Southern California Range Complex

Environmental Impact Statement/
Overseas Environmental Impact Statement

Volume 1 of 2: Chapters 1-3

Final • December 2008

Commander
United States Navy Pacific Fleet
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Southern California Range Complex

Environmental Impact Statement/
Overseas Environmental Impact Statement (EIS/OEIS)

Volume 1: Chapters 1-3

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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

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Point of Contact: Mr. Kent Randall
Naval Facilities Engineering Command Southwest
Code: OPME
2730 McKean St. Bldg. 291
San Diego, CA 92136-5198
(619) 556-2168

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COVER SHEET
FINAL 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: Final 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 and the No Action Alternative. 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 training 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: Mr. Kent Randall
Naval Facilities Engineering Command Southwest
Code OPME
2730 McKean St. Bldg. 291
San Diego, CA 92136-5198
(619) 556-2168

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Executive Summary

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 (Figure ES-1).

This Final 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.] Section [§] 4321 et seq.); the Counsel 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); 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 nautical miles (nm) (1,111 kilometers [km]) southwest into the Pacific Ocean, the SOCAL Range Complex encompasses over 120,000 square nautical miles (nm^2) (411,600 square kilometers [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 (i.e., SCI). For range management and scheduling purposes, the SOCAL Range Complex is divided into numerous subcomponent ranges or training areas which are described in detail in Chapter 2 of the EIS/OEIS (Description of Proposed Actions and Alternatives).

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.C. § 5062), which ensures 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.

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[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."

