minutes apart).
1145	1 SM-1 fired, hits target.
1147	1 SM-2 fired, hits target.
1205	5 Harpoon missiles fired, all hit target (1 minute apart).
1300-1335	7 live and 3 inert MK 82 bombs dropped – 7 hit target, 2 live and 1 inert miss target (4 minutes apart).
1355-1410	4 MK 83 bombs dropped – 3 hit target, 1 misses target (5 minutes apart).
1500	Surface gunfire commences – 400 5-inch rounds fired (one every 6 seconds), 280 hit target, 120 miss target.
1700	MK 48 Torpedo fired, hits, and sinks target.

4.2 ENVIRONMENTAL PROVINCES

Propagation loss ultimately determines the extent of the Zone of Influence (ZOI) for a particular source activity. In turn, propagation loss as a function of range responds to a number of environmental parameters:

- water depth
- sound speed variability throughout the water column
- bottom geo-acoustic properties, and
- wind speed

Due to the importance that propagation loss plays in Anti-Submarine Warfare (ASW), the Navy has over the last four to five decades invested heavily in measuring and modeling these environmental parameters. The result of this effort is the following collection of global databases of these environmental parameters, most of which are accepted as standards for all Navy modeling efforts.

- Water depth – Digital Bathymetry Data Base Variable Resolution (DBDBV)
- Sound speed – Generalized Digital Environmental Model (GDEM)
- Bottom loss – Low-Frequency Bottom Loss (LFBL), Sediment Thickness Database, and High-Frequency Bottom Loss (HFBL), and
- Wind speed – U.S. Navy Marine Climatic Atlas of the World

This section provides a discussion of the relative impact of these various environmental parameters. These examples then are used as guidance for determining environmental provinces (that is, regions in which the environmental parameters are relatively homogenous and can be represented by a single set of environmental parameters) within the SOCAL Range.

4.2.1 Impact of Environmental Parameters

Within a typical operating area, the environmental parameter that tends to vary the most is bathymetry. It is not unusual for water depths to vary by an order of magnitude or more, resulting in significant impacts upon the Zone of Influence (ZOI) calculations. Bottom loss can also vary considerably over typical operating areas but its impact upon ZOI calculations tends to be limited to waters on the continental shelf and the upper portion of the slope. Generally, the primary propagation paths in deep water, from the source to most of the ZOI volume, do not involve any interaction with bottom. In shallow water, particularly if the sound velocity profile directs all propagation paths to interact with the bottom, bottom loss variability can play a larger role.

The spatial variability of the sound speed field is generally small over operating areas of typical size. The presence of a strong oceanographic front is a noteworthy exception to this rule. To a lesser extent, variability in the depth and strength of a surface duct can be of some importance. In the mid-latitudes, seasonal variation often provides the most significant variation in the sound speed field. For this reason, both summer and winter profiles are modeled for each selected environment.

4.2.2 Environmental Provincing Methodology

The underwater acoustic environment can be quite variable over ranges in excess of ten kilometers. For ASW applications, ranges of interest are often sufficiently large as to warrant the modeling of the spatial variability of the environment. In the propagation loss calculations, each of the environmental parameters is allowed to vary (either continuously or discretely) along the path from acoustic source to receiver. In such applications, each propagation loss calculation is conditioned upon the particular locations of the source and receiver.

On the other hand, the range of interest for marine animal harassment by most Naval activities is more limited. This reduces the importance of the exact location of source and marine animal and makes the modeling required more manageable in scope.

In lieu of trying to model every environmental profile that can be encountered in an operating area, this effort utilizes a limited set of representative environments. Each environment is characterized by a fixed water depth, sound velocity profile, and bottom loss type. The operating area is then partitioned into homogeneous regions (or provinces) and the most appropriately representative environment is assigned to each. This process is aided by some initial provincing of the individual environmental parameters. The Navy-standard high-frequency bottom loss database in its native form is globally partitioned into nine classes. Low-frequency bottom loss is likewise provinced in its native form, although it is not considered in the process of selecting environmental provinces. Only the broadband sources produce acoustic energy at the frequencies of interest for low-frequency bottom loss (typically less than 1 kHz); even for those sources the low-frequency acoustic energy is secondary to the energy above 1 kHz. The Navy-standard sound velocity profiles database is also available as a provinced subset. Only the Navy-standard bathymetry database varies continuously over the world's oceans. However, even this environmental parameter is easily provinced by selecting a finite set of water depth intervals. For this analysis "octave-spaced" intervals (10, 20, 50, 100, 200, 500, 1000, 2000, and 5000 m) provide an adequate sampling of water depth dependence.

Zone of influence volumes are then computed using propagation loss estimates derived for the representative environments. Finally, a weighted average of the ZOI volumes is taken over all representative environments; the weighting factor is proportional to the geographic area spanned by the environmental province.

The selection of representative environments is subjective. However, the uncertainty introduced by this subjectivity can be mitigated by selecting more environments and by selecting the environments that occur most frequently over the operating area of interest.

As discussed in the previous subsection, ZOI estimates are most sensitive to water depth. Unless otherwise warranted, at least one representative environment is selected in each bathymetry province. Within a bathymetry province, additional representative environments are selected as needed to meet the following requirements.

- In shallow water (less than 1,000 meters), bottom interactions occur at shorter ranges and more frequently; thus significant variations in bottom loss need to be represented.
- Surface ducts provide an efficient propagation channel that can greatly influence ZOI estimates. Variations in the mixed layer depth need to be accounted for if the water is deep enough to support the full extent of the surface duct.

Depending upon the size and complexity of the operating area, the number of environmental problems tends to range for 5 - 20.

4.2.3 Description of Environmental Provinces

The SOCAL Range is located in an area south of 34^{o} N, off the west coast of the US and Mexico. The range encompasses most of Warning Area W-291 and additional near-coastal areas to the north. For this analysis, eight areas within this range have been identified as representative. Seven of these areas are quasi-rectangular regions as described below and depicted in Figure 4-1.

- Area 1: Immediately east of San Nicolas Island; boundary vertices are

- 119º 6' W 33º 40' N
- 118º 51' W 33º 29' N
- 119º 10' W 33º 3' N
- 119º 25' W 33º 14' N

- Area 2: Between San Clemente and Santa Catalina Islands; boundary vertices are:
  - 118º 40' W 33º 29' N
  - 118º 4' W 32º 2' N
  - 118º 15' W 32º 48' N
  - 118º 51' W 33º 15' N
- Area 3: Off-shore area immediately west of MCB Camp Pendleton; boundary vertices are:
  - 117º 44' W 33º 29' N
  - 117º 19' W 33º 4' N
  - 117º 31' W 32º 52' N
  - 117º 56' W 33º 17' N

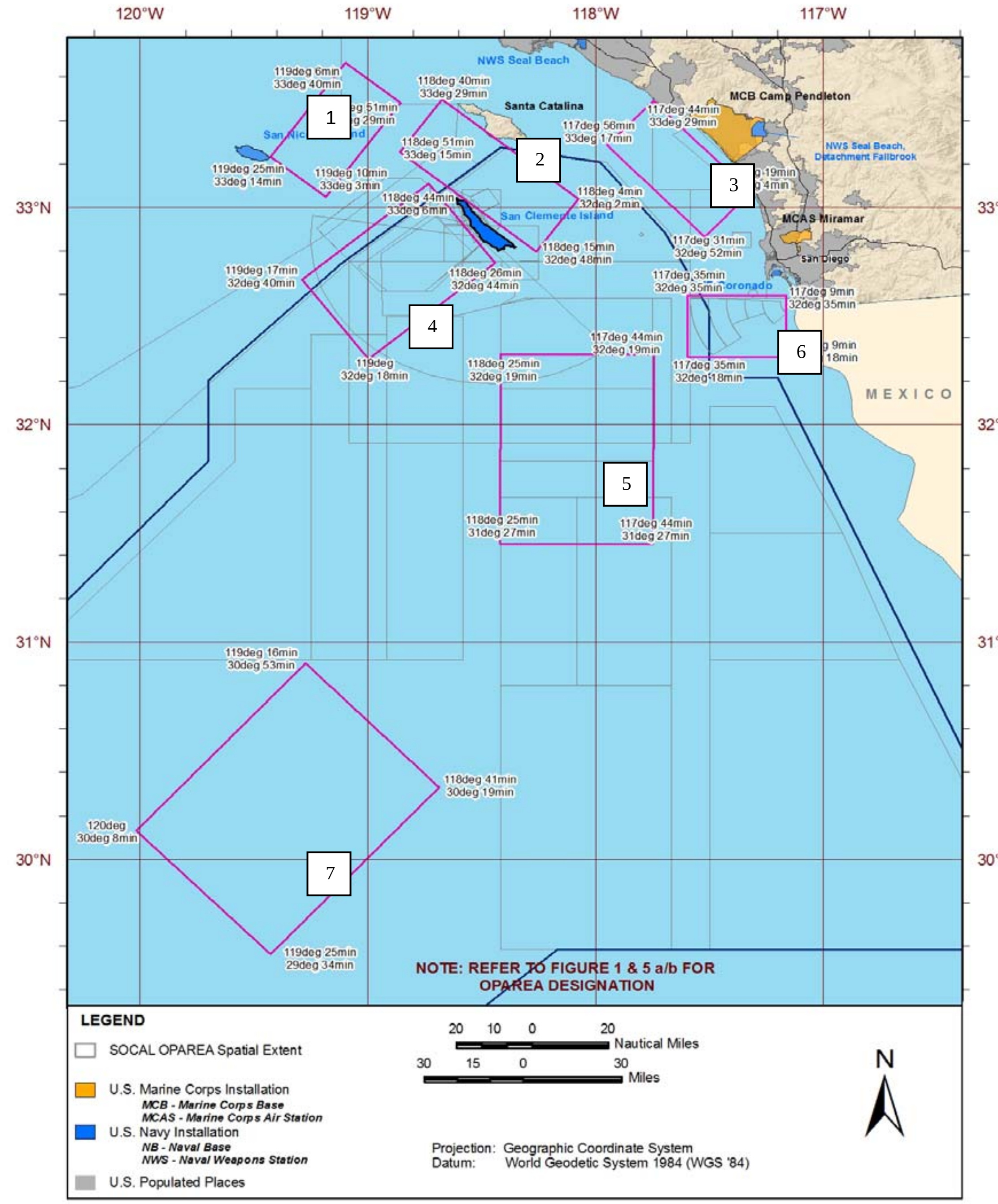


Figure 4-1. Representative Areas in SOCAL Range

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Area 4: Area immediately south and west of San Clemente Island; boundary vertices are:

- 118^o 44' W 33^o 6' N
- 118^o 26' W 32^o 44' N
- 119^o W 32^o 18' N
- 119^o 17' W 32^o 40' N

- Area 5: Area 25 n.m. south and east of San Clemente Island; boundary vertices are:
  - 118^o 25' W 32^o 19' N
  - 117^o 44' W 32^o 19' N
  - 117^o 44' W 31^o 27' N
  - 118^o 25' W 31^o 27' N
- Area 6: Off-shore area immediately west of NB Coronado; boundary vertices are:
  - 117^o 35' W 32^o 35' N
  - 117^o 9' W 32^o 35' N
  - 117^o 9' W 32^o 18' N
  - 117^o 35' W 32^o 18' N
- Area 7: Deep-water area near the middle of W-291; boundary vertices are:
  - 119^o 16' W 30^o 53' N
  - 118^o 41' W 30^o 19' N
  - 119^o 25' W 29^o 34' N
  - 120^o W 30^o 8' N

The final region, Area 8, includes all areas outside the previous seven areas that are within the quasi-rectangular region bounded in latitude by 29^o N and 34^o N, and in longitude by 120^o 30' W and 116^o 30' W.

The acoustic sonars described in subsection 4.2 are, for the most part, deployed throughout all eight areas. The lone exception is Area 6 which is restricted to only the helicopter dipping sonar The explosive sources, other than demolition charges, are primarily limited by the SINKEX restrictions (at least 50 n.m. from land in water depths greater than 1000 fathoms) to the southern portion of Area 5, all of Area 7, and parts of Area 8. The use of demolition charges is limited to the north shore of SCI (Northwest Harbor).

This subsection describes the representative environmental provinces selected for the SOCAL Range. For all of these provinces, the average wind speed, winter and summer, is 11 knots.

The SOCAL Range contains a total of 13 distinct environmental provinces. These represent various combinations of nine bathymetry provinces, one Sound Velocity Profile (SVP) province, and three High-Frequency Bottom Loss (HFBL) classes.

The bathymetry provinces represent depths ranging from 10 meters to typical deep-water depths (slightly more than 5,000 meters). Nearly half of the range is characterized as deep-water (depths of 2,000 meters or more). The second most prevalent water depth regime, covering more than 40% of the range, is representative of waters along the continental slope. The remaining water depths (200 meters and less) provide only small contributions (less than 10%) to the analysis. The distribution of the bathymetry provinces over the SOCAL Range is provided in Table 4-6.

Table 4-6. Distribution of Bathymetry Provinces in SOCAL Range

Province Depth (m)	Frequency of Occurrence
10	Demolition Charges Only
20	0.33 %
50	1.17 %
100	1.74 %
200	3.28 %
500	9.92 %
1000	33.66 %
2000	17.03 %
5000	32.54 %

A single SVP province (45) describes the entire SOCAL Range. The seasonal variation is likewise of limited dynamic range, as might be expect given that the range is located in temperate waters. The surface sound speed of the winter profile is about ten m/s slower than the summer profile as depicted in Figure 4-2. Both seasons exhibit a shallow and relatively weak surface duct.

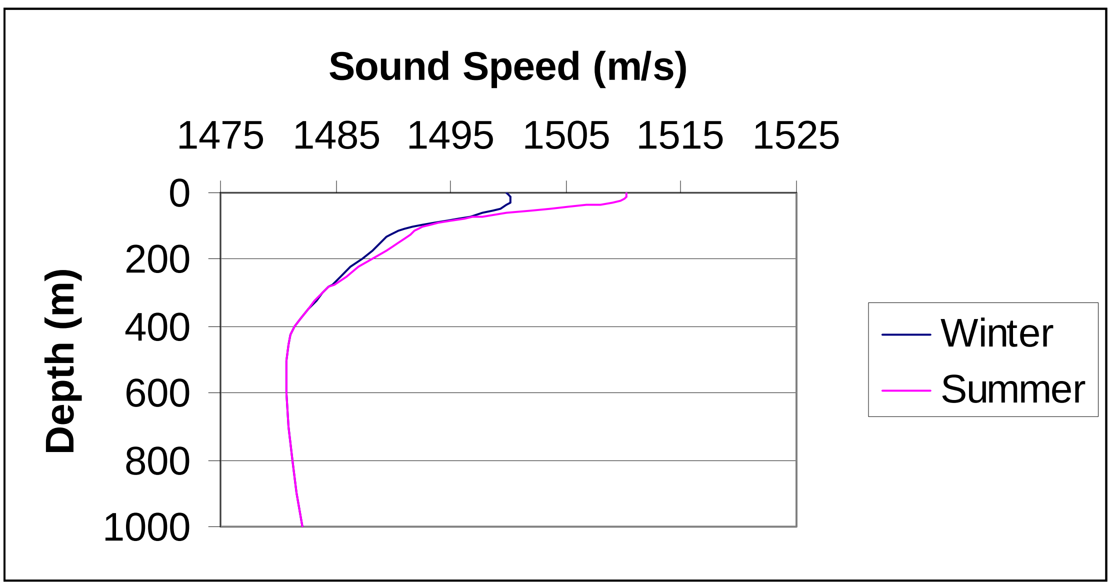


Figure 4-2. Winter and Summer SVPs in SOCAL Range

The three HFBL classes represented in the SOCAL Range are either low-loss bottoms (class 2, typically in shallow water) or high-loss bottoms (classes 7 or 8, predominately in intermediate to deep water). This partitioning by water depth leads to a distribution that is more than 90 % high-loss bottoms as indicated in Table 4-7.

Table 4-7. Distribution of High-Frequency Bottom Loss Classes in SOCAL Range

HFBL Class	Frequency of Occurrence
2	6.22 %
7	16.65 %
8	77.13 %

The logic for consolidating the environmental provinces focuses upon water depth, using the sound speed profile (in deep water) and the HFBL class (in shallow water) as secondary differentiating factors. The first consideration was to ensure that all six bathymetry provinces are represented. Then within each bathymetry province further partitioning of provinces proceeded as follows:

- The three shallowest bathymetry provinces are each represented by one environmental province. In each case, the bathymetry province is dominated (in some cases almost exclusively) by a single HFBL class, so that the secondary differentiating environmental parameter is of no consequence.
- The 100-, 200-, and 500-meter bathymetry provinces each have two environmental provinces, differing in HFBL class only (one has a low-loss bottom, the other a high-loss bottom). Since the frequency of occurrence of the secondary province is not overwhelmed by the dominant province, both are included in the analysis to ensure thoroughness.
- The 1000- and 2000-meter bathymetry provinces each contain two environmental provinces that feature different HFBL classes. However, in both cases the dominant province in the pair occurs more than a hundred times more frequently rendering the secondary province of no consequence in this analysis.
- The 5000-meter bathymetry province consists of three environmental provinces that differ only in HFBL class. One of the three provinces occurs so infrequently in comparison to the other two that it is excluded from this analysis.

The resulting thirteen environmental provinces used in the SOCAL Range acoustic modeling are described in Table 4-8.

Table 4-8. Distribution of Environmental Provinces in SOCAL Range

Environmental Province	Water Depth	SVP Province	HFBL Class	LFBL Province	Sediment Thickness	Frequency of Occurrence
1	20 m	45	2	0	0.2 secs	0.44 %
2	50 m	45	2	0	0.2 secs	1.05 %
3	100 m	45	2	0	0.2 secs	1.13 %
4	200 m	45	2	0	0.2 secs	0.90 %
5	200 m	45	8	– 49*	0.2 secs	0.66 %
6	500 m	45	2	0	0.2 secs	1.02 %
7	500 m	45	8	– 49*	0.2 secs	6.06 %
8	1000 m	45	8	– 49*	0.2 secs	22.34 %
9	2000 m	45	8	13	0.18 secs	27.58 %
10	5000 m	45	7	13	0.11 secs	24.40 %
11	5000 m	45	8	13	0.11 secs	13.66 %
12	100 m	45	8	– 49*	0.2 secs	0.36 %
13	10 m	45	2	0	0.2 secs	Demolition Charges Only

* Negative province numbers indicate shallow water provinces

The percentages given in the preceding table indicate the frequency of occurrence of each environmental province across all eight areas in the SOCAL Range as described in Figure 4-1. The distribution of the environments within each of the eight individual areas in provided in Table 4-9.

Table 4-9. Distribution of Environmental Provinces within SOCAL Areas

Environmental Province	Area 1	Area 2	Area 3	Area 4	Area 5	Area 6	Area 7	Area 8
1	1.33%	1.00%	0.00%	0.09%	0.00%	7.44%	0.00%	0.45%
2	3.55%	2.19%	0.84%	1.54%	0.00%	7.89%	0.00%	1.05%
3	0.00%	0.66%	2.95%	1.30%	0.00%	4.57%	0.00%	1.13%
4	0.00%	0.80%	4.70%	5.37%	0.00%	4.49%	0.00%	0.90%
5	14.58%	2.73%	1.15%	4.71%	0.18%	1.07%	0.00%	0.66%
6	0.00%	2.69%	10.06%	5.10%	0.00%	2.27%	0.00%	1.02%
7	31.20%	10.87%	43.13%	13.20%	3.53%	15.44%	0.00%	6.06%
8	37.23%	54.90%	36.69%	51.81%	43.57%	48.97%	0.00%	22.34%
9	6.45%	21.64%	0.00%	12.62%	52.72%	7.86%	6.82%	27.58%
10	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	47.68%	24.40%
11	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	45.50%	13.66%
12	5.66%	2.52%	0.48%	4.26%	0.00%	0.00%	0.00%	0.36%
13	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.39%

Finally, the SINKEX areas are limited to regions that are more than 50 n.m. from land and deeper than 1000 fathoms. This includes part of Area 5, all of Area 7 and part of Area 8. The distribution of environmental provinces in these three areas is provided in Table 4-10.

Table 4-10. Distribution of Environmental Provinces within SINKEX Areas

Environmental Province	Area 5	Area 7	Area 8	All Areas
9	100.00 %	6.82 %	29.74 %	26.53 %
10	0.00 %	47.68 %	42.17 %	43.10 %
11	0.00 %	45.50 %	28.09 %	30.37 %

4.3 IMPACT VOLUMES AND IMPACT RANGES

Many naval actions include the potential to injure or harass marine animals in the neighboring waters through noise emissions. The number of animals exposed to potential harassment in any such action is dictated by the propagation field and the characteristics of the noise source.

The impact volume associated with a particular activity is defined as the volume of water in which some acoustic metric exceeds a specified threshold. The product of this impact volume with a volumetric animal density yields the expected value of the number of animals exposed to that acoustic metric at a level that exceeds the threshold. The acoustic metric can either be an energy term (energy flux density, either in a limited frequency band or across the full band) or a pressure term (such as peak pressure or positive impulse). The thresholds associated with each of these metrics define the levels at which half of the animals exposed will experience some degree of harassment (ranging from behavioral change to mortality).

Impact volume is particularly relevant when trying to estimate the effect of repeated source emissions separated in either time or space. Impact range, which is defined as the maximum range at which a particular threshold is exceeded for a single source emission, defines the range to which marine mammal activity is monitored in order to meet mitigation requirements.

With the exception of explosive sources, the sole relevant measure of potential harm to the marine wildlife due to sonar operations is the accumulated (summed over all source emissions) energy flux density received by the animal over the duration of the activity. Harassment measures for explosive sources include energy flux density and pressure-related metrics (peak pressure and positive impulse).

Regardless of the type of source, estimating the number of animals that may be injured or otherwise harassed in a particular environment entails the following steps.

- Each source emission is modeled according to the particular operating mode of the sonar. The “effective” energy source level is computed by integrating over the bandwidth of the source, scaling by the pulse length, and adjusting for gains due to source directivity. The location of the source at the time of each emission must also be specified.
- For the relevant environmental acoustic parameters, transmission loss (TL) estimates are computed, sampling the water column over the appropriate depth and range intervals. TL data are sampled at the typical depth(s) of the source and at the nominal center frequency of the source. If the source is relatively broadband, an average over several frequency samples is required.
- The accumulated energy within the waters that the source is “operating” is sampled over a volumetric grid. At each grid point, the received energy from each source

emission is modeled as the effective energy source level reduced by the appropriate propagation loss from the location of the source at the time of the emission to that grid point and summed. For the peak pressure or positive impulse, the appropriate metric is similarly modeled for each emission. The maximum value of that metric, over all emissions, is stored at each grid point.

- The impact volume for a given threshold is estimated by summing the incremental volumes represented by each grid point for which the appropriate metric exceeds that threshold.
- Finally, the number of exposures is estimated as the “product” (scalar or vector, depending upon whether an animal density depth profile is available) of the impact volume and the animal densities.

This section describes in detail the process of computing impact volumes (that is, the first four steps described above). This discussion is presented in two parts: active sonars and explosive sources. The relevant assumptions associated with this approach and the limitations that are implied are also presented. The final step, computing the number of exposures is discussed in subsection 4.5.

4.3.1 Computing Impact Volumes for Active Sonars

This section provides a detailed description of the approach taken to compute impact volumes for active sonars. Included in this discussion are:

- Identification of the underwater propagation model used to compute transmission loss data, a listing of the source-related inputs to that model, and a description of the output parameters that are passed to the energy accumulation algorithm.
- Definitions of the parameters describing each sonar type.
- Description of the algorithms and sampling rates associated with the energy accumulation algorithm.

Transmission Loss Calculations

Transmission loss (TL) data are pre-computed for each of two seasons in each of the environmental provinces described in the previous subsection using the GRAB propagation loss model (Keenan, 2000). The TL output consists of a parametric description of each significant eigenray (or propagation path) from source to animal. The description of each eigenray includes the departure angle from the source (used to model the source vertical directivity later in this process), the propagation time from the source to the animal (used to make corrections to absorption loss for minor differences in frequency and to incorporate a surface-image interference correction at low frequencies), and the transmission loss suffered along the eigenray path.

The frequency and source depth TL inputs are specified in Table 4-11.

Table 4-11. TL Frequency and Source Depth by Sonar Type

SONAR	FREQUENCY	SOURCE DEPTH
MK-48	20 kHz	27 m
AN/SQS-53C	3.5 kHz	7 m
AN/SQS-56C	6.8 to 8.2 kHz	7 m
AN/AQS-22	4.1 kHz	27 m
AN/ASQ-62	8 kHz	27 m

The eigenray data for a single GRAB model run are sampled at uniform increments in range out to a maximum range for a specific "animal" (or "target" in GRAB terminology) depth. Multiple GRAB runs are made to sample the animal depth dependence. The depth and range sampling parameters are summarized in Table 4-12. Note that some of the low-power sources do not require TL data to large maximum ranges.

Table 4-12. TL Depth and Range Sampling Parameters by Sonar Type

SONAR	RANGE STEP	MAXIMUM RANGE	ANIMAL DEPTH
MK-48	10 m	10 km	0 – 1 km in 5 m steps 1 km – Bottom in 10 m steps
AN/SQS-53C	10 m	200 km	0 – 1 km in 5 m steps 1 km – Bottom in 10 m steps
AN/AQS-22	10 m	10 km	0 – 1 km in 5 m steps 1 km – Bottom in 10 m steps
AN/ASQ-62	5 m	5 km	0 – 1 km in 5 m steps 1 km – Bottom in 10 m steps

In a few cases, most notably the AN/SQS-53C for thresholds below approximately 180 dB, TL data may be required by the energy summation algorithm at ranges greater than covered by the pre-computed GRAB data. In these cases, TL is extrapolated to the required range using a simple cylindrical spreading loss law in addition to the appropriate absorption loss. This extrapolation leads to a conservative (or under) estimate of transmission loss at the greater ranges.

Although GRAB provides the option of including the effect of source directivity in its eigenray output, this capability is not exercised. By preserving data at the eigenray level, this allows source directivity to be applied later in the process and results in fewer TL calculations.

The other important feature that storing eigenray data supports is the ability to model the effects of surface-image interference that persist over range. However, this is primarily important at frequencies lower than those associated with the sonars considered in this subsection. A detailed description of the modeling of surface-image interference is presented in the subsection on explosive sources.

Energy Summation

The summation of energy flux density over multiple pings in a range-independent environment is a trivial exercise for the most part. A volumetric grid that covers the waters in and around the area of sonar operation is initialized. The source then begins its set of pings. For the first ping, the TL from the source to each grid point is determined (summing the appropriate eigenrays after they have been modified by the vertical beam pattern), the "effective" energy source level is reduced by that TL, and the result is added to the accumulated energy flux density at that grid point. After each grid point has been updated, the accumulated energy at grid points in each depth layer is compared to the specified threshold. If the accumulated energy exceeds that threshold, then the incremental volume represented by that grid point is added to the impact volume for that depth layer. Once all grid points have been processed, the resulting sum of the incremental volumes represents the impact volume for one ping.

The source is then moved along one of the axes in the horizontal plane by the specified ping separation range and the second ping is processed in a similar fashion. Again, once all grid points have been processed, the resulting sum of the incremental volumes represents the impact volume for two pings. This procedure continues until the maximum number of pings specified has been reached.

Defining the volumetric grid over which energy is accumulated is the trickiest aspect of this procedure. The volume must be large enough to contain all volumetric cells for which the accumulated energy is likely to exceed the threshold but not so large as to make the energy accumulation computationally unmanageable.

Determining the size of the volumetric grid begins with an iterative process to determine the lateral extent to be considered. Unless otherwise noted, throughout this process the source is treated as omni directional and the only animal depth that is considered is the TL target depth that is closest to the source depth (placing source and receiver at the same depth is generally an optimal TL geometry).

The first step is to determine the impact range (R_{MAX}) for a single ping. The impact range in this case is the maximum range at which the effective energy source level reduced by the transmission loss is greater than the threshold. Next, the source is moved along a straight-line track and energy flux density is accumulated at a point that has a CPA range of R_{MAX} at the mid-point of the source track. That total energy flux density summed over all pings is then compared to the prescribed threshold. If it is greater than the threshold (which, for the first R_{MAX}, it must be) then R_{MAX} is increased by ten percent, the accumulation process is repeated, and the total energy is again compared to the threshold. This continues until R_{MAX} grows large enough to ensure that the accumulated energy flux density at that lateral range is less than the threshold. The lateral range dimension of the volumetric grid is then set at twice R_{MAX}, with the grid centered along the source track. In the direction of advance for the source, the volumetric grid extends of the interval from [–R_{MAX}, 3 R_{MAX}] with the first source position located at zero in this dimension. Note that the source motion in this direction is limited to the interval [0, 2 R_{MAX}]. Once the source reaches 2 R_{MAX} in this direction, the incremental volume contributions have approximately reached their asymptotic limit and further pings add essentially the same amount. This geometry is demonstrated in Figure 4-3.

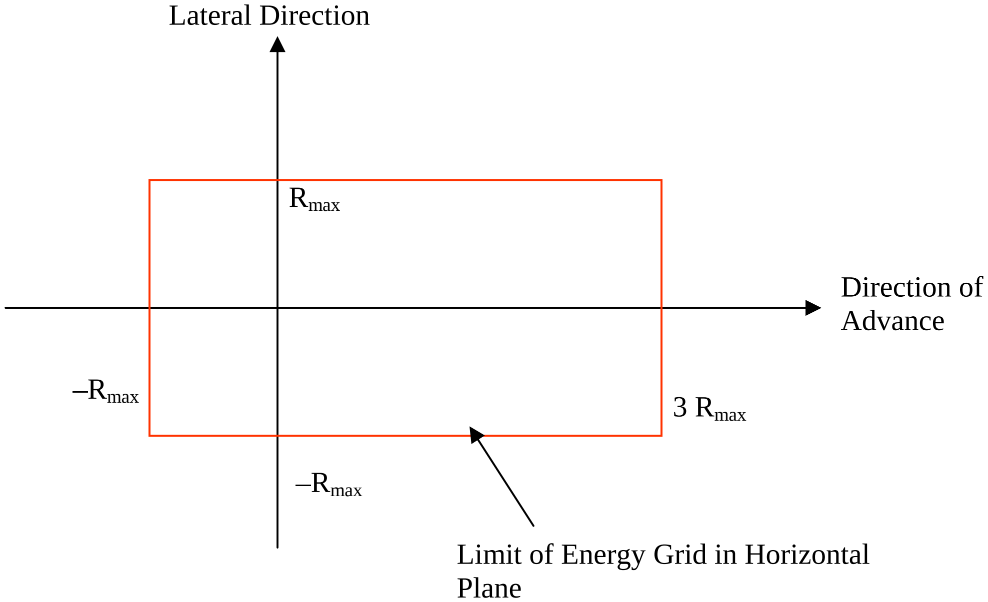


Figure 4-3. Horizontal Plane of Volumetric Grid for Omni Directional Source

If the source is directive in the horizontal plane, then the lateral dimension of the grid may be reduced and the position of the source track adjusted accordingly. For example, if the main lobe of the horizontal source beam is limited to the starboard side of the source platform, then the port side of the track is reduced substantially as demonstrated in the following figure.

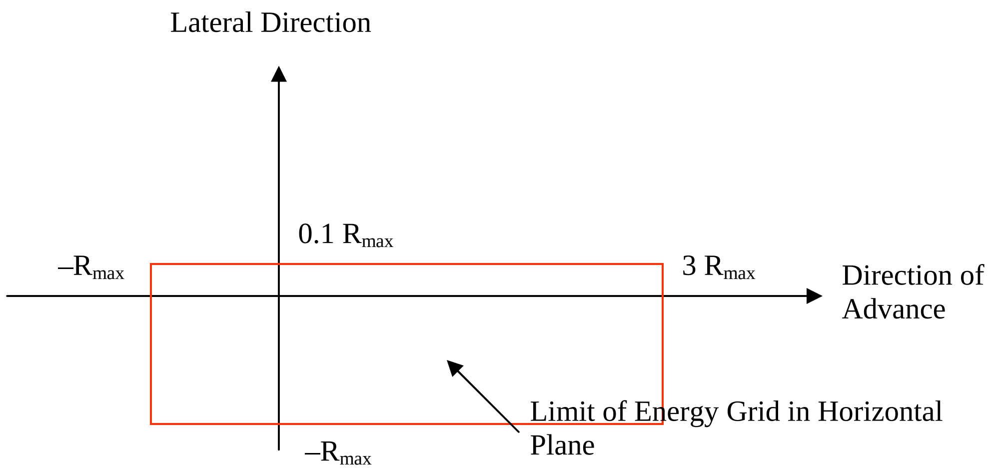


Figure 4-4. Horizontal Plane of Volumetric Grid for Starboard Beam Source

Once the extent of the grid is established, the grid sampling can be defined. In both dimensions of the horizontal plane the sampling rate is approximately $R_{MAX}/100$. The round-off error associated with this sampling rate is roughly equivalent to the error in a numerical integration to determine the area of a circle with a radius of R_{MAX} with a partitioning rate of $R_{MAX}/100$ (approximately one percent). The depth-sampling rate of the grid is comparable to the sampling rates in the horizontal plane but discretized to match an actual TL sampling depth. The depth-sampling rate is also limited to no more than ten meters to ensure that significant TL variability over depth is captured.

Impact Volume per Hour of Sonar Operation

The impact volume for a sonar moving relative to the animal population increases with each additional ping. The rate at which the impact volume increases varies with a number of parameters but eventually approaches some asymptotic limit. Beyond that point the increase in impact volume becomes essentially linear as depicted in Figure 4-5.

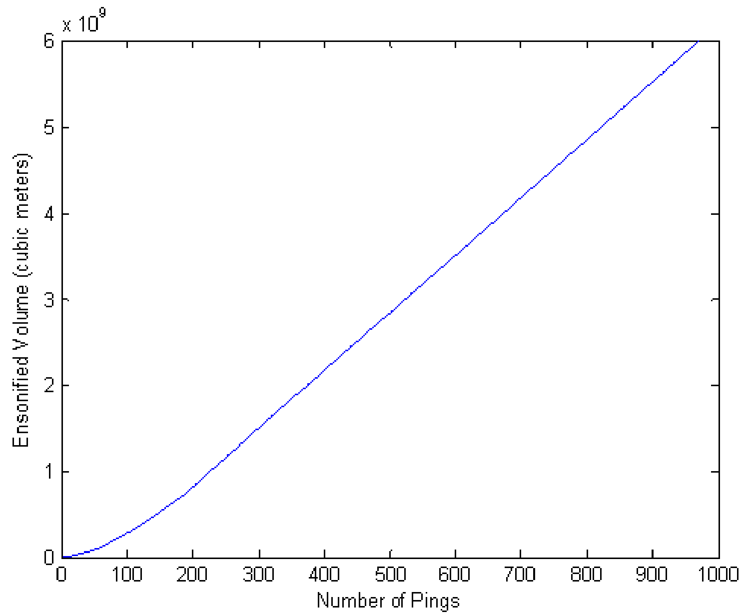


Figure 4-5. 53C Impact Volume by Ping

The slope of the asymptotic limit of the impact volume a given depth is the impact volume added per ping. This number multiplied by the number of pings in an hour gives the hourly impact volume for the given depth increment. Completing this calculation for all depths in a province, for a given source, gives the hourly impact volume vector, v_n, which contains the hourly impact volumes by depth for province n. Figure 4-6 provides an example of an hourly impact volume vector for a particular environment.

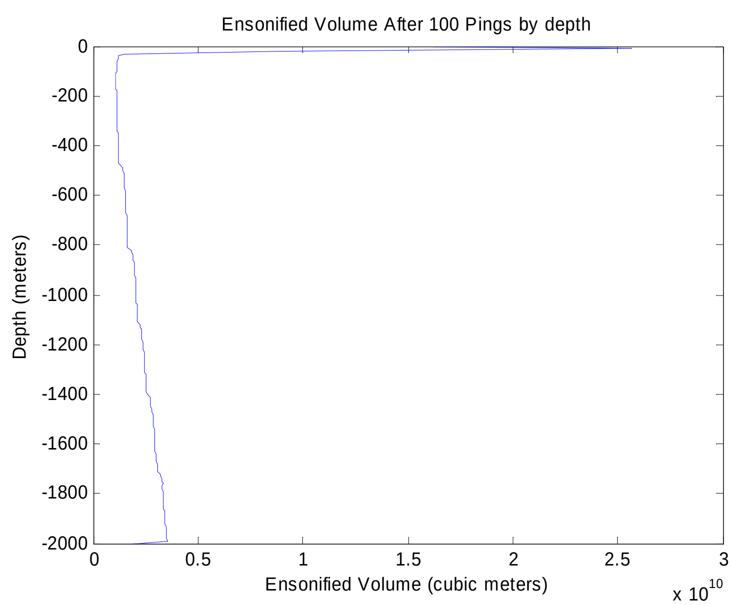


Figure 4-6. Example of an Impact Volume Vector

4.3.2 Computing Impact Volumes for Explosive Sources

This section provides the details of the modeling of the explosive sources. This energy summation algorithm is similar to that used for sonars, only differing in details such as the sampling rates and source parameters. These differences are summarized in the following subsections. A more significant difference is that the explosive sources require the modeling of additional pressure metrics: (1) peak pressure, and (2) "modified" positive impulse. The modeling of each of these metrics is described in detail in the subsections of 4.3.2.3.

4.3.2.1 Transmission Loss Calculations

Modeling impact volumes for explosive sources span requires the type of same TL data as needed for active sonars. However unlike active sonars, explosive ordnances and the EER source are very broadband, contributing significant energy from tens of Hertz to tens of kilohertz. To accommodate the broadband nature of these sources, TL data are sampled at seven frequencies from 10 Hz to 40 kHz, spaced every two octaves.

An important propagation consideration at low frequencies is the effect of surface-image interference. As either source or target approach the surface, pairs of paths that differ in history by a single surface reflection set up an interference pattern that ultimately causes the two paths to perfectly cancel each other when the source or target is at the surface. A fully coherent summation of the eigenrays produces such a result but also introduces extreme fluctuations that would have to be highly sampled in range and depth, and then smoothed to give meaningful results. An alternative approach is to implement what is sometimes called a semi-coherent summation. A semi-coherent sum attempts to capture significant effects of surface-image interference (namely the reduction of the field as the source or target approach the surface) without having to deal with the more rapid fluctuations associated with a fully coherent sum. The semi-coherent sum is formed by a random phase addition of paths that have already been multiplied by the expression:

$$\sin^2 [\, 4\pi\, f\, z_s\, z_a / (c^2 t)\,]$$

where f is the frequency, z_s is the source depth, z_a is the animal depth, c is the sound speed and t is the travel time from source to animal along the propagation path. For small arguments of the sine function this expression varies directly as the frequency and the two depths. It is this relationship that causes the propagation field to go to zero as the depths approach the surface or the frequency approaches zero

A final important consideration is the broadband nature of explosive sources. This is handled by sampling the TL field at a limited number of frequencies. However, the image-interference correction given above varies substantially over that frequency spacing. To avoid possible under sampling, the image-interference correction is averaged over each frequency interval.

4.3.2.2 Source Parameters

Unlike active sonars, explosive sources are defined by only two parameters: (1) net explosive weight, and (2) source detonation depth. Values for these source parameters are defined earlier in subsection 4.1.2.

The effective energy source level, which is treated as a de facto input for the other sonars, is instead modeled directly for EER and munitions. For both, the energy source level is comparable to the model used for other explosives (Arons (1954), Weston (1960), McGrath (1971), Urick (1983), Christian and Gaspin (1974). The energy source level over a one-third octave band with a center frequency of f for a source with a net explosive weight of w pounds is given by

$$\mathbf{10\ log_{10}\ (0.26\ f) + 10\ log_{10}\ (\ 2\ p_{max}^{\ 2} / [1/\theta^2 + 4\ \pi\ f^2]\ ) + 197\ \ dB}$$

where the peak pressure for the shock wave at one meter is defined as

$$\mathbf{p_{max} = 21600\ (w^{1/3} / 3.28\ )^{1.13}\ \ psi} \qquad \mathbf{(4\text{-}1)}$$

and the time constant is defined as:

$$\mathbf{\theta = [(0.058)\ (w^{1/3})\ (3.28 / w^{1/3})^{\ 0.22}\ ] / 1000\ msec} \qquad \mathbf{(4\text{-}2)}$$

In contrast to munitions that are modeled as omnidirectional sources, the EER source is a continuous line array that produces a directed source. The EER array consists of two explosive strips that are fired simultaneously from the center of the array. Each strip generates a beam pattern with the steer direction of the main lobe determined by the burn rate. The resulting response of the entire array is a bifurcated beam for frequencies above 200 Hz, while at lower frequencies the two beams tend to merge into one.

Since very short ranges are under consideration, the loss of directivity of the array needs to be accounted for in the near field of the array. This is accomplished by modeling the sound pressure level across the field as the coherent sum of contributions of infinitesimal sources along the array that are delayed according to the burn rate. For example, for frequency f the complex pressure contribution at a depth z and horizontal range x from an infinitesimal source located at a distance z' above the center of the array is

$$e^{\ i}$$

where

$$\phi = kr' + \alpha z'$$

$$\alpha = 2\pi f / c_b$$

with k the acoustic wave number, c_b the burn rate of the explosive ribbon, and r' the slant range from the infinitesimal source to the field point (x,z)

Beam patterns as function of vertical angle are then sampled at various ranges out to a maximum range that is approximately L^2 / λ. where L is the array length and λ is the wavelength. This maximum range is a rule-of-thumb estimate for the end of the near field (Bartberger, 1965). Finally, commensurate with the resolution of the TL samples, these beam patterns are averaged over octave bands.

A couple of sample beam patterns are provided in Figure 4-7 and Figure 4-8. In both cases, the beam response is sampled at various ranges from the source array to demonstrate the variability across the near field. The 80-Hz family of beam patterns presented in Figure 4-7 shows the rise of a single main lobe as range increases.

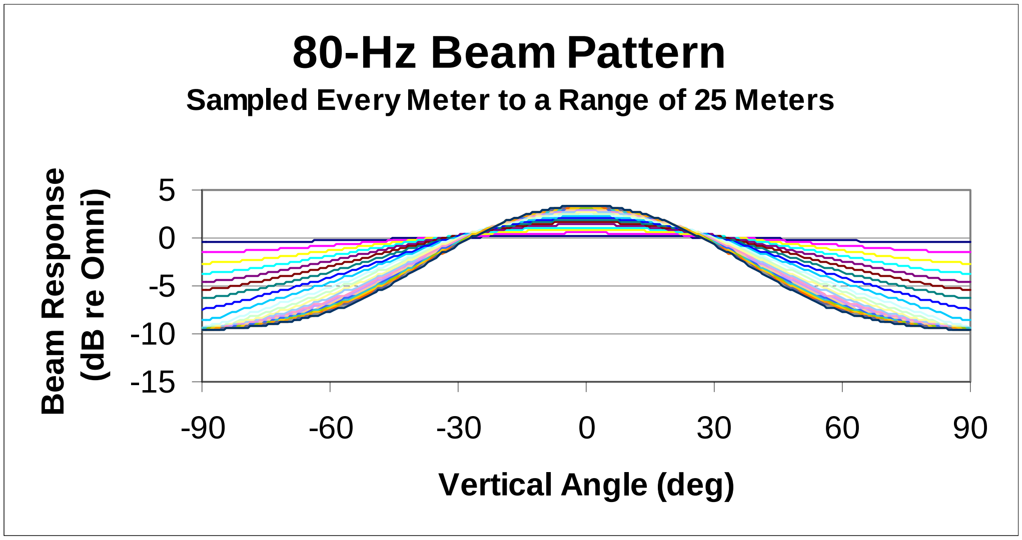


Figure 4-7. 80-Hz Beam Patterns across Near Field of EER Source

On the other hand, the 1250-Hz family of beam patterns depicted in Figure 4-8 demonstrates the typical high-frequency bifurcated beam.

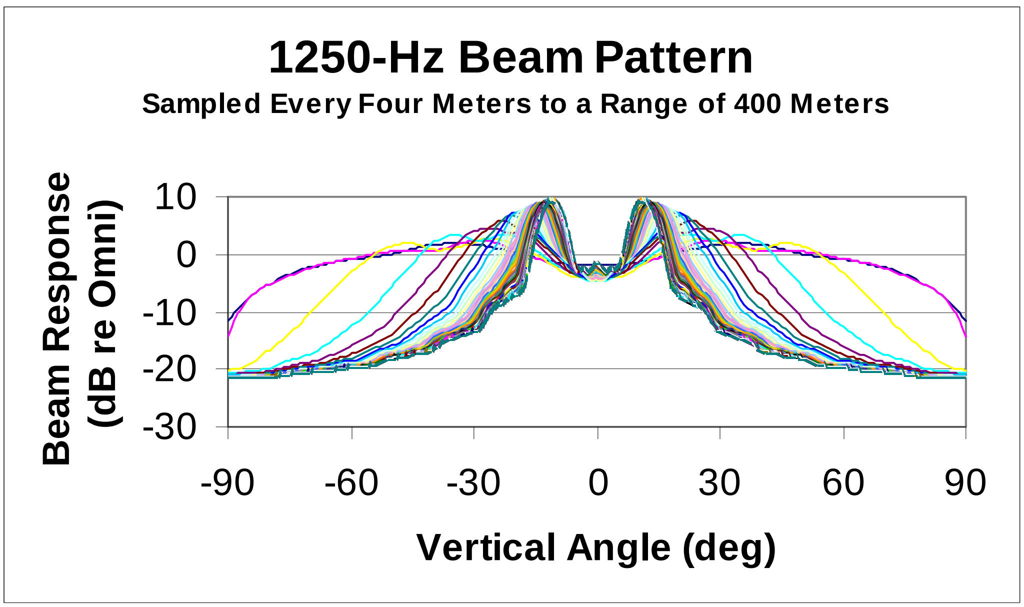


Figure 4-8. 1250-Hz Beam Patterns Across Near Field of EER Source

4.3.2.3 Impact Volumes for Various Metrics

The impact of explosive sources on marine wildlife is measured by three different metrics, each with its own thresholds. The energy metric, peak one-third octave, is treated in similar fashion as the energy metric used for the active sonars, including the summation of energy if there are multiple source emissions. The other two, peak pressure and positive impulse, are not accumulated but rather the maximum levels are taken.

4.3.2.4 Peak One-Third Octave Energy Metric

The computation of impact volumes for the energy metric follows closely the approach taken to model the energy metric for the active sonars. The only significant difference is that energy flux density is sampled at several frequencies in one-third-octave bands and only the peak one-third-octave level is accumulated.

4.3.2.5 Peak Pressure Metric

The peak pressure metric is a simple, straightforward calculation at each range/animal depth combination. First, the transmission ratio, modified by the source level in a one-octave band and the vertical beam pattern, is averaged across frequency on an eigenray-by-eigenray basis. This averaged transmission ratio (normalized by the total broadband source level) is then compared across all eigenrays with the maximum designated as the peak arrival. Peak pressure at that range/animal depth combination is then simply the product of:

- the square root of the averaged transmission ratio of the peak arrival,
- the peak pressure at a range of one meter (given by equation 4-1), and
- the similitude correction (given by $r^{-0.13}$, where r is the slant range along the eigenray estimated as tc with t the travel time along the dominant eigenray and c the nominal speed of sound).

If the peak pressure for a given grid point is greater than the specified threshold, then the incremental volume for the grid point is added to the impact volume for that depth layer.

4.3.2.6 "Modified" Positive Impulse Metric

The modeling of positive impulse follows the work of Goertner (Goertner, 1982). The Goertner model defines a "partial" impulse as

$$\int_0^{T_{min}} p(t)\,dt$$

where p(t) is the pressure wave from the explosive as a function of time t, defined so that p(t) = 0 for t < 0. This pressure wave is modeled as

$$p(t) = p_{max}\, e^{-t/\theta}$$

where p_{max} is the peak pressure at one meter (see, equation B-1), and θ is the time constant defined as

$$\theta = 0.058\, w^{1/3} (r/w^{1/3})^{0.22} \text{ seconds}$$

with w the net explosive weight (pounds), and r the slant range between source and animal.

The upper limit of the "partial" impulse integral is

$$T_{min} = \min\{T_{cut}, T_{osc}\}$$

where T_{cut} is the time to cutoff and T_{osc} is a function of the animal lung oscillation period. When the upper limit is T_{cut}, the integral is the definition of positive impulse. When the upper limit is defined by T_{osc}, the integral is smaller than the positive impulse and thus is just a "partial" impulse. Switching the integral limit from T_{cut} to T_{osc} accounts for the diminished impact of the positive impulse upon the animals lungs that compress with increasing depth and leads to what is sometimes call a "modified" positive impulse metric.

The time to cutoff is modeled as the difference in travel time between the direct path and the surface-reflected path in an isospeed environment. At a range of r, the time to cutoff for a source depth z_s and an animal depth z_a is

$$T_{cut} = 1/c \; \{ [r^2 + (z_a + z_s)^2]^{1/2} - [r^2 + (z_a - z_s)^2]^{1/2} \}$$

where c is the speed of sound.

The animal lung oscillation period is a function of animal mass M and depth z_a and is modeled as

$$T_{osc} = 1.17 \; M^{1/3} \; (1 + z_a/33)^{-5/6}$$

where M is the animal mass (in kg) and z_a is the animal depth (in feet).

The modified positive impulse threshold is unique among the various injury and harassment metrics in that it is a function of depth and the animal weight. So instead of the user specifying the threshold, it is computed as $K \; (M/42)^{1/3} \; (1 + z_a \,/\, 33)^{1/2}$. The coefficient K depends upon the level of exposure. For the onset of slight lung injury, K is 19.7; for the onset of extensive lung hemorrhaging (1% mortality), K is 47.

Although the thresholds are a function of depth and animal weight, sometimes they are summarized as their value at the sea surface for a typical dolphin calf (with an average mass of 12.2 kg). For the onset of slight lung injury, the threshold at the surface is approximately 13 psi-msec; for the onset of extensive lung hemorrhaging (1% mortality), the threshold at the surface is approximately 31 psi-msec.

As with peak pressure, the "modified" positive impulse at each grid point is compared to the derived threshold. If the impulse is greater than that threshold, then the incremental volume for the grid point is added to the impact volume for that depth layer.

4.3.2.7 Impact Volume per Explosive Detonation

The detonations of explosive sources are generally widely spaced in time and/or space. This implies that the impact volume for multiple firings can be easily derived by scaling the impact volume for a single detonation. Thus the typical impact volume vector for an explosive source is presented on a per-detonation basis.

4.3.3 Impact Volume by Region

The SOCAL Range is described by eleven environmental provinces. The hourly impact volume vector for operations involving any particular source is a linear combination of the eleven impact volume vectors with the weighting determined by the distribution of those thirteen environmental provinces within the range. Unique hourly impact volume vectors for winter and summer are calculated for each type of source and each metric/threshold combination.

4.4 RISK RESPONSE: THEORETICAL AND PRACTICAL IMPLEMENTATION

This section discusses the recent addition of a risk function "threshold" to acoustic effects analysis procedure. This approach includes two parts, a new metric, and a function to map exposure level under the new metric to probability of harassment. What these two parts mean, how they affect exposure calculations, and how they are implemented are the objects of discussion.

Thresholds and Metrics

The term "thresholds" is broadly used to refer to both thresholds and metrics. The difference, and the distinct roles of each in effects analyses, will be the foundation for understanding the dose-response approach, putting it in perspective, and showing that, conceptually, it is similar to past approaches.

Sound is a pressure wave, so at a certain point in space, sound is simply rapidly changing pressure. Pressure at a point is a function of time. Define p(t) as pressure (in micropascals) at a given point at time t (in seconds); this function is called a "time series." Figure 4-9 gives the time series of the first "hallelujah" in Handel's Hallelujah Chorus.

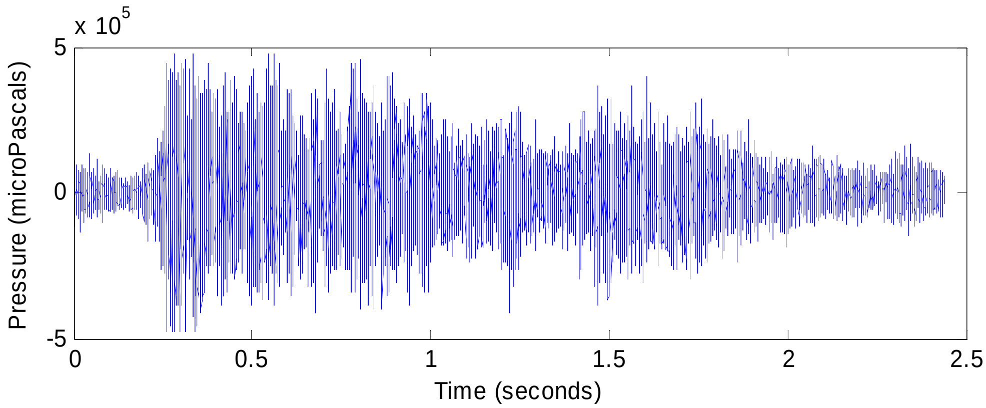


Figure 4-9. Time Series

The time-series of a source can be different at different places. Therefore, sound, or pressure, is not only a function of time, but also of location. Let the function p(t), then be expanded to p(t;x,y,z) and denote the time series at point (x,y,z) in space. Thus, the series in Figure 4-9 p(t) is for a given point (x,y,z). At a different point in space, it would be different.

Assume that the location of the source is (0,0,0) and this series is recorded at (0,10,-4). The time series above would be p(t;0,10,-4) for 0<t<2.5.

As in Figure A-9, pressure can be positive or negative, but usually the function is squared so it is always positive, this makes integration meaningful. Figure 4-10 is $p^2(t;0,10,-4)$.

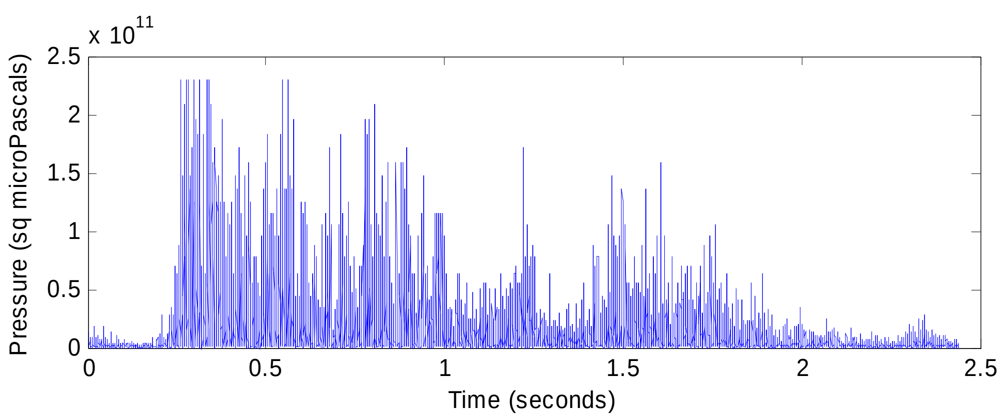


Figure 4-10. Time Series Squared

The metric chosen to evaluate the sound field at the end of this first "hallelujah" determines how the time series is summarized from thousands of points, as in Figure 4-9, to a single value for each point (x,y,z) in the space. The metric essentially "boils down" the four dimensional p(t,x,y,z) into a three dimensional function m(x,y,z) by dealing with time. There is more than one way to summarize the time component, so there is more than one metric.

Max SPL

One way to summarize $p^2(t;x,y,z)$ to one number over the 2.5 seconds is to only report the maximum value of the function over time or,

$$SPL_{\max} = \max\{p^2(t,x,y,z)\} \text{ for } 0<t<2.5$$

The $SPL_{\max}$ for this snippet of the Hallelujah Chorus is $2.3\times10^{11}\ \mu Pa^2$ and occurs at 0.2825 seconds, as shown in Figure A-11.

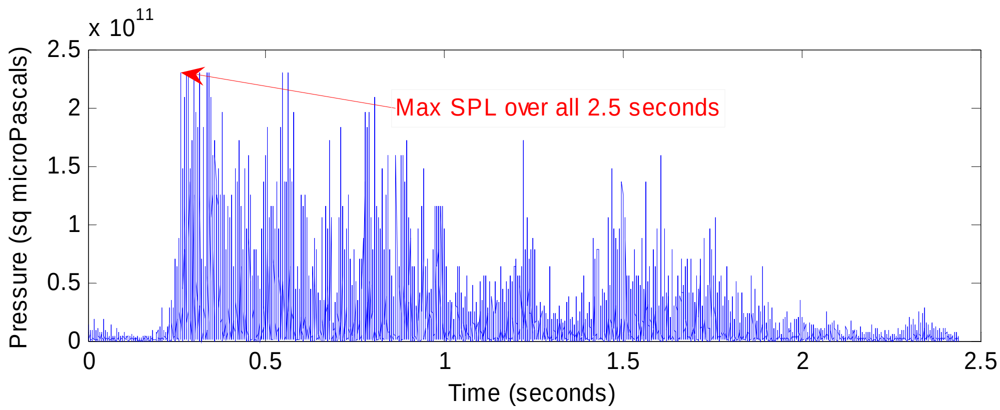


Figure 4-11. Max SPL of Time Series Squared Integration

$SPL_{\max}$ is not necessarily influenced by the duration of the sound (2.5 seconds in this case). Integrating the function over time does take this duration into account. A simple integration of $p^2(t;x,y,z)$ over t is common and usually called "energy."

$$Energy = \int_0^T p^2(t,x,y,z)dt \text{ where T is the maximum time of interest, in this case 2.5}$$

The energy for this snippet of the Hallelujah Chorus is $1.24\times10^{11}\ \mu Pa \cdot s$.

Energy is sometimes called "equal energy" because if p(t) is a constant function and the duration is doubled, the effect is the same as doubling the signal amplitude (y value). Thus, the duration and the signal have an "equal" influence on the energy metric.

Mathematically,

$$\int_0^{2T} p(t)^2\,dt = 2\int_0^T p(t)^2\,dt = \int_0^T 2\,p(t)^2\,dt$$

or a doubling in duration equals a doubling in energy equals a doubling in signal.

Sometimes, the integration metrics are referred to as having a "3 dB exchange rate" because if the duration is doubled, this integral increases by a factor of two, or 10log10(2)=3.01 dB. Thus, equal energy has "a 3 dB exchange rate."

After p(t) is determined (i.e., when the stimulus is over), propagation models can be used to determine p(t;x,y,z) for every point in the vicinity and for a given metric. Define

$m_a(x, y, z, T) =$ value of metric "a" at point (x,y,z) after time T

So,

$$m_{energy}(x, y, z; T) = \int_0^T p(t)^2 \, dt$$

$$m_{\max SPL}(x, y, z; T) = \max(p(t)) \; over \; [0, T]$$

Since modeling is concerned with the effects of an entire event, T is usually implicitly defined: a number that captures the duration of the event. This means that $m_a(x, y, z)$ is assumed to be measured over the duration of the received signal.

Three Dimensions vs Two Dimensions

To further reduce the calculation burden, it is possible to reduce the domain of $m_a(x, y, z)$ to two dimensions by defining $m_a(x, y) = \max\{m_a(x, y, z)\}$ over all z.

This reduction is not used for this analysis, which is exclusively three-dimensional.

Threshold

For a given metric, a threshold is a function that gives the probability of exposure at every value of m_a. This threshold function will be defined as

$$D(m_a(x, y, z)) = \Pr(effect \; at \; m_a(x, y, z))$$

The domain of D is the range of $m_a(x, y, z)$, and its range is the number of thresholds.

An example of threshold functions is the Heavyside (or unit step) function, currently used to determine permanent and temporary threshold shift (PTS and TTS) in cetaceans. For PTS, the metric is $m_{energy}(x, y, z)$, defined above, and the threshold function is a Heavyside function with a discontinuity at 215 dB, shown in Figure 4-12.

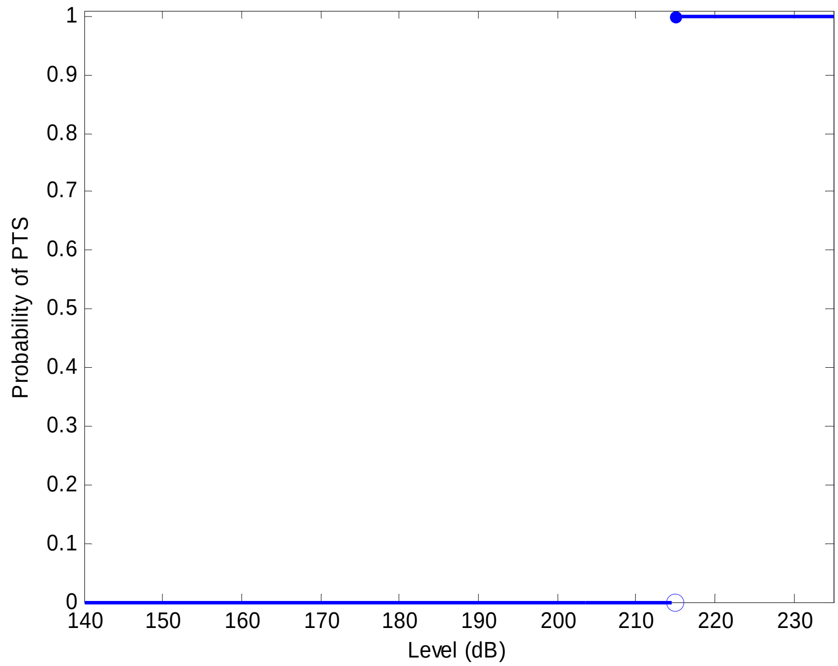


Figure 4-12. PTS Heavyside Threshold Function

Mathematically, this D is defined as:

$$D(m_{energy}) = \begin{cases} 0 \ \ for\ m_{energy} < 215 \\ 1 \ \ for\ m_{energy} \geq 215 \end{cases}$$

Any function can be used for D, as long as its range is in [0,1]. The dose-response functions use normal cumulative distribution functions (ncdfs) instead of heavyside functions, and use the max SPL metric instead of the energy metric. While a Heavyside function is specified by a single parameter, the discontinuity, a normal cumulative distribution function requires two parameters: the mean and the standard deviation. This particular approach defines a third parameter, "cutoff," to limit the support (domain of definition) of D. Mathematically, these "dose" functions are defined as

$$D(m_{\max SPL}) = \begin{cases} ncdf(\mu, \sigma, m_{\max SPL})\ for\ m_a \geq a \\ 0 \ \ for\ m_{\max SPL} < a \end{cases}$$

where a=cutoff, μ=mean, and σ=standard deviation. For these dose functions, cutoff (a) is always a function of μ and σ, a relationship in the form of a= μ-k σ, where k is an integer. The mid-frequency dose function used for small odontocetes is $ncdf(189,12,m_{\max SPL})$, with cutoff= μ-3 σ=153 dB.

Multiple Metrics and Thresholds

It is possible to have more than one metric, and more than one threshold in a given metric. For example, in this document, humpback whales have two metrics (energy and max SPL), and three thresholds (two for energy, one for max SPL). The energy thresholds are heavyside functions, as described above, with discontinuities at 215 and 195 for PTS and TTS respectively. The max SPL threshold is a dose-response function with μ=175, σ=10, and cutoff = μ-3 σ =145 for disturbance.

Calculation of Expected Exposures

Determining the number of expected exposures for disturbance is the object of this analysis.

Expected exposures in volume V= $\int_V \rho(V) D(m_a(V)) dV$

For this analysis, $m_a = m_{\max SPL}$, so

$$\int_V \rho(V) D(m_a(V)) dV = \int_{-\infty}^{\infty}\int_{-\infty}^{\infty}\int_{-\infty}^{\infty} \rho(x,y,z) D(m_{\max SPL}(x,y,z)) dx dy dz$$

In this analysis, the densities are constant over the x/y plane, and the z dimension is always negative, so this reduces to

$$\int_{-\infty}^{0} \rho(z) \int_{-\infty}^{\infty}\int_{-\infty}^{\infty} D(m_{\max SPL}(x,y,z)) dx dy dz$$

Numeric Implementation

Numeric integration of $\int_{-\infty}^{\infty} \rho(z) \int_{-\infty}^{\infty}\int_{-\infty}^{\infty} D(m_{\max SPL}(x,y,z)) dx dy dz$ can be involved because, although the bounds are infinite, D is non-negative out to 141 dB, which, depending on the environmental specifics, can drive propagation loss calculations and their numerical integration out to more than 100 km.

The first step in the solution is to separate out the x/y-plane portion of the integral:

Define f(z)= $\int_{-\infty}^{\infty}\int_{-\infty}^{\infty} D(m_{\max SPL}(x,y,z)) dx dy$.

Calculation of this integral is the most involved and time consuming part of the calculation. Once it is complete,

$$\int_{-\infty}^{0} \rho(z) \int_{-\infty}^{\infty}\int_{-\infty}^{\infty} D(m_{\max SPL}(x,y,z)) dx dy dz = \int_{-\infty}^{0} \rho(z) f(z) dz,$$

which, when numerically integrated, is a simple dot product of two vectors.

Thus, the calculation of f(z) requires the majority of the computation resources for the numerical integration. The rest of this section presents a brief outline of the steps to calculate f(z) and preserve the results efficiently.

The concept of numerical integration is, instead of integrating over continuous functions, to sample the functions at small intervals and sum the samples to approximate the integral. The smaller the size of the intervals, the closer the approximation, but the longer the calculation, so a balance between accuracy and time is determined in the decision of step size. For this analysis, z is sampled in 5 meter steps to 1000 meters in depth and 10 meter steps to 2000 meters, which is the limit of animal depth in this analysis. The step size for x is 5 meters, and y is sampled with an interval that increases as the distance from the source increases. Mathematically,

$$z \in Z = \{0,5,...1000,1010,...,2000\}$$
$$x \in X = \{0,\pm 5,...,\pm 5k\}$$
$$y \in Y = \{0,\pm 5(1.005)^0, 5 \pm (1.005)^1, \pm 5(1.005)^2,...,5(1.005)^j\}$$

for integers k,j, which depend on the propagation distance for the source. For this analysis, k=20,000 and j=600

With these steps, $f(z_0) = \int_{-\infty}^{\infty}\int_{-\infty}^{\infty} D(m_{\max SPL}(x,y,z_0))dxdy$ is approximated as

$$\sum_{z \in Y}\sum_{x \in X} D(m_{\max SPL}(x,y,z_0))\Delta x \Delta y$$

where X,Y are defined as above.

This calculation must be repeated for each $z_0 \in Z$, to build the discrete function f(z).

With the calculation of f(z) complete, the integral of its product with $\rho(z)$ must be calculated to complete evaluation of

$$\int_{-\infty}^{\infty} \rho(z) \int_{-\infty}^{\infty}\int_{-\infty}^{\infty} D(m_{\max SPL}(x,y,z))dxdydz = \int_{-\infty}^{0} \rho(z) f(z)dz$$

Since f(z) is discrete, and $\rho(z)$ can be readily made discrete,

$\int_{-\infty}^{0} \rho(z) f(z)dz$ is approximated numerically as $\sum_{z \in Z} \rho(z) f(z)$, a dot product.

Preserving Calculations for Future Use

Calculating f(z) is the most time-consuming part of the numerical integration, but the most time-consuming portion of the entire process is calculating $m_{\max SPL}(x,y,z)$ over the area range required for the minimum cutoff value (141 dB). The calculations usually require propagation estimates out to over 100 km, and those estimates, with the beam pattern, are used to construct a sound field that extends 200 km x 200 km--40,000 sq km, with a calculation at the steps for every value of X and Y, defined above. This is repeated for each depth, to a maximum of 2000 meters.

Saving the entire $m_{\max SPL}$ for each z is unrealistic, requiring great amounts of time and disk space. Instead, the different levels in the range of $m_{\max SPL}$ are sorted into 0.5 dB wide bins; the volume of water at each bin level is taken from $m_{\max SPL}$, and associated with its bin. Saving this, the amount of water ensonified at each level, at 0.5 dB resolution, preserves the ensonification information without using the space and time required to save $m_{\max SPL}$ itself. Practically, this is a histogram of occurrence of level at each depth, with 0.5 dB bins. Mathematically, this is simply defining the discrete functions $V_z(L)$, where $L = \{.5a\}$ for every positive integer a, for all $z \in Z$. These functions, or histograms, are saved for future work. The information lost by saving only the histograms is *where* in space the different levels occur, although *how often* they occur is saved. But the thresholds (dose response curves) are purely a function of level, not location, so this information is sufficient to calculate f(z).

Applying the dose function to the histograms is a dot product: $\sum_{\ell \in L_1} D(\ell) V_{z_0}(\ell) \approx \int_{-\infty}^{\infty}\int_{-\infty}^{\infty} D(m_{\max SPL}(x, y, z_0))dxdy$

So, once the histograms are saved, neither $m_{\max SPL}(x, y, z)$ nor f(z) must be recalculated to generate $\int_{-\infty}^{0} \rho(z) \int_{-\infty}^{\infty}\int_{-\infty}^{\infty} D(m_{\max SPL}(x, y, z))dxdydz$ for a new threshold function.

For the interested reader, the following section includes an in-depth discussion of the method, software, and other details of the f(z) calculation.

Software Detail

The risk function metric uses the cumulative normal probability distribution to determine the probability that an animal is affected by a given sound pressure level. The probability distribution is defined by a mean, standard deviation, and low level cutoff, below which it is assumed that animals are not affected. The acoustic quantity of interest is the maximum sound pressure level experienced over multiple pings in a range-independent environment. The procedure for calculating the impact volume at a given depth is relatively simple. In brief, given the sound pressure level of the source and the transmission loss (TL) curve, the sound pressure level is calculated on a volumetric grid. For a given depth, volume associated with a sound pressure level interval is calculated. Then, this volume is multiplied by the probability that an animal will be affected by that sound pressure level. This gives the impact volume for that depth, that can be multiplied by the animal densities at that depth, to obtain the number of animals affected at that depth. The process repeats for each depth to construct the impact volume as a function of depth.

The case of a single emission of sonar energy, one ping, illustrates the computational process in more detail. First, the sound pressure levels are segregated into a sequence of bins that cover the range encountered in the area. The sound pressure levels are used to define a volumetric grid of the local sound field. The impact volume for each depth is calculated as follows: for each depth in the volumetric grid, the sound pressure level at each x/y plane grid point is calculated using the sound pressure level of the source, the TL curve, the horizontal beam pattern of the source, and the vertical beam patterns of the source. The sound pressure levels in this grid become the bins in the volume histogram. Figure 4-13 shows a volume histogram for a low power sonar. Level bins are 0.5 dB in width and the depth is 50 meters in an environment with water depth of 100 meters. The oscillatory structure at very low levels is due the flattening of the TL curve at long distances from the source, which magnifies the fluctuations of the TL as a function of range. The "expected" impact volume for a given level at a given depth is calculated by multiplying the volume in each level bin by the dose response probability function at that level. Total expected impact volume for a given depth is the sum of these "expected" volumes. Figure 4-14 is an example of the impact volume as a function of depth at a water depth of 100 meters.

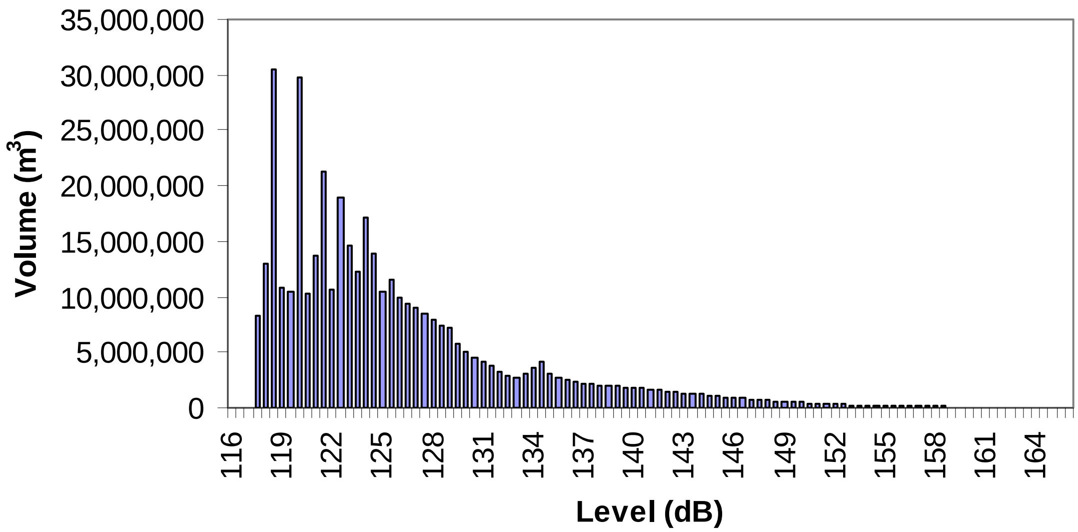


Figure 4-13. Example of a Volume Histogram

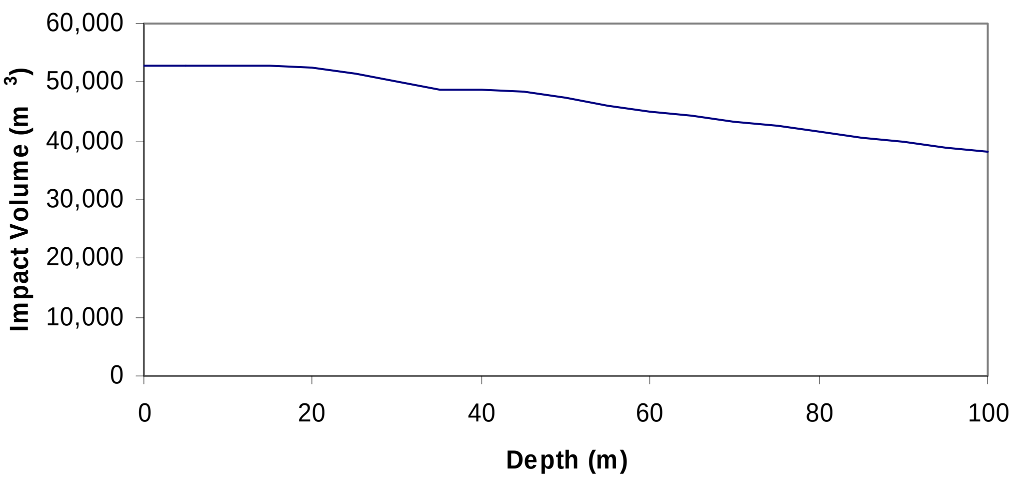


Figure 4-14. Example of the Dependence of Impact Volume on Depth

The volumetric grid covers the waters in and around the area of sonar operation. The grid for this analysis has a uniform spacing of 5 meters in the x-coordinate and a slowly expanding spacing in the y-coordinate that starts with 5 meters spacing at the origin. The growth of the grid size along the y-axis is a geometric series. Each successive grid size is obtained from the previous by multiplying it by 1+Ry, where Ry is the y-axis growth factor. This forms a geometric series. The n^{th} grid size is related to the first grid size by multiplying by $(1+Ry)^{(n-1)}$. For an initial grid size of

5 meters and a growth factor of 0.005, the 100th grid increment is 8.19 meters. The constant spacing in the x-coordinate allows greater accuracy as the source moves along the x-axis. The slowly increasing spacing in y reduces computation time, while maintaining accuracy, by taking advantage of the fact that TL changes more slowly at longer distances from the source. The x- and y-coordinates extend from –Rmax to +Rmax, where Rmax is the maximum range used in the TL calculations. The z direction uses a uniform spacing of 5 meters down to 1000 meters and 10 meters from 1000 to 2000 meters. This is the same depth mesh used for the effective energy metric as described above. The depth mesh does not extend below 2000 meters, on the assumption that animals of interest are not found below this depth.

The next three figures indicate how the accuracy of the calculation of impact volume depends on the parameters used to generate the mesh in the horizontal plane. Figure 4-19 shows the relative change of impact volume for one ping as a function of the grid size used for the x-axis. The y-axis grid size is fixed at 5m and the y-axis growth factor is 0, i.e., uniform spacing. The impact volume for a 5 meters grid size is the reference. For grid sizes between 2.5 and 7.5 meters, the change is less than 0.1%. A grid size of 5 meters for the x-axis is used in the calculations. Figure A-16 shows the relative change of impact volume for one ping as a function of the grid size used for the y-axis. The x-axis grid size is fixed at 5 meters and the y-axis growth factor is 0. The impact volume for a 5 meters grid size is the reference. This figure is very similar to that for the x-axis grid size. For grid sizes between 2.5 and 7.5 meters, the change is less than 0.1%. A grid size of 5 meters is used for the y-axis in our calculations. Figure 4-17 shows the relative change of impact volume for one ping as a function of the y-axis growth factor. The x-axis grid size is fixed at 5 meters and the initial y-axis grid size is 5 meters. The impact volume for a growth factor of 0 is the reference. For growth factors from 0 to 0.01, the change is less than 0.1%. A growth factor of 0.005 is used in the calculations.

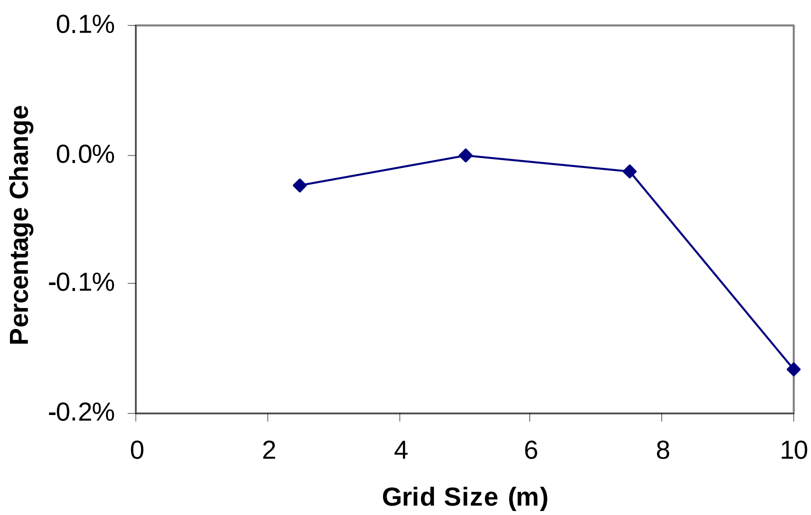


Figure 4-15. Change of Impact Volume as a Function of X-Axis Grid Size

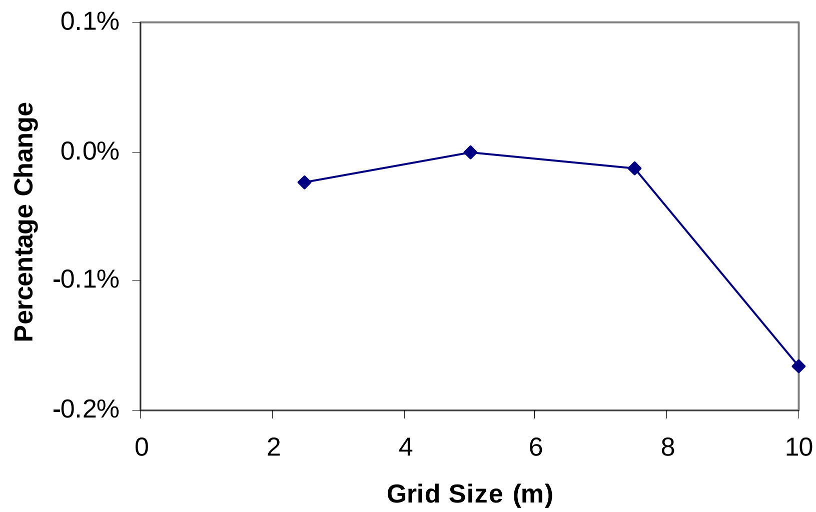


Figure 4-16. Change of Impact Volume as a Function of Y-Axis Grid Size

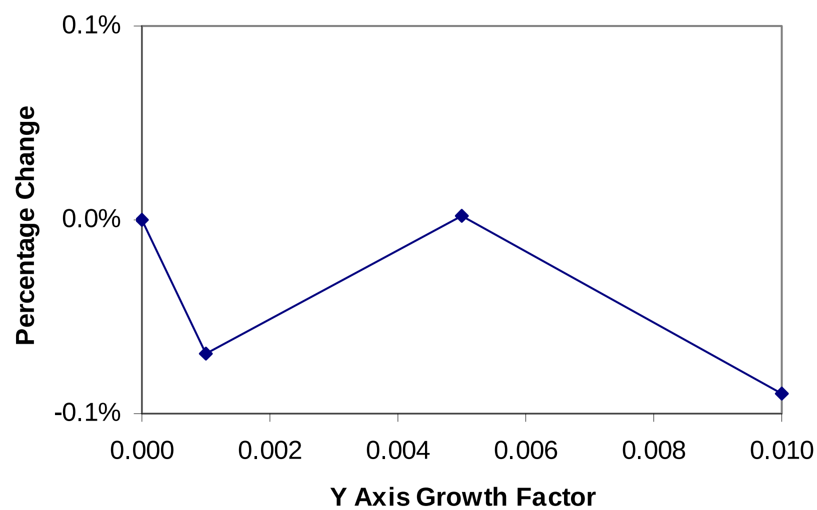


Figure 4-17. Change of Impact Volume as a Function of Y-Axis Growth Factor

Another factor influencing the accuracy of the calculation of impact volumes is the size of the bins used for sound pressure level. The sound pressure level bins extend from 100 dB (far lower than required) up to 300 dB (much higher than that expected for any sonar system). Figure 4-18 shows the relative change of impact volume for one ping as a function of the bin width. The x-axis grid size is fixed at 5 meters the initial y-axis grid size is 5 meters, and the y-axis growth factor is 0.005. The impact volume for a bin size of 0.5 dB is the reference. For bin widths from 0.25 dB to 1.00 dB, the change is about 0.1%. A bin width of 0.5 is used in our calculations.

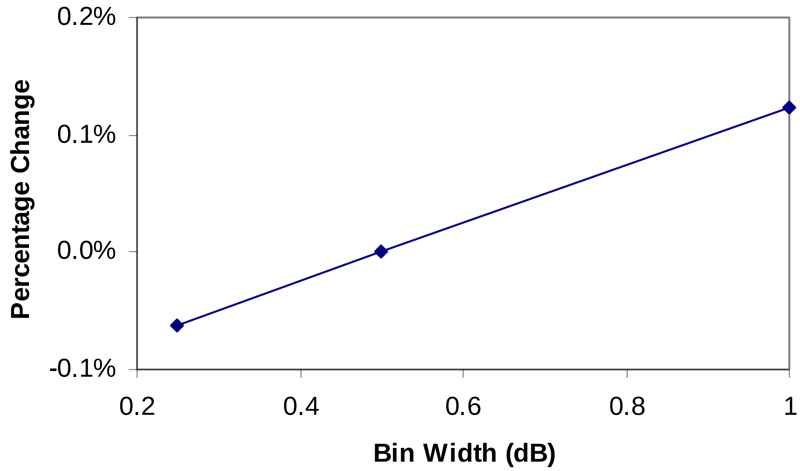


Figure 4-18. Change of Impact Volume as a Function of Bin Width

Two other issues for discussion are the maximum range (Rmax) and the spacing in range and depth used for calculating TL. The TL generated for the energy accumulation metric is used for dose-response analysis. The same sampling in range and depth is adequate for this metric because it requires a less demanding computation (i.e., maximum value instead of accumulated energy). Using the same value of Rmax needs some discussion since it is not clear that the same value can be used for both metrics. Rmax was set so that the TL at Rmax is more than needed to reach the energy accumulation threshold of 173 dB for 1000 pings. Since energy is accumulated, the same TL can be used for one ping with the source level increased by 30 dB ($10 \log_{10}(1000)$). Reducing the source level by 30 dB, to get back to its original value, permits the handling of a sound pressure level threshold down to 143 dB, comparable to the minimum required. Hence, the TL calculated to support energy accumulation for 1000 pings will also support calculation of impact volumes for the dose-response metric.

The process of obtaining the maximum sound pressure level at each grid point in the volumetric grid is straightforward. The active sonar starts at the origin and moves at constant speed along the positive x-axis emitting a burst of energy, a ping, at regularly spaced intervals. For each ping, the distance and horizontal angle connecting the sonar to each grid point is computed. Calculating the TL from the source to a grid point has several steps. The TL is made up of the sum of many eigenrays connecting the source to the grid point. The beam pattern of the source is applied to the eigenrays based on the angle at which they leave the source. After summing the vertically beamformed eigenrays on the range mesh used for the TL calculation, the vertically beamformed TL for the distance from the sonar to the grid point is derived by interpolation. Next, the horizontal beam pattern of the source is applied using the horizontal angle connecting the sonar to the grid point. To avoid problems in extrapolating TL, only use grid points with distances less than R_{max} are used. To obtain the sound pressure level at a grid point, the sound pressure level of the source is reduced by that TL. For the first ping, the volumetric grid is populated by the calculated sound pressure level at each grid point. For the second ping and subsequent pings, the source location increments along the x-axis by the spacing between pings and the sound pressure level for each grid point is again calculated for the new source location. Since the dose-response metric uses the maximum of the sound pressure levels at each grid point, the newly calculated sound pressure level at each grid point is compared to the sound pressure level stored in the grid. If the new level is larger than the stored level, the value at that grid point is replaced by the new sound pressure level.

For each bin, a volume is determined by summing the ensonified volumes with a maximum SPL in the bin's interval. This forms the volume histogram shown in Figure 4-13. Multiplying by the dose-response probability function for the level at the center of a bin gives the impact volume for that bin. The result can be seen in Figure 4-14, which is an example of the impact volume as a function of depth.

The impact volume for a sonar moving relative to the animal population increases with each additional ping. The rate at which the impact volume increases for the dose response metric is essentially linear with the number of pings. Figure 4-19 shows the dependence of impact volume on the number of pings. The function is linear; the slope of the line at a given depth is the impact volume added per ping. This number multiplied by the number of pings in an hour gives the hourly impact volume for the given depth increment. Completing this calculation for all depths in a province, for a given source, gives the hourly impact volume vector which contains the hourly impact volumes by depth for a province. Figure 4-20 provides an example of an hourly impact volume vector for a particular environment. Given the speed of the sonar, the hourly impact volume vector could be displayed as the impact volume vector per kilometer of track.

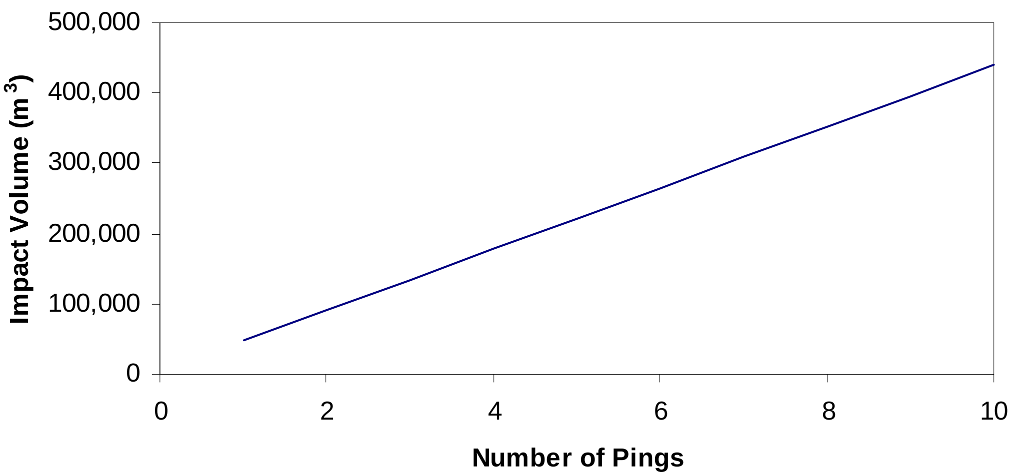


Figure 4-19. Dependence of Impact volume On the Number of Pings

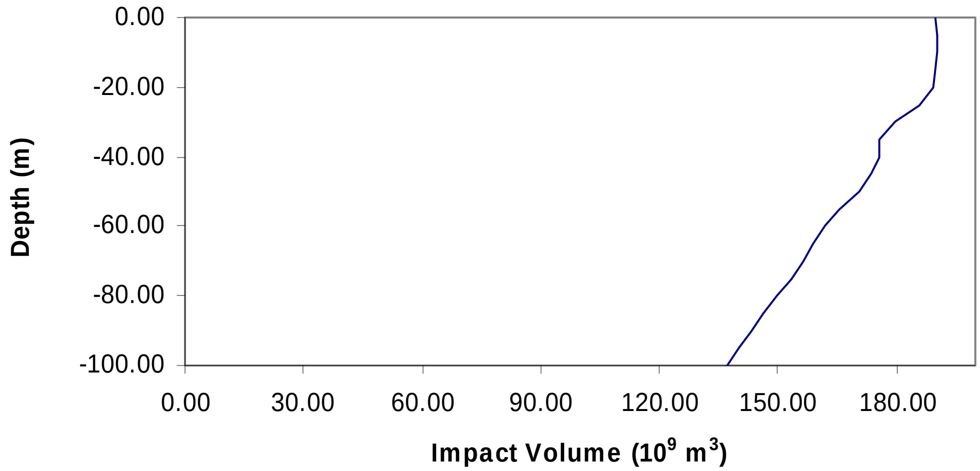


Figure 4-20. Example of an Hourly Impact Volume Vector

4.5 EXPOSURES

This section defines the animal densities and their depth distributions for the SOCAL Range. This is followed by a series of tables providing exposure estimates per unit of operation for each source type (active sonars and explosives).

4.5.1 Animal densities

Densities are usually reported by marine biologists as animals per square kilometer, which is an area metric (presented for each species in Section 2.1). This gives an estimate of the number of animals below the surface in a certain area, but does not provide any information about their distribution in depth. The impact volume vector (see subsection 4.4.3) specifies the volume of water ensonified above the specified threshold in each depth interval. A corresponding animal density for each of those depth intervals is required to compute the expected value of the number of exposures. The two-dimensional area densities do not contain this information, so three-dimensional densities must be constructed by using animal depth distributions to extrapolate the density at each depth. The density estimates used fro the acoustic modeling assumes a uniform density through the modeling area. Exposure Estimates

The following sperm whale example demonstrates the methodology used to create a three-dimensional density by merging the area densities with the depth distributions. The sperm whale surface density is 0.0028 whales per square kilometer. From the depth distribution report, "depth distribution for sperm whales based on information in the Amano paper is: 19% in 0-2 m, 10% in 2-200 m, 11% in 201-400 m, 11% in 401-600 m, 11% in 601-800 m and 38% in >800 m." So the sperm whale density at 0-2 m is 0.0028*0.19/0.002 = 0.266 per cubic km, at 2-200 m is 0.0028*0.10/0.198 = 0.001414 per cubic km, and so forth.

In general, the impact volume vector samples depth in finer detail than given by the depth distribution data. When this is the case, the densities are apportioned uniformly over the appropriate intervals. For example, suppose the impact volume vector provides volumes for the intervals 0-2 meters, 2-10 meters, and 10-50 meters. Then for the depth-distributed densities discussed in the preceding paragraph,

- 0.266 whales per cubic km is used for 0-2 meters,

- 0.001414 whales per cubic km is used for the 2-10 meters, and
- 0.001414 whales per square km is used for the 10-50 meters.

Once depth-varying, three-dimensional densities are specified for each species type, with the same depth intervals and the ensonified volume vector, the density calculations are finished. The expected number of ensonified animals within each depth interval is the ensonified volume at that interval multiplied by the volume density at that interval and this can be obtained as the dot product of the ensonified volume and animal density vectors.

Since the ensonified volume vector is the ensonified volume per unit operation (ie per hour, per sonobuoy, etc), the final exposure count for each animal is the unit operation exposure count multiplied by the number of units (hours, sonobuoys, etc). For sonar sources, exposures are reported at 195 dB, and 215 dB. For explosive sources, exposures are reported by level A (corresponding to 182 dB one-third-octave energy) and level B (corresponding to 205 dB one-third-octave energy and 13 psi-ms). These thresholds are explained in section 4.1.

4.5.2 Exposure Estimates Example

The following sperm whale example demonstrates the methodology used to create a three-dimensional density by merging the area densities with the depth distributions. The sperm whale surface density is 0.0028 whales per square kilometer. From the depth distribution report, "depth distribution for sperm whales based on information in the Amano paper is: 19% in 0-2 m, 10% in 2-200 m, 11% in 201-400 m, 11% in 401-600 m, 11% in 601-800 m and 38% in >800 m." So the sperm whale density at 0 to 2 m is (0.0028*0.19/0.002 =) 0.266 per cubic km, at 2-200 m is (0.0028*0.10/0.198 =) 0.001414 per cubic km, and so forth.

In general, the impact volume vector samples depth in finer detail than given by the depth distribution data. When this is the case, the densities are apportioned uniformly over the appropriate intervals. For example, suppose the impact volume vector provides volumes for the intervals 0 to 2 m, 2 to 10 m, and 10 to 50 m. Then for the depth-distributed densities discussed in the preceding paragraph,

- 0.266 whales per cubic km is used for 0 to 2 m,
- 0.001414 whales per cubic km is used for the 2 to 10 m, and
- 0.001414 whales per square km is used for the 10 to 50 m.

Once depth-varying, three-dimensional densities are specified for each species type, with the same depth intervals and the ensonified volume vector, the density calculations are finished. The expected number of ensonified animals within each depth interval is the ensonified volume at that interval multiplied by the volume density at that interval and this can be obtained as the dot product of the ensonified volume and animal density vectors.

Since the ensonified volume vector is the ensonified volume per unit operation (i.e., per hour, per sonobuoy, etc), the final exposure count for each animal is the unit operation exposure count multiplied by the number of units (hours, sonobuoys, etc). The tables below are organized by Alternative and threshold level; each table represents the total yearly exposures modeled at different threshold levels for each alternative. For sonar sources, exposures are reported at the appropriate dose function level, 195 dB, and 215 dB.