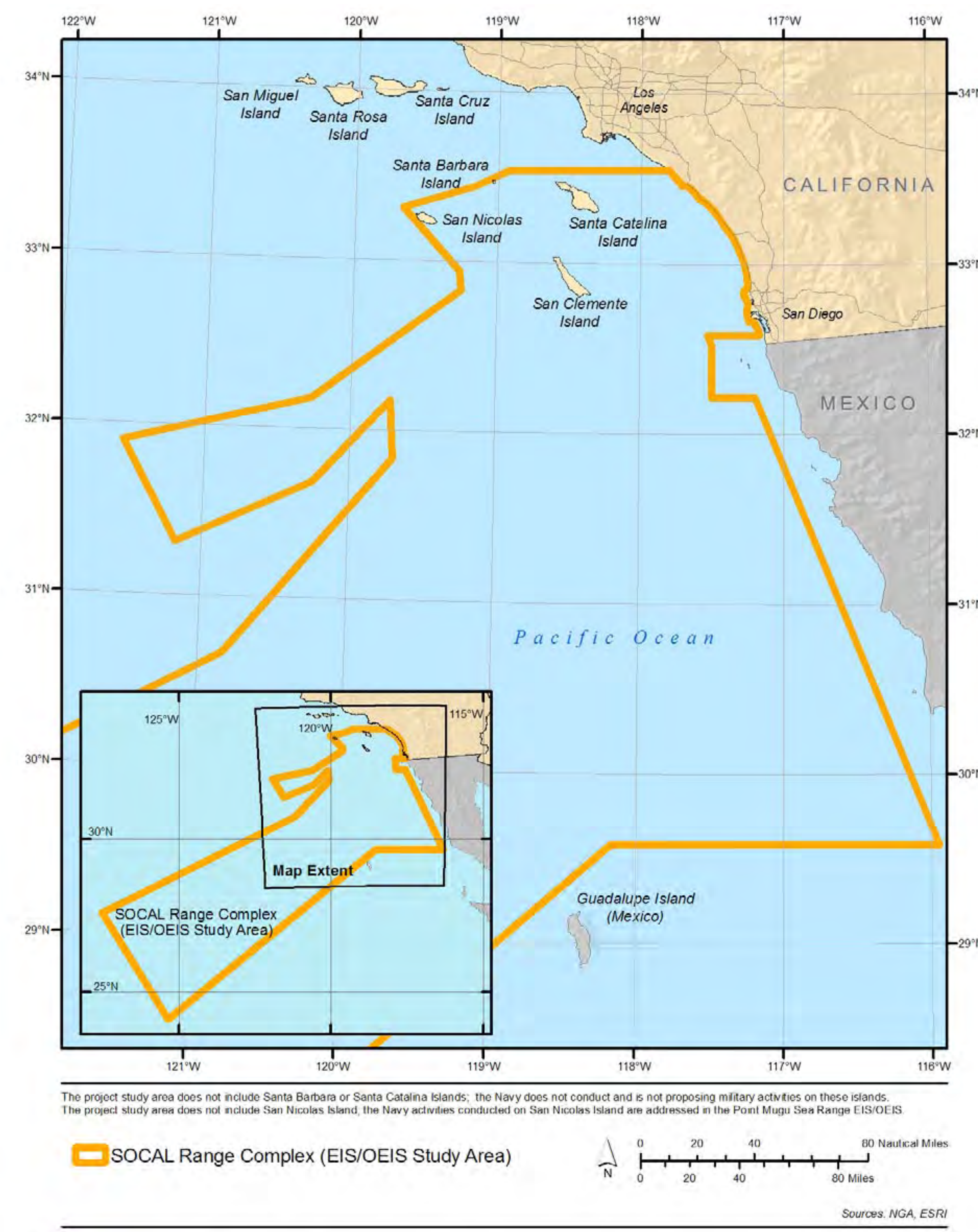

Figure ES-1: Detail of SOCAL Range Complex

ES 1.2 PURPOSE 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 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, 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 surrounding San Diego, California, is home to the largest concentration of U.S. Naval forces in the Pacific Fleet, 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 and RDT&E resource.

This EIS/OEIS provides an assessment of environmental effects associated with current and proposed training and RDT&E 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 activities from current levels in order to support the Fleet Response Training Plan[2] (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 and RDT&E. 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 ES 1.4.1. These criteria provide the basis for the statement of the Proposed Action and alternatives and selection of alternatives for further analysis, as well as analysis of the existing environment and the environmental effects of the Proposed Action and alternatives.

ES 1.3 SCOPE AND CONTENT OF THE ENVIRONMENTAL IMPACT STATEMENT/OVERSEAS ENVIRONMENTAL IMPACT STATEMENT

In its analysis under NEPA, the Navy includes areas of the SOCAL Range Complex that lie within 12 nm (22 km), or within the U.S. territorial sea. Environmental effects in the areas that

[2] Predeployment training is governed by the FRTP. The FRTP establishes a training cycle that includes four phases: (1) maintenance; (2) unit-level training; (3) integrated training; and (4) sustainment.

are outside of the U.S. territorial sea are analyzed under EO 12114 and associated implementing regulations.

ES 1.3.1 National Environmental Policy Act

The first step in the NEPA process is the preparation of a notice of intent (NOI) to develop the EIS. The NOI is published in the Federal Register and provides an overview of the Proposed Action and the scope of the EIS.

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 the EIS is 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 through written comments. Comments received from the public as a result of the scoping process will be considered in the preparation of the EIS.

Subsequent to the scoping process, a Draft EIS/OEIS is prepared to assess the potential effects of the Proposed Action and alternatives on the environment. A notice of availability is published in the Federal Register and notices are placed in local or regional newspapers announcing the availability of the Draft EIS/OEIS. The Draft EIS/OEIS is circulated for review and comment. Public meetings are held to allow the public to provide comments on the Draft EIS/OEIS.

The Final EIS/OEIS responds to all public comments received on the Draft EIS/OEIS. Responses to public comments may include correction of data, clarifications of and modifications to analytical approaches, and inclusion of additional data or analyses.

Finally, the decision maker will issue a Record of Decision (ROD), usually 30 days after the Final EIS is made available to the public. The ROD will summarize the decision maker's decision and identify the selected alternative, describe the public involvement and agency decision-making processes, and present commitments to specific mitigation measures.

During the development of this EIS/OEIS, the Navy complied with all of the processes described here. See Section 10.1 for a summary of the Navy's compliance.

ES 1.3.2 Executive Order 12114

EO 12114 directs Federal agencies to provide for informed decision making for major Federal actions outside the U.S. territorial sea. For purposes of this EIS/OEIS, areas outside the U.S. territorial sea are considered to be areas beyond 12 nm (22 km) from shore. This EIS/OEIS satisfies the requirements of EO 12114, as analyses of operations or impacts occurring, or proposed to occur, outside of 12 nm (22 km) are 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 minimally different within or outside the 12 nm (22 km) 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) the following:

- 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
- 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.

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. The EIS must rigorously and objectively evaluate all reasonable alternatives, and for alternatives which were eliminated from detailed study, briefly discuss the reasons for their having been eliminated (40 CFR § 1502.14). The purpose and need provides the framework in which reasonable alternatives to the Proposed Action are identified. In addition, the no action alternative must always be addressed. To be “reasonable,” an alternative must meet the stated purpose and need for the Proposed Action.

For the purposes of this EIS, the No Action Alternative serves as the baseline level of operations on the SOCAL Range Complex, representing the regular and historical level of training and testing activity necessary to maintain Navy readiness. Consequently, the No Action Alternative stands as no change from current levels of training and testing usage. This interpretation of the No Action Alternative is consistent with guidance provided by CEQ (40 Questions #3), which indicates that where ongoing programs continue, even as new plans are developed, "no action" is "no change" from current management direction or level of management intensity. 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.

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.

Alternatives considered in this EIS/OEIS were developed by the Navy after careful assessment by subject-matter experts, including military 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 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 in this analysis should support or employ:

1. All requirements of the FRTP and the Fleet Response Plan (FRP), including surge;
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 Anti-Submarine Warfare (ASW) and Mine Warfare (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. Use of 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.

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 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. These changes are 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. Alternative 1 and Alternative 2 actions include:

- Increasing numbers of training and RDT&E activities of the types currently being conducted in the SOCAL Range Complex.
- Expanding the size and scope of amphibious landing training operations in the SOCAL OPAREAs and at SCI to include a battalion-sized landing of 1,500+ Marines with weapons and equipment (to be conducted up to two times per year).
- Expanding 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.
- Installing a Shallow Water Training Range (SWTR), a proposed extension into shallow water[3] of the existing instrumented deepwater ASW range (known as the Southern California ASW Range [SOAR]).
- Conducting operations on the SWTR following installation.
- Increasing Commercial Air Services support for Fleet Opposition Forces (OPFOR) and Electronic Warfare (EW) Threat Training.
- Constructing and operating a Shallow Water Minefield (SWM) (at depths of 250 to 420 feet [ft] [76 to 128 meters (m)]) in offshore and near-shore areas in the vicinity of SCI.
- Supporting training for new systems and platforms, specifically, Littoral Combat Ship (LCS), MV-22 Osprey aircraft, the EA-18G Growler aircraft, the MH-60R/S Seahawk Multimission Helicopter, the P-8 Poseidon Multimission 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 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 or geographic constraints on use of the SOCAL Range Complex
- Extensive reliance on simulated training in place of live training.

[3] In the context of naval operations, specifically submarine operations, the term "shallow water" is a relative term, denoting depths of up to 400 fathoms (2,400 ft), which are considered "shallow" compared to the depth of the ocean.

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 RDT&E and Accommodate Force Structure Changes
3. Alternative 2: Increase Operational Training and RDT&E, 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 and RDT&E activities. The Navy proposes to:

- Increase training and RDT&E activities from current levels as necessary to support 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.

Each of the alternatives considered are discussed in the following sections.

ES 1.4.3.1 No Action Alternative: Current Training and RDT&E Activities 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, RDT&E activities, and major range events would continue at current levels. The SOCAL Range Complex would not accommodate an increase in activities required to execute all aspects of 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 Joint Task Force Exercises (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 brought about by 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 as previously noted 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. Another 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 that would accommodate the necessary enhancement of ASW and MIW training.

ES 1.4.3.2 Alternative 1: Increase Operational Training and RDT&E, and Accommodate Force Structure Changes

Alternative 1 is a proposal designed to meet Navy and Department of Defense (DoD) current and near-term operational training requirements. If Alternative 1 were to be selected, in addition to accommodating activities currently conducted, the SOCAL Range Complex would support an increase in training and RDT&E activities 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 MH-60R/S Seahawk Multimission Helicopter, the P-8 Poseidon Maritime Multimission Aircraft, the LPD 17 amphibious assault ship, and the DDG 1000 (Zumwalt Class) destroyer. Force structure changes associated with new weapons systems would include Mine Countermeasures (MCM) systems. Force structure changes also would include training 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, 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 that would accommodate the necessary enhancement of ASW and MIW training.

ES 1.4.3.3 Alternative 2 (Preferred Alternative): Increase Operational Training and RDT&E, Accommodate Force Structure Changes, and Implement Range Enhancements

Implementation of Alternative 2 would include all activities of Alternative 1 (accommodating training operations currently conducted, increasing training and RDT&E activities [including major range events], and accommodating force structure changes). In addition, under Alternative 2:

[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.

- In order to optimize training throughput and meet the FRTP, training and RDT&E activities of the types currently conducted would be increased over levels identified in Alternative 1.
- Range enhancements would be implemented, to include an increase in Commercial Air Services, establishment of a SWM; and installation and use of the Shallow Water Training Range (SWTR).