4.6 SUMMARY OF MARINE MAMMAL RESPONSE TO ACOUSTIC AND EXPLOSIVE EXPOSURES

The best scientific information on the status, abundance and distribution, behavior and ecology, diving behavior and acoustic abilities are provided for each species expected to be found within the SOCAL EIS Study Area. Information was reviewed on the response of marine mammals to other sound sources such as seismic air guns or ships but these sources tend to be longer in the period of exposure or continuous in nature. The response of marine mammals to those sounds, and mid-frequency active sonar, are variable with some animals showing no response or moving toward the sound source while others may move away (Review by Richardson et al. 1995; Andre et al. 1997; Nowacek et al. 2004). The analytical framework shows the range of physiological and behavioral responses that can occur when an animal is exposed to an acoustic source. Physiological effects include auditory trauma (TTS, PTS, and tympanic membrane rupture), stress or changes in health and bubble formation or decompression sickness. Behavioral responses may occur due to stress in response to the sound exposure. Behavioral responses may include flight response, changes in diving, foraging or reproductive behavior, changes in vocalizations (may cease or increase intensity), changes in migration or movement patterns or the use of certain habitats. Whether an animal responds, the types of behavioral changes, and the magnitude of those changes may depend on the intensity level of the exposure and the individual animal’s prior status or behavior. Little information is available to determine the response of animals to mid-frequency active sonar and its effects on ultimate and proximate life functions or at the population or species level.

Sections 3.3 and 3.4 presented the concept that potential effects of sound include both physiological effects and behavioral effects. Sections 3.15 and 3.16 provide information on how physiological effects and behavioral responses are considered in development of acoustic modeling.

Acoustic exposures are evaluated based on their potential direct effects on marine mammals, and these effects are then assessed in the context of the species biology and ecology to determine if there is a mode of action that may result in the acoustic exposure warranting consideration as a harassment level effect. A large body of research on terrestrial animal and human response to airborne sound exists, but results from those studies are not readily extendible to the development of effect criteria and thresholds for marine mammals. For example, “annoyance” is one of several criteria used to define impact to humans from exposure to industrial sound sources. Comparable criteria cannot be developed for marine mammals because there is no acceptable method for determining whether a non-verbal animal is annoyed. Further, differences in hearing thresholds, dynamic range of the ear, and the typical exposure patterns of interest (e.g., human data tend to focus on 8-hour-long exposures) make extrapolation of human sound exposure standards inappropriate. Behavioral observations of marine mammals exposed to anthropogenic sound sources exist, however, there are few observations and no controlled measurements of behavioral disruption of cetaceans caused by sound sources with frequencies, waveforms, durations, and repetition rates comparable to those employed by the tactical sonars to be used in the SOCAL Range Complex. At the present time there is no consensus on how to account for behavioral effects on marine mammals exposed to continuous-type sounds (NRC 2003).

This application uses behavioral observations of trained cetaceans exposed to intense underwater sound under controlled circumstances to develop a criterion and threshold for behavioral effects of sound. These data are described in detail in Schlundt et al. (2000) and Finneran and Schlundt (2004). These data, because they are based on controlled, tonal sound exposures within the tactical sonar frequency range, are the most applicable.

When analyzing the results of the acoustic effect modeling to provide an estimate of harassment, it is important to understand that there are limitations to the ecological data used in the model, and to interpret the model results within the context of a given species' ecology.

Limitations in the model include:

- Density estimates (May be limited in duration and time of year and are modeled to derive density estimates).
- When reviewing the acoustic effect modeling results, it is also important to understand that the estimates of marine mammal sound exposures are presented without consideration of mitigation which may reduce the potential for estimated sound exposures to occur.
- Overlap of TTS and risk function.

4.6.1 Acoustic Impact Model Process Applicable to All Alternative Discussions

The methodology for analyzing potential impacts from sonar and explosives is presented in Section 4.2, which explains the model process in detail, describes how the impact threshold derived from Navy-NMFS consultations are derived, and discusses relative potential impact based on species biology.

The Navy acoustic exposure model process uses a number of inter-related software tools to assess potential exposure of marine mammals to Navy generated underwater sound including sonar and explosions. For sonar, these tools estimate potential impact volumes and areas over a range of thresholds for sonar specific operating modes. Results are based upon extensive pre-computations over the range of acoustic environments that might be encountered in the operating area (Section 4).

The acoustic model includes four steps used to calculate potential exposures:

1. Identify unique acoustic environments that encompass the operating area. Parameters include depth and seafloor geography, bottom characteristics and sediment type, wind and surface roughness, sound velocity profile, surface duct, sound channel, and convergence zones.

2. Compute transmission loss (TL) data appropriate for each sensor type in each of these acoustic environments. Propagation can be complex depending on a number of environmental parameters listed in step one, as well as sonar operating parameters such as directivity, source level, ping rate, and ping length, and for explosives the amount of explosive material detonated. The standard Navy CASS-GRAB acoustic propagation model is used to resolve complexities for underwater propagation prediction.

3. Use that TL to estimate the total sound energy received at each point in the acoustic environment.

4. Apply this energy to predicted animal density for that area to estimate potential acoustic exposure, with animals distributed in 3-D based on best available science on animal dive profiles.

Model Results Explanation

Acoustic exposures are evaluated based on their potential direct effects on marine mammals, and these effects are then assessed in the context of the species biology and ecology to determine if there is a mode of action that may result in the acoustic exposure warranting consideration as a harassment level effect.

A large body of research on terrestrial animal and human response to airborne sound exists, but results from those studies are not readily extendible to the development of behavioral criteria and thresholds for marine mammals. For example, "annoyance" is one of several criteria used to define impact to humans from exposure to industrial sound sources. Comparable criteria cannot be developed for marine mammals because there is no scientifically acceptable method for determining whether a non-verbal animal is annoyed (NRC 2003). Further, differences in hearing thresholds, dynamic range of the ear, and the typical exposure patterns of interest (e.g., human data tend to focus on 8-hour-long exposures) make extrapolation of human sound exposure standards inappropriate. Behavioral observations of marine mammals exposed to anthropogenic sound sources exists, however, there are few observations and no controlled measurements of behavioral disruption of cetaceans caused by sound sources with frequencies, waveforms, durations, and repetition rates comparable to those employed by the tactical sonars described in this EIS/OEIS (Deecke 2006).

At the present time there is no general scientifically accepted consensus on how to account for behavioral effects on marine mammals exposed to anthropogenic sounds including military sonar and explosions (NRC 2003, NRC 2005). While the first three blocks in Figure 4-21 can be easily defined (source, propagation, receiver) the remaining two blocks (perception and behavior) are not well understood given the difficulties in studying marine mammals at sea (NRC 2005). NRC (2005) acknowledges "there is not one case in which data can be integrated into models to demonstrate that noise is causing adverse affects on a marine mammal population."

From: NRC. 2003. Ocean Noise And Marine Mammals. National Research Council of the National Academies. National Academies Press, Washington, DC.

Figure 4-21. Process Steps: Assessing Behavioural Effects or Absence of Behavioral Effects of Underwater Sound on Marine Species.

For purposes of predicting potential acoustic and explosive effects on marine mammals, the U.S Navy uses an acoustic impact model process with numeric criteria agreed upon with the NMFS. Tthere are some caveats necessary to understand in order to put these exposures in context.

For instance, 1) significant scientific uncertainties are implied and carried forward in any analysis using marine mammal density data as a predictor for animal occurrence within a given geographic area; 2) there are limitations to the actual model process based on information available (animal densities, animal depth distributions, animal motion data, impact thresholds, and supporting statistical model); and determination and understanding of what constitutes a significant behavioral effect is still unresolved.

The sources of marine mammal densities used in the SOCAL EIS/OEIS are derived from NMFS broad scale West Coast Surveys. These ship board surveys cover significant distance along the California coast out the extent of the U.S. EEZ. However, although survey design includes statistical placement of survey tracks, the survey itself can only cover so much ocean area and post-survey statistics are used to calculate animal abundances and densities (Barlow and Forney 2007). There is often significant statistical variation inherit within the calculation of the final density values depending on how many sightings were available during a survey.

Occurrence of marine mammals within any geographic area including Southern California is highly variable and strongly correlated to oceanographic conditions, bathymetry, and ecosystem level patterns rather than changes in reproduction success and survival (Forney 2000, Ferguson and Barlow 2001, Benson et al. 2002, Moore et al. 2002, Tynan 2005, Redfern 2006). For some species, distribution may be even more highly influence by relative small scale features over both short and long-term time scales (Balance et al. 2006, Etnoyer et al. 2006, Ferguson et al. 2006, Skov et al. 2007). Unfortunately, the scientific level of understanding of some large scale and most small scale processes thought to influence marine mammal distribution is incomplete.

Given the uncertainties in marine mammal density estimation and localized distributions, the U.S. Navy's acoustic impact models can not currently be use to predict occurrence of marine mammals within specific regions of Southern California. T o resolve this issue and allow modeling to precede, animals are "artificially and uniformly distributed" within the modeling provinces described in Section 4.2. This process does not account for animals that move into or out of the region based on foraging and migratory patterns, and adds a significant amount of variability to the model predictions.

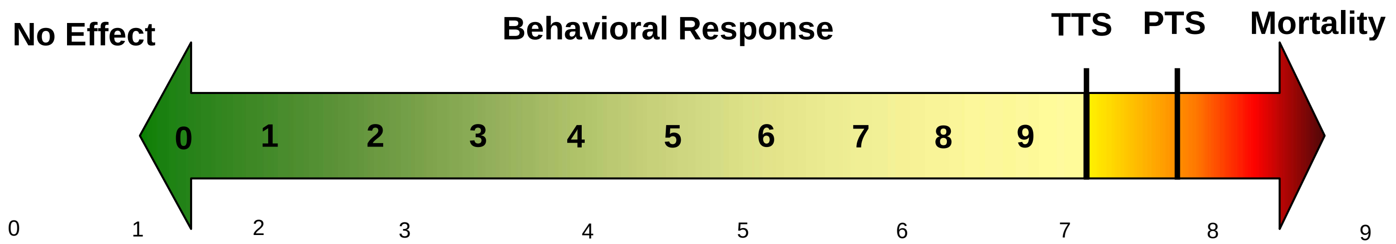
Results, therefore, from acoustic impact exposure models should be regarded as exceedingly conservative estimates strongly influenced by limited biological data. While numbers generated allow establishment of predicted marine mammal exposures for consultation with NMFS, the short duration and limited geographic extent of most sonar and explosive events does not necessarily mean that these exposures will ever be realized.

Comparison With SOCAL After Action Report Data

From exercise after action reports of major SOCAL exercises in 2007, marine mammal sightings ranged from 289 to 881 animals per event over four events. Approximately, 77 to 96% of these animals were dolphins. From all four exercises, only approximately 226 of 2303 animals were observed during mid-frequency operations and sonar was secured or powered down in all cases upon initial animal sighting and until the animal had departed the vicinity of the ship, or the ship moved from the vicinity of the animal. At no time were any of these animals potentially exposed to SEL of greater than 189 dB, with the exception of two groups of dolphins that closed with a ship to ride the bow wake while MFAS was in use, and one group of four whales observed at 50 yards during MFAS transmission and that could have been exposed to RL of 201 dB. Like other sighting, MFAS was secured when these marine mammals were first observed within 200 yards of the ship. Of interest in this evaluation, even accounting for marine mammal not detected visually, the numbers of animals potentially exposed during 2007 are many orders of magnitude below what was predicted by the SOCAL EIS/OEIS acoustic impact modeling (Tables 4-18, 4-20, 4-23).

Behavioral Responses

Behavioral responses to exposure from mid- and high-frequency active sonar and underwater detonations can range from no observable response to panic, flight and possibly stranding (Figure 3.9-7). The intensity of the behavioral responses exhibited by marine mammals depends on a number of conditions including the age, reproductive condition, experience, behavior (foraging or reproductive), species, received sound level, type of sound (impulse or continuous) and duration of sound (Reviews by Richardson et al., 1995; Wartzok et al. 2004; Cox et al. 2006, Nowacek et al. 2007; Southall et al. 2007). Most behavioral responses may be short term and of little consequence for the animal although certain responses may lead to a stranding or mother-offspring separation. Active sonar exposure is brief as the ship is constantly moving and the animal will likely be moving as well. Generally the louder the sound source the more intense the response although duration is also very important (Southall et al. 2007). According to the Southall et al. (2007) response spectrum, responses from 0-3 are brief and minor, 4-6 have a higher potential to affect foraging, reproduction or survival and 7-9 are likely to affect foraging, reproduction and survival. Mitigation measures would likely prevent animals from being exposed to the loudest sonar sounds that could cause PTS, TTS and more intense behavioral reactions (i.e. 7-9 on the response spectrum.



0	1	2	3	4	5	6	7	8	9
-no observable response	-Brief orientation response (investigati on / visual orientation)	-Moderate or multiple orientation behaviors -Brief or minor cessation/ modification of vocal behavior -Brief or minor change in respiration rates	-Prolonged orientation behavior -Individual alert behavior -Minor changes in locomotion speed, direction, and/or dive profile but no avoidance o sound source -Moderate change in respiration rate -Minor cessation or modification of vocal behavior (duration < duration of source operation), including the Lombard Effect	-Moderate changes in locomotion speed, direction, and/or dive profile, but no avoidance of sound source -Brief, minor shift in group distribution -Moderate cessation or modification of vocal behavior (duration approx duration of source operation)	-Extensive or prolonged changes in locomotion speed, direction, and/or dive profile but not avoidance of sound source -Moderate shift in group distribution -Change in inter-animal distance and/or group size (aggregation or separation) -Prolonged cessation or modifications of vocal behavior (duration > duration of source operation)	-Minor or moderate individual and/or group avoidance of sound source -Brief or minor separation of females and dependent offspring -Aggressive behavior related to noise exposure (e.g., tail/flipper slapping, fluke display, jaw clapping/ gnashing teeth, abrupt directed movement, bubble clouds) -Extended cessation or modification of vocal behavior -Visible startle response -Brief cessation of reproductive behavior	-Excessive or prolonged aggressive behavior -Moderate separation of females and dependent offspring -Clear anti-predator response -Severe and/ or sustained avoidance of sound source -Moderate cessation of reproductive behavior	-Obvious aversion and/or progressive sensitization -Prolonged or significant separation of females and dependent offspring with disruption of acoustic reunion mechanisms -Long-term avoidance of area (> source operation) -Prolonged cessation of reproductive behavior	-Outright panic, flight, stampede, attach of conspecifics, or stranding events -Avoidance behavior related to predator detection

Figure 4-22. Marine Mammal Response Spectrum to Anthropogenic Sounds
(Numbered severity scale for ranking observed behaviors from Southall et al. 2007

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There is little data on the consequences of sound exposure on vital rates of marine mammals. Several studies have shown the effects of chronic noise (either continuous or multiple pulses) on marine mammal presence in an area (e.g. Malme et al. 1984; McCauley et al. 1998; Nowacek et al. 2004)

Even for more cryptic species such as beaked whales, the main determinant of causing a stranding appears to be exposure in a narrow channel with no egress thus animals are exposed for prolonged period rather than just several sonar pings over a several minutes (See section 4.2). There are no narrow channels in the SOCAL Range Complex therefore it is unlikely that mid- or high-frequency active sonar would cause beaked whales to strand.

TTS

A temprorary threshold shift is a temporary increase in the threshold to hear a sound (usually less than 10 dB) over a small range of frequencies related to the sound source it was exposed to. The animal does not become deaf but requires a louder sound stimulus (relative to the amount of TTS) to detect that sound within the affected frequencies. TTS may last several minutes to several days and the duration is related to the intensity of the sound source and the duration of the sound. Sonar exposures are general short in duration and intermittent (several sonar pings per minute from a moving ship), and with mitigation measures in place, TTS in marine mammals exposed to mid- or high-frequency active sonar is unlikely to occur. There is currently no information to suggest that if an animal has TTS, that it will decrease the survival rate or reproductive fitness of that animal.

PTS

A permanent threshold shift is a permanent increase in the threshod to hear a sound (about 20 dB above TTS as determined in terrestrial animals) over a small range of frequencies related to the sound exposure. The animal does not become deaf but requires a louder sound stimulus (relative to the amount of PTS) to detect that sound within the affected frequencies. Sonar exposures are general short in duration and intermittent (several sonar pings per minute from a moving ship), and with mitigation measures in place, PTS in marine mammals exposed to mid- or high-frequency active sonar is unlikely to occur. There is currently no information to suggest that if an animal has PTS that it decrease the survival rate or reproductive fitness of that animal.

Population Level Effects

Some SOCAL Range Complex training activities will be conducted in the same general areas, so marine mammal populations could be exposed to repeated activities over time. The acoustic analyses assume that short-term non-injurious sound levels predicted to cause TTS or temporary behavioral disruptions qualify as Level B harassment. Application of this criterion assumes an effect even though it is highly unlikely that all behavioral disruptions or instances of TTS will result in long-term significant effects. Approximately 62% (HRC Supplemental EIS) of the exposures modeled for the SOCAL Range Complex would be below 170 dB SPL and are below the previously use behavioral threshold used for RIMPAC, USWEX and COMPTUEX-JTFEX exercises. Mitigation measures reduce the likelihood of exposures to sound levels that would cause significant behavioral disruption, TTS or PTS. It is unlikely that the short term behavioral disruption would cause biologically significant or population level effects such as decreased survivor rate or reproductive fitness.

4.7 NO ACTION ALTERNATIVE

4.7.1 Non-Sonar Acoustic Impacts and Non-Acoustic Impacts

Ship Noise

Increased number of ships operating in the area will result in increased sound from vessel traffic. Marine mammals react to vessel-generated sounds in a variety of ways. Some respond negatively by retreating or engaging in antagonistic responses while other animals ignore the stimulus altogether (Watkins 1986; Terhune and Verboom 1999). Most studies have ascertained the short-term response to vessel sound and vessel traffic (Watkins et al. 1981; Baker et al. 1983; Magalhães et al. 2002); however, the long-term implications of ship sound on marine mammals is largely unknown (NMFS 2007). Anthropogenic sound, especially around regional commercial shipping hubs has increased in the marine environment over the past 50 years (Richardson, et al. 1995; Andrew et al. 2002; NRC 2003; Hildebrand 2004; NRC 2005). This sound increase can be attributed primarily to increases in vessel traffic as well as sound from other human sources (Richardson, et al. 1995; NRC 2005). NRC (2005) has a thorough discussion of both human and natural underwater sound sources.

Given the current ambient sound levels in the Southern California marine environment, the amount of sound contributed by the use of Navy vessels in the proposed exercises is very low. In addition, as opposed to commercial vessels, Navy ships are purposely designed and engineered for the lowest underwater acoustic signature possible given the limits of current naval shipbuilding technology. The goal with ship silencing technology is to limit the amount of sound a Navy vessel radiates that could be used by a potential adversary for detection. Given these factors, it is anticipated that any marine mammals exposed may exhibit either nor reactions or only short-term reactions, and would not suffer any long-term consequences from ship sound. This assessment is also applicable to discussions of Alternatives 1 and 2.

Ship Strikes

Collisions with commercial and Navy ships can cause major wounds and may occasionally cause fatalities to cetaceans. The most vulnerable marine mammals are those that spend extended periods of time at the surface in order to restore oxygen levels within their tissues after deep dives (e.g., sperm whale). In addition, some baleen whales, such as the northern right whale and fin whale swim slowly and seem generally unresponsive to ship sound, making them more susceptible to ship strikes (Nowacek et al. 2004). Smaller marine mammals-for example, Pacific white-side dolphins and common dolphins move quickly throughout the water column and are often seen riding the bow wave of large ships. Marine mammal responses to vessels may include avoidance and changes in dive pattern (NRC 2003).

The Navy has adopted mitigation measures that reduce the potential for collisions with surfaced marine mammals and sea turtles (See Chapter 5). These standard operating procedures include: (1) use of lookouts trained to detect all objects on the surface of the water, including marine mammals; (2) reasonable and prudent actions to avoid the close interaction of Navy assets and marine mammals; and (3) maneuvering to keep away from any observed marine mammal. Based on these standard operating procedures, collisions with marine mammals are not expected. This assessment is also applicable to discussions of Alternatives 1 and 2.

Torpedoes

There is a negligible risk that a marine mammal could be struck by a torpedo during ASW training activities. This conclusion is based on (1) review of torpedo design features, and (2) review of a large number of previous naval exercise ASW torpedo activities. The acoustic homing programs of torpedoes are designed to detect either the mechanical sound signature of the submarine or active sonar returns from its metal hull with large internal air volume interface. The torpedoes are specifically designed to ignore false targets. As a result, their homing logic does not detect or recognize the relatively small air volume associated with the lungs of marine mammals. They do not detect or home to marine mammals. The Navy has conducted exercise torpedo activities since 1968. At least 14,322 exercise torpedo runs have been conducted since

1968. There have been no recorded or reported instances of a marine species strike by an exercise torpedo. Every exercise torpedo activity is monitored acoustically by on-scene range personnel listening to range hydrophones positioned on the ocean floor in the immediate vicinity of the torpedo activity. After each torpedo run, the recovered exercise torpedo is thoroughly inspected for any damage. The torpedoes then go through an extensive production line refurbishment process for re-use. This production line has stringent quality control procedures to ensure that the torpedo will safely and effectively operate during its next run. Since these exercise torpedoes are frequently used against manned Navy submarines, this post activity inspection process is thorough and accurate. Inspection records and quality control documents are prepared for each torpedo run. This post exercise inspection is the basis that supports the conclusion of negligible risk of marine mammal strike. Therefore, there will be no significant impact and no significant harm to marine mammals resulting from interactions with torpedoes during SOCAL activities under the No Action Alternative, Alternative 1, or Alternative 2. The probability of direct strike of torpedoes associated with SOCAL training is negligible and therefore will have no effect on ESA-listed marine mammal species.

Military Expendable Material

Marine mammals are subject to entanglement in expended materials, particularly anything incorporating loops or rings, hooks and lines, or sharp objects. Most documented cases of entanglements occur when whales encounter the vertical lines of fixed fishing gear. This section analyzes the potential effects of expended materials on marine mammals

The Navy endeavors to recover expended training materials. Notwithstanding, it is not possible to recover all training debris, and some may be encountered by marine mammals in the waters of the SOCAL Range Complex. Debris related to military activities that is not recovered generally sinks; the amount that might remain on or near the sea surface is low, and the density of such debris in the SOCAL Range Complex would be very low. Types of training debris that might be encountered include: parachutes of various types (e.g., those employed by personnel or on targets, flares, or sonobuoys); torpedo guidance wires, torpedo "flex hoses;" cable assemblies used to facilitate target recovery; sonobuoys; and Expendable Mobile Acoustic Training Target s (EMATT)

Entanglement in military-related debris was not cited as a source of injury or mortality for any marine mammals recorded in a large marine mammal and sea turtle stranding database for California waters. Range debris is highly unlikely to affect marine mammal species in the SOCAL Range Complex. The following discussion addresses categories of debris.

Sonobuoys. A sonobuoy is approximately 13 centimeters (cm) (5 inches [in]) in diameter, 1 meter (m) (3 feet [ft]) long, and weighs between 6 and 18 kilograms (kg) (14 and 39 pounds [lb]), depending on the type. In addition, aircraft-launched sonobuoys deploy a nylon parachute of varying sizes, ranging from 0.15 to 0.35 square meters (m2) (1.6 to 3.8 square feet [ft2]). The shroud lines range from 0.30 to 0.53 m (12 to 21 in) in length and are made of either cotton polyester with a 13.6-kg (30-lb) breaking strength or nylon with a 45.4-kg (100-lb) breaking strength. All parachutes are weighted with a 0.06-kg (2-ounce) steel material weight, which causes the parachute to sink from the surface within 15 minutes. At water impact, the parachute assembly, battery, and sonobuoy will sink to the ocean floor where they will be buried into its soft sediments or land on the hard bottom where they will eventually be colonized by marine organisms and degrade over time. These components are not expected to float at the water surface or remain suspended within the water column. Over time, the amount of materials will accumulate on the ocean floor. However, the active sonar activities using sonobuoys will not likely occur in the exact same location each time. Additionally, the materials will not likely settle in the same vicinity due to ocean currents.

Parachutes. Aircraft-launched sonobuoys, flares, torpedoes, and EMATTs deploy nylon parachutes of varying sizes. As described above, at water impact, the parachute assembly is expended and sinks, as all of the material is negatively buoyant. Some components are metallic and will sink rapidly. Entanglement and the eventual drowning of a marine mammal in a parachute assembly would be unlikely, since such an event would require the parachute to land directly on an animal, or the animal would have to swim into it before it sinks. The expended material will accumulate on the ocean floor and will be covered by sediments over time, remaining on the ocean floor and reducing the potential for entanglement. If bottom currents are present, the canopy may billow (bulge) and pose an entanglement threat to marine animals with bottom-feeding habits; however, the probability of a marine mammal encountering a submerged parachute assembly and the potential for accidental entanglement in the canopy or suspension lines is considered to be unlikely.

Torpedoes. The Mk-48 will be used during active sonar activities. These devices are approximately 19 ft (580 cm) long and 21 in (53 cm) in diameter. Mk-48 torpedoes when used in a non-detonation exercise mode are typically recovered. An assortment of air launch accessories, all of which consist of non-hazardous materials, would be expended into the marine environment during air launching of Mk-46 or Mk-54 torpedoes, which are lightweight torpedoes. Depending on the type of launch craft used, Mk-46 launch accessories may be comprised of a protective nose cover, suspension bands, air stabilizer, release wire, and propeller baffle (DoN 1996). Mk-54 air launch accessories may be comprised of a nose cap, suspension bands, air stabilizer, sway brace pad, arming wire, and fan stock clip (DoN 1996). Upon completion of an M6-46 EXTORP run, two steel-jacketed lead ballast weights are released to lighten the torpedo, allowing it to rise to the surface for recovery. Each ballast weighs 37 lbs (16.8 kg) and sinks rapidly to the bottom. In addition to the ballasted Mk-46 EXTORPs, Mk-46 REXTORPs launched from maritime patrol aircraft (MPA) must also be ballasted for safety purposes. Ballast weights for these REXTORPs are similarly released to allow for missile recovery. Ballasting the Mk-46 REXTORP for MPA use requires six ballasts, totaling 180 lbs (82 kg) of lead

Torpedo Guidance Wires. Torpedoes are equipped with a single-strand guidance wire, which is laid behind the torpedo as it moves through the water. The guidance wire is a maximum of 0.11 cm (0.043 in) in diameter and composed of a very fine thin-gauge copper-cadmium core with a polyolefin coating. The tensile breaking strength of the wire is a maximum of 19 kg (42 lb) and can be broken by hand. Up to 28 km (15 miles [mi]) of wire is deployed during a run, which will sink to the sea floor at a rate of 0.15 meters per second (m/sec) (0.5 feet per second [ft/sec]). At the end of a training torpedo run, the wire is released from the firing vessel and the torpedo to enable torpedo recovery. The wire sinks rapidly and settles on the ocean floor. Guidance wires are expended with each exercise torpedo launched. DoN (1996) analyzed the potential entanglement effects of torpedo control wires on sea turtles. The Navy analysis concluded that the potential for entanglement effects will be low for the following reasons, which apply also to potential entanglement of marine mammals:

- The guidance wire is a very fine, thin-gauge copper-cadmium core with a polyolefin coating. The tensile breaking strength of the wire is a maximum of 19 kg (42 lb) and can be broken by hand. With the exception of a chance encounter with the guidance wire while it was sinking to the sea floor (at an estimate rate of 0.2 m [0.5 ft] per second), a marine animal would be vulnerable to entanglement only if its diving and feeding patterns place it in contact with the bottom.
- The torpedo control wire is held stationary in the water column by drag forces as it is pulled from the torpedo in a relatively straight line until its length becomes sufficient for it to form a chain-like droop. When the wire is cut or broken, it is relatively straight and

the physical characteristics of the wire prevent it from tangling, unlike the monofilament fishing lines and polypropylene ropes identified in the entanglement literatures.

While it is possible that a marine mammal would encounter a torpedo guidance wire as it sinks to the ocean floor, the likelihood of such an event is considered remote, as is the likelihood of entanglement after the wire has descended to and rests upon the ocean floor.

Given the low potential probability of marine mammal entanglement with guidance wires, the potential for any harm or harassment to these species is extremely low. Therefore, there will be no significant impact to marine mammals resulting from interactions with torpedo guidance wire during SOCAL activities under the No Action Alternative, Alternative 1, and Alternative 2. In addition, there will be no significant harm to marine mammals resulting from interactions with torpedo guidance wire during. The torpedo guidance wires associated with SOCAL activities will also have no effect on ESA-listed marine mammal species

Torpedo Flex Hoses. The flex hose protects the torpedo guidance wire and prevents it from forming loops as it leaves the torpedo tube of a submarine. Improved flex hoses or strong flex hoses will be expended during torpedo exercises. DoN (1996) analyzed the potential for the flex hoses to affect sea turtles. This analysis concluded that the potential entanglement effects to marine animals will be insignificant for reasons similar to those stated for the potential entanglement effects of control wires:

- Due to weight, flex hoses will rapidly sing to the bottom upon release. With the exception of a chance encounter with the flex hose while it was sinking to the sea floor, a marine mammal would be vulnerable to entanglement only if its diving and feeding patterns placed it in contact with the bottom.
- Due to its stiffness, the 250-ft-long flex hose will not form loops that could entangle marine mammals.

Therefore, there will be no significant impact to marine mammals resulting from interactions with torpedo flex hoses under the No Action Alternative, Alternative 1, or Alternative 2. In addition, there will be no significant harm to marine mammals or ESA-listed marine species resulting from interactions with torpedo flex hoses.

EMATT. The Navy uses the EMATT and the MK-30 acoustic training targets (recovered), sonobuoys and exercise torpedoes during ASW sonar training exercises. EMATTs are approximately 5 by 36 inches (in) (12 by 91 centimeters [cm]) and weigh approximately 21 pounds (lbs). EMATTs are much smaller than sonobuoys and ADCs. Given the small sized of EMATTs and coupled with the low probability that an animal would occur at the immediate location of deployment and reconnaissance, provide little potential for a direct strike. Moreover, there is a negligible risk that a marine mammal could be struck by a torpedo during ASW training activities. The acoustic homing programs of torpedoes are designed to detect either the mechanical sound signature of the submarine or active sonar returns from its metal hull with large, internal air volume interface. Their homing logic does not detect or recognize the relatively small air volume associated with the lungs of marine mammals.

Therefore, the probability of direct strike by training target is remote, and there will be no significant impact to marine mammals resulting from interactions with targets, or exercise torpedoes during SOCAL activities under the No Action Alternative, Alternative 1, and Alternative 2. In addition, there will be no significant harm to marine mammals or ESA-listed marine species from interactions with targets, or exercise torpedoes.

EMATTs, their batteries, parachutes, and other components will scuttle and sink to the ocean floor and will be covered by sediments over time. In addition, the small amount of expended material will be spread over a relatively large area. Due to the small size and low density of the materials, these components are not expected to float at the water surface or remain suspended within the water column. Over time, the amount of materials will accumulate on the ocean floor, but due to ocean currents, the materials will not likely settle in the same vicinity. There will be no significant impact to marine habitat from expended EMATTs or their components.

Other Falling Expendable Material. Marine mammals are widely dispersed in the SOCAL Range Complex, therefore, there is an extremely low probability of injury to a marine mammal from falling debris such as munitions constituents, inert ordnance, or targets. The probability of negative interaction from direct strike, sound, or other energy by expendable material is remote. Therefore, there will be no significant impact to marine mammals resulting from interactions with targets, or exercise torpedoes during SOCAL activities under the No Action Alternative, Alternative 1, and Alternative 2. In addition, there will be no significant harm to marine mammals or ESA-listed marine species from interactions with targets, or exercise torpedoes.

4.7.2 Summary of Potential Mid- and High-Frequency Active Sonar Effects

The following table represents the number of sonar hours, dipping sonar, or sonobuoys usage per year for the different sonar sources including the 53C, 56C, submarine, AN/AWS-22 dipping sonar, SSQ-62 Sonobuoys, and MK-48 torpedo sonar.

Table 4-13. Summary of the sonar hours, number of sonar dips and sonobuoys deployed, and MK-48 torpedo events for each type of exercise for the No Action Alternative.

Event	SQS-53 C Sonar Hours	SQS-56 C Sonar Hours	Total Sonar Hours	AQS-22 Number of Dips	SSQ-62 Number of Sonobuoys	MK-48 Number of Torpedo Events
Major Exercise (8/yr)	927	231	1,158	299	1,999	9
Sustainment Exercise (2/yr)	75	19	94	39	151	3
IAC II (4/yr)	216	55	271	361	453	2
ULT, Coordinated Events & Maintenance	535	133	668	1,712	1,169	62
Total	1,753	438	2,191	2,411	3,773	77

Table 4-14 presents a summary of the estimated marine mammal exposures for potential non-injurious (Level B) harassment, as well as potential onset of injury (Level A) to cetaceans and pinnipeds. Tables 4-19 through 4-18 present estimated marine mammal exposures further separated by component activites as listed in Table 4-13. The numbers contained in these tables may be slightly less than those presented in Table 4-14 as a result of the order of summation and the application of rounding rules utilized in the calculation of exposures.

Specifically, under this assessment for mid-frequency active sonar, the risk function methodology estimates 83,686 annual exposures that could potentially result in behavioral sub-TTS (Level B Harassment); 16,706 annual exposures that could potentially result in TTS (Level B Harassment); and 26 annual exposures could result in potential injury as PTS (Level A Harassment). No mid-frequency active sonar exposures are predicted to result in any animal mortality.

It should be noted, however, that these exposure modeling results are statistically derived estimates of potential marine mammal sonar exposures without consideration of standard mitigation and monitoring procedures. The caveats to intrepreations of model results are explained previously. It is highly unlikely that a marine mammal would experience any long-term effects because the large SOCAL Range Complex training areas makes individual mammals' repeated or prolonged exposures to high-level sonar signals unlikely. Specifically, mid-frequency active sonars have limited marine mammal exposure ranges and relatively high platform speeds. The number of exposures that exceed the PTS threshold and result in Level A harassment from sonar is eight for six species (blue whale, gray whale, sperm whale, long-beaked common dolphin, shortbeaked common dolphin, and Pacific harbor seal). Therefore, long term effects on individuals, populations or stocks are unlikely.

When analyzing the results of the acoustic exposure modeling to provide an estimate of effects, it is important to understand that there are limitations to the ecological data (diving behavior, migration or movement patterns and population dynamics) used in the model, and that the model results must be interpreted within the context of a given species' ecology.

As described previously, this authorization request assumes that short-term non-injurious sound exposure levels predicted to cause TTS or temporary behavioral disruptions qualify as Level B harassment. This approach is overestimating because there is no established scientific correlation between mid-frequency active sonar use and long term abandonment or significant alteration of behavioral patterns in marine mammals.

Because of the time delay between pings, and platform speed, an animal encountering the sonar will accumulate energy for only a few sonar pings over the course of a few minutes. Therefore, exposure to sonar would be a short-term event, minimizing any single animal's exposure to sound levels approaching the harassment thresholds.

The implementation of the mitigation and monitoring procedures as addressed in Section 11 will further minimize the potential for marine mammal exposures to underwater detonations. When reviewing the acoustic exposure modeling results, it is also important to understand that the estimates of marine mammal sound exposures are presented without consideration of standard protective measure operating procedures. Section 11 presents details of the mitigation measures currently used for ASW activities including detection of marine mammals and power down procedures if marine mammals are dectected within one of the safety zones. The Navy will work through the MMPA incidental harassment regulatory process to discuss the mitigation measures and their potential to reduce the likelihood for incidental harassment of marine mammals.

Table 4-14. No-Action Alternative: Summary of All Annual Mid- and High- Frequency Active Sonar Exposures

Species	Level B Sonar Exposures		Level A Sonar Exposures
	Risk Response	TTS	PTS
ESA Species			
Blue whale	463	113	1
Fin whale	101	21	0
Humpback whale	12	2	0
Sei whale	0	0	0
Sperm whale	104	17	1
Guadalupe fur seal	807	285	0
Sea otter	N/A	N/A	N/A
Mysticetes			
Bryde's whale	0	0	0
Gray whale	4,797	901	2
Minke whale	90	26	0
Odontocetes			
Baird's beaked whale	8	2	0
Bottlenose dolphin	853	317	0
Cuvier's beaked whale	288	63	0
Dall's porpoise	419	145	0
Dwarf sperm whale	N/A	N/A	N/A
False killer whale	N/A	N/A	N/A
Killer whale	6	2	0
Long beaked common dolphin	2,255	715	1
Longman's beaked whale	N/A	N/A	N/A
Melon-headed whale	N/A	N/A!	N/A
Mesoplodon spp.	86	22	0
Northern right whale dolphin	811	277	0
Pacific white-sided dolphin	756	312	0
Pantropical spotted dolphin	N/A	N/A	N/A
Pygmy killer whale	N/A	N/A	N/A
Pygmy sperm whale	108	27	0
Risso's dolphin	1,968	570	0
Rough-toothed dolphin	N/A	N/A	N/A
Short beaked common dolphin	19,377	6,148	8
Short-finned pilot whale	34	9	0
Spinner dolphin	N/A	N/A	N/A
Striped dolphin	1,401	411	0
Ziphiid whales	65	15	0
Pinnipeds			
Northern elephant seal	599	7	0
Pacific harbor seal	906	6,290	13
California sea lion	46,715	5	0
Northern fur seal	656	5	0
Total	**83,686**	**16,706**	**26**

Thresholds: Cetaceans TTS = 195 dB re 1 μPa^2-s; PTS = 215 dB, re 1 μPa^2-s, northern elephant seal TTS = 204 re 1 μPa^2-s, PTS = 224 re 1 μPa^2-s; harbor seal TTS = 183 re 1 μPa^2-s, PTS = 203; Otariids TTS = 206 re 1 μPa^2-s, PTS = 226 re 1 μPa^2-s.

Table 4-15. No Action Alternative Summary of ULT, Coordinated Events and Maintenance Annual Sonar Exposures

Species	Level B Sonar Exposures		Level A Sonar Exposures
	Risk Function	TTS	PTS
ESA Species			
Blue whale	212	52	0
Fin whale	44	9	0
Humpback whale	6	1	0
Sei whale	0	0	0
Sperm whale	46	8	0
Guadalupe fur seal	372	138	0
Sea otter	0	0	0
Mysticetes			
Bryde's whale	0	0	0
Gray whale	2,254	410	1
Minke whale	41	12	0
Odontocetes			
Baird's beaked whale	4	1	0
Bottlenose dolphin	394	146	0
Cuvier's beaked whale	124	30	0
Dall's porpoise	191	66	0
Dwarf sperm whale	N/A	N/A	N/A
False killer whale	N/A	N/A	N/A
Killer whale	3	1	0
Long beaked common dolphin	1,083	333	1
Longman's beaked whale	N/A	N/A	N/A
Melon-headed whale	N/A	N/A	N/A
Mesoplodon spp.	39	10	0
Northern right whale dolphin	380	129	0
Pacific white-sided dolphin	356	143	0
Pantropical spotted dolphin	N/A	N/A	N/A
Pygmy killer whale	N/A	N/A	N/A
Pygmy sperm whale	48	13	0
Risso's dolphin	899	268	0
Rough-toothed dolphin	N/A	N/A	N/A
Short beaked common dolphin	9,312	2,861	4
Short-finned pilot whale	16	5	0
Spinner dolphin	N/A	N/A	N/A
Striped dolphin	641	187	0
Ziphiid whales	28	7	0
Pinnipeds			
Northern elephant seal	394	5	0
Pacific harbor seal	564	3,940	8
California sea lion	22,651	4	0
Northern fur seal	308	2	0
Total	**40,409**	**8,780**	**14**

TTS and PTS Thresholds: Cetaceans TTS = 195 dB re 1 μPa^2-s; PTS = 215 dB, re 1 μPa^2-s; Northern elephant seal TTS = 204 re 1 μPa^2-s, PTS = 224 re 1 μPa^2-s; Harbor seal TTS = 183 re 1 μPa^2-s, PTS = 203 re 1 μPa^2-s; Otariids TTS = 206 re 1 μPa^2-s, PTS = 226 re 1 μPa^2-s.

N/A: Not applicable – Based on a few historic observations, its habitat preference or overall distribution, a species may occur rarely in the SOCAL Range Complex, but no density estimates were available for modeling exposures.

Table 4-16. No Action Alternative Summary of Major Exercise Annual Sonar Exposures

Species	Level B Sonar Exposures		Level A Sonar Exposures
	Risk Function	TTS	PTS
ESA Species			
Blue whale	190	45	0
Fin whale	43	8	0
Humpback whale	5	1	0
Sei whale	0	0	0
Sperm whale	44	6	0
Guadalupe fur seal	326	117	0
Sea otter	0	0	0
Mysticetes			
Bryde's whale	0	0	0
Gray whale	1,898	368	1
Minke whale	37	10	0
Odontocetes			
Baird's beaked whale	4	1	0
Bottlenose dolphin	340	127	0
Cuvier's beaked whale	125	24	0
Dall's porpoise	172	59	0
Dwarf sperm whale	N/A	N/A	N/A
False killer whale	N/A	N/A	N/A
Killer whale	2	1	0
Long beaked common dolphin	849	282	0
Longman's beaked whale	N/A	N/A	N/A
Melon-headed whale	N/A	N/A	N/A
Mesoplodon spp.	36	8	0
Northern right whale dolphin	317	110	0
Pacific white-sided dolphin	294	126	0
Pantropical spotted dolphin	N/A	N/A	N/A
Pygmy killer whale	N/A	N/A	N/A
Pygmy sperm whale	45	10	0
Risso's dolphin	799	221	0
Rough-toothed dolphin	N/A	N/A	N/A
Short beaked common dolphin	7,291	2,423	4
Short-finned pilot whale	14	4	0
Spinner dolphin	N/A	N/A	N/A
Striped dolphin	569	167	0
Ziphiid whales	28	6	0
Pinnipeds			
Northern elephant seal	165	2	0
Pacific harbor seal	237	1,598	4
California sea lion	19,176	1	0
Northern fur seal	257	2	0
Total	**33,261**	**5,726**	**9**

TTS and PTS Thresholds: Cetaceans TTS = 195 dB re 1 μPa^2-s; PTS = 215 dB, re 1 μPa^2-s; Northern elephant seal TTS = 204 re 1 μPa^2-s, PTS = 224 re 1 μPa^2-s; Harbor seal TTS = 183 re 1 μPa^2-s, PTS = 203 re 1 μPa^2-s; Otariids TTS = 206 re 1 μPa^2-s, PTS = 226 re 1 μPa^2-s.

N/A: Not applicable – Based on a few historic observations, its habitat preference or overall distribution, a species may occur rarely in the SOCAL Range Complex, but no density estimates were available for modeling exposures.

Table 4-17. No Action Alternative Summary of IAC II Annual Sonar Exposures

Species	Level B Sonar Exposures		Level A Sonar Exposures
	Risk Function	TTS	PTS
ESA Species			
Blue whale	43	11	0
Fin whale	9	2	0
Humpback whale	1	0	0
Sei whale	0	0	0
Sperm whale	9	2	0
Guadalupe fur seal	75	21	0
Sea otter	0	0	0
Mysticetes			
Bryde’s whale	0	0	0
Gray whale	445	86	0
Minke whale	8	3	0
Odontocetes			
Baird’s beaked whale	1	0	0
Bottlenose dolphin	83	31	0
Cuvier’s beaked whale	26	7	0
Dall’s porpoise	39	14	0
Dwarf sperm whale	N/A	N/A	N/A
False killer whale	N/A	N/A	N/A
Killer whale	1	0	0
Long beaked common dolphin	233	71	0
Longman’s beaked whale	N/A	N/A	N/A
Melon-headed whale	N/A	N/A	N/A
Mesoplodon spp.	8	2	0
Northern right whale dolphin	81	27	0
Pacific white-sided dolphin	74	30	0
Pantropical spotted dolphin	N/A	N/A	N/A
Pygmy killer whale	N/A	N/A	N/A
Pygmy sperm whale	10	3	0
Risso’s dolphin	189	57	0
Rough-toothed dolphin	N/A	N/A	N/A
Short beaked common dolphin	2,000	607	1
Short-finned pilot whale	3	1	0
Spinner dolphin	N/A	N/A	N/A
Striped dolphin	133	39	0
Ziphiid whales	6	2	0
Pinnipeds			
Northern elephant seal	31	0	0
Pacific harbor seal	82	588	1
California sea lion	3,280	0	0
Northern fur seal	65	1	0
Total	**6,936**	**1,606**	**2**

TTS and PTS Thresholds: Cetaceans TTS = 195 dB re 1 μPa^2-s; PTS = 215 dB, re 1 μPa^2-s; Northern elephant seal TTS = 204 re 1 μPa^2-s, PTS = 224 re 1 μPa^2-s; Harbor seal TTS = 183 re 1 μPa^2-s, PTS = 203 re 1 μPa^2-s; Otariids TTS = 206 re 1 μPa^2-s, PTS = 226 re 1 μPa^2-s.

N/A: Not applicable – Based on a few historic observations, its habitat preference or overall distribution, a species may occur rarely in the SOCAL Range Complex, but no density estimates were available for modeling exposures.

Table 4-18. No Action Alternative Summary of Sustainment Annual Sonar Exposures

Species	Level B Sonar Exposures		Level A Sonar Exposures
	Risk Function	TTS	PTS
ESA Species			
Blue whale	19	5	0
Fin whale	4	1	0
Humpback whale	1	0	0
Sei whale	0	0	0
Sperm whale	5	1	0
Guadalupe fur seal	34	10	0
Sea otter	0	0	0
Mysticetes			
Bryde's whale	0	0	0
Gray whale	200	38	0
Minke whale	4	1	0
Odontocetes			
Baird's beaked whale	0	0	0
Bottlenose dolphin	36	13	0
Cuvier's beaked whale	12	3	0
Dall's porpoise	17	6	0
Dwarf sperm whale	N/A	N/A	N/A
False killer whale	N/A	N/A	N/A
Killer whale	0	0	0
Long beaked common dolphin	90	30	0
Longman's beaked whale	N/A	N/A	N/A
Melon-headed whale	N/A	N/A	N/A
Mesoplodon spp.	4	1	0
Northern right whale dolphin	34	11	0
Pacific white-sided dolphin	31	13	0
Pantropical spotted dolphin	N/A	N/A	N/A
Pygmy killer whale	N/A	N/A	N/A
Pygmy sperm whale	5	1	0
Risso's dolphin	82	24	0
Rough-toothed dolphin	N/A	N/A	N/A
Short beaked common dolphin	775	256	0
Short-finned pilot whale	1	0	0
Spinner dolphin	N/A	N/A	N/A
Striped dolphin	58	17	0
Ziphiid whales	3	1	0
Pinnipeds			
Northern elephant seal	9	0	0
Pacific harbor seal	24	165	0
California sea lion	1,608	0	0
Northern fur seal	26	0	0
Total	**3,080**	**594**	**0**

TTS and PTS Thresholds: Cetaceans TTS = 195 dB re 1 μPa^2-s; PTS = 215 dB, re 1 μPa^2-s; Northern elephant seal TTS = 204 re 1 μPa^2-s, PTS = 224 re 1 μPa^2-s; Harbor seal TTS = 183 re 1 μPa^2-s, PTS = 203 re 1 μPa^2-s; Otariids TTS = 206 re 1 μPa^2-s, PTS = 226 re 1 μPa^2-s.