Alternative 2 is the preferred alternative, because it would optimize the training and RDT&E capability of the SOCAL Range Complex. Alternative 2 fully meets the criteria identified above.

ES 1.5 ALTERNATIVES ANALYSIS

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 Table ES-1.

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, SUA, and the land area of SCI to the extent affected resources or potential impacts are present.

Table ES-1: Categories of Resources Addressed, and EIS/OEIS Chapter 3 Analysis Guide

Geology and Soils (1.5.1)	Air Quality (1.5.2)
Hazardous Materials and Wastes (1.5.3)	Water Resources (1.5.4)
Acoustic Environment (1.5.5)	Marine Plants and Invertebrates (1.5.6)
Fish (1.5.7)	Sea Turtles (1.5.8)
Marine Mammals (1.5.9)	Sea Birds (1.5.10)
Terrestrial Biological Resources (1.5.11)	Cultural Resources (1.5.12)
Traffic (1.5.13)	Socioeconomics (1.5.14)
Environmental Justice and Protection of Children (1.5.15)	Public Safety (1.5.16)

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 1.5.1 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 Section 1.5.4, Water Resources. Activities under each Alternative were analyzed for their effects on soils, particularly soil erosion and deposition of expended training materials.

A recent erosion study of SCI found that, on a watershed-wide basis, erosion rates were not, in general, substantially influenced by the current level of Navy activity (DoN 2006).

The increases in land training and testing activities proposed under Alternative 1 and 2 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.

Specific impacts to geology and soils and a summary of applicable mitigation are listed in Table ES-2.

Table ES-2: Summary of Geology and Soil 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 Shore Bombardment Area (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 applicable operations are within the territorial limits of the U.S.; EO 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 Assault Vehicle Maneuver Corridor (AVMC), would increase erosion potential that would be limited by site-specific mitigation measures and measures presented in the Integrated Natural Resources Management Plan (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 be limited to designated areas.	• All applicable operations are within the territorial limits of the U.S.; EO 12114 does not apply.

Table ES-2: Summary of Geology and Soil Effects by Alternative (cont'd)

Alternative	NEPA (On-Land and U.S. Territorial Waters)	EO12114 (Non-U.S. Territorial Waters)
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 applicable operations are within the territorial limits of the U.S.; EO 12114 does not apply.
Mitigation Measures	• 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 INRMP identifies presents policies to reduce the impacts of erosion on SCI. • Biannual sweeps and range clearance after exercises.	• All applicable operations are within the territorial limits of the U.S.; EO 12114 does not apply.

ES 1.5.2 Air Quality

Air quality is determined with reference to ambient air concentrations of seven major pollutants determined by the 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.

As shown in Table ES-3, 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 Naval Auxiliary Landing Field (NALF) at SCI, 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.

Table ES-3: Summary of Air Quality 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 San Diego Air Basin (SDAB) would be less than the screening thresholds of 100 tons (T) 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, oxides of sulfur (So_x), 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 South Coast Air Basin (SCAB) be redesignated as an extreme non-attainment area for the 8-hour National Air Ambient Air Quality Standards (NAAQS) for O_3, emission increases over baseline for oxides of nitrogen (NO_x) would be above the de minimis levels but would be within the South Coast Air Quality Management District (SCAQMD) State Implementation Plan (SIP) emissions budget for the San Clemente Island Range Complex (SCIRC). The Proposed Action under Alternative 1 would therefore conform to the SIP under the General Conformity Rule.	• 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.

Table ES-3: Summary of Air Quality Effects by Alternative (continued)

Alternative	NEPA (On-Land and U.S. Territorial Waters)	EO 12114 (Non-U.S. Territorial Waters)
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.	

ES 1.5.3 Hazardous Materials and Wastes

Hazardous materials addressed in this EIS/OEIS are broadly defined as substances that could pose a hazard by virtue of their chemical or biological properties, in the event of a substantial public exposure (human health) or release (environment). The purpose of evaluating hazardous materials and hazardous wastes is to determine whether they pose a direct hazard to individuals or the environment, given the specified source concentrations, environmental pathways, environmental sinks, and whether fresh or marine surface waters, soils, or groundwater would be contaminated. The purpose of evaluating hazardous wastes, a regulated subcategory of hazardous materials, is to determine whether these materials are being stored and transported appropriately, and whether waste generation would exceed regional capacity of hazardous waste management facilities.