N/A: Not applicable – Based on a few historic observations, its habitat preference or overall distribution, a species may occur rarely in the SOCAL Range Complex, but no density estimates were available for modeling exposures.

4.7.3 Summary of Potential Underwater Detonation Effects

The modeled exposure harassment numbers for all training operations involving explosives are presented by species in Table 4-19. The modeling indicates 635 annual exposures to pressure from underwater detonations that could potentially result in TTS (Level B Harassment); 28 annual exposures from pressure from underwater detonations that could cause slight injury (Level A Harassment); and eight exposures that could cause severe injury or mortality.

Training operations involving explosives include Mine Neutralization, Air to Surface Missile Exercise, Surface to Surface Missile Exercise, Bombing Exercise, Sinking Exercise, Surface to Surface Gunnery exercise, and Naval Surface Fire Support. In a SINKEX, weapons are typically fired in order of decreasing range from the source with weapons fired until the target is sunk. Since the target may sink at any time during the exercise, the actual number of weapons used can vary widely. In the representative case, however, all of the ordnances are assumed expended; this represents the worst case of maximum exposure.

These exposure modeling results are estimates of marine mammal underwater detonation sound exposures without considerating similar model limitations as discussed in the summary of mid-frequency active sonar sub-section (Section 4.7.2). In addition, implementation of the mitigation and monitoring procedures as addressed in Section 11 will further minimize the potential for marine mammal exposures to underwater detonations.

Table 4-15. No-Action Underwater Detonation Exposures Summary.

Species	Level B Exposures	Level A Exposures	
	TTS 182 dB re 1 µPa^2-s /23 psi	50% TM Rupture 205 dB re 1 µPa^2-s Slight Lung Injury or 13 psi-ms	Onset Massive Lung Injury or Mortality 31 psi-ms
ESA Species			
Blue whale	1	1	0
Fin whale	0	0	0
Humpback whale	0	0	0
North Pacific right whale	N/A	N/A	N/A
Sei whale	0	0	0
Sperm whale	0	0	0
Guadalupe fur seal	2	0	0
Sea otter	N/A	N/A	N/A
Mysticetes			
Bryde's whale	0	0	0
Gray whale	5	0	0
Minke whale	0	0	0
Odontocetes			
Baird's beaked whale	0	0	0
Bottlenose dolphin	5	0	0
Cuvier's beaked whale	1	0	0
Dall's porpoise	1	0	0
Dwarf sperm whale	N/A	N/A	N/A
False killer whale	N/A	N/A	N/A
Killer whale	0	0	0
Long-beaked common dolphin	20	1	0
Longman's beaked whale	N/A	N/A	N/A
Melon-headed whale	N/A	N/A	N/A
Mesoplodon spp.	0	0	0
Northern right whale dolphin	5	0	0
Pacific white-sided dolphin	5	0	0
Pantropical spotted dolphin	N/A	N/A	N/A
Pygmy killer whale	N/A	N/A	N/A
Pygmy sperm whale	0	0	0
Risso's dolphin	12	1	0
Rough-toothed dolphin	N/A	N/A	N/A
Short-beaked common dolphin	175	9	3
Short-finned pilot whale	0	0	0
Spinner dolphin	N/A	N/A	N/A
Striped dolphin	5	0	0
Ziphiid whale	0	0	0
Pinnipeds			
Northern elephant seal	13	0	0
Pacific harbor seal	19	1	0
California sea lion	333	13	4
Northern fur seal	33	2	1
Total	**635**	**28**	**8**

N/A: Not applicable – Based on a few historic observations, its habitat preference or overall distribution, a species may occur rarely in the SOCAL Range Complex, but no density estimates were available for modeling exposures

4.7.4 Species-Specific Potential Impacts: No Action Alternative

Blue Whale (*Balaenoptera musculus*)

The risk function and Navy post-modeling analysis estimates 463 blue whales will exhibit behavioral responses NMFS will classify as harassment under the MMPA (Table 4-14). Modeling also indicates there would be 113 exposures to accumulated acoustic energy above 195 dB re 1 μPa^2-s, which is the threshold established indicative of onset TTS. One blue whale would be exposed to sound levels that could cause PTS.

One blue whale would be exposed to impulsive sound or pressures from underwater detonations that would cause TTS one that would be exposed to slight physical injury, no blue whales would be exposed to impulsive sound or pressures that would cause severe injury or mortality (Table 4-19).

Given the large size (up to 98 ft [30 m]) of individual blue whales (Leatherwood et al. 1982), pronounced vertical blow, and aggregation of approximately two to three animals in a group (probability of track line detection = 0.90 in Beaufort Sea States of 6 or less; Barlow 2003), it is very likely that lookouts would detect a group of blue whales at the surface. Additionally, mitigation measures call for continuous visual observation during operations with active sonar; therefore, blue whales that migrate into the operating area would be detected by visual observers. Implementation of mitigation measures and probability of detecting a large blue whale reduces the likelihood of exposure to sound levels that would likely cause a behavioral response that would affect vital rates (foraging, reproduction or survival), TTS or PTS. It is unlikely that the short duration and intermittent mid- or high-frequency active sonar exposure would cause a decrease in survivor rate or reproductive fitness.

In the unlikely event that blue whales are exposed to mid-frequency sonar, the anatomical information available on blue whales suggests that they are not likely to hear mid-frequency (1 kHz–10 kHz) sounds (Ketten 1997). There are no audiograms of baleen whales, but blue whales tend to react to anthropogenic sound below 1 kHz (e.g., seismic air guns), and most of their vocalizations are also in that range, suggesting that they are more sensitive to low frequency sounds (Richardson et al. 1995). Based on this information, if they do no hear these sounds, they are not likely to respond physiologically or behaviorally to those received levels.

Based on the model results, behavioral patterns, acoustic abilities of blue whales, results of past training exercises, and the implementation of mitigation measures presented in sections 5.1 for sonar and 5.2 for underwater detonations, the Navy finds that the SOCAL Range Complex training events would not likely result in any population level effects, death or injury to blue whales.

Fin Whale (*Balaenoptera physalus*)

The risk function and Navy post-modeling analysis estimates 101 fin whales will exhibit behavioral responses NMFS will classify as harassment under the MMPA (Table 4-14). Modeling also indicates there would be 21 exposures to accumulated acoustic energy above 195 dB re 1 μPa^2-s, which is the threshold established indicative of onset TTS. No fin whales would be exposed to sound levels that could cause PTS.

No fin whales would be exposed to impulsive sound or pressures from underwater detonations that would cause TTS or physical injury (Table 4-19).

Given the large size (up to 78 ft [24m]) of individual fin whales (Leatherwood et al. 1982), pronounced vertical blow, mean aggregation of three animals in a group (probability of trackline detection = 0.90 in Beaufort Sea States of 6 or less; Barlow 2003) it is very likely that lookouts would detect a group of fin whales at the surface. Additionally, mitigation measures call for continuous visual observation during operations with active sonar, therefore, fin whales in the vicinity of operations would be detected by visual observers. Implementation of mitigation measures and probability of detecting a large fin whale reduces the likelihood of exposures to sound levels that would likely cause a behavioral response that would affect vital rates (foraging, reproduction or survival), TTS or PTS. It is unlikely that the short duration and intermittent mid- or high-frequency active sonar exposure would cause a decrease in survivor rate or reproductive fitness.

In the unlikely event that fin whales are exposed to mid-frequency sonar, the anatomical information available on fin whales suggests that they are not likely to hear mid-frequency (1 kHz–10 kHz) sounds (Richardson et al. 1995; Ketten 1997). Fin whales primarily produce low frequency calls (below 1 kHz) with source levels up to 186 dB re 1µPa at 1 m, although it is possible they produce some sounds in the range of 1.5 to 28 kHz (review by Richardson et al., 1995; Croll et al. 2002). There are no audiograms of baleen whales, but they tend to react to anthropogenic sound below 1 kHz, suggesting that they are more sensitive to low frequency sounds (Richardson et al. 1995). Based on this information, if they do no hear these sounds, they are not likely to respond physiologically or behaviorally to those received levels.

In the St. Lawrence estuary area, fin whales avoided vessels with small changes in travel direction, speed and dive duration, and slow approaches by boats usually caused little response (MacFarlane 1981). Fin whales continued to vocalize in the presence of boat sound (Edds and Macfarlane 1987).

Based on the model results, behavioral patterns, acoustic abilities of fin whales, results of past SOCAL Range Complex training, and the implementation of procedure mitigation measures presented in sections 5.1 for sonar and 5.2 for underwater detonations, the Navy finds that the SOCAL Range Complex training events would likely not result in any population level effects, death or injury to fin whales.

Humpback Whale (*Megaptera novaeangliae*)

The risk function and Navy post-modeling analysis estimates 12 humpback whales will exhibit behavioral responses NMFS will classify as harassment under the MMPA (Table 4-14). Modeling also indicates there would be two exposures to accumulated acoustic energy above 195 dB re 1 μPa^2-s, which is the threshold established indicative of onset TTS. No humpback whales would be exposed to sound levels that could cause PTS.

Without consideration of clearance procedures, there would be no exposures from impulsive sound or pressures from underwater detonations that would exceed the TTS threshold and none that would exceed the onset of slight injury threshold and no exposure that would exceed the onset of massive lung injury threshold (Table 4-19). Target and demolition area clearance procedures would make sure there are no humpback whales within the safety zone and therefore potential exposure of humpback whales to sound levels to sound levels that would likely cause a behavioral response that would affect vital rates (foraging, reproduction or survival), TTS or PTS. It is unlikely that the short duration and intermittent mid- or high-frequency active sonar exposure would cause a decrease in survivor rate or reproductive fitness.

Given the large size (up to 53 ft [16m] of individual humpback whales (Leatherwood et al. 1982), and pronounced vertical blow, it is very likely that lookouts would detect humpback whales at the surface. Additionally, mitigation measures call for continuous visual observation during operations with active sonar, therefore, humpback whales that are present in the vicinity of ASW operations would be detected by visual observers reducing the likelihood of exposure, such that effects would be discountable.

There are no audiograms of baleen whales, but Houser et al. (2001) estimated their hearing rage 700 Hz-10 kHz but they tend to react to anthropogenic sound below 1 kHz, suggesting that they are more sensitive to low frequency sounds (Richardson et al. 1995). A single study suggested that humpback whales responded to mid-frequency sonar (3.1-3.6 kHz re 1 μPa^2-s) sound (Maybaum 1989). The hand held sonar system had a sound artifact below 1,000 Hz which caused a response to the control playback (a blank tape) and may have affected the response to sonar (i.e. the humpback whale responded to the low frequency artifact rather than the mid-frequency active sonar sound). Humpback whales responded to small vessels (often whale watching boats) by changing swim speed, respiratory rates and social interactions depending on proximity to the vessel and vessel speed, with reponses varying by social status and gender (Watkins *et al*. 1981; Bauer, 1986; Bauer and Herman 1986). Animals may even move out of the area in response to vessel noise (Salden 1988). Humpback whale mother-calf pairs are generally in the shallow protected waters. ASW mid-frequency active sonar activities takes place through out the extensive SOCAL Range Complex but the areas inhabited by humpback whales is represents only a small portion of the SOCAL Range Complex. Frankel and Clark (2000; 2002) reported that there was only a minor response by humpback whales to the Acoustic Thermometry of Ocean Climate (ATOC) sound source and that response was variable with some animals being found closer to the sound source during operation.

Based on the model results, behavioral patterns, acoustic abilities of humpback whales, results of past training, and the implementation of procedure mitigation measures presented in sections 5.1 for sonar and 5.2 for underwater detonations, the Navy finds that the SOCAL Range Complex training events would not likely result in any population level effects, death or injury to humpback whales.

Sei Whale (*Balaenoptera borealis*)

The risk function and Navy post-modeling analysis estimates that no sei whales will exhibit behavioral responses NMFS will classify as harassment under the MMPA (Table 4-14). Modeling also indicates there would be no exposures to accumulated acoustic energy above 195 dB re 1 μPa^2-s, which is the threshold established indicative of onset TTS. No sei whales would be exposed to sound levels that could cause PTS.

No sei whales would be exposed to impulsive sound or pressures from underwater detonations that would cause TTS or physical injury (Table 4-19).

Given the large size (up to 53 ft [16m}) of individual sei whales (Leatherwood et al. 1982), pronounced vertical blow, aggregation of approximately three animals (probability of trackline detection = 0.90 in Beaufort Sea States of 6 or less; Barlow 2003), it is very likely that lookouts would detect a group of sei whales at the surface. Additionally, mitigation measures call for continuous visual observation during operations with active sonar, therefore, sei whales that migrate into the operating area would be detected by visual observers. Implementation of mitigation measures and probability of detecting a large sei whale reduces the likelihood of exposure to sound levels that would likely cause a behavioral response that would affect vital rates (foraging, reproduction or survival), TTS or PTS. It is unlikely that the short duration and intermittent mid- or high-frequency active sonar exposure would cause a decrease in survivor rate or reproductive fitness.

There is little information on the acoustic abilities of sei whales or their response to human activities. The only recorded sounds of sei whales are frequency modulated sweeps in the range of 1.5 to 3.5 kHz (Thompson et al. 1979) but it is likely that they also vocalized at frequencies below 1 kHz as do fin whales. There are no audiograms of baleen whales but they tend to react to anthropogenic sound below 1 kHz suggesting that they are more sensitive to low frequency sounds (Richardson et al. 1995). Sei whales were more difficult to approach than were fin whales and moved away from boats but were less responsive when feeding (Gunther 1949).

Based on the model results, behavioral patterns, acoustic abilities of sei whales, results of past training, and the implementation of procedure mitigation measures presented in sections 5.1 for sonar and 5.2 for underwater detonations, the Navy finds that the SOCAL Range Complex training events would not likely result in any death or injury to sei whales, but some Level B behavioral harassment may occur.

Sperm Whales (*Physeter macrocephalus*)

The risk function and Navy post-modeling analysis estimates 104 sperm whales will exhibit behavioral responses NMFS will classify as harassment under the MMPA (Table 4-14). Modeling also indicates there would be 17 exposures to accumulated acoustic energy above 195 dB re 1 μPa^2-s, which is the threshold established indicative of onset TTS. One sperm whale would be exposed to sound levels that could cause PTS.

There would be no exposures from impulsive sound or pressures from underwater detonations that would exceed the TTS threshold (Table 4-19). Target and demolition area clearance procedures would make sure there are no sperm whales within the safety zone, and therefore potential exposure of sperm whales to sound levels that exceed TTS are highly unlikely.

Given the large size (up to 56 ft [17m]) of individual sperm whales (Leatherwood et al. 1982), pronounced blow (large and angled), mean group size of approximately seven animals (probability of trackline detection = 0.87 in Beaufort Sea States of 6 or less; Barlow 2003; 2006), it is very likely that lookouts would detect a group of sperm whales at the surface. Sperm whales can make prolonged dives of up to two hours making detection more difficult but passive acoustic monitoring can detect and localize sperm whales from their calls (Watwood et al. 2006). Additionally, mitigation measures call for continuous visual observation during operations with active sonar; therefore, sperm whales that migrate into the operating area would likely be detected by visual observers when the whales surface. Implementation of mitigation measures and probability of detecting a large sperm whale reduces the likelihood of exposure to sound levels that would likely cause a behavioral response that would affect vital rates (foraging, reproduction or survival), TTS or PTS. It is unlikely that the short duration and intermittent mid- or high-frequency active sonar exposure would cause a decrease in survivor rate or reproductive fitness.

In the unlikely event that sperm whales are exposed to mid-frequency sonar, the information available on sperm whales exposed to received levels of active mid-frequency sonar suggests that the response to mid-frequency (1 kHz to 10 kHz) sounds is variable (Richardson et al. 1995). While Watkins et al. (1985) observed that sperm whales exposed to 3.25 kHz to 8.4 kHz pulses interrupted their activities and left the area, other studies indicate that, after an initial disturbance, the animals return to their previous activity. During playback experiments off the Canary Islands, André et al. (1997) reported that foraging whales exposed to a 10 kHz pulsed signal did not exhibit any general avoidance reactions. When resting at the surface in a compact group, sperm whales initially reacted strongly but then ignored the signal completely (André et al. 1997).

Based on the model results, behavioral patterns, acoustic abilities of sperm whales, results of past training, and the implementation of procedure protective measures presented in sections 5.1 for sonar and 5.2 for underwater detonations, the Navy finds that the SOCAL Range Complex training events would not result in any population level effects, death or injury to sperm whales..

Guadalupe fur Seal (*Arctocephalus townsendi*)

The risk function and Navy post-modeling analysis estimates 807 Guadalupe fur seals will exhibit behavioral responses NMFS will classify as harassment under the MMPA (Table 4-14). Modeling also indicates there would be 285 exposures to accumulated acoustic energy above 195 dB re 1 μPa^2-s, which is the threshold established indicative of onset TTS. No Guadalupe fur seals would be exposed to sound levels that could cause PTS.

Modeling indicates there would be two exposures to impulsive sound or pressures from underwater detonations of 182 dB or 23 psi, which is the threshold indicative of onset TTS and no exposures to impulsive sound or pressures from underwater detonations that would cause slight physical injury (Table 4-19).

Guadalupe fur seals do not dive for long periods and may rest on the surface between foraging bouths (Gallo 1994) making them easier to detect. Additionally, mitigation measures call for continuous visual observation during operations with active sonar; therefore, Guadalupe fur seals that migrate into the operating area would likely be detected by visual observers when the fur seals surface. Implementation of mitigation measures and probability of detecting fur seals resting at the surface reduces the likelihood of exposure to sound levels that would likely cause a behavioral response that would affect vital rates (foraging, reproduction or survival), TTS or PTS. It is unlikely that the short duration and intermittent mid- or high-frequency active sonar exposure would cause a decrease in survivor rate or reproductive fitness.

Based on the model results, behavioral patterns, acoustic abilities of Guadalupe fur seals, results of past training, and the implementation of procedure mitigation measures presented in sections 5.1 for sonar and 5.2 for underwater detonations, the Navy finds that the SOCAL Range Complex training events would not result in any population level effects, death or injury to Guadalupe fur seals.

Bryde's Whale (*Balaenoptera edeni*)

The risk function and Navy post-modeling analysis estimates that no Bryde's whales will exhibit behavioral responses NMFS will classify as harassment under the MMPA (Table 4-14). Modeling also indicates there would be no exposures to accumulated acoustic energy above 195 dB re 1 μPa^2-s, which is the threshold established indicative of onset TTS. No Bryde's whales would be exposed to sound levels that could cause PTS.

No Bryde's whales would be exposed to impulsive sound or pressures from underwater detonations that would cause physical injury or mortality (Table 4-19).

Given the large size (up to 46 ft. [14 m]) of individual Bryde's whales, pronounced blow, and mean group size of approximately 1.5 animals and (probability of trackline detection = 0.87 in Beaufort Sea States of 6 or less; Barlow 2003; 2006), it is very likely that lookouts would detect a group of Bryde's whales at the surface. Additionally, mitigation measures call for continuous visual observation during operations with active sonar, therefore, minke whales that migrate into the operating area would be detected by visual observers. Implementation of mitigation measures and probability of detecting a minke whale reduces the likelihood of exposure to sound levels that would likely cause a behavioral response that would affect vital rates (foraging, reproduction or survival), TTS or PTS. It is unlikely that the short duration and intermittent mid- or high-frequency active sonar exposure would cause a decrease in survivor rate or reproductive fitness.

Based on the model results, behavioral patterns, acoustic abilities of Bryde's whales, results of past training, and the implementation of procedure protective measures presented in sections 5.1 for sonar and 5.2 for underwater detonations, the Navy finds that the SOCAL Range Complex training events would not result in any population level effects, death or injury to Bryde's whales.

Gray Whale (*Eschrichtius robustus*)

The risk function and Navy post-modeling analysis estimates 4,797 gray whales will exhibit behavioral responses NMFS will classify as harassment under the MMPA (Table 4-14). Modeling also indicates there would be 901 exposures to accumulated acoustic energy above 195 dB re 1 μPa^2-s, which is the threshold established indicative of onset TTS. Two grays whale would be exposed to sound levels that could cause PTS.

Five gray whales would be exposed to impulsive sound or pressures from underwater detonations that would cause TTS or slight physical injury (Table 4-19).

Given the large size (up to 46 ft. [14 m]) of individual gray whales, and pronounced blow (Leatherwood et al. 1982) and (probability of trackline detection = 0.87 in Beaufort Sea States of 6 or less; Barlow 2003; 2006), it is very likely that lookouts would detect a group of gray whales at the surface. Additionally, mitigation measures call for continuous visual observation during operations with active sonar, therefore, gray whales that migrate into the operating area would be detected by visual observers. Implementation of mitigation measures and probability of detecting a minke whale reduces the likelihood of exposure to sound levels that would likely cause a behavioral response that would affect vital rates (foraging, reproduction or survival), TTS or PTS. It is unlikely that the short duration and intermittent mid- or high-frequency active sonar exposure would cause a decrease in survivor rate or reproductive fitness.

Based on the model results, behavioral patterns, acoustic abilities of gray whales, results of past training, and the implementation of procedure protective measures presented in sections 5.1 for sonar and 5.2 for underwater detonations, the Navy finds that the SOCAL Range Complex training events would not result in any population level effects, death or injury to gray whales.

Minke Whale (*Balaenoptera acutorostrata*)

The risk function and Navy post-modeling analysis estimates 90 minke whales will exhibit behavioral responses NMFS will classify as harassment under the MMPA (Table 4-14). Modeling also indicates there would be 26 exposures to accumulated acoustic energy above 195 dB re 1 μPa^2-s, which is the threshold established indicative of onset TTS. No minke whales would be exposed to sound levels that could cause PTS.

No minke whales would be exposed to impulsive sound or pressures from underwater detonations that would cause TTS or physical injury (Table 4-19).

Minke whales are difficult to spot visually but can be detected using passive acoustic monitoring. Additionally, mitigation measures call for continuous visual observation during operations with active sonar, therefore, minke whales that migrate into the operating area would be detected by visual observers. Implementation of mitigation measures and probability of detecting a minke whale reduces the likelihood of exposure to sound levels that would likely cause a behavioral response that would affect vital rates (foraging, reproduction or survival), TTS or PTS. It is unlikely that the short duration and intermittent mid- or high-frequency active sonar exposure would cause a decrease in survivor rate or reproductive fitness.

Based on the model results, behavioral patterns, acoustic abilities of minke whales, results of past training, and the implementation of procedure protective measures presented in sections 5.1 for sonar and 5.2 for underwater detonations, the Navy finds that the SOCAL Range Complex training events would not result in any population level effects, death or injury to minke whales.

Baird's Beaked Whale (*Berardius baridii*)

The risk function and Navy post-modeling analysis estimates eight Baird's beaked whales will exhibit behavioral responses NMFS will classify as harassment under the MMPA (Table 4-14). Modeling also indicates there would be two exposures to accumulated acoustic energy above 195 dB re 1 μPa^2-s, which is the threshold established indicative of onset TTS. No Baird's beaked whales would be exposed to sound levels that could cause PTS.

Modeling indicates there would be no exposures to impulsive sound or pressures from underwater detonations of 182 dB or 23 psi, which is the threshold indicative of onset TTS, and no exposures to impulsive sound or pressures from underwater detonations that would cause physical injury (Table 4-19).

Given the size (up to 15.5 ft. [4.7 m]) of individual Baird's beaked whales, aggregation of 2.3 animals, it is likely that lookouts would detect a group of Baird's beaked whales at the surface although beaked whales make prolonged dives that can last up to an hour making them difficult to detect (Baird et al. 2004). Implementation of mitigation measures reduces the likelihood of exposure to sound levels that would likely cause a behavioral response that would affect vital rates (foraging, reproduction or survival), TTS or PTS. It is unlikely that the short duration and intermittent mid- or high-frequency active sonar exposure would cause a decrease in survivor rate or reproductive fitness.

Based on the model results, behavioral patterns, acoustic abilities of Baird's beaked whales, results of past training, and the implementation of procedure protective measures presented in sections 5.1 for sonar and 5.2 for underwater detonations, the Navy finds that the SOCAL Range Complex training events would not result in any population level effects, death or injury to Baird's beaked whales.

Bottlenose Dolphin (*Tursiops truncatus*)

The risk function and Navy post-modeling analysis estimates 853 bottlenose dolphins will exhibit behavioral responses NMFS will classify as harassment under the MMPA (Table 4-14). Modeling also indicates there would be 317 exposures to accumulated acoustic energy above 195 dB re 1 μPa^2-s, which is the threshold established indicative of onset TTS. No bottlenose dolphins would be exposed to sound levels that could cause PTS.

Five bottlenose dolphins would be exposed to impulsive sound or pressures from underwater detonations that would cause TTS or slight physical injury. No bottlenose dolphins would be exposed to impulsive sound or pressures that would cause severe injury or mortality (Table 4-19).

Given the frequent surfacing, aggregation of approximately 9 animals (probability of trackline detection = 0.76 in Beaufort Sea States of 6 or less; Barlow 2003), it is very likely that lookouts would detect a group of bottlenose dolphins at the surface. Additionally, mitigation measures call for continuous visual observation during operations with active sonar, therefore, bottlenose dolphins that migrate into the operating area would be detected by visual observers. Implementation of mitigation measures and probability of detecting bottlenose dolphins reduces the likelihood of exposure to sound levels that would likely cause a behavioral response that would affect vital rates (foraging, reproduction or survival), TTS or PTS. It is unlikely that the short duration and intermittent mid- or high-frequency active sonar exposure would cause a decrease in survivor rate or reproductive fitness.

Based on the model results, behavioral patterns, acoustic abilities of bottlenose dolphins, results of past training, and the implementation of procedure mitigation measures presented in sections 5.1 for sonar and 5.2 for underwater detonations, the Navy finds that the SOCAL Range Complex training events would not result in any population level effects, death or injury to bottlenose dolphins.

Cuvier's Beaked Whale (*Ziphius cavirostris*)

The risk function and Navy post-modeling analysis estimates 288 Cuvier's beaked whales will exhibit behavioral responses NMFS will classify as harassment under the MMPA (Table 4-14). Modeling also indicates there would be 63 exposures to accumulated acoustic energy above 195 dB re 1 μPa^2-s, which is the threshold established indicative of onset TTS. No Cuvier's beaked whales would be exposed to sound levels that could cause PTS.

Modeling indicates there would one exposures to impulsive sound or pressures from underwater detonations of 182 dB or 23 psi, which is the threshold indicative of onset TTS and no exposures to impulsive sound or pressures from underwater detonations that would cause slight physical injury (Table 4-19).

Given the medium size (up to 23 ft. [7.0 m]) of individual Cuvier's beaked whales, aggregation of approximately two animals (Barlow 2006), it is likely that lookouts would detect a group of Cuvier's beaked whales at the surface although beaked whales make prolonged dives that can last up to an hour (Baird et al. 2004). Implementation of mitigation measures reduces the likelihood of exposure to sound levels that would likely cause a behavioral response that would affect vital rates (foraging, reproduction or survival), TTS or PTS. It is unlikely that the short duration and intermittent mid- or high-frequency active sonar exposure would cause a decrease in survivor rate or reproductive fitness.

Based on the model results, behavioral patterns, acoustic abilities of Cuvier's beaked whales, results of past training, and the implementation of procedure protective measures presented in sections 5.1 for sonar and 5.2 for underwater detonations, the Navy finds that the SOCAL Range Complex training events would not result in any population level effects, death or injury to Cuvier's beaked whales.

Dall's Porpoise (*Phocoenides dalli*)

The risk function and Navy post-modeling analysis estimates 419 Dall's porpoise will exhibit behavioral responses NMFS will classify as harassment under the MMPA (Table 4-14). Modeling also indicates there would be 145 exposures to accumulated acoustic energy above 195 dB re 1 μPa^2-s, which is the threshold established indicative of onset TTS. One Dall's porpoise would be exposed to sound levels that could cause PTS.

Modeling indicates there would one exposures to impulsive sound or pressures from underwater detonations of 182 dB or 23 psi, which is the threshold indicative of onset TTS and no exposures to impulsive sound or pressures from underwater detonations that would cause slight physical injury (Table 4-19).

Given the frequent surfacing and aggregation of approximately 2-20 animals, it is very likely that

lookouts would detect a group of Dall's porpoises at the surface. Additionally, protective measures call for continuous visual observation during operations with active sonar, therefore, Dall's porpoises that migrate into the operating area would be detected by visual observers. Implementation of mitigation measures and probability of detecting large groups of Dall's porpoises reduces the likelihood of exposure to sound levels that would likely cause a behavioral response that would affect vital rates (foraging, reproduction or survival), TTS or PTS. It is unlikely that the short duration and intermittent mid- or high-frequency active sonar exposure would cause a decrease in survivor rate or reproductive fitness.

Based on the model results, behavioral patterns, acoustic abilities of Dall's porpoise, results of past training, and the implementation of procedure protective measures presented in sections 5.1 for sonar and 5.2 for underwater detonations, the Navy finds that the SOCAL Range Complex training events would not result in any population level effects, death or injury to Dall's porpoise.

Killer Whale (*Orcinus orca*)

The risk function and Navy post-modeling analysis estimates six killer whales will exhibit behavioral responses NMFS will classify as harassment under the MMPA (Table 4-14). Modeling also indicates there would be two exposures to accumulated acoustic energy above 195 dB re 1 μPa^2-s, which is the threshold established indicative of onset TTS. One killer whales would be exposed to sound levels that could cause PTS.

No killer whales would be exposed to impulsive sound or pressures from underwater detonations that would cause physical injury (Table 4-19).

Given their size (up to 23 ft [7.0 m]), conspicuous coloring, pronounce dorsal fin and large mean group size of 6.5 animals (probability of trackline detection = 0.90 in Beaufort Sea States of 6 or less; Barlow 2003). It is very likely that lookouts would detect a group of killer whales at the surface. Additionally, mitigation measures call for continuous visual observation during operations with active sonar, therefore, killer whales that migrate into the operating area would be detected by visual observers. Implementation of mitigation measures and probability of detecting large groups of killer whales reduces the likelihood of exposure to sound levels that would likely cause a behavioral response that would affect vital rates (foraging, reproduction or survival), TTS or PTS. It is unlikely that the short duration and intermittent mid- or high-frequency active sonar exposure would cause a decrease in survivor rate or reproductive fitness.

Based on the model results, behavioral patterns, acoustic abilities of killer whales, results of past training, and the implementation of procedure mitigation measures presented in sections 5.1 for sonar and 5.2 for underwater detonations, the Navy finds that the SOCAL Range Complex training events would not result in any population level effects, death or injury to killer whales.

Long Beaked Common Dolphin (*Delphinus capensis*)

The risk function and Navy post-modeling analysis estimates 2,255 long beaked common dolphin will exhibit behavioral responses NMFS will classify as harassment under the MMPA (Table 4-14). Modeling also indicates there would be 715 exposures to accumulated acoustic energy above 195 dB re 1 μPa^2-s, which is the threshold established indicative of onset TTS. One long beaked common dolphin would be exposed to sound levels that could cause PTS.

Twenty long-beaked common dolphins would be exposed to impulsive sound or pressures from underwater that may cause TTS or slight injury and one to pressure that cause slight injury (Table 4-19).

Given the frequent surfacing and their large group size (Leatherwood et al. 1982), it is very likely, that lookouts would detect a group of long-beaked common dolphins at the surface. Additionally, protective measures call for continuous visual observation during operations with active sonar and underwater detonations, therefore, common dolphins that migrate into the operating area would be detected by visual observers. Exposure of long-beaked common dolphins to energy levels associated with Level A harassment would not occur because protective measures would be implemented, large groups of long-beaked common dolphins would be observed, and underwater detonations result in a small zone of influence. Exposure to sound levels that would likely cause a behavioral response that would affect vital rates (foraging, reproduction or survival), TTS or PTS. It is unlikely that the short duration and intermittent mid- or high-frequency active sonar exposure would cause a decrease in survivor rate or reproductive fitness.

Based on the model results, behavioral patterns, acoustic abilities of long-beaked common dolphins, results of past training, and the implementation of procedure mitigation measures presented in sections 5.1 for sonar and 5.2 for underwater detonations, the Navy finds that the SOCAL Range Complex training events would not result in any population level effects, death or injury to long-beaked common dolphins.

Mesoplodont Whales *(Mesoplodon spp.)*

The risk function and Navy post-modeling analysis estimates 86 Mesoplodont whales will exhibit behavioral responses NMFS will classify as harassment under the MMPA (Table 4-14). Modeling also indicates there would be 22 exposures to accumulated acoustic energy above 195 dB re 1 μPa^2-s, which is the threshold established indicative of onset TTS. No Mesoplodont whales would be exposed to sound levels that could cause PTS.

Modeling indicates there would no exposures to impulsive sound or pressures from underwater detonations of 182 dB or 23 psi, which is the threshold indicative of onset TTS, and no exposures to impulsive sound or pressures from underwater detonations that would cause physical injury (Table 4-19).

Given the size (up to 15.5 ft. [4.7 m]) of individual Mesoplodont beaked whales, it is likely that lookouts would detect a group of Mesoplodont beaked whales at the surface although beaked whales make prolonged dives that can last up to an hour (Baird et al. 2004). Implementation of mitigation measures and probability of detecting a Mesoplodont whale reduces the likelihood of exposure to sound levels that would likely cause a behavioral response that would affect vital rates (foraging, reproduction or survival), TTS or PTS. It is unlikely that the short duration and intermittent mid- or high-frequency active sonar exposure would cause a decrease in survivor rate or reproductive fitness.

Based on the model results, behavioral patterns, acoustic abilities of Mesoplodont beaked whales, results of past training, and the implementation of procedure protective measures presented in sections 5.1 for sonar and 5.2 for underwater detonations, the Navy finds that the SOCAL Range Complex training events would not result in any population level effects, death or injury to Mesoplodont beaked whales.

Northern Right Whale Dolphin (*Lissodelphis borealis*)

The risk function and Navy post-modeling analysis estimates 811 northern right whale dolphins will exhibit behavioral responses NMFS will classify as harassment under the MMPA (Table 4-14). Modeling also indicates there would be 277 exposures to accumulated acoustic energy above 195 dB re 1 μPa^2-s, which is the threshold established indicative of onset TTS. No northern right whale dolphins would be exposed to sound levels that could cause PTS.

Modeling indicates there would five exposures to impulsive sound or pressures from underwater detonations of 182 dB or 23 psi, which is the threshold indicative of onset TTS, and no exposures to impulsive sound or pressures from underwater detonations that would cause physical injury (Table 4-19).

Given their large group size of up to 100 animals (Leatherwood et al. 1982), it is very likely, that

lookouts would detect a group of northern right whale dolphins at the surface. Additionally, mitigation measures call for continuous visual observation during operations with active sonar and underwater detonations, therefore, northern right whale dolphins that migrate into the operating area would be detected by visual observers. Implementation of protective measures and probability of detecting large groups of northern right whale dolphins reduces the likelihood of exposure to sound levels that would likely cause a behavioral response that would affect vital rates (foraging, reproduction or survival), TTS or PTS. It is unlikely that the short duration and intermittent mid- or high-frequency active sonar exposure would cause a decrease in survivor rate or reproductive fitness.

Based on the model results, behavioral patterns, acoustic abilities of northern right whale dolphins, results of past training, and the implementation of procedure protective measures presented in sections 5.1 for sonar and 5.2 for underwater detonations, the Navy finds that the SOCAL Range Complex training events would not result in any population level effects, death or injury to northern right whale dolphins.

Pacific White-sided Dolphin (*Lagenorhynchus obliquidens*)

The risk function and Navy post-modeling analysis estimates 756 Pacific white-sided dolphins will exhibit behavioral responses NMFS will classify as harassment under the MMPA (Table 4-14). Modeling also indicates there would be 312 exposures to accumulated acoustic energy above 195 dB re 1 μPa^2-s, which is the threshold established indicative of onset TTS. No Pacific white-sided dolphins would be exposed to sound levels that could cause PTS.

Modeling indicates there would five exposures to impulsive sound or pressures from underwater detonations of 182 dB or 23 psi, which is the threshold indicative of onset TTS, and no exposures to impulsive sound or pressures from underwater detonations that would cause physical injury (Table 4-19).

Given their frequent surfacing and large group size of up to several thousand animals (Leatherwood et al. 1982), it is very likely that lookouts would detect a group of Pacific white-sided dolphins at the surface. Additionally, protective measures call for continuous visual observation during operations with active sonar and underwater detonations, therefore, Pacific white-sided dolphins that migrate into the operating area would be detected by visual observers. Implementation of mitigation measures and probability of detecting large groups of Pacific white-sided dolphins reduces the likelihood of exposure to sound levels that would likely cause a behavioral response that would affect vital rates (foraging, reproduction or survival), TTS or PTS. It is unlikely that the short duration and intermittent mid- or high-frequency active sonar exposure would cause a decrease in survivor rate or reproductive fitness.

Based on the model results, behavioral patterns, acoustic abilities of Pacific white-sided dolphins, results of past training, and the implementation of procedure protective measures presented in sections 5.1 for sonar and 5.2 for underwater detonations, the Navy finds that the SOCAL Range Complex training events would not result in any population level effects, death or injury to Pacific white-sided dolphins.

Pygmy Sperm Whale (*Kogia breviceps*)

The risk function and Navy post-modeling analysis estimates 108 pygmy sperm whales will exhibit behavioral responses NMFS will classify as harassment under the MMPA (Table 4-14). Modeling also indicates there would be 27 exposures to accumulated acoustic energy above 195 dB re 1 μPa^2-s, which is the threshold established indicative of onset TTS. No pygmy sperm whales would be exposed to sound levels that could cause PTS.

Modeling indicates no exposures to impulsive sound or pressures from underwater detonations of 182 dB or 23 psi, which is the threshold indicative of onset TTS and no exposures to impulsive sound or pressures from underwater detonations that would cause slight physical injury (Table 4-19).

Given their size (up to 10 ft [3 m]) and behavior of resting at the surface (Leatherwood et al. 1982), it is very likely that lookouts would detect a pygmy sperm whale at the surface. Additionally, mitigation measures call for continuous visual observation during operations with active sonar and underwater detonations, therefore, pygmy sperm whales that migrate into the operating area would be detected by visual observers. Implementation of mitigation measures and probability of detecting large groups of pygmy sperm whales reduces the likelihood of exposure to sound levels that would likely cause a behavioral response that would affect vital rates (foraging, reproduction or survival), TTS or PTS. It is unlikely that the short duration and intermittent mid- or high-frequency active sonar exposure would cause a decrease in survivor rate or reproductive fitness.

Based on the model results, behavioral patterns, acoustic abilities of pygmy sperm whale, results of past training, and the implementation of procedure mitigation measures presented in sections

5.1 for sonar and 5.2 for underwater detonations, the Navy finds that the SOCAL Range Complex training events would not result in any population level effects, death or injury to pygmy sperm whale.

Risso's Dolphin (*Grampus griseus*)

The risk function and Navy post-modeling analysis estimates 1,968 Risso's dolphins will exhibit behavioral responses NMFS will classify as harassment under the MMPA (Table 4-14). Modeling also indicates there would be 570 exposures to accumulated acoustic energy above 195 dB re 1 μPa^2-s, which is the threshold established indicative of onset TTS. No Risso's dolphins would be exposed to sound levels that could cause PTS.

Twelve Risso's dolphins would be exposed to impulsive sound or pressures from underwater detonations that would cause TTS and one to impulsive sound or pressures that could cause slight injury (Table 4-19).

Given their frequent surfacing, light coloration and large group size of up to several hundred animals (Leatherwood et al. 1982), mean group size of 15.4 dolphins in Hawaii and probability of trackline detection of 0.76 in Beaufort Sea States of 6 or less (Barlow 2006), it is very likely that lookouts would detect a group of Risso's dolphins at the surface. Additionally, mitigation measures call for continuous visual observation during operations with active sonar and underwater detonations, therefore, Risso's dolphins that migrate into the operating area would be detected by visual observers. Implementation of mitigation measures and probability of detecting large groups of Risso's dolphins reduces the likelihood of exposure to sound levels that would likely cause a behavioral response that would affect vital rates (foraging, reproduction or survival), TTS or PTS. It is unlikely that the short duration and intermittent mid- or high-frequency active sonar exposure would cause a decrease in survivor rate or reproductive fitness.Based on the model results, behavioral patterns, acoustic abilities of Risso's dolphins, results of past training, and the implementation of procedure mitigation measures presented in sections 5.1 for sonar and 5.2 for underwater detonations, the Navy finds that the SOCAL Range Complex training events would not result in any population level effects, death or injury to Risso's dolphins.

Short-Beaked Common Dolphin (*Delphinus delphis*)

The risk function and Navy post-modeling analysis estimates 19,377 short-beaked common dolphins will exhibit behavioral responses NMFS will classify as harassment under the MMPA (Table 4-14). Modeling also indicates there would be 6,148 exposures to accumulated acoustic energy above 195 dB re 1 μPa^2-s, which is the threshold established indicative of onset TTS. Eight short-beaked common dolphins would be exposed to sound levels that could cause PTS.

One-hundred seventy-five short-beaked common dolphins would be exposed to impulsive sound or pressures from underwater detonations that could cause TTS, nine exposures to impulsive sound or pressures that could cause slight injury and three exposures that could cause severe injury or mortality (Table 4.15).

Given the frequent surfacing and their large group size of up to 1,000 animals (Leatherwood et al. 1982), it is very likely, that lookouts would detect a group of short-beaked common dolphins at the surface. Additionally, protective measures call for continuous visual observation during operations with active sonar and underwater detonations, therefore, common dolphins that migrate into the operating area would be detected by visual observers. Exposure of short-beaked common dolphins to energy levels associated with Level A harassment would not occur because protective measures would be implemented, large groups of short-beaked common dolphins would be observed, and underwater detonations result in a small zone of influence. Exposure to sound levels that would likely cause a behavioral response that would affect vital rates (foraging, reproduction or survival), TTS or PTS. It is unlikely that the short duration and intermittent mid- or high-frequency active sonar exposure would cause a decrease in survivor rate or reproductive fitness.

Based on the model results, behavioral patterns, acoustic abilities of short-beaked common dolphins, results of past training, and the implementation of procedure mitigation measures presented in sections 5.1 for sonar and 5.2 for underwater detonations, the Navy finds that the SOCAL Range Complex training events would not result in any population level effects, death or injury to short-beaked common dolphins.

Short-finned Pilot Whale (*Globicephala macrorhynchus*)

The risk function and Navy post-modeling analysis estimates 34 short-finned pilot whales will exhibit behavioral responses NMFS will classify as harassment under the MMPA (Table 4-14). Modeling also indicates there would be nine exposures to accumulated acoustic energy above 195 dB re 1 μPa^2-s, which is the threshold established indicative of onset TTS. No short-finned pilot whales would be exposed to sound levels that could cause PTS.

Modeling indicates there would be no exposures to impulsive sound or pressures from underwater detonations of 182 dB or 23 psi, which is the threshold indicative of onset TTS and no exposures to impulsive sound or pressures from underwater detonations that would cause slight physical injury or massive lung injury (Table 4-19).

Given their size (up to 20 ft [6.1 m]), and large mean group size of 22.5 animals (probability of trackline detection = 0.76 in Beaufort Sea States of 6 or less; Barlow 2006). It is very likely that lookouts would detect a group of short-finned pilot whales at the surface. Additionally, mitigation measures call for continuous visual observation during operations with active sonar, therefore, short-finned pilot whales that migrate into the operating area would be detected by visual observers. Implementation of mitigation measures and probability of detecting groups of short-finned pilot whales reduces the likelihood of exposure to sound levels that would likely cause a behavioral response that would affect vital rates (foraging, reproduction or survival), TTS or PTS. It is unlikely that the short duration and intermittent mid- or high-frequency active sonar exposure would cause a decrease in survivor rate or reproductive fitness.

Based on the model results, behavioral patterns, acoustic abilities of short-finned pilot whale, results of past training, and the implementation of procedure mitigation measures presented in sections 5.1 for sonar and 5.2 for underwater detonations, the Navy finds that the SOCAL Range Complex training events would not result in any population level effects, death or injury to short-finned pilot whale.

Striped Dolphin (*Stenella coeruleoalba*)

The risk function and Navy post-modeling analysis estimates 1,401 striped dolphins will exhibit behavioral responses NMFS will classify as harassment under the MMPA (Table 4-14). Modeling also indicates there would be 411 exposures to accumulated acoustic energy above 195 dB re 1 μPa^2-s, which is the threshold established indicative of onset TTS. No striped dolphins would be exposed to sound levels that could cause PTS.

Modeling indicates five exposures to impulsive sound or pressures from underwater detonations of 182 dB or 23 psi, which is the threshold indicative of onset TTS and no exposures to impulsive sound or pressures from underwater detonations that would cause slight physical injury or massive lung injury (Table 4-19).

Given their frequent surfacing, aerobatics and large mean group size of 37.3 animals (probability of trackline detection = 1.00 in Beaufort Sea States of 6 or less; Barlow 2006), it is very likely that lookouts would detect a group of striped dolphins at the surface. Additionally, mitigation measures call for continuous visual observation during operations with active sonar, therefore, striped dolphins that migrate into the operating area would be detected by visual observers. Implementation of mitigation measures and probability of detecting groups of striped dolphins reduces the likelihood of exposure to sound levels that would likely cause a behavioral response that would affect vital rates (foraging, reproduction or survival), TTS or PTS. It is unlikely that the short duration and intermittent mid- or high-frequency active sonar exposure would cause a decrease in survivor rate or reproductive fitness.

Based on the model results, behavioral patterns, acoustic abilities of striped dolphins, results of past training, and the implementation of procedure mitigation measures presented in sections 5.1 for sonar and 5.2 for underwater detonations, the Navy finds that the SOCAL Range Complex training events would not result in any population level effects, death or injury to striped dolphins.

Ziphiid Whales (*Ziphus* spp.)

The risk function and Navy post-modeling analysis estimates 65 Ziphiid whales will exhibit behavioral responses NMFS will classify as harassment under the MMPA (Table 4-14). Modeling also indicates there would be 15 exposures to accumulated acoustic energy above 195 dB re 1 μPa^2-s, which is the threshold established indicative of onset TTS. No Ziphiid whales would be exposed to sound levels that could cause PTS.

Modeling indicates there would be no exposures to impulsive sound or pressures from underwater detonations of 182 dB or 23 psi, which is the threshold indicative of onset TTS and no exposures to impulsive sound or pressures from underwater detonations that would cause slight physical injury (Table 4-19).

Given the medium size (up to 23 ft. [7.0 m]) of individual Ziphiid whales, aggregation of approximately two animals (Barlow 2006), it is likely that lookouts would detect a group of Ziphiid whales at the surface although Ziphiid whales make prolonged dives that can last up to an hour (Baird et al. 2004). Implementation of mitigation measures and probability of detecting a large sei whale reduces the likelihood of exposure to sound levels that would likely cause a behavioral response that would affect vital rates (foraging, reproduction or survival), TTS or PTS. It is unlikely that the short duration and intermittent mid- or high-frequency active sonar exposure would cause a decrease in survivor rate or reproductive fitness.

Based on the model results, behavioral patterns, acoustic abilities of Ziphiid whales, results of past training, and the implementation of procedure protective measures presented in sections 5.1 for sonar and 5.2 for underwater detonations, the Navy finds that the SOCAL Range Complex training events would not result in any population level effects, death or injury to Ziphiid whales.

Northern Elephant Seal (*Mirounga angustirostris*)

The risk function and Navy post-modeling analysis estimates 599 northern elephant seals will exhibit behavioral responses NMFS will classify as harassment under the MMPA (Table 4-14). Modeling also indicates there would be seven exposures to accumulated acoustic energy above 204 dB re 1 μPa^2-s, which is the threshold established indicative of onset TTS for northern elephant seals. No northern elephant seals would be exposed to sound levels that could cause PTS.

Modeling indicates there would be 13 exposures to impulsive sound or pressures from underwater detonations of 182 dB or 23 psi, which is the threshold indicative of onset TTS and no exposures to impulsive sound or pressures from underwater detonations that would cause slight physical injury (Table 4-19).

Northern elephant seals tend to dive for long periods, 20-30 minutes, and only spend about 10% of the time at the surface making them difficult to detect. Elephant seals migrate out of the Southern California area to forage for several months at a time (Le Boeuf 1994). Exposure to sound levels that would likely cause a behavioral response that would affect vital rates (foraging, reproduction or survival), TTS or PTS. It is unlikely that the short duration and intermittent mid- or high-frequency active sonar exposure would cause a decrease in survivor rate or reproductive fitness.

Based on the model results, behavioral patterns, acoustic abilities of Northern elephant seals, results of past training, and the implementation of procedure mitigation measures presented in sections 5.1 for sonar and 5.2 for underwater detonations, the Navy finds that the SOCAL Range Complex training events would not result in any population level effects, death or injury to Northern elephant seals.

Pacific Harbor Seal (*Phoca vitulina richardii*)

The risk function and Navy post-modeling analysis estimates 906 Pacific harbor seals will exhibit behavioral responses NMFS will classify as harassment under the MMPA (Table 4-14). Modeling also indicates there would be 6,290 exposures to accumulated acoustic energy above 183 dB re 1 μPa^2-s, which is the threshold established indicative of onset TTS for harbor seals. Thirteen Pacific harbor seals would be exposed to sound levels that could cause PTS.

Modeling indicates there would be 19 exposures to impulsive sound or pressures from underwater detonations of 182 dB or 23 psi, which is the threshold indicative of onset TTS and one exposure to impulsive sound or pressures from underwater detonations that would cause slight physical injury (Table 4-19).

Harbor seals forage near their rookeries (usually within 50 km) therefore they tend to remain in the Southern California area most of the time in comparison to northern elephant seals. Exposures to sound levels that would likely cause a behavioral response that would affect vital rates (foraging, reproduction or survival), TTS or PTS. It is unlikely that the short duration and intermittent mid- or high-frequency active sonar exposure would cause a decrease in survivor rate or reproductive fitness.

Based on the model results, behavioral patterns, acoustic abilities of harbor seals, results of past training, and the implementation of procedure mitigation measures presented in sections 5.1 for sonar and 5.2 for underwater detonations, the Navy finds that the SOCAL Range Complex training events would not result in any population level effects, death or injury to harbor seals.

California Sea Lion (*Zalophus californianus*)

The risk function and Navy post-modeling analysis estimates 46,715 California sea lions will exhibit behavioral responses NMFS will classify as harassment under the MMPA (Table 4-14). Modeling also indicates there would be five exposures to accumulated acoustic energy above 206 dB re 1 μPa^2-s, which is the threshold established indicative of onset TTS for California sea lions. No California sea lions would be exposed to sound levels that could cause PTS.

Modeling indicates there would be 333 exposures to impulsive sound or pressures from underwater detonations of 182 dB or 23 psi, which is the threshold indicative of onset TTS, 13 exposures to impulsive sound or pressures from underwater detonations that would cause slight physical injury, and four exposures to impulsive sound or pressures that could cause severe injury or mortality (Table 4-19).

California sea lions make short duration dives and may rest at the surface (Feldkamp et al. 1989) making them easier to detect than other pinnipeds. Exposures to sound levels that would likely cause a behavioral response that would affect vital rates (foraging, reproduction or survival), TTS or PTS. It is unlikely that the short duration and intermittent mid- or high-frequency active sonar exposure would cause a decrease in survivor rate or reproductive fitness.

Based on the model results, behavioral patterns, acoustic abilities of California sea lions, results of past training, and the implementation of procedure mitigation measures presented in sections 5.1 for sonar and 5.2 for underwater detonations, the Navy finds that the SOCAL Range Complex training events would not result in any population level effects, death or injury to harbor seals.

Northern Fur Seal (*Callorhinus ursinus*)

The risk function and Navy post-modeling analysis estimates 656 northern fur seals will exhibit behavioral responses NMFS will classify as harassment under the MMPA (Table 4-14). Modeling also indicates there would be five exposures to accumulated acoustic energy above 206 dB re 1 μPa^2-s, which is the threshold established indicative of onset TTS for northern fur seals. No northern fur seals would be exposed to sound levels that could cause PTS.

Modeling indicates there would be 33 exposures to impulsive sound or pressures from underwater detonations of 182 dB or 23 psi, which is the threshold indicative of onset TTS, two exposures to impulsive sound or pressures from underwater detonations that would cause slight physical injury, and one exposure to impulsive sound or pressures that could cause severe injury or mortality (Table 4-19).

Northern fur seals do not dive for long periods and may rest on the surface between foraging bouths (Gentry and Goebel 1984) making them easier to detect. Additionally, mitigation measures call for continuous visual observation during operations with active sonar; therefore, northern fur seals that migrate into the operating area would likely be detected by visual observers when the fur seals surface. Implementation of mitigation measures and probability of detecting fur seals resting at the surface reduces the likelihood of exposure to sound levels that would likely cause a behavioral response that would affect vital rates (foraging, reproduction or survival), TTS or PTS. It is unlikely that the short duration and intermittent mid- or high-frequency active sonar exposure would cause a decrease in survivor rate or reproductive fitness.

Based on the model results, behavioral patterns, acoustic abilities of northern fur seals, results of past training, and the implementation of procedure mitigation measures presented in sections 5.1 for sonar and 5.2 for underwater detonations, the Navy finds that the SOCAL Range Complex training events would not result in any population level effects, death or injury to northern fur seals.

4.8 ALTERNATIVE 1

4.8.1 Non-Sonar Acoustic Impacts and Non-Acoustic Impacts

Non-acoustic impacts on marine mammals under Alternative 1 would be substantially the same as impacts identified under the No Action Alternative. Under Alternative 1, increased operations would not increase the risk of collisions between Navy ships and marine mammals, given the extensive mitigation measures in effect to avoid such an event. Based on these standard operating procedures, collisions with marine mammals are not expected under Alternative 1. With regard to potential encounters between marine mammals and unrecovered military debris expended on the SOCAL Range Complex: Debris related to military activities that is not recovered generally sinks; the amount that might remain on or near the sea surface is low, and the density of such debris in the SOCAL Range Complex would be very low under Alternative 1 as under the No Action Alternative. Impacts to marine mammals from expended debris are unlikely.

4.8.2 Summary of Potential Mid- and High-Frequency Active Sonar Effects

Table 4-20 represents the number of sonar hours, dipping sonar, or sonobuoys usage per year for the different sonar sources including the 53C, 56C, submarine, AN/AWS-22 dipping sonar, SSQ-62 Sonobuoys, and MK-48 torpedo sonar.

Table 4-20. Summary of the sonar hours, number of sonar dips and sonobuoys, and torpedo runs for each type of exercise for Alternative 1.

Event	SQS-53 C Sonar Hours	SQS-56 C Sonar Hours	Total Sonar Hours	AQS-22 Number of Dips	SSQ-62 Number of Sonobuoys	MK-48 Number of Torpedo Events
Major Exercise (8/yr)	986	246	1,232	318	2,127	10
Sustainment Exercise (2/yr)	80	20	100	42	161	3.2
IAC II (4/yr)	230	58	288	384	482	2.4
ULT, Coordinated Events & Maintenance	569	142	711	1,821	1,244	66.4
Total	**1,865**	**466**	**2,331**	**2,565**	**4,014**	**82**

Table 4-21 presents a summary of the estimated marine mammal exposures for potential non-injurious (Level B) harassment, as well as potential onset of injury (Level A) to cetaceans and pinnipeds. Tables 4-22 through 4-25 present estimated marine mammal exposures further separated by component activites as listed in Table 4-20. The numbers contained in these tables may be slightly less than those presented in Table 4-21 as a result of the order of summation and the application of rounding rules utilized in the calculation of exposures.

Specifically, under this assessment for mid-frequency active sonar, the risk function methodology estimates 89,028 annual exposures that could potentially result in behavioral sub-TTS (Level B Harassment); 17,772 annual exposures that could potentially result in TTS (Level B Harassment); and 28 annual exposures could result in potential injury as PTS (Level A Harassment). No mid-frequency active sonar exposures are predicted to result in any animal mortality.

It should be noted, however, that these exposure modeling results are statistically derived estimates of potential marine mammal sonar exposures without consideration of standard mitigation and monitoring procedures. The caveats to interpretations of model results are described previously. It is highly unlikely that a marine mammal would experience any long-term effects because the large SOCAL Range Complex training areas makes individual mammals' repeated or prolonged exposures to high-level sonar signals unlikely. Specifically, mid-frequency active sonars have limited marine mammal exposure ranges and relatively high platform speeds. The number of exposures that exceed the PTS threshold and result in Level A harassment from sonar is 28 for six species (blue whale, gray whale, long-beaked common dolphin, Pacific harbor seal, short-beaked common dolphin, and sperm whale). Therefore, long term effects on individuals, populations or stocks are unlikely.

When analyzing the results of the acoustic exposure modeling to provide an estimate of effects, it is important to understand that there are limitations to the ecological data (diving behavior, migration or movement patterns and population dynamics) used in the model, and that the model results must be interpreted within the context of a given species' ecology.

As described previously, this analysis assumes that short-term non-injurious sound exposure levels predicted to cause TTS or temporary behavioral disruptions qualify as Level B harassment. This approach is overestimating because there is no established scientific correlation between mid-frequency active sonar use and long term abandonment or significant alteration of behavioral patterns in marine mammals.

Because of the time delay between pings, and platform speed, an animal encountering the sonar will accumulate energy for only a few sonar pings over the course of a few minutes. Therefore, exposure to sonar would be a short-term event, minimizing any single animal's exposure to sound levels approaching the harassment thresholds.

The implementation of the mitigation and monitoring procedures as addressed in Section 5 of the EIS/OEIS will further minimize the potential for marine mammal exposures to underwater detonations. When reviewing the acoustic exposure modeling results, it is also important to understand that the estimates of marine mammal sound exposures are presented without consideration of standard protective measure operating procedures. Section 5 presents details of the mitigation measures currently used for ASW activities including detection of marine mammals and power down procedures if marine mammals are detected within one of the safety zones. The Navy will work through the MMPA incidental harassment regulatory process to discuss the mitigation measures and their potential to reduce the likelihood for incidental harassment of marine mammals.

Table 4-21. Alternative 1 Summary of All Annual Sonar Exposures

Species	Level B Sonar Exposures		Level A Sonar Exposures
	Risk Function	TTS	PTS
ESA Species			
Blue whale	493	120	1
Fin whale	107	22	0
Humpback whale	13	2	0
Sei whale	0	0	0
Sperm whale	111	18	1
Guadalupe fur seal	859	303	0
Sea otter	N/A	N/A	N/A
Mysticetes			
Bryde's whale	0	0	0
Gray whale	5,103	959	2
Minke whale	96	28	0
Odontocetes			
Baird's beaked whale	9	2	0
Bottlenose dolphin	907	337	0
Cuvier's beaked whale	306	67	0
Dall's porpoise	446	154	0
Dwarf sperm whale	N/A	N/A	N/A
False killer whale	N/A	N/A	N/A
Killer whale	6	2	0
Long beaked common dolphin	2,399	761	1
Longman's beaked whale	N/A	N/A	N/A
Melon-headed whale	N/A	N/A	N/A
Mesoplodon spp.	92	23	0
Northern right whale dolphin	863	295	0
Pacific white-sided dolphin	804	332	0
Pantropical spotted dolphin	N/A	N/A	N/A
Pygmy killer whale	N/A	N/A	N/A
Pygmy sperm whale	115	29	0
Risso's dolphin	2,094	606	0
Rough-toothed dolphin	N/A	N/A	N/A
Short beaked common dolphin	20,614	6,540	9
Short-finned pilot whale	36	10	0
Spinner dolphin	N/A	N/A	N/A
Striped dolphin	1,490	437	0
Ziphiid whales	69	16	0
Pinnipeds			
Northern elephant seal	637	7	0
Pacific harbor seal	964	6,692	14
California sea lion	49,697	5	0
Northern fur seal	698	5	0
Total	**89,028**	**17,772**	**28**

Thresholds: Cetaceans TTS = 195 dB re 1 µPa^2-s; PTS = 215 dB, re 1 µPa^2-s, northern elephant seal TTS = 204 re 1 µPa^2-s, PTS = 224 re 1 µPa^2-s; harbor seal TTS = 183 re 1 µPa^2-s, PTS = 203; Otariids TTS = 206 re 1 µPa^2-s, PTS = 226 re 1 µPa^2-s.

N/A: Not applicable – Based on a few historic observations, its habitat preference or overall distribution, a species may occur rarely in the SOCAL Range Complex, but no density estimates were available for modeling exposures

Table 4-22. Alternative 1 Summary of ULT, Coordinated Events and Maintenance Annual Sonar Exposures

Species	Level B Sonar Exposures		Level A Sonar Exposures
	Risk Function	TTS	PTS
ESA Species			
Blue whale	225	55	0
Fin whale	47	10	0
Humpback whale	6	1	0
Sei whale	0	0	0
Sperm whale	49	9	0
Guadalupe fur seal	396	147	0
Sea otter	N/A	N/A	N/A
Mysticetes			
Bryde’s whale	0	0	0
Gray whale	2,398	436	1
Minke whale	44	13	0
Odontocetes			
Baird’s beaked whale	4	1	0
Bottlenose dolphin	419	155	0
Cuvier’s beaked whale	132	32	0
Dall’s porpoise	203		0
Dwarf sperm whale	N/A	N/A	N/A
False killer whale	N/A	N/A	N/A
Killer whale	3	1	0
Long beaked common dolphin	1,152		1
Longman’s beaked whale	N/A	N/A	N/A
Melon-headed whale	N/A	N/A	N/A
Mesoplodon spp.	41	11	0
Northern right whale dolphin	404	137	0
Pacific white-sided dolphin	379	152	0
Pantropical spotted dolphin	N/A	N/A	N/A
Pygmy killer whale	N/A	N/A	N/A
Pygmy sperm whale	51	14	0
Risso’s dolphin	956	285	0
Rough-toothed dolphin	N/A	N/A	N/A
Short beaked common dolphin	9,906	3,044	4
Short-finned pilot whale	17	5	0
Spinner dolphin	N/A	N/A	N/A
Striped dolphin	682	199	0
Ziphiid whales	30	7	0
Pinnipeds			
Northern elephant seal	419	5	0
Pacific harbor seal	600	4,191	9
California sea lion	24,097	4	0
Northern fur seal	328	2	0
Total	**42,988**	**9,340**	**15**

TTS and PTS Thresholds: Cetaceans TTS = 195 dB re 1 μPa^2-s; PTS = 215 dB, re 1 μPa^2-s; Northern elephant seal TTS = 204 re 1 μPa^2-s, PTS = 224 re 1 μPa^2-s; Harbor seal TTS = 183 re 1 μPa^2-s, PTS = 203 re 1 μPa^2-s; Otariids TTS = 206 re 1 μPa^2-s, PTS = 226 re 1 μPa^2-s.

N/A: Not applicable – Based on a few historic observations, its habitat preference or overall distribution, a species may occur rarely in the SOCAL Range Complex, but no density estimates were available for modeling exposures.

Table 4-23. Alternative 1 Summary of Major Exercises Annual Sonar Exposures

Species	Level B Sonar Exposures		Level A Sonar Exposures
	Risk Function	TTS	PTS
ESA Species			
Blue whale	202	48	1
Fin whale	46	9	0
Humpback whale	5	1	0
Sei whale	0	0	0
Sperm whale	47	6	0
Guadalupe fur seal	347	124	0
Sea otter	0	0	0
Mysticetes			
Bryde's whale	0	0	0
Gray whale	2,019	391	1
Minke whale	39	11	0
Odontocetes			
Baird's beaked whale	4	1	0
Bottlenose dolphin	362	135	0
Cuvier's beaked whale	133	25	0
Dall's porpoise	183	63	0
Dwarf sperm whale	N/A	N/A	N/A
False killer whale	N/A	N/A	N/A
Killer whale	2	1	0
Long beaked common dolphin	903	300	1
Longman's beaked whale	N/A	N/A	N/A
Melon-headed whale	N/A	N/A	N/A
Mesoplodon spp.	38	9	0
Northern right whale dolphin	337	117	0
Pacific white-sided dolphin	313	134	0
Pantropical spotted dolphin	N/A	N/A	N/A
Pygmy killer whale	N/A	N/A	N/A
Pygmy sperm whale	48		0
Risso's dolphin	850	235	0
Rough-toothed dolphin	N/A	N/A	N/A
Short beaked common dolphin	7,756	2,578	4
Short-finned pilot whale	15	4	0
Spinner dolphin	N/A	N/A	N/A
Striped dolphin	605	178	0
Ziphiid whales	30		0
Pinnipeds			
Northern elephant seal	175	2	0
Pacific harbor seal	252	1,700	4
California sea lion	20,400	1	0
Northern fur seal	273	2	0
Total	**35,384**	**6,092**	**11**

TTS and PTS Thresholds: Cetaceans TTS = 195 dB re 1 μPa^2-s; PTS = 215 dB, re 1 μPa^2-s; Northern elephant seal TTS = 204 re 1 μPa^2-s, PTS = 224 re 1 μPa^2-s; Harbor seal TTS = 183 re 1 μPa^2-s, PTS = 203 re 1 μPa^2-s; Otariids TTS = 206 re 1 μPa^2-s, PTS = 226 re 1 μPa^2-s.

N/A: Not applicable – Based on a few historic observations, its habitat preference or overall distribution, a species may occur rarely in the SOCAL Range Complex, but no density estimates were available for modeling exposures.

Table 4-24. Alternative 1 Summary of IAC II Annual Sonar Exposures

Species	Level B Sonar Exposures		Level A Sonar Exposures
	Risk Function	TTS	PTS
ESA Species			
Blue whale	46	12	0
Fin whale	10	2	0
Humpback whale	1	0	0
Sei whale	0	0	0
Sperm whale	10	2	0
Guadalupe fur seal	80	22	0
Sea otter	0	0	0
Mysticetes			
Bryde's whale	0	0	0
Gray whale	473	92	0
Minke whale	9	3	0
Odontocetes			
Baird's beaked whale	1	0	0
Bottlenose dolphin	88	33	0
Cuvier's beaked whale	28	7	0
Dall's porpoise	42	15	0
Dwarf sperm whale	N/A	N/A	N/A
False killer whale	N/A	N/A	N/A
Killer whale	1	0	0
Long beaked common dolphin	248	75	0
Longman's beaked whale	N/A	N/A	N/A
Melon-headed whale	N/A	N/A	N/A
Mesoplodon spp.	9	2	0
Northern right whale dolphin	86	29	0
Pacific white-sided dolphin	79	32	0
Pantropical spotted dolphin	N/A	N/A	N/A
Pygmy killer whale	N/A	N/A	N/A
Pygmy sperm whale	11	3	0
Risso's dolphin	201	61	0
Rough-toothed dolphin	N/A	N/A	N/A
Short beaked common dolphin	2,128	646	1
Short-finned pilot whale	3	1	0
Spinner dolphin	N/A	N/A	N/A
Striped dolphin	141	42	0
Ziphiid whales	6	2	0
Pinnipeds			
Northern elephant seal	33	0	0
Pacific harbor seal	87	626	1
California sea lion	3,489	0	0
Northern fur seal	69	1	0
Total	**7,379**	**1,708**	**2**

TTS and PTS Thresholds: Cetaceans TTS = 195 dB re 1 μPa^2-s; PTS = 215 dB, re 1 μPa^2-s; Northern elephant seal TTS = 204 re 1 μPa^2-s, PTS = 224 re 1 μPa^2-s; Harbor seal TTS = 183 re 1 μPa^2-s, PTS = 203 re 1 μPa^2-s; Otariids TTS = 206 re 1 μPa^2-s, PTS = 226 re 1 μPa^2-s.

N/A: Not applicable – Based on a few historic observations, its habitat preference or overall distribution, a species may occur rarely in the SOCAL Range Complex, but no density estimates were available for modeling exposures.

Table 4-25. Alternative 1 Summary of Sustainment Annual Sonar Exposures

Species	Level B Sonar Exposures		Level A Sonar Exposures
	Risk Function	TTS	PTS
ESA Species			
Blue whale	20	5	0
Fin whale	4	1	0
Humpback whale	1	0	0
Sei whale	0	0	0
Sperm whale	5	1	0
Guadalupe fur seal	36	10	0
Sea otter	0	0	0
Mysticetes			
Bryde's whale	0	0	0
Gray whale	213	40	0
Minke whale	4	1	0
Odontocetes			
Baird's beaked whale	0	0	0
Bottlenose dolphin	38	14	0
Cuvier's beaked whale	13	3	0
Dall's porpoise	18	6	0
Dwarf sperm whale	N/A	N/A	N/A
False killer whale	N/A	N/A	N/A
Killer whale	0	0	0
Long beaked common dolphin	96	32	0
Longman's beaked whale	N/A	N/A	N/A
Melon-headed whale	N/A	N/A	N/A
Mesoplodon spp.	4	1	0
Northern right whale dolphin	36	12	0
Pacific white-sided dolphin	33	14	0
Pantropical spotted dolphin	N/A	N/A	N/A
Pygmy killer whale	N/A	N/A	N/A
Pygmy sperm whale	5	1	0
Risso's dolphin	87	25	0
Rough-toothed dolphin	N/A	N/A	N/A
Short beaked common dolphin	824	272	0
Short-finned pilot whale	1	0	0
Spinner dolphin	N/A	N/A	N/A
Striped dolphin	62	18	0
Ziphiid whales	3	1	0
Pinnipeds			
Northern elephant seal	10	0	0
Pacific harbor seal	25	175	0
California sea lion	1,711	0	0
Northern fur seal	28	0	0
Total	**3,277**	**632**	**0**

TTS and PTS Thresholds: Cetaceans TTS = 195 dB re 1 μPa^2-s; PTS = 215 dB, re 1 μPa^2-s; Northern elephant seal TTS = 204 re 1 μPa^2-s, PTS = 224 re 1 μPa^2-s; Harbor seal TTS = 183 re 1 μPa^2-s, PTS = 203 re 1 μPa^2-s; Otariids TTS = 206 re 1 μPa^2-s, PTS = 226 re 1 μPa^2-s.

N/A: Not applicable – Based on a few historic observations, its habitat preference or overall distribution, a species may occur rarely in the SOCAL Range Complex, but no density estimates were available for modeling exposures.

4.8.3 Summary of Potential Underwater Detonation Effects

The modeled exposure harassment numbers for all training operations involving explosives are presented by species in Table 4-18. The modeling indicates 742 annual exposures to pressure from underwater detonations that could potentially result in TTS (Level B Harassment); 29 annual exposures from pressure from underwater detonations that could cause slight injury (Level A Harassment); and 10 exposures that could cause severe injury or mortality.

Training operations involving explosives include Mine Neutralization, Air to Surface Missile Exercise, Surface to Surface Missile Exercise, Bombing Exercise, Sinking Exercise, Surface to Surface Gunnery exercise, and Naval Surface Fire Support. In a SINKEX, weapons are typically fired in order of decreasing range from the source with weapons fired until the target is sunk. Since the target may sink at any time during the exercise, the actual number of weapons used can vary widely. In the representative case, however, all of the ordnances are assumed expended; this represents the worst case of maximum exposure.

These exposure modeling results are estimates of marine mammal underwater detonation sound exposures without considering similar model limitations as discussed in the summary of mid-frequency active sonar sub-section (Section 4.7.2). In addition, implementation of the mitigation and monitoring procedures will further minimize the potential for marine mammal exposures to underwater detonations.

Table 4-26. Alternative 1 Annual Underwater Detonation Exposures Summary.

Species	Level B Exposures	Level A Exposures	
	TTS 182 dB re 1 μPa²-s/23 psi	50% TM Rupture 205 dB re 1 μPa²-s or Slight Lung Injury 13 psi-ms	Onset Massive Lung Injury or Mortality 31 psi-ms
ESA Species			
Blue whale	2	0	0
Fin whale	1	0	0
Humpback whale	0	0	0
Sei whale	0	0	0
Sperm whale	1	0	0
Guadalupe fur seal	2	0	0
Sea otter			
Mysticetes			
Bryde's whale	0	0	0
Gray whale	6	0	0
Minke whale	0	0	0
Odontocetes			
Baird's beaked whale	0	0	0
Bottlenose dolphin	6	0	0
Cuvier's beaked whale	1	0	0
Dall's porpoise	2	0	0
Dwarf sperm whale	N/A	N/A	N/A
False killer whale	N/A	N/A	N/A
Killer whale	0	0	0
Long-beaked common dolphin	24	1	0
Longman's beaked whale	N/A	N/A	N/A
Melon-headed whale	N/A	N/A	N/A
Mesoplodon spp.	0	0	0
Northern right whale dolphin	6	0	0
Pacific white-sided dolphin	6	0	0
Pantropical spotted dolphin	N/A	N/A	N/A
Pygmy killer whale	N/A	N/A	N/A
Pygmy sperm whale	1	0	0
Risso's dolphin	14	1	0
Rough-toothed dolphin	N/A	N/A	N/A
Short-beaked common dolphin	202	10	4
Short-finned pilot whale	0	0	0
Spinner dolphin	N/A	N/A	N/A
Striped dolphin	5	0	0
Ziphiid whale	0	0	0
Pinnipeds			
Northern elephant seal	15	0	0
Pacific harbor seal	22	1	0
California sea lion	388	14	5
Northern fur seal	38	2	1
Total	**742**	**29**	**10**

N/A: Not applicable – Based on a few historic observations, its habitat preference or overall distribution, a species may occur rarely in the SOCAL Range Complex, but no density estimates were available for modeling exposures

4.8.4 Species-Specific Potential Impacts: Alternative 1

Blue Whale (*Balaenoptera musculus*)

The risk function and Navy post-modeling analysis estimates 493 blue whales will exhibit behavioral responses NMFS will classify as harassment under the MMPA (Table 4-21). Modeling also indicates there would be 120 exposures to accumulated acoustic energy above 195 dB re 1 μPa^2-s, which is the threshold established indicative of onset TTS. One blue whale would be exposed to sound levels that could cause PTS.

Two blue whales would be exposed to impulsive sound or pressures from underwater detonations that would cause TTS and one that would be exposed to impulsive sound or pressures that would cause slight injury (Table 4-26).

Given the large size (up to 98 ft [30 m]) of individual blue whales (Leatherwood et al. 1982), pronounced vertical blow, and aggregation of approximately two to three animals in a group (probability of track line detection = 0.90 in Beaufort Sea States of 6 or less; Barlow 2003), it is very likely that lookouts would detect a group of blue whales at the surface. Additionally, mitigation measures call for continuous visual observation during operations with active sonar; therefore, blue whales that migrate into the operating area would be detected by visual observers. Implementation of mitigation measures and probability of detecting a large blue whale reduces the likelihood of exposure to sound levels that would likely cause a behavioral response that would affect vital rates (foraging, reproduction or survival), TTS or PTS. It is unlikely that the short duration and intermittent mid- or high-frequency active sonar exposure would cause a decrease in survivor rate or reproductive fitness.

In the unlikely event that blue whales are exposed to mid-frequency sonar, the anatomical information available on blue whales suggests that they are not likely to hear mid-frequency (1 kHz–10 kHz) sounds (Ketten 1997). There are no audiograms of baleen whales, but blue whales tend to react to anthropogenic sound below 1 kHz (e.g., seismic air guns), and most of their vocalizations are also in that range, suggesting that they are more sensitive to low frequency sounds (Richardson et al. 1995). Based on this information, if they do no hear these sounds, they are not likely to respond physiologically or behaviorally to those received levels.

Based on the model results, behavioral patterns, acoustic abilities of blue whales, results of past training exercises, and the implementation of mitigation measures presented in sections 5.1 for sonar and 5.2 for underwater detonations, the Navy finds that the SOCAL Range Complex training events would not result in any population level effects, death or injury to blue whales.

Fin Whale (*Balaenoptera physalus*)

The risk function and Navy post-modeling analysis estimates 107 fin whales will exhibit behavioral responses NMFS will classify as harassment under the MMPA (Table 4-21). Modeling also indicates there would be 22 exposures to accumulated acoustic energy above 195 dB re 1 μPa^2-s, which is the threshold established indicative of onset TTS. No fin whales would be exposed to sound levels that could cause PTS.

One fin whale would be exposed to impulsive sound or pressures from underwater detonations that would cause TTS (Table 4-26).

Given the large size (up to 78 ft [24m]) of individual fin whales (Leatherwood et al. 1982), pronounced vertical blow, mean aggregation of three animals in a group (probability of trackline detection = 0.90 in Beaufort Sea States of 6 or less; Barlow 2003) it is very likely that lookouts would detect a group of fin whales at the surface. Additionally, mitigation measures call for continuous visual observation during operations with active sonar, therefore, fin whales in the vicinity of operations would be detected by visual observers. Implementation of mitigation measures and probability of detecting a large fin whale reduces the likelihood of exposure to sound levels that would likely cause a behavioral response that would affect vital rates (foraging, reproduction or survival), TTS or PTS. It is unlikely that the short duration and intermittent mid- or high-frequency active sonar exposure would cause a decrease in survivor rate or reproductive fitnessIn the unlikely event that fin whales are exposed to mid-frequency sonar, the anatomical information available on fin whales suggests that they are not likely to hear mid-frequency (1 kHz–10 kHz) sounds (Richardson et al. 1995; Ketten 1997). Fin whales primarily produce low frequency calls (below 1 kHz) with source levels up to 186 dB re 1μPa at 1 m, although it is possible they produce some sounds in the range of 1.5 to 28 kHz (review by Richardson et al. 1995; Croll et al. 2002). There are no audiograms of baleen whales, but they tend to react to anthropogenic sound below 1 kHz, suggesting that they are more sensitive to low frequency sounds (Richardson et al. 1995). Based on this information, if they do no hear these sounds, they are not likely to respond physiologically or behaviorally to those received levels.

In the St. Lawrence estuary area, fin whales avoided vessels with small changes in travel direction, speed and dive duration, and slow approaches by boats usually caused little response (MacFarlane 1981). Fin whales continued to vocalize in the presence of boat sound (Edds and Macfarlane 1987). Even though any undetected fin whales transiting the SOCAL Range Complex may exhibit a reaction when initially exposed to active acoustic energy, field observations indicate the effects would not cause disruption of natural behavioral patterns to a point where such behavioral patterns would be abandoned or significantly altered.

Based on the model results, behavioral patterns, acoustic abilities of fin whales, results of past SOCAL Range Complex training, and the implementation of procedure mitigation measures presented in sections 5.1 for sonar and 5.2 for underwater detonations, the Navy finds that the SOCAL Range Complex training events would not result in any population level effects, death or injury to fin whales.

Humpback Whale (*Megaptera novaeangliae*)

The risk function and Navy post-modeling analysis estimates 13 humpback whales will exhibit behavioral responses NMFS will classify as harassment under the MMPA (Table 4-21). Modeling also indicates there would be two exposures to accumulated acoustic energy above 195 dB re 1 μPa^2-s, which is the threshold established indicative of onset TTS. No humpback whales would be exposed to sound levels that could cause PTS.

Modeling indicates there would no exposures to impulsive sound or pressures from underwater detonations of 182 dB or 23 psi, which is the threshold indicative of onset TTS, and no exposures to impulsive sound or pressures from underwater detonations that would cause physical injury (Table 4-26). Target and demolition area clearance procedures would make sure there are no humpback whales within the safety zone and therefore potential exposure of humpback whales to sound levels that exceed TTS or injury levels are highly unlikely Given the mitigation measures detailed in Chapter 5, most ASW exercises take place in offshore waters and with the knowledge of the nearshore areas of humpback whale breeding aggregations, the Navy would likely avoid those nearshore areas regularly used by breeding humpback. This makes it is unlikely that mother calf pairs would be disturbed to the point of separation or the cessation of reproductive behaviors.

Given the large size (up to 53 ft [16m] of individual humpback whales (Leatherwood et al. 1982), and pronounced vertical blow, it is very likely that lookouts would detect humpback whales at the surface. Additionally, mitigation measures call for continuous visual observation during operations with active sonar, therefore, humpback whales that are present in the vicinity of ASW operations would be detected by visual observers reducing the likelihood of exposureto sound levels that would likely cause a behavioral response that would affect vital rates (foraging, reproduction or survival), TTS or PTS. It is unlikely that the short duration and intermittent mid- or high-frequency active sonar exposure would cause a decrease in survivor rate or reproductive fitnessThere are no audiograms of baleen whales, but they tend to react to anthropogenic sound below 1 kHz, suggesting that they are more sensitive to low frequency sounds (Richardson et al. 1995). A single study suggested that humpback whales responded to mid-frequency sonar (3.1-3.6 kHz re 1 µPa^2-s) sound (Maybaum 1989). The hand held sonar system had a sound artifact below 1,000 Hz which caused a response to the control playback (a blank tape) and may have affected the response to sonar (i.e. the humpback whale responded to the low frequency artifact rather than the mid-frequency active sonar sound). Humpback whales responded to small vessels (often whale watching boats) by changing swim speed, respiratory rates and social interactions depending on proximity to the vessel and vessel speed, with reponses varying by social status and gender (Watkins et al. 1981; Bauer, 1986; Bauer and Herman 1986). Animals may even move out of the area in response to vessel noise (Salden 1988). Humpback whale mother-calf pairs are generally in the shallow protected waters. ASW mid-frequency active sonar activities takes place through out the extensive SOCAL Range Complex but the areas inhabited by humpback whales is represents only a small portion of the SOCAL Range Complex. Frankel and Clark (2000; 2002) reported that there was only a minor response by humpback whales to the Acoustic Thermometry of Ocean Climate (ATOC) sound source and that response was variable with some animals being found closer to the sound source during operation.

Based on the model results, behavioral patterns, acoustic abilities of humpback whales, results of past training, and the implementation of procedure mitigation measures presented in sections 5.1 for sonar and 5.2 for underwater detonations, the Navy finds that the SOCAL Range Complex training events would not likely result in any population level effects, death or injury to humpback whales.

Sei Whale (*Balaenoptera borealis*)

The risk function and Navy post-modeling analysis estimates no sei whales will exhibit behavioral responses NMFS will classify as harassment under the MMPA (Table 4-21). Modeling also indicates there would be no exposures to accumulated acoustic energy above 195 dB re 1 µPa^2-s, which is the threshold established indicative of onset TTS. No sei whales would be exposed to sound levels that could cause PTS.

No sei whales would be exposed to impulsive sound or pressures from underwater detonations that would cause TTS or physical injury (Table 4-26).

Given the large size (up to 53 ft [16m}) of individual sei whales (Leatherwood et al. 1982), pronounced vertical blow, aggregation of approximately three animals (probability of trackline detection = 0.90 in Beaufort Sea States of 6 or less; Barlow 2003), it is very likely that lookouts would detect a group of sei whales at the surface. Additionally, mitigation measures call for continuous visual observation during operations with active sonar, therefore, sei whales that migrate into the operating area would be detected by visual observers. Implementation of mitigation measures and probability of detecting a large sei whale reduces the likelihood of exposureto sound levels that would likely cause a behavioral response that would affect vital rates (foraging, reproduction or survival), TTS or PTS. It is unlikely that the short duration and intermittent mid- or high-frequency active sonar exposure would cause a decrease in survivor rate or reproductive fitness There is little information on the acoustic abilities of sei whales or their response to human activities. The only recorded sounds of sei whales are frequency modulated sweeps in the range of 1.5 to 3.5 kHz (Thompson et al. 1979) but it is likely that they also vocalized at frequencies below 1 kHz as do fin whales. There are no audiograms of baleen whales but they tend to react to anthropogenic sound below 1 kHz suggesting that they are more sensitive to low frequency sounds (Richardson et al. 1995). Sei whales were more difficult to approach than were fin whales and moved away from boats but were less responsive when feeding (Gunther 1949).

Based on the model results, behavioral patterns, acoustic abilities of sei whales, results of past training, and the implementation of procedure mitigation measures presented in sections 5.1 for sonar and 5.2 for underwater detonations, the Navy finds that the SOCAL Range Complex training events would not likely result in any population level effects, death or injury to sei whales.

Sperm Whales (*Physeter macrocephalus*)

The risk function and Navy post-modeling analysis estimates 111 sperm whales will exhibit behavioral responses NMFS will classify as harassment under the MMPA (Table 4-21). Modeling also indicates there would be 18 exposures to accumulated acoustic energy above 195 dB re 1 μPa^2-s, which is the threshold established indicative of onset TTS. One sperm whale would be exposed to sound levels that could cause PTS.

Without consideration of clearance procedures, there would be one exposure from impulsive sound or pressures from underwater detonations that would exceed the TTS threshold (Table 4-26). Target and demolition area clearance procedures would make sure there are no sperm whales within the safety zone, and therefore potential exposure of sperm whales to sound levels that exceed TTS are highly unlikely.

Given the large size (up to 56 ft [17m]) of individual sperm whales (Leatherwood et al. 1982), pronounced blow (large and angled), mean group size of approximately seven animals (probability of trackline detection = 0.87 in Beaufort Sea States of 6 or less; Barlow 2003; 2006), it is likely that lookouts would detect a group of sperm whales at the surface. Sperm whales can make prolonged dives of up to two hours making detection more difficult but passive acoustic monitoring can detect and localize sperm whales from their calls (Watwood et al. 2006). Implementation of mitigation measures and probability of detecting a large sperm whale reduces the likelihood of exposure to sound levels that would likely cause a behavioral response that would affect vital rates (foraging, reproduction or survival), TTS or PTS. It is unlikely that the short duration and intermittent mid- or high-frequency active sonar exposure would cause a decrease in survivor rate or reproductive fitnessIn the unlikely event that sperm whales are exposed to mid-frequency sonar, the information available on sperm whales exposed to received levels of active mid-frequency sonar suggests that the response to mid-frequency (1 kHz to 10 kHz) sounds is variable (Richardson et al. 1995). While Watkins et al. (1985) observed that sperm whales exposed to 3.25 kHz to 8.4 kHz pulses interrupted their activities and left the area, other studies indicate that, after an initial disturbance, the animals return to their previous activity. During playback experiments off the Canary Islands, André et al. (1997) reported that foraging whales exposed to a 10 kHz pulsed signal did not exhibit any general avoidance reactions. When resting at the surface in a compact group, sperm whales initially reacted strongly but then ignored the signal completely (André et al. 1997).

Based on the model results, behavioral patterns, acoustic abilities of sperm whales, results of past training, and the implementation of procedure protective measures presented in sections 5.1 for sonar and 5.2 for underwater detonations, the Navy finds that the SOCAL Range Complex training events would not result in any population level effects, death or injury to sperm whales.

Guadalupe fur Seal (*Arctocephalus townsendi*)

The risk function and Navy post-modeling analysis estimates 859 Guadalupe fur seals will exhibit behavioral responses NMFS will classify as harassment under the MMPA (Table 4-21). Modeling also indicates there would be 303 exposures to accumulated acoustic energy above 195 dB re 1 μPa^2-s, which is the threshold established indicative of onset TTS. No Guadalupe fur seals would be exposed to sound levels that could cause PTS.

Modeling indicates there would two exposures to impulsive sound or pressures from underwater detonations of 182 dB or 23 psi, which is the threshold indicative of onset TTS, and no exposures to impulsive sound or pressures from underwater detonations that would cause physical injury (Table 4-26).

Guadalupe fur seals dive for short periods and often rest on the surface between foraging bouts (Gallo 1994) making them easier to detect. Exposures to sound levels that would likely cause a behavioral response that would affect vital rates (foraging, reproduction or survival), TTS or PTS. It is unlikely that the short duration and intermittent mid- or high-frequency active sonar exposure would cause a decrease in survivor rate or reproductive fitness

Based on the model results, behavioral patterns, acoustic abilities of Guadalupe fur seals, results of past training, and the implementation of procedure mitigation measures presented in sections 5.1 for sonar and 5.2 for underwater detonations, the Navy finds that the SOCAL Range Complex training events would not result in any population level effects, death or injury to Guadalupe fur seals.

Bryde's Whale (*Balaenoptera edeni*)

The risk function and Navy post-modeling analysis estimates no Bryde's whales will exhibit behavioral responses NMFS will classify as harassment under the MMPA (Table 4-21). Modeling also indicates there would be no exposures to accumulated acoustic energy above 195 dB re 1 μPa^2-s, which is the threshold established indicative of onset TTS. No Bryde's whales would be exposed to sound levels that could cause PTS.

No Bryde's whales would be exposed to impulsive sound or pressures from underwater detonations that would cause physical injury (Table 4-26).

Given the large size (up to 46 ft. [14 m]) of individual Bryde's whales, pronounced blow, and mean group size of approximately 1.5 animals and (probability of trackline detection = 0.87 in Beaufort Sea States of 6 or less; Barlow 2003; 2006), it is very likely that lookouts would detect a group of Bryde's whales at the surface. Additionally, mitigation measures call for continuous visual observation during operations with active sonar, therefore, minke whales that migrate into the operating area would be detected by visual observers. Implementation of mitigation measures and probability of detecting a minke whale reduces the likelihood of exposure to sound levels that would likely cause a behavioral response that would affect vital rates (foraging, reproduction or survival), TTS or PTS. It is unlikely that the short duration and intermittent mid- or high-frequency active sonar exposure would cause a decrease in survivor rate or reproductive fitnessBased on the model results, behavioral patterns, acoustic abilities of Bryde's whales, results of past training, and the implementation of procedure protective measures presented in sections 5.1 for sonar and 5.2 for underwater detonations, the Navy finds that the SOCAL Range Complex training events would not result in any population level effects, death or injury to Bryde's whales.

Gray Whale (*Eschrichtius robustus*)

The risk function and Navy post-modeling analysis estimates 5,103 gray whales will exhibit behavioral responses NMFS will classify as harassment under the MMPA (Table 4-21). Modeling also indicates there would be 959 exposures to accumulated acoustic energy above 195 dB re 1 μPa^2-s, which is the threshold established indicative of onset TTS. Two gray whales would be exposed to sound levels that could cause PTS.

Six gray whales would be exposed to impulsive sound or pressures from underwater detonations that would cause TTS (Table 4-26).

Given the large size (up to 46 ft. [14 m]) of individual gray whales, and pronounced blow (Leatherwood et al. 1982) and (probability of trackline detection = 0.87 in Beaufort Sea States of 6 or less; Barlow 2003; 2006), it is very likely that lookouts would detect gray whales at the surface. Additionally, mitigation measures call for continuous visual observation during operations with active sonar, therefore, gray whales that migrate into the operating area would be detected by visual observers. Implementation of mitigation measures and probability of detecting a minke whale reduces the likelihood of exposure to sound levels that would likely cause a behavioral response that would affect vital rates (foraging, reproduction or survival), TTS or PTS. It is unlikely that the short duration and intermittent mid- or high-frequency active sonar exposure would cause a decrease in survivor rate or reproductive fitnessBased on the model results, behavioral patterns, acoustic abilities of gray whales, results of past training, and the implementation of procedure protective measures presented in sections 5.1 for sonar and 5.2 for underwater detonations, the Navy finds that the SOCAL Range Complex training events would not result in any population level effects, death or injury to gray whales.

Minke Whale (*Balaenoptera acutorostrata*)

The risk function and Navy post-modeling analysis estimates 96 minke whales will exhibit behavioral responses NMFS will classify as harassment under the MMPA (Table 4-21). Modeling also indicates there would be 28 exposures to accumulated acoustic energy above 195 dB re 1 μPa^2-s, which is the threshold established indicative of onset TTS. No minke whales would be exposed to sound levels that could cause PTS.

No minke whales would be exposed to impulsive sound or pressures from underwater detonations that would cause TTS or physical injury (Table 4-26).

Minke whales are difficult to spot visually but can be detected using passive acoustic monitoring. Additionally, mitigation measures call for continuous visual observation during operations with active sonar, therefore, minke whales that migrate into the operating area would be detected by visual observers. Implementation of mitigation measures and probability of detecting a minke whale reduces the likelihood of exposure to sound levels that would likely cause a behavioral response that would affect vital rates (foraging, reproduction or survival), TTS or PTS. It is unlikely that the short duration and intermittent mid- or high-frequency active sonar exposure would cause a decrease in survivor rate or reproductive fitnessBased on the model results, behavioral patterns, acoustic abilities of minke whales, results of past training, and the implementation of procedure protective measures presented in sections 5.1 for sonar and 5.2 for underwater detonations, the Navy finds that the SOCAL Range Complex training events would not result in any population level effects, death or injury to minke whales.

Baird's Beaked Whale (*Berardius baridii*)

The risk function and Navy post-modeling analysis estimates nine Baird's beaked whales will exhibit behavioral responses NMFS will classify as harassment under the MMPA (Table 4-21). Modeling also indicates there would be two exposures to accumulated acoustic energy above 195 dB re 1 μPa^2-s, which is the threshold established indicative of onset TTS. No Baird's beaked whales would be exposed to sound levels that could cause PTS.

Modeling indicates there would be no exposures to impulsive sound or pressures from underwater detonations of 182 dB or 23 psi, which is the threshold indicative of onset TTS, and no exposures to impulsive sound or pressures from underwater detonations that would cause physical injury (Table 4-26).

Given the size (up to 15.5 ft. [4.7 m]) of individual Baird's beaked whales, aggregation of 2.3 animals, it is likely that lookouts would detect a group of Baird's beaked whales at the surface although beaked whales make prolonged dives that can last up to an hour (Baird et al. 2004). Implementation of mitigation measures and probability of detecting a Baird's beaked whale reduces the likelihood of exposure to sound levels that would likely cause a behavioral response that would affect vital rates (foraging, reproduction or survival), TTS or PTS. It is unlikely that the short duration and intermittent mid- or high-frequency active sonar exposure would cause a decrease in survivor rate or reproductive fitnessBased on the model results, behavioral patterns, acoustic abilities of Baird's beaked whales, results of past training, and the implementation of procedure protective measures presented in sections 5.1 for sonar and 5.2 for underwater detonations, the Navy finds that the SOCAL Range Complex training events would not result in any population level effects, death or injury to Baird's beaked whales.

Bottlenose Dolphin (*Tursiops truncatus*)

The risk function and Navy post-modeling analysis estimates 907 bottlenose dolphins will exhibit behavioral responses NMFS will classify as harassment under the MMPA (Table 4-21). Modeling also indicates there would be 337 exposures to accumulated acoustic energy above 195 dB re 1 μPa^2-s, which is the threshold established indicative of onset TTS. No bottlenose dolphins would be exposed to sound levels that could cause PTS.

Six bottlenose dolphins would be exposed to impulsive sound or pressures from underwater detonations that would cause TTS (Table 4-26).

Given the frequent surfacing, aggregation of approximately 9 animals (probability of trackline detection = 0.76 in Beaufort Sea States of 6 or less; Barlow 2003), it is very likely that lookouts would detect a group of bottlenose dolphins at the surface. Additionally, mitigation measures call for continuous visual observation during operations with active sonar, therefore, bottlenose dolphins that migrate into the operating area would be detected by visual observers. Implementation of mitigation measures and probability of detecting bottlenose dolphins reduces the likelihood of exposure to sound levels that would likely cause a behavioral response that would affect vital rates (foraging, reproduction or survival), TTS or PTS. It is unlikely that the short duration and intermittent mid- or high-frequency active sonar exposure would cause a decrease in survivor rate or reproductive fitnessBased on the model results, behavioral patterns, acoustic abilities of bottlenose dolphins, results of past training, and the implementation of procedure mitigation measures presented in sections 5.1 for sonar and 5.2 for underwater detonations, the Navy finds that the SOCAL Range Complex training events would not result in any population level effects, death or injury to bottlenose dolphins.

Cuvier's Beaked Whale (*Ziphius cavirostris*)

The risk function and Navy post-modeling analysis estimates 306 Cuvier's beaked whales will exhibit behavioral responses NMFS will classify as harassment under the MMPA (Table 4-21). Modeling also indicates there would be 67 exposures to accumulated acoustic energy above 195 dB re 1 μPa^2-s, which is the threshold established indicative of onset TTS. No Cuvier's beaked whales would be exposed to sound levels that could cause PTS.

Modeling indicates there would one exposure to impulsive sound or pressures from underwater detonations of 182 dB or 23 psi, which is the threshold indicative of onset TTS and no exposures to impulsive sound or pressures from underwater detonations that would cause slight physical injury (Table 4-26).

Given the medium size (up to 23 ft. [7.0 m]) of individual Cuvier's beaked whales, aggregation of approximately two animals (Barlow 2006), it is likely that lookouts would detect a group of Cuvier's beaked whales at the surface although beaked whales make prolonged dives that can last up to an hour (Baird et al. 2004). Exposures to sound levels that would likely cause a behavioral response that would affect vital rates (foraging, reproduction or survival), TTS or PTS. It is unlikely that the short duration and intermittent mid- or high-frequency active sonar exposure would cause a decrease in survivor rate or reproductive fitnessBased on the model results, behavioral patterns, acoustic abilities of Cuvier's beaked whales, results of past training, and the implementation of procedure protective measures presented in sections 5.1 for sonar and 5.2 for underwater detonations, the Navy finds that the SOCAL Range Complex training events would not result in any population level effects, death or injury to Cuvier's beaked whales.

Dall's Porpoise (*Phocoenides dalli*)

The risk function and Navy post-modeling analysis estimates 446 Dall's porpoise will exhibit behavioral responses NMFS will classify as harassment under the MMPA (Table 4-21). Modeling also indicates there would be 154 exposures to accumulated acoustic energy above 195 dB re 1 μPa^2-s, which is the threshold established indicative of onset TTS. No Dall's porpoises would be exposed to sound levels that could cause PTS.

Modeling indicates there would two exposures to impulsive sound or pressures from underwater detonations of 182 dB or 23 psi, which is the threshold indicative of onset TTS, and no exposures to impulsive sound or pressures from underwater detonations that would cause physical injury (Table 4-26).

Given the frequent surfacing and aggregation of approximately 2-20 animals, it is very likely that

lookouts would detect a group of Dall's porpoises at the surface. Additionally, protective measures call for continuous visual observation during operations with active sonar, therefore, Dall's porpoises that migrate into the operating area would be detected by visual observers. Implementation of mitigation measures and probability of detecting large groups of Dall's porpoises reduces the likelihood of exposure to sound levels that would likely cause a behavioral response that would affect vital rates (foraging, reproduction or survival), TTS or PTS. It is unlikely that the short duration and intermittent mid- or high-frequency active sonar exposure would cause a decrease in survivor rate or reproductive fitness.

Based on the model results, behavioral patterns, acoustic abilities of Dall's porpoise, results of past training, and the implementation of procedure protective measures presented in sections 5.1 for sonar and 5.2 for underwater detonations, the Navy finds that the SOCAL Range Complex training events would not result in any population level effects, death or injury to Dall's porpoise.

Killer Whale (*Orcinus orca*)

The risk function and Navy post-modeling analysis estimates six killer whales will exhibit behavioral responses NMFS will classify as harassment under the MMPA (Table 4-21). Modeling also indicates there would be two exposures to accumulated acoustic energy above 195 dB re 1 μPa^2-s, which is the threshold established indicative of onset TTS. No killer whales would be exposed to sound levels that could cause PTS.

No killer whales would be exposed to impulsive sound or pressures from underwater detonations that would cause physical injury (Table 4-26).

Given their size (up to 23 ft [7.0 m]), conspicuous coloring, pronounce dorsal fin and large mean group size of 6.5 animals (probability of trackline detection = 0.90 in Beaufort Sea States of 6 or less; Barlow 2003). It is very likely that lookouts would detect a group of killer whales at the surface. Additionally, mitigation measures call for continuous visual observation during operations with active sonar, therefore, killer whales that migrate into the operating area would be detected by visual observers. Implementation of mitigation measures and probability of detecting large groups of killer whales reduces the likelihood of exposure to sound levels that would likely cause a behavioral response that would affect vital rates (foraging, reproduction or survival), TTS or PTS. It is unlikely that the short duration and intermittent mid- or high-frequency active sonar exposure would cause a decrease in survivor rate or reproductive fitness

Based on the model results, behavioral patterns, acoustic abilities of killer whales, results of past training, and the implementation of procedure mitigation measures presented in sections 5.1 for sonar and 5.2 for underwater detonations, the Navy finds that the SOCAL Range Complex training events would not result in any population level effects, death or injury to killer whales.

Long Beaked Common Dolphin (*Delphinus capensis*)

The risk function and Navy post-modeling analysis estimates 2,399 long beaked common dolphins will exhibit behavioral responses NMFS will classify as harassment under the MMPA (Table 4-21). Modeling also indicates there would be 761 exposures to accumulated acoustic energy above 195 dB re 1 μPa^2-s, which is the threshold established indicative of onset TTS. One long beaked common dolphin would be exposed to sound levels that could cause PTS.

Modeling indicates there would 24 exposures to impulsive sound or pressures from underwater detonations of 182 dB or 23 psi, which is the threshold indicative of onset TTS, and one exposure to impulsive sound or pressures from underwater detonations that would cause slight physical injury (Table 4-26).

Given the frequent surfacing and their large group size (Leatherwood et al. 1982), it is very likely, that lookouts would detect a group of long-beaked common dolphins at the surface. Additionally, protective measures call for continuous visual observation during operations with active sonar and underwater detonations, therefore, common dolphins that migrate into the operating area would be detected by visual observers. Exposure of long-beaked common dolphins to energy levels associated with Level A harassment would not occur because protective measures would be implemented, large groups of long-beaked common dolphins would be observed, and underwater detonations result in a small zone of influence. Exposures to sound levels that would likely cause a behavioral response that would affect vital rates (foraging, reproduction or survival), TTS or PTS. It is unlikely that the short duration and intermittent mid- or high-frequency active sonar exposure would cause a decrease in survivor rate or reproductive fitness.

Based on the model results, behavioral patterns, acoustic abilities of long-beaked common dolphins, results of past training, and the implementation of procedure mitigation measures presented in sections 5.1 for sonar and 5.2 for underwater detonations, the Navy finds that the SOCAL Range Complex training events would not result in any population level effects, death or injury to long-beaked common dolphins.

Mesoplodont Whales (Mesoplodon spp.)

The risk function and Navy post-modeling analysis estimates 92 Mesoplodont whales will exhibit behavioral responses NMFS will classify as harassment under the MMPA (Table 4-21). Modeling also indicates there would be 23 exposures to accumulated acoustic energy above 195 dB re 1 μPa^2-s, which is the threshold established indicative of onset TTS. One Mesoplodont whalse would be exposed to sound levels that could cause PTS.

Modeling indicates there would be no exposures to impulsive sound or pressures from underwater detonations of 182 dB or 23 psi, which is the threshold indicative of the onset of TTS, and no exposures to impulsive sound or pressures from underwater detonations that would cause physical injury (Table 4-26).

Given the size (up to 15.5 ft. [4.7 m]) of individual Mesoplodont beaked whales, it is likely that lookouts would detect a group of Mesoplodont beaked whales at the surface although beaked whales make prolonged dives that can last up to an hour (Baird et al. 2004). Implementation of mitigation measures and probability of detecting a Mesoplodont whale reduces the likelihood of exposure to sound levels that would likely cause a behavioral response that would affect vital rates (foraging, reproduction or survival), TTS or PTS. It is unlikely that the short duration and intermittent mid- or high-frequency active sonar exposure would cause a decrease in survivor rate or reproductive fitnessBased on the model results, behavioral patterns, acoustic abilities of Mesoplodont beaked whales, results of past training, and the implementation of procedure protective measures presented in sections 5.1 for sonar and 5.2 for underwater detonations, the Navy finds that the SOCAL Range Complex training events would not result in any population level effects, death or injury to Mesoplodont beaked whales.

Northern Right Whale Dolphin (*Lissodelphis borealis*)

The risk function and Navy post-modeling analysis estimates 863 northern right whale dolphins will exhibit behavioral responses NMFS will classify as harassment under the MMPA (Table 4-21). Modeling also indicates there would be 295 exposures to accumulated acoustic energy above 195 dB re 1 μPa^2-s, which is the threshold established indicative of onset TTS. No northern right whale dolphins would be exposed to sound levels that could cause PTS.

Modeling indicates there would six exposures to impulsive sound or pressures from underwater detonations of 182 dB or 23 psi, which is the threshold indicative of onset TTS, and no exposures to impulsive sound or pressures from underwater detonations that would cause physical injury (Table 4-26).

Given their large group size of up to 100 animals (Leatherwood et al. 1982), it is very likely, that lookouts would detect a group of northern right whale dolphins at the surface. Additionally, mitigation measures call for continuous visual observation during operations with active sonar and underwater detonations, therefore, northern right whale dolphins that migrate into the operating area would be detected by visual observers. Implementation of protective measures and probability of detecting large groups of northern right whale dolphins reduces the likelihood of exposure to sound levels that would likely cause a behavioral response that would affect vital rates (foraging, reproduction or survival), TTS or PTS. It is unlikely that the short duration and intermittent mid- or high-frequency active sonar exposure would cause a decrease in survivor rate or reproductive fitness.

Based on the model results, behavioral patterns, acoustic abilities of northern right whale dolphins, results of past training, and the implementation of procedure protective measures presented in sections 5.1 for sonar and 5.2 for underwater detonations, the Navy finds that the SOCAL Range Complex training events would not result in population level effects, any death or injury to northern right whale dolphins.

Pacific White-sided Dolphin (*Lagenorhynchus obliquidens*)

The risk function and Navy post-modeling analysis estimates 804 Pacific white-sided dolphin will exhibit behavioral responses NMFS will classify as harassment under the MMPA (Table 4-21). Modeling also indicates there would be 332 exposures to accumulated acoustic energy above 195 dB re 1 μPa^2-s, which is the threshold established indicative of onset TTS. No Pacific white-sided dolphins would be exposed to sound levels that could cause PTS.

Modeling indicates there would six exposures to impulsive sound or pressures from underwater detonations of 182 dB or 23 psi, which is the threshold indicative of onset TTS, and no exposures to impulsive sound or pressures from underwater detonations that would cause physical injury (Table 4-26).

Given their frequent surfacing and large group size of up to several thousand animals (Leatherwood et al. 1982), it is very likely that lookouts would detect a group of Pacific white-sided dolphins at the surface. Additionally, protective measures call for continuous visual observation during operations with active sonar and underwater detonations, therefore, Pacific white-sided dolphins that migrate into the operating area would be detected by visual observers. Implementation of mitigation measures and probability of detecting large groups of Pacific white-sided dolphins reduces the likelihood of exposure to to sound levels that would likely cause a behavioral response that would affect vital rates (foraging, reproduction or survival), TTS or PTS. It is unlikely that the short duration and intermittent mid- or high-frequency active sonar exposure would cause a decrease in survivor rate or reproductive fitness.

Based on the model results, behavioral patterns, acoustic abilities of Pacific white-sided dolphins, results of past training, and the implementation of procedure protective measures presented in sections 5.1 for sonar and 5.2 for underwater detonations, the Navy finds that the SOCAL Range Complex training events would not result in any population level effects, death or injury to Pacific white-sided dolphins.

Pygmy Sperm Whale (*Kogia breviceps*)

The risk function and Navy post-modeling analysis estimates 115 pygmy whales will exhibit behavioral responses NMFS will classify as harassment under the MMPA (Table 4-21). Modeling also indicates there would be 29 exposures to accumulated acoustic energy above 195 dB re 1 μPa^2-s, which is the threshold established indicative of onset TTS. One pygmy whale would be exposed to sound levels that could cause PTS.

Modeling indicates one exposure to impulsive sound or pressures from underwater detonations of 182 dB or 23 psi, which is the threshold indicative of onset TTS and no exposures to impulsive sound or pressures from underwater detonations that would cause slight physical injury (Table 4-26).

Given their size (up to 10 ft [3 m]) and behavior of resting at the surface (Leatherwood et al. 1982), it is very likely that lookouts would detect a pygmy sperm whale at the surface. Additionally, mitigation measures call for continuous visual observation during operations with active sonar and underwater detonations, therefore, pygmy sperm whales that migrate into the operating area would be detected by visual observers. Implementation of mitigation measures and probability of detecting large groups of pygmy sperm whales reduces the likelihood of exposure to sound levels that would likely cause a behavioral response that would affect vital rates (foraging, reproduction or survival), TTS or PTS. It is unlikely that the short duration and intermittent mid- or high-frequency active sonar exposure would cause a decrease in survivor rate or reproductive fitness.

Based on the model results, behavioral patterns, acoustic abilities of pygmy sperm whale, results of past training, and the implementation of procedure mitigation measures presented in sections 5.1 for sonar and 5.2 for underwater detonations, the Navy finds that the SOCAL Range Complex training events would not result in any population level effects, death or injury to pygmy sperm whale.

Risso's Dolphin (*Grampus griseus*)

The risk function and Navy post-modeling analysis estimates 2,094 Risso's dolphins will exhibit behavioral responses NMFS will classify as harassment under the MMPA (Table 4-21). Modeling also indicates there would be 606 exposures to accumulated acoustic energy above 195 dB re 1 μPa^2-s, which is the threshold established indicative of onset TTS. No Risso's dolphins would be exposed to sound levels that could cause PTS.

Modeling indicates there would 14 exposures to impulsive sound or pressures from underwater detonations of 182 dB or 23 psi, which is the threshold indicative of onset TTS, and one exposure to impulsive sound or pressures from underwater detonations that would cause slight physical injury (Table 4-26).

Given their frequent surfacing, light coloration and large group size of up to several hundred animals (Leatherwood et al. 1982), mean group size of 15.4 dolphins in Hawaii and probability of trackline detection of 0.76 in Beaufort Sea States of 6 or less (Barlow 2006), it is very likely that lookouts would detect a group of Risso's dolphins at the surface. Additionally, mitigation measures call for continuous visual observation during operations with active sonar and underwater detonations, therefore, Risso's dolphins that migrate into the operating area would be detected by visual observers. Implementation of mitigation measures and probability of detecting large groups of Risso's dolphins reduces the likelihood of exposure to sound levels that would likely cause a behavioral response that would affect vital rates (foraging, reproduction or survival), TTS or PTS. It is unlikely that the short duration and intermittent mid- or high-frequency active sonar exposure would cause a decrease in survivor rate or reproductive fitness.

Based on the model results, behavioral patterns, acoustic abilities of Risso's dolphins, results of past training, and the implementation of procedure mitigation measures presented in sections 5.1 for sonar and 5.2 for underwater detonations, the Navy finds that the SOCAL Range Complex training events would not result in any population level effects, death or injury to Risso's dolphins.

Short- Beaked Common Dolphin (*Delphinus delphis*)

The risk function and Navy post-modeling analysis estimates 20,614 short-beaked common dolphins will exhibit behavioral responses NMFS will classify as harassment under the MMPA (Table 4-21). Modeling also indicates there would be 6,540 exposures to accumulated acoustic energy above 195 dB re 1 μPa^2-s, which is the threshold established indicative of onset TTS. Nine short-beaked common dolphins would be exposed to sound levels that could cause PTS.

Modeling indicates there would 202 exposures to impulsive sound or pressures from underwater detonations of 182 dB or 23 psi, which is the threshold indicative of onset TTS, and 10 exposures to impulsive sound or pressures from underwater detonations that would cause slight physical injury and four exposures that would cause severe injury or mortality (Table 4-26).

Given the frequent surfacing and their large group size of up to 1,000 animals (Leatherwood et al. 1982), it is very likely, that lookouts would detect a group of short-beaked common dolphins at the surface. Additionally, protective measures call for continuous visual observation during operations with active sonar and underwater detonations, therefore, common dolphins that migrate into the operating area would be detected by visual observers. Exposure of long-beaked common dolphins to energy levels associated with Level A harassment would not occur because protective measures would be implemented, large groups of long-beaked common dolphins would be observed, and underwater detonations result in a small zone of influence. Exposure to sound levels that would likely cause a behavioral response that would affect vital rates (foraging, reproduction or survival), TTS or PTS. It is unlikely that the short duration and intermittent mid- or high-frequency active sonar exposure would cause a decrease in survivor rate or reproductive fitness.

Based on the model results, behavioral patterns, acoustic abilities of short-beaked common dolphins, results of past training, and the implementation of procedure mitigation measures presented in sections 5.1 for sonar and 5.2 for underwater detonations, the Navy finds that the SOCAL Range Complex training events would not result in any population level effects, death or injury to long-beaked common dolphins.

Short-finned Pilot Whale (*Globicephala macrorhynchus*)

The risk function and Navy post-modeling analysis estimates 36 short-finned pilot whales will exhibit behavioral responses NMFS will classify as harassment under the MMPA (Table 4-21). Modeling also indicates there would be 10 exposures to accumulated acoustic energy above 195 dB re 1 μPa^2-s, which is the threshold established indicative of onset TTS. No short-finned pilot whales would be exposed to sound levels that could cause PTS.

Modeling indicates there would be no exposures to impulsive sound or pressures from underwater detonations of 182 dB or 23 psi, which is the threshold indicative of onset TTS and no exposures to impulsive sound or pressures from underwater detonations that would cause slight physical injury or massive lung injury (Table 4-26).

Given their size (up to 20 ft [6.1 m]), and large mean group size of 22.5 animals (probability of trackline detection = 0.76 in Beaufort Sea States of 6 or less; Barlow 2006). It is very likely that lookouts would detect a group of short-finned pilot whales at the surface. Additionally, mitigation measures call for continuous visual observation during operations with active sonar, therefore, short-finned pilot whales that migrate into the operating area would be detected by visual observers. Implementation of mitigation measures and probability of detecting groups of short-finned pilot whales reduces the likelihood of exposure to sound levels that would likely cause a behavioral response that would affect vital rates (foraging, reproduction or survival), TTS or PTS. It is unlikely that the short duration and intermittent mid- or high-frequency active sonar exposure would cause a decrease in survivor rate or reproductive fitness.

Based on the model results, behavioral patterns, acoustic abilities of short-finned pilot whale, results of past training, and the implementation of procedure mitigation measures presented in sections 5.1 for sonar and 5.2 for underwater detonations, the Navy finds that the SOCAL Range Complex training events would not result in any population level effects, death or injury to short-finned pilot whale.

Striped Dolphin (*Stenella coeruleoalba*)

The risk function and Navy post-modeling analysis estimates 1,490 striped dolphins will exhibit behavioral responses NMFS will classify as harassment under the MMPA (Table 4-21). Modeling also indicates there would be 437 exposures to accumulated acoustic energy above 195 dB re 1 μPa^2-s, which is the threshold established indicative of onset TTS. No striped dolphins would be exposed to sound levels that could cause PTS.

Modeling indicates five exposures to impulsive sound or pressures from underwater detonations of 182 dB or 23 psi, which is the threshold indicative of onset TTS and no exposures to impulsive sound or pressures from underwater detonations that would cause slight physical injury or massive lung injury (Table 4-26).

Given their frequent surfacing, aerobatics and large mean group size of 37.3 animals (probability of trackline detection = 1.00 in Beaufort Sea States of 6 or less; Barlow 2006), it is very likely that lookouts would detect a group of striped dolphins at the surface. Additionally, mitigation measures call for continuous visual observation during operations with active sonar, therefore, striped dolphins that migrate into the operating area would be detected by visual observers. Implementation of mitigation measures and probability of detecting groups of striped dolphins reduces the likelihood of exposure to sound levels that would likely cause a behavioral response that would affect vital rates (foraging, reproduction or survival), TTS or PTS. It is unlikely that the short duration and intermittent mid- or high-frequency active sonar exposure would cause a decrease in survivor rate or reproductive fitness.

Based on the model results, behavioral patterns, acoustic abilities of striped dolphins, results of past training, and the implementation of procedure mitigation measures presented in sections 11.1

for sonar and 11.2 for underwater detonations, the Navy finds that the SOCAL Range Complex training events would not result in any population level effects, death or injury to striped dolphins.

Ziphiid Whales (*Ziphus* spp.)

The risk function and Navy post-modeling analysis estimates 69 Ziphiid whales will exhibit behavioral responses NMFS will classify as harassment under the MMPA (Table 4-21). Modeling also indicates there would be 16 exposures to accumulated acoustic energy above 195 dB re 1 μPa^2-s, which is the threshold established indicative of onset TTS. No Ziphiid whales would be exposed to sound levels that could cause PTS.

Modeling indicates there would be no exposures to impulsive sound or pressures from underwater detonations of 182 dB or 23 psi, which is the threshold indicative of onset TTS and no exposures to impulsive sound or pressures from underwater detonations that would cause slight physical injury (Table 4-26).

Given the medium size (up to 23 ft. [7.0 m]) of individual Ziphiid whales, aggregation of approximately two animals (Barlow 2006), it is likely that lookouts would detect a group of Ziphiid whales at the surface although Ziphiid whales make prolonged dives that can last up to an hour (Baird et al. 2004). Additionally, mitigation measures call for continuous visual observation during operations with active sonar, therefore, Ziphiid whales that migrate into the operating area would be detected by visual observers. Implementation of mitigation measures and probability of detecting a large sei whale reduces the likelihood of exposureto sound levels that would likely cause a behavioral response that would affect vital rates (foraging, reproduction or survival), TTS or PTS. It is unlikely that the short duration and intermittent mid- or high-frequency active sonar exposure would cause a decrease in survivor rate or reproductive fitness.Based on the model results, behavioral patterns, acoustic abilities of Ziphiid whales, results of past training, and the implementation of procedure protective measures presented in sections 5.1 for sonar and 5.2 for underwater detonations, the Navy finds that the SOCAL Range Complex training events would not result in any population level effects, death or injury to Ziphiid whales.

Northern Elephant Seal (*Mirounga angustirostris*)

The risk function and Navy post-modeling analysis estimates 637 northern elephant seals will exhibit behavioral responses NMFS will classify as harassment under the MMPA (Table 4-21). Modeling also indicates there would be seven exposures to accumulated acoustic energy above 204 dB re 1 μPa^2-s, which is the threshold established indicative of onset TTS for northern elephant seals. No northern elephant seals would be exposed to sound levels that could cause PTS.

Modeling indicates there would 15 exposures to impulsive sound or pressures from underwater detonations of 182 dB or 23 psi, which is the threshold indicative of onset TTS, and no exposures to impulsive sound or pressures from underwater detonations that would cause physical injury (Table 4-26).

Northern elephant seals tend to dive for long periods, 20-30 minutes, and only spend about 10% of the time at the surface making them difficult to detect. Elephant seals migrate out of the Southern California area to forage for several months at a time (Le Boeuf 1994). Exposure to sound levels that would likely cause a behavioral response that would affect vital rates (foraging, reproduction or survival), TTS or PTS. It is unlikely that the short duration and intermittent mid- or high-frequency active sonar exposure would cause a decrease in survivor rate or reproductive fitness.

Based on the model results, behavioral patterns, acoustic abilities of Northern elephant seals, results of past training, and the implementation of procedure mitigation measures presented in sections 5.1 for sonar and 5.2 for underwater detonations, the Navy finds that the SOCAL Range Complex training events would not result in any population level effects, death or injury to Northern elephant seals.

Pacific Harbor Seal (*Phoca vitulina richardii*)

The risk function and Navy post-modeling analysis estimates 964 Pacific harbor seals will exhibit behavioral responses NMFS will classify as harassment under the MMPA (Table 4-21). Modeling also indicates there would be 6,692 exposures to accumulated acoustic energy above 183 dB re 1 μPa^2-s, which is the threshold established indicative of onset TTS for Pacific harbor seals. Fourteen Pacific harbor seals would be exposed to sound levels that could cause PTS.

Modeling indicates there would 22 exposures to impulsive sound or pressures from underwater detonations of 182 dB or 23 psi, which is the threshold indicative of onset TTS, and one exposure to impulsive sound or pressures from underwater detonations that would cause slight physical injury (Table 4-26).

Harbor seals forage near their rookeries (usually within 50 km) therefore they tend to remain in the Southern California area most of the time in comparison to northern elephant seals. Exposure to sound levels that would likely cause a behavioral response that would affect vital rates (foraging, reproduction or survival), TTS or PTS. It is unlikely that the short duration and intermittent mid- or high-frequency active sonar exposure would cause a decrease in survivor rate or reproductive fitness.

Based on the model results, behavioral patterns, acoustic abilities of harbor seals, results of past training, and the implementation of procedure mitigation measures presented in sections 5.1 for sonar and 5.2 for underwater detonations, the Navy finds that the SOCAL Range Complex training events would not result in any population level effects, death or injury to harbor seals.

California Sea Lion (*Zalophus californianus*)

The risk function and Navy post-modeling analysis estimates 49,697 California sea lions will exhibit behavioral responses NMFS will classify as harassment under the MMPA (Table 4-21). Modeling also indicates there would be five exposures to accumulated acoustic energy above 206 dB re 1 μPa^2-s, which is the threshold established indicative of onset TTS for California sea lions. No California sea lions would be exposed to sound levels that could cause PTS.

Modeling indicates there would 388 exposures to impulsive sound or pressures from underwater detonations of 182 dB or 23 psi, which is the threshold indicative of onset TTS, 14 exposures to impulsive sound or pressures from underwater detonations that would cause slight physical injury and five exposures that would cause severe injury or mortality (Table 4-26).

California sea lions make short duration dives and may rest at the surface (Feldkamp et al. 1989) making them easier to detect than other pinnipeds. Exposure to sound levels that would likely cause a behavioral response that would affect vital rates (foraging, reproduction or survival), TTS or PTS. It is unlikely that the short duration and intermittent mid- or high-frequency active sonar exposure would cause a decrease in survivor rate or reproductive fitness.

Based on the model results, behavioral patterns, acoustic abilities of California sea lions, results of past training, and the implementation of procedure mitigation measures presented in sections 5.1 for sonar and 5.2 for underwater detonations, the Navy finds that the SOCAL Range Complex training events would not result in any population level effects, death or injury to harbor seals.

Northern Fur Seal (*Callorhinus ursinus*)

The risk function and Navy post-modeling analysis estimates 698 northern fur seals will exhibit behavioral responses NMFS will classify as harassment under the MMPA (Table 4-21). Modeling also indicates there would be five exposures to accumulated acoustic energy above 206 dB re 1 μPa^2-s, which is the threshold established indicative of onset TTS for northern fur seals. No northern fur seals would be exposed to sound levels that could cause PTS.

Modeling indicates there would 38 exposures to impulsive sound or pressures from underwater detonations of 182 dB or 23 psi, which is the threshold indicative of onset TTS, two exposures to impulsive sound or pressures from underwater detonations that would cause slight physical injury and one exposure that could cause severe injury or mortality (Table 4-26).

Northern fur seals do not dive for long periods and may rest on the surface between foraging bouths (Gentry and Goebel 1984) making them easier to detect. Additionally, mitigation measures call for continuous visual observation during operations with active sonar; therefore, northern fur seals that migrate into the operating area would likely be detected by visual observers when the fur seals surface. Implementation of mitigation measures and probability of detecting fur seals resting at the surface reduces the likelihood of exposure to sound levels that would likely cause a behavioral response that would affect vital rates (foraging, reproduction or survival), TTS or PTS. It is unlikely that the short duration and intermittent mid- or high-frequency active sonar exposure would cause a decrease in survivor rate or reproductive fitness.

Based on the model results, behavioral patterns, acoustic abilities of northern fur seals, results of past training, and the implementation of procedure mitigation measures presented in sections 5.1 for sonar and 5.2 for underwater detonations, the Navy finds that the SOCAL Range Complex training events would not result in any population level effects, death or injury to northern fur seals.

4.9 ALTERNATIVE 2

4.9.1 Non-Sonar Acoustic Impacts and Non-Acoustic Impacts

Non-acoustic impacts on marine mammals under Alternative 2 would be substantially the same as impacts identified under the No Action Alternative. Under Alternative 2, increased operations would not increase the risk of collisions between Navy ships and marine mammals, given the extensive mitigation measures in effect to avoid such an event. Based on these standard operating procedures, collisions with marine mammals are not expected under Alternative 2. With regard to potential encounters between marine mammals and unrecovered military debris expended on the SOCAL Range Complex: Debris related to military activities that is not recovered generally sinks; the amount that might remain on or near the sea surface is low, and the density of such debris in the SOCAL Range Complex would be very low under Alternative 2 as under the No Action Alternative. Impacts to marine mammals from expended debris are unlikely.

4.9.2 Summary of Potential Mid- and High-Frequency Active Sonar Effects

Table 4-27 represents the number of sonar hours, dipping sonar, or sonobuoys usage per year for the different sonar sources including the 53C, 56C, submarine, AN/AWS-22 dipping sonar, SSQ-62 Sonobuoys, and MK-48 torpedo sonar.

Table 4-27. Summary of the sonar hours, number of sonar dips and sonobuoys, and torpedo runs for each type of exercise for Alternative 2.

Event	SQS-53 C Sonar Hours	SQS-56 C Sonar Hours	Total Sonar Hours	AQS-22 Number of Dips	SSQ-62 Number of Sonobuoys	MK-48 Number of Torpedo Events
Major Exercise (8/yr)	1,045	261	1,306	337	2,255	11
Sustainment Exercise (2/yr)	85	21	106	45	171	3
IAC II (4/yr)	244	61	305	407	511	3
ULT, Coordinated Events & Maintenance	603	151	754	1,930	1319	70
Total	1,977	494	2,471	2,719	4,255	87

Table 4-28 presents a summary of the estimated marine mammal exposures for potential non-injurious (Level B) harassment, as well as potential onset of injury (Level A) to cetaceans and pinnipeds. Tables 4-29 through 4-32 present estimated marine mammal exposures further separated by component activites as listed in Table 4-27. The numbers contained in these tables may be slightly less than those presented in Table 4-28 as a result of the order of summation and the application of rounding rules utilized in the calculation of exposures.

Specifically, under this assessment for mid-frequency active sonar, the risk function methodology estimates 94,370 annual exposures that could potentially result in behavioral sub-TTS (Level B Harassment); 18,838 annual exposures that could potentially result in TTS (Level B Harassment); and 30 annual exposures could result in potential injury as PTS (Level A Harassment). No mid-frequency active sonar exposures are predicted to result in any animal mortality.

It should be noted, however, that these exposure modeling results are statistically derived estimates of potential marine mammal sonar exposures without consideration of standard mitigation and monitoring procedures. The caveats to interpretations of model results are described previously. It is highly unlikely that a marine mammal would experience any long-term effects because the large SOCAL Range Complex training areas makes individual mammals' repeated or prolonged exposures to high-level sonar signals unlikely. Specifically, mid-frequency active sonars have limited marine mammal exposure ranges and relatively high platform speeds. The number of exposures that exceed the PTS threshold and result in Level A harassment from sonar is 30 for six species (blue whale, gray whale, long-beaked common dolphin, Pacific harbor seal, short-beaked common dolphin, and sperm whale). Therefore, long term effects on individuals, populations or stocks are unlikely.

When analyzing the results of the acoustic exposure modeling to provide an estimate of effects, it is important to understand that there are limitations to the ecological data (diving behavior, migration or movement patterns and population dynamics) used in the model, and that the model results must be interpreted within the context of a given species' ecology.

As described previously, this analysis assumes that short-term non-injurious sound exposure levels predicted to cause TTS or temporary behavioral disruptions qualify as Level B harassment. This approach is overestimating because there is no established scientific correlation between mid-frequency active sonar use and long term abandonment or significant alteration of behavioral patterns in marine mammals.

Because of the time delay between pings, and platform speed, an animal encountering the sonar will accumulate energy for only a few sonar pings over the course of a few minutes. Therefore, exposure to sonar would be a short-term event, minimizing any single animal's exposure to sound levels approaching the harassment thresholds.

The implementation of the mitigation and monitoring procedures as addressed in Section 11 will further minimize the potential for marine mammal exposures to underwater detonations. When reviewing the acoustic exposure modeling results, it is also important to understand that the estimates of marine mammal sound exposures are presented without consideration of standard protective measure operating procedures. Section 5 of the EIS/OEIS presents details of the mitigation measures currently used for ASW activities including detection of marine mammals and power down procedures if marine mammals are detected within one of the safety zones. The Navy will work through the MMPA incidental harassment regulatory process to discuss the mitigation measures and their potential to reduce the likelihood for incidental harassment of marine mammals.

Table 4-28. Alternative 2 Summary of All Annual Mid- and High-Frequency Active Sonar Exposures

Species	Level B Sonar Exposures		Level A Sonar Exposures
	Risk Function	TTS	PTS
ESA Species			
Blue whale	523	127	1
Fin whale	113	23	0
Humpback whale	14	2	0
Sei whale	0	0	0
Sperm whale	118	19	1
Guadalupe fur seal	911	321	0
Sea otter	N/A	N/A	N/A
Mysticetes			
Bryde's whale	0	0	0
Gray whale	5,409	1,017	2
Minke whale	102	30	0
Odontocetes			
Baird's beaked whale	10	2	0
Bottlenose dolphin	961	357	0
Cuvier's beaked whale	324	71	0
Dall's porpoise	473	163	0
Dwarf sperm whale	N/A	N/A	N/A
False killer whale	N/A	N/A	N/A
Killer whale	6	2	0
Long beaked common dolphin	2,543	807	1
Longman's beaked whale	N/A	N/A	N/A
Melon-headed whale	N/A	N/A	N/A
Mesoplodon spp.	98	24	0
Northern right whale dolphin	915	313	0
Pacific white-sided dolphin	852	352	0
Pantropical spotted dolphin	N/A	N/A	N/A
Pygmy killer whale	N/A	N/A	N/A
Pygmy sperm whale	122	31	0
Risso's dolphin	2,220	642	0
Rough-toothed dolphin	N/A	N/A	N/A
Short beaked common dolphin	21,851	6,932	10
Short-finned pilot whale	38	11	0
Spinner dolphin	N/A	N/A	N/A
Striped dolphin	1,579	463	0
Ziphiid whales	73	17	0
Pinnipeds			
Northern elephant seal	675	7	0
Pacific harbor seal	1,022	7,094	15
California sea lion	52,679	5	0
Northern fur seal	740	5	0
Total	**94,370**	**18,838**	**30**

TTS and PTS Thresholds: Cetaceans TTS = 195 dB re 1 μPa^2-s; PTS = 215 dB, re 1 μPa^2-s; Northern elephant seal TTS = 204 re 1 μPa^2-s, PTS = 224 re 1 μPa^2-s; Harbor seal TTS = 183 re 1 μPa^2-s, PTS = 203 re 1 μPa^2-s; Otariids TTS = 206 re 1 μPa^2-s, PTS = 226 re 1 μPa^2-s.

N/A: Not applicable – Based on a few historic observations, its habitat preference or overall distribution, a species may occur rarely in the SOCAL Range Complex, but no density estimates were available for modeling exposures.

Table 4-29: Alternative 2 Summary of ULT, Coordinated Events and Maintenance Annual Sonar Exposures

Species	Level B Sonar Exposures		Level A Sonar Exposures
	Risk Function	TTS	PTS
ESA Species			
Blue whale	239	58	0
Fin whale	50	11	0
Humpback whale	6	1	0
Sei whale	0	0	0
Sperm whale	52	10	0
Guadalupe fur seal	420	156	0
Sea otter	0	0	0
Mysticetes			
Bryde's whale	0	0	0
Gray whale	2,542	462	1
Minke whale	47	14	0
Odontocetes			
Baird's beaked whale	4	1	0
Bottlenose dolphin	444	164	0
Cuvier's beaked whale	140	34	0
Dall's porpoise	215	74	0
Dwarf sperm whale	N/A	N/A	N/A
False killer whale	N/A	N/A	N/A
Killer whale	3	1	0
Long beaked common dolphin	1,221	375	1
Longman's beaked whale	N/A	N/A	N/A
Melon-headed whale	N/A	N/A	N/A
Mesoplodon spp.	43	12	0
Northern right whale dolphin	428	145	0
Pacific white-sided dolphin	402	161	0
Pantropical spotted dolphin	N/A	N/A	N/A
Pygmy killer whale	N/A	N/A	N/A
Pygmy sperm whale	54	15	0
Risso's dolphin	1,013	302	0
Rough-toothed dolphin	N/A	N/A	N/A
Short beaked common dolphin	10,500	3,227	4
Short-finned pilot whale	18	5	0
Spinner dolphin	N/A	N/A	N/A
Striped dolphin	723	211	0
Ziphiid whales	32	7	0
Pinnipeds			
Northern elephant seal	444	5	0
Pacific harbor seal	636	4,442	10
California sea lion	25,543	4	0
Northern fur seal	348	2	0
Total	**45,567**	**9,900**	**16**

TTS and PTS Thresholds: Cetaceans TTS = 195 dB re 1 µPa^2-s; PTS = 215 dB, re 1 µPa^2-s; Northern elephant seal TTS = 204 re 1 µPa^2-s, PTS = 224 re 1 µPa^2-s; Harbor seal TTS = 183 re 1 µPa^2-s, PTS = 203 re 1 µPa^2-s; Otariids TTS = 206 re 1 µPa^2-s, PTS = 226 re 1 µPa^2-s.

N/A: Not applicable – Based on a few historic observations, its habitat preference or overall distribution, a species may occur rarely in the SOCAL Range Complex, but no density estimates were available for modeling exposures.

Table 4-30: Alternative 2 Summary of Major Exercises Annual Sonar Exposures

Species	Level B Sonar Exposures		Level A Sonar Exposures
	Risk Function	TTS	PTS
ESA Species			
Blue whale	214	51	1
Fin whale	49	10	0
Humpback whale	5	1	0
Sei whale	0	0	0
Sperm whale	50	6	0
Guadalupe fur seal	368	131	0
Sea otter	0	0	0
Mysticetes			
Bryde's whale	0	0	0
Gray whale	2,140	414	1
Minke whale	41	12	0
Odontocetes			
Baird's beaked whale	4	1	0
Bottlenose dolphin	384	143	0
Cuvier's beaked whale	141	27	0
Dall's porpoise	194	67	0
Dwarf sperm whale	N/A	N/A	N/A
False killer whale	N/A	N/A	N/A
Killer whale	2	1	0
Long beaked common dolphin	957	318	0
Longman's beaked whale	N/A	N/A	N/A
Melon-headed whale	N/A	N/A	N/A
Mesoplodon spp.	40	10	0
Northern right whale dolphin	357	124	0
Pacific white-sided dolphin	332	142	0
Pantropical spotted dolphin	N/A	N/A	N/A
Pygmy killer whale	N/A	N/A	N/A
Pygmy sperm whale	51	12	0
Risso's dolphin	901	249	0
Rough-toothed dolphin	N/A	N/A	N/A
Short beaked common dolphin	8,221	2,733	4
Short-finned pilot whale	16	4	0
Spinner dolphin	N/A	N/A	N/A
Striped dolphin	641	189	0
Ziphiid whales	32	6	0
Pinnipeds			
Northern elephant seal	186	2	0
Pacific harbor seal	267	1802	4
California sea lion	21,624	1	0
Northern fur seal	289	2	0
Total	**37,507**	**6,458**	**10**

TTS and PTS Thresholds: Cetaceans TTS = 195 dB re 1 μPa^2-s; PTS = 215 dB, re 1 μPa^2-s; Northern elephant seal TTS = 204 re 1 μPa^2-s, PTS = 224 re 1 μPa^2-s; Harbor seal TTS = 183 re 1 μPa^2-s, PTS = 203 re 1 μPa^2-s; Otariids TTS = 206 re 1 μPa^2-s, PTS = 226 re 1 μPa^2-s.

N/A: Not applicable – Based on a few historic observations, its habitat preference or overall distribution, a species may occur rarely in the SOCAL Range Complex, but no density estimates were available for modeling exposures.

Table 4-31: Alternative 2 Summary of IAC II Annual Sonar Exposures

Species	Level B Sonar Exposures		Level A Sonar Exposures
	Risk Function	TTS	PTS
ESA Species			
Blue whale	49	13	0
Fin whale	11	2	0
Humpback whale	1	0	0
Sei whale	0	0	0
Sperm whale	11	2	0
Guadalupe fur seal	85	23	0
Sea otter	0	0	0
Mysticetes			
Bryde's whale	0	0	0
Gray whale	501	98	0
Minke whale	10	3	0
Odontocetes			
Baird's beaked whale	1	0	0
Bottlenose dolphin	93	35	0
Cuvier's beaked whale	30	7	0
Dall's porpoise	45	16	0
Dwarf sperm whale	N/A	N/A	N/A
False killer whale	N/A	N/A	N/A
Killer whale	1	0	0
Long beaked common dolphin	263	80	0
Longman's beaked whale	N/A	N/A	N/A
Melon-headed whale	N/A	N/A	N/A
Mesoplodon spp.	10	2	0
Northern right whale dolphin	91	31	0
Pacific white-sided dolphin	84	34	0
Pantropical spotted dolphin	N/A	N/A	N/A
Pygmy killer whale	N/A	N/A	N/A
Pygmy sperm whale	12	3	0
Risso's dolphin	213	65	0
Rough-toothed dolphin	N/A	N/A	N/A
Short beaked common dolphin	2,256	685	1
Short-finned pilot whale	3	1	0
Spinner dolphin	N/A	N/A	N/A
Striped dolphin	149	45	0
Ziphiid whales	6	2	0
Pinnipeds			
Northern elephant seal	35	0	0
Pacific harbor seal	92	664	1
California sea lion	3,698	0	0
Northern fur seal	73	1	0
Total	**7,822**	**1,810**	**2**

TTS and PTS Thresholds: Cetaceans TTS = 195 dB re 1 μPa^2-s; PTS = 215 dB, re 1 μPa^2-s; Northern elephant seal TTS = 204 re 1 μPa^2-s, PTS = 224 re 1 μPa^2-s; Harbor seal TTS = 183 re 1 μPa^2-s, PTS = 203 re 1 μPa^2-s; Otariids TTS = 206 re 1 μPa^2-s, PTS = 226 re 1 μPa^2-s.

N/A: Not applicable – Based on a few historic observations, its habitat preference or overall distribution, a species may occur rarely in the SOCAL Range Complex, but no density estimates were available for modeling exposures.

Table 4-32: Alternative 2 Summary of Sustainment Annual Sonar Exposures

Species	Level B Sonar Exposures		Level A Sonar Exposures
	Risk Function	TTS	PTS
ESA Species			
Blue whale	21	5	0
Fin whale	4	1	0
Humpback whale	1	0	0
Sei whale	0	0	0
Sperm whale	5	1	0
Guadalupe fur seal	38	11	0
Sea otter	0	0	0
Mysticetes			
Bryde's whale	0	0	0
Gray whale	226	42	0
Minke whale	4	1	0
Odontocetes			
Baird's beaked whale	0	0	0
Bottlenose dolphin	40	15	0
Cuvier's beaked whale	14	3	0
Dall's porpoise	19	6	0
Dwarf sperm whale	N/A	N/A	N/A
False killer whale	N/A	N/A	N/A
Killer whale	0	0	0
Long beaked common dolphin	102	34	0
Longman's beaked whale	N/A	N/A	N/A
Melon-headed whale	N/A	N/A	N/A
Mesoplodon spp.	4	1	0
Northern right whale dolphin	38	13	0
Pacific white-sided dolphin	35	15	0
Pantropical spotted dolphin	N/A	N/A	N/A
Pygmy killer whale	N/A	N/A	N/A
Pygmy sperm whale	5	1	0
Risso's dolphin	92	27	0
Rough-toothed dolphin	N/A	N/A	N/A
Short beaked common dolphin	873	288	0
Short-finned pilot whale	1	0	0
Spinner dolphin	N/A	N/A	N/A
Striped dolphin	66	19	0
Ziphiid whales	3	1	0
Pinnipeds			
Northern elephant seal	11	0	0
Pacific harbor seal	27	186	0
California sea lion	1,814	0	0
Northern fur seal	30	0	0
Total	**3,474**	**670**	**0**

TTS and PTS Thresholds: Cetaceans TTS = 195 dB re 1 μPa^2-s; PTS = 215 dB, re 1 μPa^2-s; Northern elephant seal TTS = 204 re 1 μPa^2-s, PTS = 224 re 1 μPa^2-s; Harbor seal TTS = 183 re 1 μPa^2-s, PTS = 203 re 1 μPa^2-s; Otariids TTS = 206 re 1 μPa^2-s, PTS = 226 re 1 μPa^2-s.

N/A: Not applicable – Based on a few historic observations, its habitat preference or overall distribution, a species may occur rarely in the SOCAL Range Complex, but no density estimates were available for modeling exposures.

4.9.3 Summary of Potential Underwater Detonation Effects

The modeled exposure harassment numbers for all training operations involving explosives are presented by species in Table 4-33. The modeling indicates 817 annual exposures to pressure from underwater detonations that could potentially result in TTS (Level B Harassment); 36 annual exposures from pressure from underwater detonations that could cause slight injury (Level A Harassment); and 12 exposures that could cause severe injury or mortality.

Training operations involving explosives include Mine Neutralization, Air to Surface Missile Exercise, Surface to Surface Missile Exercise, Bombing Exercise, Sinking Exercise, Surface to Surface Gunnery exercise, and Naval Surface Fire Support. In a SINKEX, weapons are typically fired in order of decreasing range from the source with weapons fired until the target is sunk. Since the target may sink at any time during the exercise, the actual number of weapons used can vary widely. In the representative case, however, all of the ordnances are assumed expended; this represents the worst case of maximum exposure.

These exposure modeling results are estimates of marine mammal underwater detonation sound exposures without considering similar model limitations as discussed in the summary of mid-frequency active sonar sub-section (Section 4.7.2). In addition, implementation of the mitigation and monitoring procedures will further minimize the potential for marine mammal exposures to underwater detonations.

Table 4-33. Alternative 2 Annual Underwater Detonation Exposures Summary.

Species	Level B Exposures	Level A Exposures	
	TTS 182 dB re 1 μPa²-s /23 psi	50% TM Rupture 205 dB re 1 μPa²-s or Slight Lung Injury 13 psi-ms	Onset Massive Lung Injury or Mortality 31 psi-ms
ESA Species			
Blue whale	2	1	0
Fin whale	1	0	0
Humpback whale	0	0	0
Sei whale	0	0	0
Sperm whale	1	0	0
Guadalupe fur seal	2	1	0
Sea otter	N/A	N/A	N/A
Mysticetes			
Bryde's whale	0	0	0
Gray whale	7	0	0
Minke whale	0	0	0
Odontocetes			
Baird's beaked whale	0	0	0
Bottlenose dolphin	6	0	0
Cuvier's beaked whale	2	0	0
Dall's porpoise	2	0	0
Dwarf sperm whale	N/A	N/A	N/A
False killer whale	N/A	N/A	N/A
Killer whale	0	0	0
Long-beaked common dolphin	26	1	1
Longman's beaked whale	N/A	N/A	N/A
Melon-headed whale	N/A	N/A	N/A
Mesoplodon spp.	0	0	0
Northern right whale dolphin	6	0	0
Pacific white-sided dolphin	6	0	0
Pantropical spotted dolphin	N/A	N/A	N/A
Pygmy killer whale	N/A	N/A	N/A
Pygmy sperm whale	1	0	0
Risso's dolphin	15	1	0
Rough-toothed dolphin	N/A	N/A	N/A
Short-beaked common dolphin	227	12	4
Short-finned pilot whale	0	0	0
Spinner dolphin	N/A	N/A	N/A
Striped dolphin	6	0	0
Ziphiid whale	0	0	0
Pinnipeds			
Northern elephant seal	17	0	0
Pacific harbor seal	24	1	0
California sea lion	424	16	6
Northern fur seal	42	3	1
Total	**817**	**36**	**12**

N/A: Not applicable – Based on a few historic observations, its habitat preference or overall distribution, a species may occur rarely in the SOCAL Range Complex, but no density estimates were available for modeling exposures..

4.9.4 Species-Specific Potential Impacts: Alternative 2

Blue Whale (*Balaenoptera musculus*)

The risk function and Navy post-modeling analysis estimates 523 blue whales will exhibit behavioral responses NMFS will classify as harassment under the MMPA (Table 4-28). Modeling also indicates there would be 127 exposures to accumulated acoustic energy above 195 dB re 1 μPa^2-s, which is the threshold established indicative of onset TTS. One blue whale would be exposed to sound levels that could cause PTS.

Modeling indicates there would two exposures to impulsive sound or pressures from underwater detonations of 182 dB or 23 psi, which is the threshold indicative of onset TTS, and one exposures to impulsive sound or pressures from underwater detonations that would cause slight physical injury (Table 4-33).

Given the large size (up to 98 ft [30 m]) of individual blue whales (Leatherwood et al. 1982), pronounced vertical blow, and aggregation of approximately two to three animals in a group (probability of track line detection = 0.90 in Beaufort Sea States of 6 or less; Barlow 2003), it is very likely that lookouts would detect a group of blue whales at the surface. Additionally, mitigation measures call for continuous visual observation during operations with active sonar; therefore, blue whales that migrate into the operating area would be detected by visual observers. Implementation of mitigation measures and probability of detecting a large blue whale reduces the likelihood of exposure, such that effects would be discountable.

In the unlikely event that blue whales are exposed to mid-frequency sonar, the anatomical information available on blue whales suggests that they are not likely to hear mid-frequency (1 kHz–10 kHz) sounds (Ketten 1997). There are no audiograms of baleen whales, but blue whales tend to react to anthropogenic sound below 1 kHz (e.g., seismic air guns), and most of their vocalizations are also in that range, suggesting that they are more sensitive to low frequency sounds (Richardson *et al*. 1995). Based on this information, if they do no hear these sounds, they are not likely to respond physiologically or behaviorally to those received levels.

Based on the model results, behavioral patterns, acoustic abilities of blue whales, results of past training exercises, and the implementation of mitigation measures presented in sections 5.1 for sonar and 5.2 for underwater detonations, the Navy finds that the SOCAL Range Complex training events would likely not result in any population level effects, death or injury to blue whales.

Fin Whale (*Balaenoptera physalus*)

The risk function and Navy post-modeling analysis estimates 113 fin whales will exhibit behavioral responses NMFS will classify as harassment under the MMPA (Table 4-28). Modeling also indicates there would be 23 exposures to accumulated acoustic energy above 195 dB re 1 μPa^2-s, which is the threshold established indicative of onset TTS. No fin whales would be exposed to sound levels that could cause PTS.

Modeling indicates there would one exposure to impulsive sound or pressures from underwater detonations of 182 dB or 23 psi, which is the threshold indicative of onset TTS, and no exposures to impulsive sound or pressures from underwater detonations that would cause slight physical injury and one exposure that would cause severe injury (Table 4-33).

Given the large size (up to 78 ft [24m]) of individual fin whales (Leatherwood et al. 1982), pronounced vertical blow, mean aggregation of three animals in a group (probability of trackline detection = 0.90 in Beaufort Sea States of 6 or less; Barlow 2003) it is very likely that lookouts would detect a group of fin whales at the surface. Additionally, mitigation measures call for continuous visual observation during operations with active sonar, therefore, fin whales in the vicinity of operations would be detected by visual observers. Implementation of mitigation measures and probability of detecting a large fin whale reduces the likelihood of exposure, such that effects would be discountable.

In the unlikely event that fin whales are exposed to mid-frequency sonar, the anatomical information available on fin whales suggests that they are not likely to hear mid-frequency (1 kHz–10 kHz) sounds (Richardson et al. 1995; Ketten 1997). Fin whales primarily produce low frequency calls (below 1 kHz) with source levels up to 186 dB re 1µPa at 1 m, although it is possible they produce some sounds in the range of 1.5 to 28 kHz (review by Richardson et al. 1995; Croll et al. 2002). There are no audiograms of baleen whales, but they tend to react to anthropogenic sound below 1 kHz, suggesting that they are more sensitive to low frequency sounds (Richardson et al. 1995). Based on this information, if they do no hear these sounds, they are not likely to respond physiologically or behaviorally to those received levels.

In the St. Lawrence estuary area, fin whales avoided vessels with small changes in travel direction, speed and dive duration, and slow approaches by boats usually caused little response (MacFarlane 1981). Fin whales continued to vocalize in the presence of boat sound (Edds and Macfarlane 1987). Even though any undetected fin whales transiting the SOCAL Range Complex may exhibit a reaction when initially exposed to active acoustic energy, field observations indicate the effects would not cause disruption of natural behavioral patterns to a point where such behavioral patterns would be abandoned or significantly altered.

Based on the model results, behavioral patterns, acoustic abilities of fin whales, results of past SOCAL Range Complex training, and the implementation of procedure mitigation measures presented in sections 5.1 for sonar and 5.2 for underwater detonations, the Navy finds that the SOCAL Range Complex training events would likely not result in any population level effects, death or injury to fin whales.

Humpback Whale (*Megaptera novaeangliae*)

The risk function and Navy post-modeling analysis estimates 14 humpback whales will exhibit behavioral responses NMFS will classify as harassment under the MMPA (Table 4-28). Modeling also indicates there would be two exposures to accumulated acoustic energy above 195 dB re 1 μPa^2-s, which is the threshold established indicative of onset TTS. No humpback whales would be exposed to sound levels that could cause PTS.

Modeling indicates there would be no exposures to impulsive sound or pressures from underwater detonations of 182 dB or 23 psi, which is the threshold indicative of onset TTS, and no exposures to impulsive sound or pressures from underwater detonations that would cause slight physical injury (Table 4-33).

Given the large size (up to 53 ft [16m] of individual humpback whales (Leatherwood et al. 1982), and pronounced vertical blow, it is very likely that lookouts would detect humpback whales at the surface. Additionally, mitigation measures call for continuous visual observation during operations with active sonar, therefore, humpback whales that are present in the vicinity of ASW operations would be detected by visual observers reducing the likelihood of exposure, such that effects would be discountable.

There are no audiograms of baleen whales, but they tend to react to anthropogenic sound below 1 kHz, suggesting that they are more sensitive to low frequency sounds (Richardson et al. 1995). A single study suggested that humpback whales responded to mid-frequency sonar (3.1-3.6 kHz re 1 μPa^2-s) sound (Maybaum 1989). The hand held sonar system had a sound artifact below 1,000 Hz which caused a response to the control playback (a blank tape) and may have affected the response to sonar (i.e. the humpback whale responded to the low frequency artifact rather than the mid-frequency active sonar sound). Humpback whales responded to small vessels (often whale watching boats) by changing swim speed, respiratory rates and social interactions depending on proximity to the vessel and vessel speed, with reponses varying by social status and gender (Watkins et al. 1981; Bauer 1986; Bauer and Herman 1986). Animals may even move out of the area in response to vessel noise (Salden 1988). Humpback whale mother-calf pairs are generally in the shallow protected waters. ASW mid-frequency active sonar activities takes place through out the extensive SOCAL Range Complex but the areas inhabited by humpback whales is represents only a small portion of the SOCAL Range Complex. Frankel and Clark (2000; 2002) reported that there was only a minor response by humpback whales to the Acoustic Thermometry of Ocean Climate (ATOC) sound source and that response was variable with some animals being found closer to the sound source during operation.

Based on the model results, behavioral patterns, acoustic abilities of humpback whales, results of past training, and the implementation of procedure mitigation measures presented in sections 5.1 for sonar and 5.2 for underwater detonations, the Navy finds that the SOCAL Range Complex training events would not likely result in any population level effects, death or injury to humpback whales.

Sei Whale (*Balaenoptera borealis*)

The risk function and Navy post-modeling analysis estimates no sei whales will exhibit behavioral responses NMFS will classify as harassment under the MMPA (Table 4-28). Modeling also indicates there would be no exposures to accumulated acoustic energy above 195 dB re 1 μPa^2-s, which is the threshold established indicative of onset TTS. No sei whales would be exposed to sound levels that could cause PTS.

Modeling indicates there would be no exposures to impulsive sound or pressures from underwater detonations of 182 dB or 23 psi, which is the threshold indicative of onset TTS, and no exposures to impulsive sound or pressures from underwater detonations that would cause slight physical injury (Table 4-33).

Given the large size (up to 53 ft [16m}) of individual sei whales (Leatherwood et al. 1982), pronounced vertical blow, aggregation of approximately three animals (probability of trackline detection = 0.90 in Beaufort Sea States of 6 or less; Barlow 2003), it is very likely that lookouts would detect a group of sei whales at the surface. Additionally, mitigation measures call for continuous visual observation during operations with active sonar, therefore, sei whales that migrate into the operating area would be detected by visual observers. Implementation of mitigation measures and probability of detecting a large sei whale reduces the likelihood of exposure, such that effects would be discountable.

There is little information on the acoustic abilities of sei whales or their response to human activities. The only recorded sounds of sei whales are frequency modulated sweeps in the range of 1.5 to 3.5 kHz (Thompson et al. 1979) but it is likely that they also vocalized at frequencies below 1 kHz as do fin whales. There are no audiograms of baleen whales but they tend to react to anthropogenic sound below 1 kHz suggesting that they are more sensitive to low frequency sounds (Richardson et al. 1995). Sei whales were more difficult to approach than were fin whales and moved away from boats but were less responsive when feeding (Gunther 1949).

Based on the model results, behavioral patterns, acoustic abilities of sei whales, results of past training, and the implementation of procedure mitigation measures presented in sections 5.1 for sonar and 5.2 for underwater detonations, the Navy finds that the SOCAL Range Complex training events would not likely result in any population level effects, death or injury to sei whales.

Sperm Whales (*Physeter macrocephalus*)

The risk function and Navy post-modeling analysis estimates 118 sperm whales will exhibit behavioral responses NMFS will classify as harassment under the MMPA (Table 4-28). Modeling also indicates there would be 19 exposures to accumulated acoustic energy above 195 dB re 1 μPa^2-s, which is the threshold established indicative of onset TTS. One sperm whale would be exposed to sound levels that could cause PTS.

Modeling indicates there would one exposure to impulsive sound or pressures from underwater detonations of 182 dB or 23 psi, which is the threshold indicative of onset TTS, and no exposures to impulsive sound or pressures from underwater detonations that would cause slight physical injury (Table 4-33).

Given the large size (up to 56 ft [17m]) of individual sperm whales (Leatherwood et al. 1982), pronounced blow (large and angled), mean group size of approximately seven animals (probability of trackline detection = 0.87 in Beaufort Sea States of 6 or less; Barlow 2003; 2006), it is very likely that lookouts would detect a group of sperm whales at the surface. Sperm whales can make prolonged dives of up to two hours (Watwood et al. 2006) making detection more difficult. Additionally, mitigation measures call for continuous visual observation during operations with active sonar; therefore, sperm whales that migrate into the operating area would be detected by visual observers. Implementation of mitigation measures and probability of detecting a large sperm whale reduces the likelihood of exposure, such that effects would be discountable.

In the unlikely event that sperm whales are exposed to mid-frequency sonar, the information available on sperm whales exposed to received levels of active mid-frequency sonar suggests that the response to mid-frequency (1 kHz to 10 kHz) sounds is variable (Richardson et al. 1995). While Watkins et al. (1985) observed that sperm whales exposed to 3.25 kHz to 8.4 kHz pulses interrupted their activities and left the area, other studies indicate that, after an initial disturbance, the animals return to their previous activity. During playback experiments off the Canary Islands, André et al. (1997) reported that foraging whales exposed to a 10 kHz pulsed signal did not exhibit any general avoidance reactions. When resting at the surface in a compact group, sperm whales initially reacted strongly but then ignored the signal completely (André et al. 1997).

Based on the model results, behavioral patterns, acoustic abilities of sperm whales, results of past training, and the implementation of procedure protective measures presented in sections 5.1 for sonar and 5.2 for underwater detonations, the Navy finds that the SOCAL Range Complex training events would not result in any population level effects, death or injury to sperm whales.

Guadalupe fur Seal (*Arctocephalus townsendi*)

The risk function and Navy post-modeling analysis estimates 911 Guadalupe fur seals will exhibit behavioral responses NMFS will classify as harassment under the MMPA (Table 4-28). Modeling also indicates there would be 321 exposures to accumulated acoustic energy above 195 dB re 1 μPa^2-s, which is the threshold established indicative of onset TTS. No Guadalupe fur seals would be exposed to sound levels that could cause PTS.

Modeling indicates there would two exposures to impulsive sound or pressures from underwater detonations of 182 dB or 23 psi, which is the threshold indicative of onset TTS, and one exposure to impulsive sound or pressures from underwater detonations that would cause slight physical injury and no exposures that would cause severe injury or mortality (Table 4-33).

Guadalupe fur seals dive for short periods and often rest on the surface between foraging bouts (Gallo 1994) making them easier to detect.

Based on the model results, behavioral patterns, acoustic abilities of Guadalupe fur seals, results of past training, and the implementation of procedure mitigation measures presented in sections 5.1 for sonar and 5.2 for underwater detonations, the Navy finds that the SOCAL Range Complex training events would not result in any population level effects, death or injury to Guadalupe fur seals.

Bryde's Whale (*Balaenoptera edeni*)

The risk function and Navy post-modeling analysis estimates no Bryde's whales will exhibit behavioral responses NMFS will classify as harassment under the MMPA (Table 4-28). Modeling also indicates there would be no exposures to accumulated acoustic energy above 195 dB re 1 μPa^2-s, which is the threshold established indicative of onset TTS. No Bryde's whales would be exposed to sound levels that could cause PTS.

Modeling indicates there would be no exposures to impulsive sound or pressures from underwater detonations of 182 dB or 23 psi, which is the threshold indicative of onset TTS, and no exposures to impulsive sound or pressures from underwater detonations that would cause slight physical injury (Table 4-33).

Given the large size (up to 46 ft. [14 m]) of individual Bryde's whales, pronounced blow, and mean group size of approximately 1.5 animals and (probability of trackline detection = 0.87 in Beaufort Sea States of 6 or less; Barlow 2003; 2006), it is very likely that lookouts would detect a group of Bryde's whales at the surface. Additionally, mitigation measures call for continuous visual observation during operations with active sonar, therefore, minke whales that migrate into the operating area would be detected by visual observers. Implementation of mitigation measures and probability of detecting a minke whale reduces the likelihood of exposure, such that effects would be discountable.

Based on the model results, behavioral patterns, acoustic abilities of Bryde's whales, results of past training, and the implementation of procedure protective measures presented in sections 5.1 for sonar and 5.2 for underwater detonations, the Navy finds that the SOCAL Range Complex training events would not result in any population level effects, death or injury to Bryde's whales.

Gray Whale (*Eschrichtius robustus*)

The risk function and Navy post-modeling analysis estimates 5,409 gray whales will exhibit behavioral responses NMFS will classify as harassment under the MMPA (Table 4-28). Modeling also indicates there would be 1,017 exposures to accumulated acoustic energy above 195 dB re 1 μPa^2-s, which is the threshold established indicative of onset TTS. Two gray whales would be exposed to sound levels that could cause PTS.

Modeling indicates there would seven exposures to impulsive sound or pressures from underwater detonations of 182 dB or 23 psi, which is the threshold indicative of onset TTS, and no exposures to impulsive sound or pressures from underwater detonations that would cause slight physical injury (Table 4-33).

Given the large size (up to 46 ft. [14 m]) of individual gray whales, pronounced blow, and group size of up to 16 animals (Leatherwood et al. 1982) and (probability of trackline detection = 0.87 in Beaufort Sea States of 6 or less; Barlow 2003; 2006), it is very likely that lookouts would detect a group of gray whales at the surface. Additionally, mitigation measures call for continuous visual observation during operations with active sonar, therefore, gray whales that migrate into the operating area would be detected by visual observers. Implementation of mitigation measures and probability of detecting a gray whale reduces the likelihood of exposure, such that effects would be discountable.

Based on the model results, behavioral patterns, acoustic abilities of gray whales, results of past training, and the implementation of procedure protective measures presented in sections 5.1 for sonar and 5.2 for underwater detonations, the Navy finds that the SOCAL Range Complex training events would not result in any population level effects, death or injury to gray whales.

Minke Whale (*Balaenoptera acutorostrata*)

The risk function and Navy post-modeling analysis estimates 102 minke whales will exhibit behavioral responses NMFS will classify as harassment under the MMPA (Table 4-28). Modeling also indicates there would be 30 exposures to accumulated acoustic energy above 195 dB re 1 μPa^2-s, which is the threshold established indicative of onset TTS. No minke whales would be exposed to sound levels that could cause PTS.

Modeling indicates there would be no exposures to impulsive sound or pressures from underwater detonations of 182 dB or 23 psi, which is the threshold indicative of onset TTS, and no exposures to impulsive sound or pressures from underwater detonations that would cause slight physical injury and one exposure that would cause severe injury (Table 4-33).

Minke whales are difficult to spot visually but can be detected using passive acoustic monitoring. Additionally, mitigation measures call for continuous visual observation during operations with active sonar, therefore, minke whales that migrate into the operating area would be detected by visual observers. Implementation of mitigation measures and probability of detecting a minke whale reduces the likelihood of exposure, such that effects would be discountable.

Based on the model results, behavioral patterns, acoustic abilities of minke whales, results of past training, and the implementation of procedure protective measures presented in sections 5.1 for sonar and 5.2 for underwater detonations, the Navy finds that the SOCAL Range Complex training events would not result in any population level effects, death or injury to minke whales.

Baird's Beaked Whale (*Berardius baridii*)

The risk function and Navy post-modeling analysis estimates 10 Baird's beaked whales will exhibit behavioral responses NMFS will classify as harassment under the MMPA (Table 4-28). Modeling also indicates there would be two exposures to accumulated acoustic energy above 195 dB re 1 μPa^2-s, which is the threshold established indicative of onset TTS. No Baird's beaked whales would be exposed to sound levels that could cause PTS.

Modeling indicates there would be no exposures to impulsive sound or pressures from underwater detonations of 182 dB or 23 psi, which is the threshold indicative of onset TTS, and no exposures to impulsive sound or pressures from underwater detonations that would cause slight physical injury and one exposure that would cause severe injury (Table 4-33).

Given the size (up to 15.5 ft. [4.7 m]) of individual Baird's beaked whales, aggregation of 2.3 animals, it is likely that lookouts would detect a group of Baird's beaked whales at the surface although beaked whales make prolonged dives that can last up to an hour (Baird et al. 2004). . Implementation of mitigation measures and probability of detecting a large sei whale reduces the likelihood of exposure, such that effects would be discountable.

Based on the model results, behavioral patterns, acoustic abilities of Baird's beaked whales, results of past training, and the implementation of procedure protective measures presented in sections 5.1 for sonar and 5.2 for underwater detonations, the Navy finds that the SOCAL Range Complex training events would not result in any population level effects, death or injury to Baird's beaked whales.

Bottlenose Dolphin (*Tursiops truncatus*)

The risk function and Navy post-modeling analysis estimates 961 bottlenose dolphins will exhibit behavioral responses NMFS will classify as harassment under the MMPA (Table 4-28). Modeling also indicates there would be 357 exposures to accumulated acoustic energy above 195 dB re 1 μPa^2-s, which is the threshold established indicative of onset TTS. No bottlenose dolphins would be exposed to sound levels that could cause PTS.

Modeling indicates there would six exposures to impulsive sound or pressures from underwater detonations of 182 dB or 23 psi, which is the threshold indicative of onset TTS, and no exposures to impulsive sound or pressures from underwater detonations that would cause slight physical injury and one exposure that would cause severe injury (Table 4-33).

Given the frequent surfacing, aggregation of approximately 9 animals (probability of trackline detection = 0.76 in Beaufort Sea States of 6 or less; Barlow 2003), it is very likely that lookouts would detect a group of bottlenose dolphins at the surface. Additionally, mitigation measures call for continuous visual observation during operations with active sonar, therefore, bottlenose dolphins that migrate into the operating area would be detected by visual observers. Implementation of mitigation measures and probability of detecting bottlenose dolphins reduces the likelihood of exposure, such that effects would be discountable.

Based on the model results, behavioral patterns, acoustic abilities of bottlenose dolphins, results of past training, and the implementation of procedure mitigation measures presented in sections 5.1 for sonar and 5.2 for underwater detonations, the Navy finds that the SOCAL Range Complex training events would not result in any population level effects, death or injury to bottlenose dolphins.

Cuvier's Beaked Whale (*Ziphius cavirostris*)

The risk function and Navy post-modeling analysis estimates 324 Cuvier's beaked whales will exhibit behavioral responses NMFS will classify as harassment under the MMPA (Table 4-28). Modeling also indicates there would be 71 exposures to accumulated acoustic energy above 195 dB re 1 μPa^2-s, which is the threshold established indicative of onset TTS. No Cuvier's beaked whale would be exposed to sound levels that could cause PTS.

Modeling indicates there would two exposures to impulsive sound or pressures from underwater detonations of 182 dB or 23 psi, which is the threshold indicative of onset TTS, and no exposures to impulsive sound or pressures from underwater detonations that would cause slight physical injury and one exposure that would cause severe injury (Table 4-33).

Given the medium size (up to 23 ft. [7.0 m]) of individual Cuvier's beaked whales, aggregation of approximately two animals (Barlow 2006), it is likely that lookouts would detect a group of Cuvier's beaked whales at the surface although beaked whales make prolonged dives that can last up to an hour (Baird et al. 2004). Implementation of mitigation measures and probability of detecting a large sei whale reduces the likelihood of exposure, such that effects would be discountable.

Based on the model results, behavioral patterns, acoustic abilities of Cuvier's beaked whales, results of past training, and the implementation of procedure protective measures presented in sections 5.1 for sonar and 5.2 for underwater detonations, the Navy finds that the SOCAL Range Complex training events would not result in any population level effects, death or injury to Cuvier's beaked whales.

Dall's Porpoise (*Phocoenides dalli*)

The risk function and Navy post-modeling analysis estimates 473 Dall's porpoises will exhibit behavioral responses NMFS will classify as harassment under the MMPA (Table 4-28).

Modeling also indicates there would be 163 exposures to accumulated acoustic energy above 195 dB re 1 μPa^2-s, which is the threshold established indicative of onset TTS. No Dall's porpoises would be exposed to sound levels that could cause PTS.

Modeling indicates there would two exposures to impulsive sound or pressures from underwater detonations of 182 dB or 23 psi, which is the threshold indicative of onset TTS, and no exposures to impulsive sound or pressures from underwater detonations that would cause slight physical injury and one exposure that would cause severe injury (Table 4-33).

Given the frequent surfacing and aggregation of approximately 2-20 animals, it is very likely that

lookouts would detect a group of Dall's porpoises at the surface. Additionally, protective measures call for continuous visual observation during operations with active sonar, therefore, Dall's porpoises that migrate into the operating area would be detected by visual observers. Implementation of mitigation measures and probability of detecting large groups of Dall's porpoises reduces the likelihood of exposure.

Based on the model results, behavioral patterns, acoustic abilities of Dall's porpoise, results of past training, and the implementation of procedure protective measures presented in sections 5.1 for sonar and 5.2 for underwater detonations, the Navy finds that the SOCAL Range Complex training events would not result in any population level effects, death or injury to Dall's porpoise.

Killer Whale (*Orcinus orca*)

The risk function and Navy post-modeling analysis estimates six killer whales will exhibit behavioral responses NMFS will classify as harassment under the MMPA (Table 4-28). Modeling also indicates there would be two exposures to accumulated acoustic energy above 195 dB re 1 μPa^2-s, which is the threshold established indicative of onset TTS. No killer whales would be exposed to sound levels that could cause PTS.

Modeling indicates there would be no exposures to impulsive sound or pressures from underwater detonations of 182 dB or 23 psi, which is the threshold indicative of onset TTS, and no exposures to impulsive sound or pressures from underwater detonations that would cause slight physical injury and one exposure that would cause severe injury (Table 4-33).

Given their size (up to 23 ft [7.0 m]), conspicuous coloring, pronounce dorsal fin and large mean group size of 6.5 animals (probability of trackline detection = 0.90 in Beaufort Sea States of 6 or less; Barlow, 2003). It is very likely that lookouts would detect a group of killer whales at the surface. Additionally, mitigation measures call for continuous visual observation during operations with active sonar, therefore, killer whales that migrate into the operating area would be detected by visual observers. Implementation of mitigation measures and probability of detecting large groups of killer whales reduces the likelihood of exposure.

Based on the model results, behavioral patterns, acoustic abilities of killer whales, results of past training, and the implementation of procedure mitigation measures presented in sections 5.1 for sonar and 5..2 for underwater detonations, the Navy finds that the SOCAL Range Complex training events would not result in any population level effects, death or injury to killer whales.

Long Beaked Common Dolphin (*Delphinus capensis*)

The risk function and Navy post-modeling analysis estimates 2,543 long beaked common dolphin will exhibit behavioral responses NMFS will classify as harassment under the MMPA (Table 4-28). Modeling also indicates there would be 807 exposures to accumulated acoustic energy above 195 dB re 1 μPa^2-s, which is the threshold established indicative of onset TTS. One long beaked common dolphin would be exposed to sound levels that could cause PTS.

Modeling indicates there would 26 exposures to impulsive sound or pressures from underwater detonations of 182 dB or 23 psi, which is the threshold indicative of onset TTS, and one exposure to impulsive sound or pressures from underwater detonations that would cause slight physical injury and one exposure that would cause severe injury or mortality (Table 4-33).

Given the frequent surfacing and their large group size (Leatherwood et al. 1982), it is very likely, that lookouts would detect a group of long-beaked common dolphins at the surface. Additionally, protective measures call for continuous visual observation during operations with active sonar and underwater detonations, therefore, common dolphins that migrate into the operating area would be detected by visual observers. Exposure of long-beaked common dolphins to energy levels associated with Level A harassment would not occur because protective measures would be implemented, large groups of long-beaked common dolphins would be observed, and underwater detonations result in a small zone of influence.

Based on the model results, behavioral patterns, acoustic abilities of long-beaked common dolphins, results of past training, and the implementation of procedure mitigation measures presented in sections 5.1 for sonar and 5.2 for underwater detonations, the Navy finds that the SOCAL Range Complex training events would not result in any population level effects, death or injury to long-beaked common dolphins.

Mesoplodont Whales (Mesoplodon spp.)

The risk function and Navy post-modeling analysis estimates 98 Mesoplodont whales will exhibit behavioral responses NMFS will classify as harassment under the MMPA (Table 4-28). Modeling also indicates there would be 24 exposures to accumulated acoustic energy above 195 dB re 1 μPa^2-s, which is the threshold established indicative of onset TTS. No Mesoplodont whales would be exposed to sound levels that could cause PTS.

Modeling indicates there would be no exposures to impulsive sound or pressures from underwater detonations of 182 dB or 23 psi, which is the threshold indicative of onset TTS, and no exposures to impulsive sound or pressures from underwater detonations that would cause slight physical injury and one exposure that would cause severe injury (Table 4-33).

Given the size (up to 15.5 ft. [4.7 m]) of individual Mesoplodont beaked whales, it is likely that lookouts would detect a group of Mesoplodont beaked whales at the surface although beaked whales make prolonged dives that can last up to an hour (Baird et al. 2004). Implementation of mitigation measures and probability of detecting a Mesoplodont whale reduces the likelihood of exposure, such that effects would be discountable.

Based on the model results, behavioral patterns, acoustic abilities of Mesoplodont beaked whales, results of past training, and the implementation of procedure protective measures presented in sections 5.1 for sonar and 5.2 for underwater detonations, the Navy finds that the SOCAL Range Complex training events would not result in any population level effects, death or injury to Mesoplodont beaked whales.

Northern Right Whale Dolphin (*Lissodelphis borealis*)

The risk function and Navy post-modeling analysis estimates 915 northern right whale dolphins will exhibit behavioral responses NMFS will classify as harassment under the MMPA (Table 4-28). Modeling also indicates there would be 313 exposures to accumulated acoustic energy above 195 dB re 1 μPa^2-s, which is the threshold established indicative of onset TTS. No northern right whale dolphins would be exposed to sound levels that could cause PTS.

Modeling indicates there would six exposures to impulsive sound or pressures from underwater detonations of 182 dB or 23 psi, which is the threshold indicative of onset TTS, and no exposures to impulsive sound or pressures from underwater detonations that would cause slight physical injury and one exposure that would cause severe injury (Table 4-33).

Given their large group size of up to 100 animals (Leatherwood et al. 1982), it is very likely, that

lookouts would detect a group of northern right whale dolphins at the surface. Additionally, mitigation measures call for continuous visual observation during operations with active sonar and underwater detonations, therefore, northern right whale dolphins that migrate into the operating area would be detected by visual observers. Implementation of protective measures and probability of detecting large groups of northern right whale dolphins reduces the likelihood of exposure.

Based on the model results, behavioral patterns, acoustic abilities of northern right whale dolphins, results of past training, and the implementation of procedure protective measures presented in sections 5.1 for sonar and 5.2 for underwater detonations, the Navy finds that the SOCAL Range Complex training events would not result in any population level effects, death or injury to northern right whale dolphins.

Pacific White-sided Dolphin (*Lagenorhynchus obliquidens*)

The risk function and Navy post-modeling analysis estimates 852 Pacific white-sided dolphin will exhibit behavioral responses NMFS will classify as harassment under the MMPA (Table 4-28). Modeling also indicates there would be 352 exposures to accumulated acoustic energy above 195 dB re 1 μPa^2-s, which is the threshold established indicative of onset TTS. No Pacific white-sided dolphins would be exposed to sound levels that could cause PTS.

Modeling indicates there would six exposures to impulsive sound or pressures from underwater detonations of 182 dB or 23 psi, which is the threshold indicative of onset TTS, and no exposures to impulsive sound or pressures from underwater detonations that would cause slight physical injury and one exposure that would cause severe injury or mortality (Table 4-33).

Given their frequent surfacing and large group size of up to several thousand animals (Leatherwood et al. 1982), it is very likely that lookouts would detect a group of Pacific white-sided dolphins at the surface. Additionally, protective measures call for continuous visual observation during operations with active sonar and underwater detonations, therefore, Pacific white-sided dolphins that migrate into the operating area would be detected by visual observers. Implementation of mitigation measures and probability of detecting large groups of Pacific white-sided dolphins reduces the likelihood of exposure.

Based on the model results, behavioral patterns, acoustic abilities of Pacific white-sided dolphins, results of past training, and the implementation of procedure protective measures presented in sections 5.1 for sonar and 5.2 for underwater detonations, the Navy finds that the SOCAL Range Complex training events would not result in any population level effects, death or injury to Pacific white-sided dolphins.

Pygmy Sperm Whale (*Kogia breviceps*)

The risk function and Navy post-modeling analysis estimates 122 pygmy sperm whales will exhibit behavioral responses NMFS will classify as harassment under the MMPA (Table 4-28). Modeling also indicates there would be 31 exposures to accumulated acoustic energy above 195 dB re 1 μPa^2-s, which is the threshold established indicative of onset TTS. No pygmy sperm whales would be exposed to sound levels that could cause PTS.

Modeling indicates one exposure to impulsive sound or pressures from underwater detonations of 182 dB or 23 psi, which is the threshold indicative of onset TTS and no exposures to impulsive sound or pressures from underwater detonations that would cause slight physical injury (Table 4-33).

Given their size (up to 10 ft [3 m]) and behavior of resting at the surface (Leatherwood et al. 1982), it is very likely that lookouts would detect a pygmy sperm whale at the surface. Additionally, mitigation measures call for continuous visual observation during operations with active sonar and underwater detonations, therefore, pygmy sperm whales that migrate into the operating area would be detected by visual observers. Implementation of mitigation measures and probability of detecting large groups of pygmy sperm whales reduces the likelihood of exposure.

Based on the model results, behavioral patterns, acoustic abilities of pygmy sperm whale, results of past training, and the implementation of procedure mitigation measures presented in sections 5.1 for sonar and 5.2 for underwater detonations, the Navy finds that the SOCAL Range Complex training events would not result in any population level effects, death or injury to pygmy sperm whale.

Risso's Dolphin (*Grampus griseus*)

The risk function and Navy post-modeling analysis estimates 2,220 Risso's dolphins will exhibit behavioral responses NMFS will classify as harassment under the MMPA (Table 4-28). Modeling also indicates there would be 642 exposures to accumulated acoustic energy above 195 dB re 1 μPa^2-s, which is the threshold established indicative of onset TTS. No Risso's dolphins would be exposed to sound levels that could cause PTS.

Modeling indicates there would 15 exposures to impulsive sound or pressures from underwater detonations of 182 dB or 23 psi, which is the threshold indicative of onset TTS, and one exposure to impulsive sound or pressures from underwater detonations that would cause slight physical injury and one exposure that would cause severe injury or mortality (Table 4-33).

Given their frequent surfacing, light coloration and large group size of up to several hundred animals (Leatherwood et al. 1982), probability of trackline detection of 0.76 in Beaufort Sea States of 6 or less (Barlow 2006), it is very likely that lookouts would detect a group of Risso's dolphins at the surface. Additionally, mitigation measures call for continuous visual observation during operations with active sonar and underwater detonations, therefore, Risso's dolphins that migrate into the operating area would be detected by visual observers. Implementation of mitigation measures and probability of detecting large groups of Risso's dolphins reduces the likelihood of exposure.

Based on the model results, behavioral patterns, acoustic abilities of Risso's dolphins, results of past training, and the implementation of procedure mitigation measures presented in sections 5.1 for sonar and 5.2 for underwater detonations, the Navy finds that the SOCAL Range Complex training events would not result in any population level effects, death or injury to Risso's dolphins.

Short-Beaked Common Dolphin (*Delphinus delphis*)

The risk function and Navy post-modeling analysis estimates 21,851 short-beaked common dolphins will exhibit behavioral responses NMFS will classify as harassment under the MMPA (Table 4-28). Modeling also indicates there would be 6,932 exposures to accumulated acoustic energy above 195 dB re 1 μPa^2-s, which is the threshold established indicative of onset TTS. Ten short-beaked common dolphins would be exposed to sound levels that could cause PTS.

Modeling indicates there would 227 exposures to impulsive sound or pressures from underwater detonations of 182 dB or 23 psi, which is the threshold indicative of onset TTS, and 12 exposures to impulsive sound or pressures from underwater detonations that would cause slight physical injury and four exposures that would cause severe injury or mortality (Table 4-33).

Given the frequent surfacing and their large group size of up to 1,000 animals (Leatherwood et al. 1982), it is very likely, that lookouts would detect a group of short-beaked common dolphins at the surface. Additionally, mitigation measures call for continuous visual observation during operations with active sonar and underwater detonations, therefore, common dolphins that migrate into the operating area would be detected by visual observers. Exposure of short-beaked common dolphins to energy levels associated with Level A harassment would not occur because mitigation measures would be implemented, large groups of short-beaked common dolphins would be observed, and underwater detonations result in a small zone of influence.

Based on the model results, behavioral patterns, acoustic abilities of short-beaked common dolphins, results of past training, and the implementation of procedure mitigation measures presented in sections 5.1 for sonar and 5.2 for underwater detonations, the Navy finds that the SOCAL Range Complex training events would not result in any population level effects, death or injury to short-beaked common dolphins.

Short-finned Pilot Whale (*Globicephala macrorhynchus*)

The risk function and Navy post-modeling analysis estimates 38 short-finned pilot whales will exhibit behavioral responses NMFS will classify as harassment under the MMPA (Table 4-28). Modeling also indicates there would be 11 exposures to accumulated acoustic energy above 195 dB re 1 μPa^2-s, which is the threshold established indicative of onset TTS. No short-finned pilot whale would be exposed to sound levels that could cause PTS.

Modeling indicates there would be no exposures to impulsive sound or pressures from underwater detonations of 182 dB or 23 psi, which is the threshold indicative of onset TTS, and no exposures to impulsive sound or pressures from underwater detonations that would cause slight physical injury and one exposure that would cause severe injury (Table 4-33).

Given their size (up to 20 ft [6.1 m]), and large mean group size of 22.5 animals (probability of trackline detection = 0.76 in Beaufort Sea States of 6 or less; Barlow 2006). It is very likely that lookouts would detect a group of short-finned pilot whales at the surface. Additionally, mitigation measures call for continuous visual observation during operations with active sonar, therefore, short-finned pilot whales that migrate into the operating area would be detected by visual observers. Implementation of mitigation measures and probability of detecting groups of short-finned pilot whales reduces the likelihood of exposure.

Based on the model results, behavioral patterns, acoustic abilities of short-finned pilot whale, results of past training, and the implementation of procedure mitigation measures presented in sections 5.1 for sonar and 5.2 for underwater detonations, the Navy finds that the SOCAL Range Complex training events would not result in any population level effects, death or injury to short-finned pilot whale.

Striped Dolphin (*Stenella coeruleoalba*)

The risk function and Navy post-modeling analysis estimates 1,579 striped dolphins will exhibit behavioral responses NMFS will classify as harassment under the MMPA (Table 4-28). Modeling also indicates there would be 463 exposures to accumulated acoustic energy above 195 dB re 1 μPa^2-s, which is the threshold established indicative of onset TTS. No striped dolphins would be exposed to sound levels that could cause PTS.

Modeling indicates there would six exposures to impulsive sound or pressures from underwater detonations of 182 dB or 23 psi, which is the threshold indicative of onset TTS, and no exposures to impulsive sound or pressures from underwater detonations that would cause slight physical injury and one exposure that would cause severe injury (Table 4-33).

Given their frequent surfacing, aerobatics and large mean group size of 37.3 animals (probability of trackline detection = 1.00 in Beaufort Sea States of 6 or less; Barlow 2006), it is very likely that lookouts would detect a group of striped dolphins at the surface. Additionally, mitigation measures call for continuous visual observation during operations with active sonar, therefore, striped dolphins that migrate into the operating area would be detected by visual observers. Implementation of mitigation measures and probability of detecting groups of striped dolphins reduces the likelihood of exposure.

Based on the model results, behavioral patterns, acoustic abilities of striped dolphins, results of past training, and the implementation of procedure mitigation measures presented in sections 11.1 for sonar and 11.2 for underwater detonations, the Navy finds that the SOCAL Range Complex training events would not result in any population level effects, death or injury to striped dolphins.

Ziphiid Whales (*Ziphus* spp.)

The risk function and Navy post-modeling analysis estimates 73 Ziphiid whales will exhibit behavioral responses NMFS will classify as harassment under the MMPA (Table 4-28). Modeling also indicates there would be 17 exposures to accumulated acoustic energy above 195 dB re 1 μPa^2-s, which is the threshold established indicative of onset TTS. No Ziphiid whales would be exposed to sound levels that could cause PTS.

Modeling indicates there would be no exposures to impulsive sound or pressures from underwater detonations of 182 dB or 23 psi, which is the threshold indicative of onset TTS, and no exposures to impulsive sound or pressures from underwater detonations that would cause slight physical injury and no exposures that would cause severe injury or mortality (Table 4-33).

Given the medium size (up to 23 ft. [7.0 m]) of individual Ziphiid whales, aggregation of approximately two animals (Barlow 2006), it is likely that lookouts would detect a group of Ziphiid whales at the surface although Ziphiid whales make prolonged dives that can last up to an hour (Baird et al. 2004). Implementation of mitigation measures and probability of detecting a large sei whale reduces the likelihood of exposure, such that effects would be discountable.

Based on the model results, behavioral patterns, acoustic abilities of Ziphiid whales, results of past training, and the implementation of procedure protective measures presented in sections 5.1 for sonar and 5.2 for underwater detonations, the Navy finds that the SOCAL Range Complex training events would not result in any population level effects, death or injury to Ziphiid whales.

Northern Elephant Seal (*Mirounga angustirostris*)

The risk function and Navy post-modeling analysis estimates 675 northern elephant seals will exhibit behavioral responses NMFS will classify as harassment under the MMPA (Table 4-28). Modeling also indicates there would be seven exposures to accumulated acoustic energy above 204 dB re 1 μPa^2-s, which is the threshold established indicative of onset TTS for northern elephant seals. No northern elephant seals would be exposed to sound levels that could cause PTS.

Modeling indicates there would 17 exposures to impulsive sound or pressures from underwater detonations of 182 dB or 23 psi, which is the threshold indicative of onset TTS, and no exposures to impulsive sound or pressures from underwater detonations that would cause slight physical injury and no exposures that would cause severe injury or mortality (Table 4-33).

Northern elephant seals tend to dive for long periods, 20-30 minutes, and only spend about 10% of the time at the surface making them difficult to detect. Elephant seals migrate out of the Southern California area to forage for several months at a time (Le Boeuf 1994).

Based on the model results, behavioral patterns, acoustic abilities of Northern elephant seals, results of past training, and the implementation of procedure mitigation measures presented in sections 5.1 for sonar and 5.2 for underwater detonations, the Navy finds that the SOCAL Range Comples training events would not result in any population level effects, death or injury to Northern elephant seals.

Pacific Harbor Seal (*Phoca vitulina richardii*)

The risk function and Navy post-modeling analysis estimates 1,022 Pacific harbor seals will exhibit behavioral responses NMFS will classify as harassment under the MMPA (Table 4-28). Modeling also indicates there would be 7,094 exposures to accumulated acoustic energy above 183 dB re 1 μPa^2-s, which is the threshold established indicative of onset TTS for Pacific harbor seals. Fifteen Pacific harbor seals would be exposed to sound levels that could cause PTS.

Modeling indicates there would 24 exposures to impulsive sound or pressures from underwater detonations of 182 dB or 23 psi, which is the threshold indicative of onset TTS, and one exposure to impulsive sound or pressures from underwater detonations that would cause slight physical injury and no exposures that would cause severe injury or mortality (Table 4-33).

Harbor seals forage near their rookeries (usually within 50 km) therefore they tend to remain in the Southern California area most of the time in comparison to northern elephant seals.

Based on the model results, behavioral patterns, acoustic abilities of harbor seals, results of past training, and the implementation of procedure mitigation measures presented in sections 5.1 for sonar and 5.2 for underwater detonations, the Navy finds that the SOCAL Range Complex training events would not result in any population level effects, death or injury to harbor seals.

California Sea Lion (*Zalophus californianus*)

The risk function and Navy post-modeling analysis estimates 52,679 California sea lions will exhibit behavioral responses NMFS will classify as harassment under the MMPA (Table 4-28). Modeling also indicates there would be five exposures to accumulated acoustic energy above 206 dB re 1 μPa^2-s, which is the threshold established indicative of onset TTS for California sea lions. No California sea lions would be exposed to sound levels that could cause PTS.

Modeling indicates there would 424 exposures to impulsive sound or pressures from underwater detonations of 182 dB or 23 psi, which is the threshold indicative of onset TTS, and 16 exposures to impulsive sound or pressures from underwater detonations that would cause slight physical injury and six exposures that could cause severe injury or mortality (Table 4-33).

California sea lions make short duration dives and may rest at the surface (Feldkamp et al. 1989) making them easier to detect than other pinnipeds.

Based on the model results, behavioral patterns, acoustic abilities of California sea lions, results of past training, and the implementation of procedure mitigation measures presented in sections 5.1 for sonar and 5.2 for underwater detonations, the Navy finds that the SOCAL Range Complex training events would not result in any population level effects, death or injury to harbor seals.

Northern Fur Seal (*Callorhinus ursinus*)

The risk function and Navy post-modeling analysis estimates 740 northern fur seals will exhibit behavioral responses NMFS will classify as harassment under the MMPA (Table 4-28). Modeling also indicates there would be five exposures to accumulated acoustic energy above 195 dB re 1 μPa^2-s, which is the threshold established indicative of onset TTS. No northern fur seals would be exposed to sound levels that could cause PTS.

Modeling indicates there would 42 exposures to impulsive sound or pressures from underwater detonations of 182 dB or 23 psi, which is the threshold indicative of onset TTS, and three exposures to impulsive sound or pressures from underwater detonations that would cause slight physical injury and one exposure that could cause severe injury or mortality (Table 4-33).

Nothern fur seals make short duration dives and often rest at the surface (Antonelis et al. 1990) making them easier to detect.

Based on the model results, behavioral patterns, acoustic abilities of northern fur seals, results of past training, and the implementation of procedure mitigation measures presented in sections 5.1 for sonar and 5.2 for underwater detonations, the Navy finds that the SOCAL Range Complex training events would not result in any population level effects, death or injury to northern fur seals.

4.9.5 Summary of Effects by Alternative

Modeled effects of Navy activities on marine mammals, as identified in this section, do not account for reductions in potential impacts through application of the extensive mitigation measures detailed in Section 3.9.10.

4.9.5.1 Potential Non-Acoustic Impacts

Impacts to marine mammals from Navy activities in the SOCAL Range Complex may result from non-acoustic sources including ship collisions, entanglement or falling debris. Impacts from these sources are inherently unpredictable; however, impacts from such sources are considered unlikely, would not result in any death or injury to any marine mammal species and would have negligible impact, if any, on annual survival, recruitment, and birth rates.

4.9.5.2 Potential Mid- and High-Frequency Active Sonar Effects

No Action Alternative-The risk function methodology estimates 83,686 annual exposures to mid- or high-frequency active sonar that could result in a behavioral change (Level B harassment), 16,706 could result in TTS (Level B Harassment). Twenty-six annual exposures could result in injury as PTS. The modeled sonar exposure numbers by species are presented in Table 4-14. These exposure modeling results are estimates of marine mammal sonar exposures without consideration of standard mitigation and monitoring procedures.

Alternative 1-The risk function methodology estimates 89,028 annual exposures to mid- or high-frequency active sonar that could result in a behavioral change, 17,772 could result in TTS (Level B Harassment). Twenty-eight annual exposures could result in injury as PTS. The modeled sonar exposure numbers by species are presented in Table 4-17.

Alternative 2-The risk function methodology estimates 94,370 annual exposures to mid- or high frequency active sonar that could result in a behavioral change, 18,838 could result in TTS (Level B Harassment). Thirty annual exposures could result in injury as PTS. The modeled sonar exposure numbers by species are presented in Table 4-28.

4.9.5.3 Potential Underwater Detonation Effects

No Action Alternative-Modeling estimates 635 annual exposures to pressure from underwater detonations could result in TTS (Level B Harassment). Twenty-eight annual exposures could result in slight injury. Eight annual exposures could result in severe injury or mortality. The modeled explosive exposure numbers by species are presented in Table 4-19

Alternative 1-Modeling estimates 742 annual exposures to pressure from underwater detonations could result in TTS (Level B Harassment). Twenty-nine annual exposures could result in slight injury. Ten annual exposures could result in severe injury or mortality. The modeled explosive exposure numbers by species are presented in Table 4-18.

Alternative 2-Modeling estimates 817 annual exposures to pressure from underwater detonations could result in TTS (Level B Harassment). Thirty-six annual exposures could result in slight injury. Twelve annual exposures could result in severe injury or mortality. The modeled explosive exposure numbers by species are presented in Table 4-33.

4.9.5.4 Statement Regarding Potential Mortality of Marine Mammals

Without consideration of mitigation measures for underwater detonations, the modeling results from the SOCAL Range Complex analysis predict underwater detonations could cause mortality to long-and short-beaked common dolphins, northern fur seals, and California sea lions (12 mortalities total are predicted). However, given range clearance procedures with long set-up times, standard mitigation measures presented in Section 3.10 and again in Chapter 5, and the likelihood that these species can be readily detected, Level A exposures and mortally are unlikely to occur. In light of the modeled results, however, the Navy will request authorization for take, by mortality, of long-and short-beaked common dolphins, northern fur seals, and California sea lions.

The history of Navy activities in the southern California and analysis in this document indicate that military readiness activities are not expected to result in any sonar–induced Level A injury or mortalities to marine mammals.

Evidence from five beaked whale strandings, all of which have taken place outside or the SOCAL Range Complex, and have occurred over approximately a decade, suggests that the exposure of beaked whales to MFA sonar in the presence of certain conditions (e.g., multiple units using tactical sonar, steep bathymetry, constricted channels, strong surface ducts, etc.) may result in strandings, potentially leading to mortality. Although these physical factors believed to contribute to the likelihood of beaked whale strandings are not present, in the aggregate, in the SOCAL Range Complex, scientific uncertainty exists regarding what other factors, or combination of factors, may contribute to beaked whale strandings. Accordingly, to allow for scientific uncertainty regarding contributing causes of beaked whale strandings and the exact mechanisms of the physical effects, the Navy will also request authorization for take, by mortality, of the beaked whale species present in Southern California.

5 MITIGATION MEASURES

The Navy has implemented a comprehensive suite of mitigation measures reduce impacts to marine mammals that might result from Navy training and RDT&E activities in the SOCAL Range Complex. In order to make the findings necessary to issue a Letter of Authorization (LOA) under the Marine Mammal Protection Act (MMPA), it may be necessary for National Marine Fisheries Service (NMFS) to require additional mitigation or monitoring measures beyond those addressed in this Draft Environmental Impact Statement (EIS)/ Overseas Environmental Impact Statement (OEIS). These measures could include measures considered, but eliminated in this EIS/OEIS, or as yet undeveloped measures. The public will have an opportunity, through the MMPA process, both to provide information to NMFS in the comment period following NMFS' Notice of Receipt of the application for an LOA, and to review any additional mitigation or monitoring measures that NMFS might propose in the comment period at the proposed rule stage. The final suite of measures developed as a result of the MMPA process would be identified and analyzed in the Final EIS/OEIS.

Effective training in the SOCAL Range Complex dictates that ship, submarine, and aircraft participants utilize their sensors and exercise weapons to their optimum capabilities as required by the mission. This section is a comprehensive list of mitigation measures that would be utilized for training activities analyzed in the SOCAL EIS/OEIS in order to minimize potential for impacts on marine mammals and sea turtles in the SOCAL Range Complex.

This section includes mitigation measures that are followed for all types of exercises; those that are associated with a particular type of training event; and those that apply generally to all Navy training at sea. For major exercises, the applicable mitigation measures are incorporated into a naval message which is disseminated to all of the units participating in the exercise or training event and applicable responsible commands. Appropriate measures are also provided to non-Navy participants (other DoD and allied forces) as information in order to ensure their use by these participants.

5.1 SONAR MITIGATION MEASURES

General Maritime Measures

Personnel Training – Watchstanders and Lookouts

The use of shipboard lookouts is a critical component of all Navy protective measures. Navy shipboard lookouts (also referred to as "watchstanders") are highly qualified and experienced observers of the marine environment. Their duties require that they report all objects sighted in the water to the officer of the deck (OOD) (e.g., trash, a periscope, marine mammals, sea turtles) and all disturbances (e.g., surface disturbance, discoloration) that may be indicative of a threat to the vessel and its crew. There are personnel serving as lookouts on station at all times (day and night) when a ship or surfaced submarine is moving through the water.

- All commanding officers (COs), executive officers (XOs), lookouts, OODs, junior OODs (JOODs), maritime patrol aircraft aircrews, and Anti-submarine Warfare (ASW)/Mine Warfare (MIW) helicopter crews will complete the NMFS-approved Marine Species Awareness Training (MSAT) by viewing the U.S. Navy MSAT digital versatile disk (DVD). MSAT may also be viewed on-line at https://mmrc.tecquest.net. All bridge watchstanders/lookouts will complete both parts one and two of the MSAT; part two is optional for other personnel. This training addresses the lookout's role in environmental protection, laws governing the protection of marine species, Navy stewardship commitments and general observation information to aid in avoiding interactions with marine species.

- Navy lookouts will undertake extensive training in order to qualify as a watchstander in accordance with the Lookout Training Handbook (Naval Education and Training Command [NAVEDTRA] 12968-B).
- Lookout training will include on-the-job instruction under the supervision of a qualified, experienced watchstander. Following successful completion of this supervised training period, lookouts will complete the Personal Qualification Standard Program, certifying that they have demonstrated the necessary skills (such as detection and reporting of partially submerged objects). Personnel being trained as lookouts can be counted among those listed below as long as supervisors monitor their progress and performance.
- Lookouts will be trained in the most effective means to ensure quick and effective communication within the command structure in order to facilitate implementation of protective measures if marine species are spotted.

Operating Procedures & Collision Avoidance

- Prior to major exercises, a Letter of Instruction, Mitigation Measures Message or Environmental Annex to the Operational Order will be issued to further disseminate the personnel training requirement and general marine species protective measures.
- COs will make use of marine species detection cues and information to limit interaction with marine species to the maximum extent possible consistent with safety of the ship.
- While underway, surface vessels will have at least two lookouts with binoculars; surfaced submarines will have at least one lookout with binoculars. Lookouts already posted for safety of navigation and man-overboard precautions may be used to fill this requirement. As part of their regular duties, lookouts will watch for and report to the OOD the presence of marine mammals and sea turtles.
- On surface vessels equipped with a multi-function active sensor, pedestal mounted “Big Eye” (20x10) binoculars will be properly installed and in good working order to assist in the detection of marine mammals and sea turtles in the vicinity of the vessel.
- Personnel on lookout will employ visual search procedures employing a scanning methodology in accordance with the Lookout Training Handbook (NAVEDTRA 12968-B).
- After sunset and prior to sunrise, lookouts will employ Night Lookouts Techniques in accordance with the Lookout Training Handbook. (NAVEDTRA 12968-B)
- While in transit, naval vessels will be alert at all times, use extreme caution, and proceed at a “safe speed” so that the vessel can take proper and effective action to avoid a collision with any marine animal and can be stopped within a distance appropriate to the prevailing circumstances and conditions.
- When whales have been sighted in the area, Navy vessels will increase vigilance and take reasonable and practicable actions to avoid collisions and activities that might result in close interaction of naval assets and marine mammals. Actions may include changing speed and/or direction and are dictated by environmental and other conditions (e.g., safety, weather).

- Naval vessels will maneuver to keep at least 460 m (1,500 ft) away from any observed whale and avoid approaching whales head-on. This requirement does not apply if a vessel's safety is threatened, such as when change of course will create an imminent and serious threat to a person, vessel, or aircraft, and to the extent vessels are restricted in their ability to maneuver. Restricted maneuverability includes, but is not limited to, situations when vessels are engaged in dredging, submerged operations, launching and recovering aircraft or landing craft, minesweeping operations, replenishment while underway and towing operations that severely restrict a vessel's ability to deviate course. Vessels will take reasonable steps to alert other vessels in the vicinity of the whale.
- Where feasible and consistent with mission and safety, vessels will avoid closing to within 200-yd of sea turtles and marine mammals other than whales (whales addressed above).
- Floating weeds and kelp, algal mats, clusters of seabirds, and jellyfish are good indicators of sea turtles and marine mammals. Therefore, increased vigilance in watching for sea turtles and marine mammals will be taken where these are present.
- Navy aircraft participating in exercises at sea will conduct and maintain, when operationally feasible and safe, surveillance for marine species of concern as long as it does not violate safety constraints or interfere with the accomplishment of primary operational duties. Marine mammal detections will be immediately reported to assigned Aircraft Control Unit for further dissemination to ships in the vicinity of the marine species as appropriate where it is reasonable to conclude that the course of the ship will likely result in a closing of the distance to the detected marine mammal.
- All vessels will maintain logs and records documenting training operations should they be required for event reconstruction purposes. Logs and records will be kept for a period of 30 days following completion of a major training exercise.

Measures for Specific Training Events

Mid-Frequency Active Sonar Operations

General Maritime Mitigation Measures: Personnel Training

- All lookouts onboard platforms involved in ASW training events will review the NMFS-approved Marine Species Awareness Training material prior to use of mid-frequency active sonar.
- All COs, XOs, and officers standing watch on the bridge will have reviewed the Marine Species Awareness Training material prior to a training event employing the use of mid-frequency active sonar.
- Navy lookouts will undertake extensive training in order to qualify as a watchstander in accordance with the Lookout Training Handbook (Naval Educational Training [NAVEDTRA], 12968-B).
- Lookout training will include on-the-job instruction under the supervision of a qualified, experienced watchstander. Following successful completion of this supervised training period, lookouts will complete the Personal Qualification Standard program, certifying that they have demonstrated the necessary skills (such as detection and reporting of partially submerged objects). This does not forbid personnel being trained as lookouts from being counted as those listed in previous measures so long as supervisors monitor their progress and performance.

- Lookouts will be trained in the most effective means to ensure quick and effective communication within the command structure in order to facilitate implementation of mitigation measures if marine species are spotted.

General Maritime Mitigation Measures: Lookout and Watchstander Responsibilities

- On the bridge of surface ships, there will always be at least three people on watch whose duties include observing the water surface around the vessel.
- All surface ships participating in ASW training events will, in addition to the three personnel on watch noted previously, have at all times during the exercise at least two additional personnel on watch as marine mammal lookouts.
- Personnel on lookout and officers on watch on the bridge will have at least one set of binoculars available for each person to aid in the detection of marine mammals.
- On surface vessels equipped with mid-frequency active sonar, pedestal mounted "Big Eye" (20x110) binoculars will be present and in good working order to assist in the detection of marine mammals in the vicinity of the vessel.
- Personnel on lookout will employ visual search procedures employing a scanning methodology in accordance with the Lookout Training Handbook (NAVEDTRA 12968-B).
- After sunset and prior to sunrise, lookouts will employ Night Lookouts Techniques in accordance with the Lookout Training Handbook.
- Personnel on lookout will be responsible for reporting all objects or anomalies sighted in the water (regardless of the distance from the vessel) to the Officer of the Deck, since any object or disturbance (e.g., trash, periscope, surface disturbance, discoloration) in the water may be indicative of a threat to the vessel and its crew or indicative of a marine species that may need to be avoided as warranted.

Operating Procedures

- A Letter of Instruction, Mitigation Measures Message, or Environmental Annex to the Operational Order will be issued prior to the exercise to further disseminate the personnel training requirement and general marine mammal mitigation measures.
- COs will make use of marine species detection cues and information to limit interaction with marine species to the maximum extent possible consistent with safety of the ship.
- All personnel engaged in passive acoustic sonar operation (including aircraft, surface ships, or submarines) will monitor for marine mammal vocalizations and report the detection of any marine mammal to the appropriate watch station for dissemination and appropriate action.
- During mid-frequency active sonar operations, personnel will utilize all available sensor and optical systems (such as night vision goggles) to aid in the detection of marine mammals.
- Navy aircraft participating in exercises at sea will conduct and maintain, when operationally feasible and safe, surveillance for marine species of concern as long as it does not violate safety constraints or interfere with the accomplishment of primary operational duties.

- Aircraft with deployed sonobuoys will use only the passive capability of sonobuoys when marine mammals are detected within 200 yds (183 m) of the sonobuoy.
- Marine mammal detections will be immediately reported to assigned Aircraft Control Unit for further dissemination to ships in the vicinity of the marine species as appropriate where it is reasonable to conclude that the course of the ship will likely result in a closing of the distance to the detected marine mammal.
- Safety Zones—When marine mammals are detected by any means (aircraft, shipboard lookout, or acoustically) within 1,000 yds (914 m) of the sonar dome (the bow), the ship or submarine will limit active transmission levels to at least 6 decibels (dB) below normal operating levels. (A 6 dB reduction equates to a 75 percent power reduction. The reason is that decibel levels are on a logarithmic scale, not a linear scale. Thus, a 6 dB reduction results in a power level only 25 percent of the original power.)
    - Ships and submarines will continue to limit maximum transmission levels by this 6-dB factor until the animal has been seen to leave the area, has not been detected for 30 minutes, or the vessel has transited more than 2,000 yds (1829 m) beyond the location of the last detection.
    - Should a marine mammal be detected within or closing to inside 500 yds (457 m) of the sonar dome, active sonar transmissions will be limited to at least 10 dB below the equipment's normal operating level. (A 10 dB reduction equates to a 90 percent power reduction from normal operating levels.). Ships and submarines will continue to limit maximum ping levels by this 10-dB factor until the animal has been seen to leave the area, has not been detected for 30 minutes, or the vessel has transited more than 2,000 yds (457 m) beyond the location of the last detection.
    - Should the marine mammal be detected within or closing to inside 200 yds (183 m) of the sonar dome, active sonar transmissions will cease. Sonar will not resume until the animal has been seen to leave the area, has not been detected for 30 minutes, or the vessel has transited more than 2,000 yds (457 m) beyond the location of the last detection.
    - Special conditions applicable for dolphins and porpoises only: If, after conducting an initial maneuver to avoid close quarters with dolphins or porpoises, the OOD concludes that dolphins or porpoises are deliberately closing to ride the vessel's bow wave, no further mitigation actions are necessary while the dolphins or porpoises continue to exhibit bow wave riding behavior.
    - If the need for power-down should arise as detailed in “Safety Zones” above, the Navy shall follow the requirements as though they were operating at 235 dB—the normal operating level (i.e., the first power-down will be to 229 dB, regardless of at what level above 235 sonar was being operated).
- Prior to start up or restart of active sonar, operators will check that the Safety Zone radius around the sound source is clear of marine mammals.
- Sonar levels (generally)—Navy will operate sonar at the lowest practicable level, not to exceed 235 dB, except as required to meet tactical training objectives.
- Helicopters shall observe/survey the vicinity of an ASW training event for 10 minutes before the first deployment of active (dipping) sonar in the water.

- Helicopters shall not dip their sonar within 200 yds (183 m) of a marine mammal and shall cease pinging if a marine mammal closes within 200 yds (183 m) after pinging has begun.
- Submarine sonar operators will review detection indicators of close-aboard marine mammals prior to the commencement of ASW training events involving active mid-frequency sonar.
- Increased vigilance during ASW training events with tactical active sonar when critical conditions are present.

  Based on lessons learned from strandings in Bahamas 2000, Madeiras 2000, Canaries 2002 and Spain 2006, beaked whales are of particular concern since they have been associated with mid-frequency active sonar operations. The Navy should avoid planning Major ASW Training Exercises with mid-frequency active sonar in areas where they will encounter conditions which, in their aggregate, may contribute to a marine mammal stranding event.

  The conditions to be considered during exercise planning include:

  - Areas of at least 1,000-meter depth near a shoreline where there is a rapid change in bathymetry on the order of 1,000-6,000 yds (914-5486 m) occurring across a relatively short horizontal distance (e.g., 5 nautical miles [nm]).
  - Cases for which multiple ships or submarines ($\geq$ 3) operating mid-frequency active sonar in the same area over extended periods of time ($\geq$ 6 hours) in close proximity ($\leq$ 10 nm apart).
  - An area surrounded by land masses, separated by less than 35 nm and at least 10 nm in length, or an embayment, wherein operations involving multiple ships/subs ($\geq$ 3) employing mid-frequency active sonar near land may produce sound directed toward the channel or embayment that may cut off the lines of egress for marine mammals.
  - Though not as dominant a condition as bathymetric features, the historical presence of a significant surface duct (i.e., a mixed layer of constant water temperature extending from the sea surface to 100 or more feet [ft]).

If the Major Range Event is to occur in an area where the above conditions exist in their aggregate, these conditions must be fully analyzed in environmental planning documentation. The Navy will increase vigilance by undertaking the following additional mitigation measure:

- A dedicated aircraft (Navy asset or contracted aircraft) will undertake reconnaissance of the embayment or channel ahead of the exercise participants to detect marine mammals that may be in the area exposed to active sonar. Where practical, advance survey should occur within about 2 hours prior to mid-frequency active sonar use and periodic surveillance should continue for the duration of the exercise. Any unusual conditions (e.g., presence of sensitive species, groups of species milling out of habitat, and any stranded animals) shall be reported to the Office in Tactical Command, who should give consideration to delaying, suspending, or altering the exercise.
- All safety zone power down requirements described above will apply.
- The post-exercise report must include specific reference to any event conducted in areas where the above conditions exist, with exact location and time/duration of the event, and noting results of surveys conducted.

5.2 UNDERWATER DETONATION MITIGATION MEASURES

Surface-to-Surface Gunnery (5-inch, 76 mm, 20 mm, 25 mm and 30 mm explosive rounds)

- Lookouts will visually survey for floating weeds and kelp, and algal mats which may be inhabited by immature sea turtles in the target area. Intended impact shall not be within 600 yds (585 m) of known or observed floating weeds and kelp, and algal mats.
- For exercises using targets towed by a vessel or aircraft, target-towing vessels/aircraft shall maintain a trained lookout for marine mammals and sea turtles. If a marine mammal or sea turtle is sighted in the vicinity, the tow aircraft/vessel will immediately notify the firing vessel, which will suspend the exercise until the area is clear.
- A 600 yard radius buffer zone will be established around the intended target.
- From the intended firing position, trained lookouts will survey the buffer zone for marine mammals and sea turtles prior to commencement and during the exercise as long as practicable. Due to the distance between the firing position and the buffer zone, lookouts are only expected to visually detect breaching whales, whale blows, and large pods of dolphins and porpoises.
- The exercise will be conducted only when the buffer zone is visible and marine mammals and sea turtles are not detected within it.

Surface-to-Surface Gunnery (non-explosive rounds)

- Lookouts will visually survey for floating weeds and kelp, and algal mats which may be inhabited by immature sea turtles in the target area. Intended impact will not be within 200 yds (183 m) of known or observed floating weeds and kelp, and algal mats.
- A 200 yd (183 m) radius buffer zone will be established around the intended target.
- From the intended firing position, trained lookouts will survey the buffer zone for marine mammals and sea turtles prior to commencement and during the exercise as long as practicable. Due to the distance between the firing position and the buffer zone, lookouts are only expected to visually detect breaching whales, whale blows, and large pods of dolphins and porpoises.
- If applicable, target towing vessels will maintain a lookout. If a marine mammal or sea turtle is sighted in the vicinity of the exercise, the tow vessel will immediately notify the firing vessel in order to secure gunnery firing until the area is clear.
- The exercise will be conducted only when the buffer zone is visible and marine mammals and sea turtles are not detected within the target area and the buffer zone.

Surface-to-Air Gunnery (explosive and non-explosive rounds)

- Vessels will orient the geometry of gunnery exercises in order to prevent debris from falling in the area of sighted marine mammals, sea turtles, algal mats, and floating kelp.
- Vessels will expedite the recovery of any parachute deploying aerial targets to reduce the potential for entanglement of marine mammals and sea turtles.
- Target towing aircraft shall maintain a lookout. If a marine mammal or sea turtle is sighted in the vicinity of the exercise, the tow aircraft will immediately notify the firing vessel in order to secure gunnery firing until the area is clear.

Air-to-Surface Gunnery (explosive and non-explosive rounds)

- If surface vessels are involved, lookouts will visually survey for floating kelp, which may be inhabited by immature sea turtles, in the target area. Impact should not occur within 200 yds (183 m) of known or observed floating weeds and kelp or algal mats.
- A 200 yd (183 m) radius buffer zone will be established around the intended target.
- If surface vessels are involved, lookout(s) will visually survey the buffer zone for marine mammals and sea turtles prior to and during the exercise.
- Aerial surveillance of the buffer zone for marine mammals and sea turtles will be conducted prior to commencement of the exercise. Aerial surveillance altitude of 500 feet to 1,500 feet (ft) (152 - 456 m) is optimum. Aircraft crew/pilot will maintain visual watch during exercises. Release of ordnance through cloud cover is prohibited: aircraft must be able to actually see ordnance impact areas.
- The exercise will be conducted only if marine mammals and sea turtles are not visible within the buffer zone.

Small Arms Training - (grenades, explosive and non-explosive rounds)

- Lookouts will visually survey for floating weeds or kelp, algal mats, marine mammals, and sea turtles. Weapons will not be fired in the direction of known or observed floating weeds or kelp, algal mats, marine mammals, sea turtles.

Air-to-Surface At-Sea Bombing Exercises (explosive bombs and cluster munitions, rockets)

- If surface vessels are involved, trained lookouts will survey for floating kelp, which may be inhabited by immature sea turtles. Ordnance shall not be targeted to impact within 1,000 yds (914 m) of known or observed floating kelp, sea turtles, or marine mammals.
- A buffer zone of 1,000 yd (914 m) radius will be established around the intended target.
- Aircraft will visually survey the target and buffer zone for marine mammals and sea turtles prior to and during the exercise. The survey of the impact area will be made by flying at 1,500 feet or lower, if safe to do so, and at the slowest safe speed. Release of ordnance through cloud cover is prohibited: aircraft must be able to actually see ordnance impact areas. Survey aircraft should employ most effective search tactics and capabilities.
- The exercises will be conducted only if marine mammals and sea turtles are not visible within the buffer zone.

Air-to-Surface At-Sea Bombing Exercises (non-explosive bombs and cluster munitions, rockets)

- If surface vessels are involved, trained lookouts will survey for floating kelp, which may be inhabited by immature sea turtles, and for sea turtles and marine mammals. Ordnance shall not be targeted to impact within 1,000 yds (914 m) of known or observed floating kelp, sea turtles, or marine mammals.
- A 1,000 yd (914 m) radius buffer zone will be established around the intended target.
- Aircraft will visually survey the target and buffer zone for marine mammals and sea turtles prior to and during the exercise. The survey of the impact area will be made by flying at 1,500 ft (152 m) or lower, if safe to do so, and at the slowest safe speed. Release of ordnance through cloud cover is prohibited: aircraft must be able to actually

see ordnance impact areas. Survey aircraft should employ most effective search tactics and capabilities.

- The exercise will be conducted only if marine mammals and sea turtles are not visible within the buffer zone.

Air-to-Surface Missile Exercises (explosive and non-explosive)

- Ordnance shall not be targeted to impact within 1,800 yds (1646 m) of known or observed floating kelp, which may be inhabited by immature sea turtles, or coral reefs.
- Aircraft will visually survey the target area for marine mammals and sea turtles. Visual inspection of the target area will be made by flying at 1,500 (457 m) feet or lower, if safe to do so, and at slowest safe speed. Firing or range clearance aircraft must be able to actually see ordnance impact areas. Explosive ordnance shall not be targeted to impact within 1,800 yds (1646 m) of sighted marine mammals and sea turtles.

Underwater Detonations (up to 20-lb charges)

To ensure protection of marine mammals and sea turtles during underwater detonation training, the operating area must be determined to be clear of marine mammals and sea turtles prior to detonation. Implementation of the following mitigation measures continue to ensure that marine mammals would not be exposed to temporary threshold shift (TTS), permanent threshold shift (PTS), or injury from physical contact with training mine shapes during Major Exercises.

Exclusion Zones

All Mine Warfare and Mine Countermeasures Operations involving the use of explosive charges must include exclusion zones for marine mammals and sea turtles to prevent physical and/or acoustic effects to those species. These exclusion zones shall extend in a 700-yard arc radius around the detonation site.

Pre-Exercise Surveys

For Demolition and Ship Mine Countermeasures Operations, pre-exercise survey shall be conducted within 30 minutes prior to the commencement of the scheduled explosive event. The survey may be conducted from the surface, by divers, and/or from the air, and personnel shall be alert to the presence of any marine mammal or sea turtle. Should such an animal be present within the survey area, the exercise shall be paused until the animal voluntarily leaves the area. The Navy will suspend detonation exercises and ensure the area is clear for a full 30 minutes prior to detonation. Personnel will record any protected species marine mammal and sea turtle observations during the exercise as well as measures taken if species are detected within the exclusion zone.

Post-Exercise Surveys

Surveys within the same radius shall also be conducted within 30 minutes after the completion of the explosive event.

Reporting

If there is evidence that a marine mammal or sea turtle may have been stranded, injured or killed by the action, Navy training activities will be immediately suspended and the situation immediately reported by the participating unit to the Officer in Charge of the Exercise (OCE), who will follow Navy procedures for reporting the incident to Commander, Pacific Fleet, Commander, Navy Region Southwest, Environmental Director, and the chain-of-command.

Mining Operations

Mining Operations involve aerial drops of inert training shapes on target points. Aircrews are scored for their ability to accurately hit the target points. Although this operation does not involve live ordnance, marine mammals have the potential to be injured if they are in the immediate vicinity of a target points; therefore, the safety zone shall be clear of marine mammals and sea turtles around the target location. Pre- and post-surveys and reporting requirements outlined for underwater detonations shall be implemented during Mining Operations. To the maximum extent feasible, the Navy shall retrieve inert mine shapes dropped during Mining Operations.

Sink Exercise

The selection of sites suitable for Sink Exercises (SINKEXs) involves a balance of operational suitability, requirements established under the Marine Protection, Research and Sanctuaries Act (MPRSA) permit granted to the Navy (40 Code of Federal Regulations § 229.2), and the identification of areas with a low likelihood of encountering Endangered Species Act (ESA) listed species. To meet operational suitability criteria, locations must be within a reasonable distance of the target vessels' originating location. The locations should also be close to active military bases to allow participating assets access to shore facilities. For safety purposes, these locations should also be in areas that are not generally used by non-military air or watercraft. The MPRSA permit requires vessels to be sunk in waters which are at least 1,000 fathoms (3,000 yds / 2742 m)) deep and at least 50 nm from land.

In general, most listed species prefer areas with strong bathymetric gradients and oceanographic fronts for significant biological activity such as feeding and reproduction. Typical locations include the continental shelf and shelf-edge.

SINKEX Mitigation Plan

The Navy has developed range clearance procedures to maximize the probability of sighting any ships or protected species in the vicinity of an exercise, which are as follows:

- All weapons firing would be conducted during the period 1 hour after official sunrise to 30 minutes before official sunset.
- Extensive range clearance operations would be conducted in the hours prior to commencement of the exercise, ensuring that no shipping is located within the hazard range of the longest-range weapon being fired for that event.
- Prior to conducting the exercise, remotely sensed sea surface temperature maps would be reviewed. SINKEX would not be conducted within areas where strong temperature discontinuities are present, thereby indicating the existence of oceanographic fronts. These areas would be avoided because concentrations of some listed species, or their prey, are known to be associated with these oceanographic features.
- An exclusion zone with a radius of 1.0 nm would be established around each target. This exclusion zone is based on calculations using a 990-pound (lb) H6 net explosive weight high explosive source detonated 5 ft below the surface of the water, which yields a distance of 0.85 nm (cold season) and 0.89 nm (warm season) beyond which the received level is below the 182 decibels (dB) re: 1 micropascal squared-seconds (µPa2-s) threshold established for the WINSTON S. CHURCHILL (DDG 81) shock trials (U.S.

Navy, 2001). An additional buffer of 0.5 nm would be added to account for errors, target drift, and animal movements. Additionally, a safety zone, which extends from the exclusion zone at 1.0 nm out an additional 0.5 nm, would be surveyed. Together, the zones extend out 2 nm from the target.

- A series of surveillance over-flights would be conducted within the exclusion and the safety zones, prior to and during the exercise, when feasible. Survey protocol would be as follows:
  - Overflights within the exclusion zone would be conducted in a manner that optimizes the surface area of the water observed. This may be accomplished through the use of the Navy's Search and Rescue Tactical Aid, which provides the best search altitude, ground speed, and track spacing for the discovery of small, possibly dark objects in the water based on the environmental conditions of the day. These environmental conditions include the angle of sun inclination, amount of daylight, cloud cover, visibility, and sea state.
  - All visual surveillance activities would be conducted by Navy personnel trained in visual surveillance. At least one member of the mitigation team would have completed the Navy's marine mammal training program for lookouts.
  - In addition to the overflights, the exclusion zone would be monitored by passive acoustic means, when assets are available. This passive acoustic monitoring would be maintained throughout the exercise. Potential assets include sonobuoys, which can be utilized to detect any vocalizing marine mammals (particularly sperm whales) in the vicinity of the exercise. The sonobuoys would be re-seeded as necessary throughout the exercise. Additionally, passive sonar onboard submarines may be utilized to detect any vocalizing marine mammals in the area. The OCE would be informed of any aural detection of marine mammals and would include this information in the determination of when it is safe to commence the exercise.
  - On each day of the exercise, aerial surveillance of the exclusion and safety zones would commence 2 hours prior to the first firing.
  - The results of all visual, aerial, and acoustic searches would be reported immediately to the OCE. No weapons launches or firing would commence until the OCE declares the safety and exclusion zones free of marine mammals and threatened and endangered species.
  - If a protected species observed within the exclusion zone is diving, firing would be delayed until the animal is re-sighted outside the exclusion zone, or 30 minutes have elapsed. After 30 minutes, if the animal has not been re-sighted it would be assumed to have left the exclusion zone. This is based on a typical dive time of 30 minutes for traveling listed species of concern. The OCE would determine if the listed species is in danger of being adversely affected by commencement of the exercise.
  - During breaks in the exercise of 30 minutes or more, the exclusion zone would again be surveyed for any protected species. If protected species are sighted within the exclusion zone, the OCE would be notified, and the procedure described above would be followed.

- Upon sinking of the vessel, a final surveillance of the exclusion zone would be monitored for 2 hours, or until sunset, to verify that no listed species were harmed.

- Aerial surveillance would be conducted using helicopters or other aircraft based on necessity and availability. The Navy has several types of aircraft capable of performing this task; however, not all types are available for every exercise. For each exercise, the available asset best suited for identifying objects on and near the surface of the ocean would be used. These aircraft would be capable of flying at the slow safe speeds necessary to enable viewing of marine vertebrates with unobstructed, or minimally obstructed, downward and outward visibility. The exclusion and safety zone surveys may be cancelled in the event that a mechanical problem, emergency search and rescue, or other similar and unexpected event preempts the use of one of the aircraft onsite for the exercise.
- Every attempt would be made to conduct the exercise in sea states that are ideal for marine mammal sighting, Beaufort Sea State 3 or less. In the event of a 4 or above, survey efforts would be increased within the zones. This would be accomplished through the use of an additional aircraft, if available, and conducting tight search patterns.
- The exercise would not be conducted unless the exclusion zone could be adequately monitored visually.
- In the unlikely event that any listed species are observed to be harmed in the area, a detailed description of the animal would be taken, the location noted, and if possible, photos taken. This information would be provided to NOAA Fisheries via the Navy's regional environmental coordinator for purposes of identification.
- An after action report detailing the exercise's time line, the time the surveys commenced and terminated, amount, and types of all ordnance expended, and the results of survey efforts for each event would be submitted to NOAA Fisheries.

Mitigation Measures Related to Explosive Source Sonobuoys (AN/SSQ-110A) (AN/SSQ-110A)

- Crews will conduct visual reconnaissance of the drop area prior to laying their intended sonobuoy pattern. This search should be conducted below 457 m (500 yd) at a slow speed, if operationally feasible and weather conditions permit. In dual aircraft operations, crews are allowed to conduct coordinated area clearances.
- Crews shall conduct a minimum of 30 minutes of visual and aural monitoring of the search area prior to commanding the first post detonation. This 30-minute observation period may include pattern deployment time.
- For any part of the briefed pattern where a post (source/receiver sonobuoy pair) will be deployed within 914 m (1,000 yd) of observed marine mammal activity, deploy the receiver ONLY and monitor while conducting a visual search. When marine mammals are no longer detected within 914 m (1,000 yd) of the intended post position, co-locate the explosive source sonobuoy (AN/SSQ-110A) (source) with the receiver.
- When able, crews will conduct continuous visual and aural monitoring of marine mammal activity. This is to include monitoring of own-aircraft sensors from first sensor placement to checking off station and out of RF range of these sensors.
- Aural Detection:

  - If the presence of marine mammals is detected aurally, then that should cue the aircrew to increase the diligence of their visual surveillance. Subsequently, if no marine mammals are visually detected, then the crew may continue multi-static active search.

- Visual Detection:
  - If marine mammals are visually detected within 914 m (1,000 yd) of the explosive source sonobuoy (AN/SSQ-110A) intended for use, then that payload shall not be detonated. Aircrews may utilize this post once the marine mammals have not been re-sighted for 10 minutes, or are observed to have moved outside the 914 m (1,000 yd) safety buffer.
  - Aircrews may shift their multi-static active search to another post, where marine mammals are outside the 914 m (1,000 yd) safety buffer.

- Aircrews shall make every attempt to manually detonate the unexploded charges at each post in the pattern prior to departing the operations area by using the “Payload 1 Release” command followed by the “Payload 2 Release” command. Aircrews shall refrain from using the “Scuttle” command when two payloads remain at a given post. Aircrews will ensure that a 914 m (1,000 yd) safety buffer, visually clear of marine mammals, is maintained around each post as is done during active search operations.

- Aircrews shall only leave posts with unexploded charges in the event of a sonobuoy malfunction, an aircraft system malfunction, or when an aircraft must immediately depart the area due to issues such as fuel constraints, inclement weather, and in-flight emergencies. In these cases, the sonobuoy will self-scuttle using the secondary or tertiary method.

- Ensure all payloads are accounted for. Explosive source sonobuoys (AN/SSQ-110A) that can not be scuttled shall be reported as unexploded ordnance via voice communications while airborne, then upon landing via naval message.

- Mammal monitoring shall continue until out of own-aircraft sensor range.

5.3 SOCAL MARINE SPECIES MONITORING PLAN

The Navy is developing a Marine Species Monitoring Plan (MSMP) that provides recommendations for site-specific monitoring for MMPA and ESA listed species (primarily marine mammals) within the SOCAL Range Complex, including during training. The primary goals of monitoring are to evaluate trends in marine species distribution and abundance in order to assess potential population effects from Navy training activities and determine the effectiveness of the Navy’s mitigation measures. The information gained from the monitoring will also allow the Navy to evaluate the models used to predict effects to marine mammals.

By using a combination of monitoring techniques or tools appropriate for the species of concern, type of Navy activities conducted, sea state conditions, and the size of the Range Complex, the detection, localization, and observation of marine mammals and sea turtles can be maximized. The following available monitoring techniques and tools are described in this monitoring plan for monitoring for range events (several days or weeks) and monitoring of population effects such as abundance and distribution (months or years):

- Visual Observations – Vessel-, Aerial- and Shore-based Surveys (for marine mammals and sea turtles) will provide data on population trends (abundance, distribution, and presence) and response of marine species to Navy training activities. Navy lookouts will also record observations of detected marine mammals from Navy ships during appropriate training and test events.

- Acoustic Monitoring – Passive Acoustic Monitoring possibly using towed hydrophone arrays, Autonomous Acoustic Recording buoys and U.S. Navy Instrument Acoustic Range (for marine mammals only) may provide presence/absence data on cryptic species that are difficult to detect visually (beaked whales and minke whales) that could address long term population trends and response to Navy training exercises.

- Tagging – Tagging marine mammals with instruments to messure their dive depth and duration, determine location and record the received level of natural and anthropogenic sounds.

- Additional Methods – Oceanographic Observations and Other Environmental Factors will be obtained during ship-based surveys and satellite remote sensing data. Oceanographic data is important factor that influences the abundance and distribution of prey items and therefore the distribution and movements of marine mammals.

The monitoring plan will be reviewed annually by Navy biologists to determine the effectiveness of the monitoring elements and to consider any new monitoring tools or techniques that may have become available.

Research

The Navy provides a significant amount of funding and support to marine research. The agency provides nearly 10 million dollars annually to universities, research institutions, federal laboratories, private companies, and independent researchers around the world to study marine mammals. The U.S. Navy sponsors seventy percent of all U.S. research concerning the effects of human-generated sound on marine mammals and 50 percent of such research conducted worldwide. Major topics of Navy-supported research include the following:

- Better understanding of marine species distribution and important habitat areas,
- Developing methods to detect and monitor marine species before and during training,
- Understanding the effects of sound on marine mammals, sea turtles, fish, and birds, and
- Developing tools to model and estimate potential effects of sound.

This research is directly applicable to Fleet training activities, particularly with respect to the investigations of the potential effects of underwater noise sources on marine mammals and other protected species. Proposed training activities employ sonar and underwater explosives, which introduce sound into the marine environment.

The Marine Life Sciences Division of the Office of Naval Research currently coordinates six programs that examine the marine environment and are devoted solely to studying the effects of noise and/or the implementation of technology tools that will assist the Navy in studying and tracking marine mammals. The six programs are as follows:

- Environmental Consequences of Underwater Sound,
- Non-Auditory Biological Effects of Sound on Marine Mammals,
- Effects of Sound on the Marine Environment,
- Sensors and Models for Marine Environmental Monitoring,

- Effects of Sound on Hearing of Marine Animals, and
- Passive Acoustic Detection, Classification, and Tracking of Marine Mammals.

The Navy has also developed the technical reports referenced within this document, which include the Marine Resource Assessments and the Navy OPAREA Density Estimates (NODE) reports. Furthermore, research cruises by the National Marine Fisheries Service (NMFS) and by academic institutions have received funding from the U.S. Navy.

The Navy has sponsored several workshops to evaluate the current state of knowledge and potential for future acoustic monitoring of marine mammals. The workshops brought together acoustic experts and marine biologists from the Navy and other research organizations to present data and information on current acoustic monitoring research efforts and to evaluate the potential for incorporating similar technology and methods on instrumented ranges. However, acoustic detection, identification, localization, and tracking of individual animals still requires a significant amount of research effort to be considered a reliable method for marine mammal monitoring. The Navy supports research efforts on acoustic monitoring and will continue to investigate the feasibility of passive acoustics as a potential mitigation and monitoring tool.

Overall, the Navy will continue to fund ongoing marine mammal research, and is planning to coordinate long term monitoring/studies of marine mammals on various established ranges and operating areas. The Navy will continue to research and contribute to university/external research to improve the state of the science regarding marine species biology and acoustic effects. These efforts include mitigation and monitoring programs; data sharing with NMFS and via the literature for research and development efforts; and future research as described previously.

Coordination and Reporting

The Navy will coordinate with the local NMFS Stranding Coordinator for any unusual marine mammal behavior and any stranding, beached live/dead or floating marine mammals that may occur coincident with Navy training activities.

Alternative Mitigation Measures Considered but Eliminated

As described in Chapter 4, the vast majority of estimated sound exposures of marine mammals during proposed active sonar activities would not cause injury. Potential acoustic effects on marine mammals would be further reduced by the mitigation measures described above. Therefore, the Navy concludes the proposed action and mitigation measures would achieve the least practical adverse impact on species or stocks of marine mammals.

A determination of “least practicable adverse impacts” includes consideration of personnel safety, practicality of implementation, and impact on the effectiveness of the military readiness activity in consultation with the DoD. Therefore, the following additional mitigation measures were analyzed and eliminated from further consideration:

- Reduction of training. The requirements for training have been developed through many years of iteration to ensure sailors achieve levels of readiness to ensure they are prepared to properly respond to the many contingencies that may occur during an actual mission. These training requirements are designed provide the experience needed to ensure sailors are properly prepared for operational success. There is no extra training built in to the plan, as this would not be an efficient use of the resources needed to support the training (e.g. fuel, time). Therefore, any reduction of training would not allow sailors to achieve satisfactory levels of readiness needed to accomplish their mission.
- Use of ramp-up to attempt to clear the range prior to the conduct of exercises. Ramp-up procedures, (slowly increasing the sound in the water to necessary levels), are not a

viable alternative for training exercises because the ramp-up would alert opponents to the participants' presence. This affects the realism of training in that the target submarine would be able to detect the searching unit prior to themselves being detected, enabling them to take evasive measures. This would insert a significant anomaly to the training, affecting its realism and effectiveness. Though ramp-up procedures have been used in testing, the procedure is not effective in training sailors to react to tactical situations, as it provides an unrealistic advantage by alerting the target. Using these procedures would not allow the Navy to conduct realistic training, thus adversely impacting the effectiveness of the military readiness activity.

- Visual monitoring using third-party observers from air or surface platforms, in addition to the existing Navy-trained lookouts.
    - The use of third-party observers would compromise security due to the requirement to provide advance notification of specific times/locations of Navy platforms.
    - Reliance on the availability of third-party personnel would also impact training flexibility, thus adversely affecting training effectiveness.
    - The presence of other aircraft in the vicinity of naval exercises would raise safety concerns for both the commercial observers and naval aircraft.
    - Use of Navy observers is the most effective means to ensure quick and effective implementation of mitigation measures if marine species are spotted. A critical skill set of effective Navy training is communication. Navy lookouts are trained to act swiftly and decisively to ensure that appropriate actions are taken.
    - Use of third-party observers is not necessary because Navy personnel are extensively trained in spotting items on or near the water surface. Navy spotters receive more hours of training, and use their spotting skills more frequently, than many third-party trained personnel.
    - Crew members participating in training activities involving aerial assets have been specifically trained to detect objects in the water. The crew's ability to sight from both surface and aerial platforms provides excellent survey capabilities using the Navy's existing exercise assets.
    - Security clearance issues would have to be overcome to allow non-Navy observers onboard exercise participants.
    - Some training events will span one or more 24-hour periods, with operations underway continuously in that timeframe. It is not feasible to maintain non-Navy surveillance of these operations, given the number of non-Navy observers that would be required onboard.
    - Surface ships having active mid-frequency sonar have limited berthing capacity. As exercise planning includes careful consideration of this limited capacity in the placement of exercise controllers, data collection personnel, and Afloat Training Group personnel on ships involved in the exercise. Inclusion of non-Navy observers onboard these ships would require that in some cases there would be no additional berthing space for essential Navy personnel required to fully evaluate and efficiently use the training opportunity to accomplish the exercise objectives.

- Contiguous ASW events may cover many hundreds of square miles. The number of civilian ships and/or aircraft required to monitor the area of these events would be considerable. It is, thus, not feasible to survey or monitor the large exercise areas in the time required ensuring these areas are devoid of marine mammals. In addition, marine mammals may move into or out of an area, if surveyed before an event, or an animal could move into an area after an exercise took place. Given that there are no adequate controls to account for these or other possibilities and there are no identified research objectives, there is no utility to performing either a before or an after the event survey of an exercise area.
- Survey during an event raises safety issues with multiple, slow civilian aircraft operating in the same airspace as military aircraft engaged in combat training activities. In addition, most of the training events take place far from land, limiting both the time available for civilian aircraft to be in the exercise area and presenting a concern should aircraft mechanical problems arise.
- Scheduling civilian vessels or aircraft to coincide with training events would impact training effectiveness, since exercise event timetables cannot be precisely fixed and are instead based on the free-flow development of tactical situations. Waiting for civilian aircraft or vessels to complete surveys, refuel, or be on station would slow the unceasing progress of the exercise and impact the effectiveness of the military readiness activity.
- Multiple simultaneous training events continue for extended periods. There are not enough qualified third-party personnel to accomplish the monitoring task.

- Reducing or securing power during the following conditions.
  - Low-visibility / night training: ASW can require a significant amount of time to develop the “tactical picture,” or an understanding of the battle space such as area searched or unsearched, identifying false contacts, understanding the water conditions, etc. Reducing or securing power in low-visibility conditions would affect a commander’s ability to develop this tactical picture and would not provide realistic training.
  - Strong surface duct: The complexity of ASW requires the most realistic training possible for the effectiveness and safety of the sailors. Reducing power in strong surface duct conditions would not provide this training realism because the unit would be operating differently than it would in a combat scenario, reducing training effectiveness and the crew’s ability. Additionally, water conditions may change rapidly, resulting in continually changing mitigation requirements, resulting in a focus on mitigation versus training.
- Vessel speed: Establish and implement a set vessel speed.
  - Navy personnel are required to use caution and operate at a slow, safe speed consistent with mission and safety. Ships and submarines need to be able to react to changing tactical situations in training as they would in actual combat. Placing arbitrary speed restrictions would not allow them to properly react to these situations, resulting in decreased training effectiveness and reduction the crew proficiency.
- Increasing power down and shut down zones:
  - The current power down zones of 457 and 914 m (500 and 1,000 yd), as well as the 183 m (200 yd) shut down zone were developed to minimize exposing marine

mammals to sound levels that could cause temporary threshold shift (TTS) or permanent threshold shift (PTS), levels that are supported by the scientific community. Implementation of the safety zones discussed above will prevent exposure to sound levels greater than 195 dB re 1µPa for animals sighted. The safety range the Navy has developed is also within a range sailors can realistically maintain situational awareness and achieve visually during most conditions at sea.

   - Although the three action alternatives were developed using marine mammal density data and areas believed to provide habitat features conducive to marine mammals, not all such areas could be avoided. ASW requires large areas of ocean space to provide realistic and meaningful training to the sailors. These areas were considered to the maximum extent practicable while ensuring Navy's ability to properly train its forces in accordance with federal law. Avoiding any area that has the potential for marine mammal populations is impractical and would impact the effectiveness of the military readiness activity.

- Using active sonar with output levels as low as possible consistent with mission requirements and use of active sonar only when necessary.
   - Operators of sonar equipment are always cognizant of the environmental variables affecting sound propagation. In this regard, the sonar equipment power levels are always set consistent with mission requirements.
   - Active sonar is only used when required by the mission since it has the potential to alert opposing forces to the sonar platform's presence. Passive sonar and all other sensors are used in concert with active sonar to the maximum extent practicable when available and when required by the mission.

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