Expended training materials containing hazardous constituents that will be deposited in the SOCAL OPAREAs (i.e., ocean area) are addressed in Section 1.5.4, Water Resources. Hazardous materials used at SCI are discussed below.

The expended ordnance is likely to be concentrated at certain points on SCI, such as around fixed targets. Sediment transport processes will tend to move surface soils downslope over time; conveying metals and other insoluble constituents into nearby marine areas.

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 Unexploded Ordnance (UXO) or low-order detonations result in large deposits of these materials, areas of greater concentration 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. Regular range clearances by Explosive Ordnance Disposal (EOD) personnel reduce the likelihood of high concentrations of contaminants developing on land ranges.

The anticipated amounts of hazardous wastes produced under the various alternatives 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.

Specific impacts to hazardous materials and waste and a summary of applicable mitigation are listed in Table ES-4.

Table ES-4: Summary of Hazardous Materials and Waste 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 munitions will deposit tens of thousands of pounds of training materials on the land ranges. Most of the degradation products of these materials are nonhazardous 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.	• No effect from land activities. • The Navy's existing hazardous waste management system is sufficient for handling of wastes generated.
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.	• No effect from land activities. • The Navy's existing hazardous waste management system is sufficient for handling of wastes generated.
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.	• No effect from land activities. • The Navy's existing hazardous waste management system is sufficient for handling of wastes generated.
Mitigation Measures	• The Navy's general instructions (e.g., Chief of Naval Operations' Instructions [OPNAVINST] 5090.1C) and training activity planning and review processes serve to ensure that hazardous materials and hazardous wastes are stored and handled appropriately.	

ES 1.5.4 Water Resources

Water resources include water bodies, water processes and uses, and water quality. This section evaluates effects of the Proposed Action on marine water quality and surface and groundwaters on SCI.

ES 1.5.4.1 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 subsurface 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 in Section 3.4, Water Resources, of this EIS/OEIS, however, these pollutants will be released in quantities and at rates such that they will not violate any water quality standard or criteria. None of the alternatives will have an effect on the designated beneficial uses of marine waters.

Lead and other potentially hazardous materials from projectiles may leach into the soils on SCI over a long period; however, no groundwater resources are present on SCI and surface water is not located within impact or firing areas, and runoff potential is minimal due to topography and existing conditions.

ES 1.5.4.2 Bottom Sediments

The deposition rate on the ocean bottom of expended training materials, by weight, is about 32 pounds (lb)/nm^2 (4.1 kilogram (kg)/km^2) per year for the No Action Alternative, 46 lb/nm^2 (6.1 kg/km^2) per year for Alternative 1, and 48 lb/nm^2 (6.3 kg/km^2) per year for Alternative 2. 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 ft^3 (2.2 kg/million m^3) of sediment for the No Action Alternative and 8 lb per million ft^3 (119 kg per million m^3) of sediment for Alternatives 1 and 2. Depending on the density of bottom sediments, the concentration of expended training materials would be about 45 parts per billion (ppb), 69 ppb, and 70 ppb by weight for the No Action, Alternative 1, and Alternative 2 respectively. This concentration is several orders of magnitude below USEPA sediment quality guidelines for all alternatives.

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 primarily aluminum and steel, 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 is not high enough to result in substantial sediment toxicity. Neither inert nor toxic substances at this density will measurably affect sediment quality.

Expended training materials will accumulate in ocean bottom sediments over the entire period of military training and testing, 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 would still have no discernable effect on the quality of bottom sediments.

Specific impacts to water resources and a summary of applicable mitigation are listed in Table ES-5.

Table ES-5: Summary of Water Resource Effects by Alternative

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 USEPA sediment quality guidelines; 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, EO 12856, and EO 13101, and OPNAVINST 5090.1C also cover pollution prevention requirements. These instructions reinforce the Clean Water Act's (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. • 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.	• 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, 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.

ES 1.5.5 Acoustic Environment

The acoustic environment analyzed here includes only airborne noise. In-water sound, which includes sonar and its potential effect to marine resources, is discussed in Sections ES 1.5.7, 1.5.8, and 1.5.9. Airborne sound 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 and RDT&E activities in the SOCAL Range Complex would be dispersed and intermittent, so it would not contribute to long-term noise levels;
- Training and test areas on SCI are remote and isolated from the general public, so no nonparticipants would be exposed to these noise events;
- No new public areas would be exposed to noise from training and testing activities;
- Advanced notice to mariners is given when particularly hazardous activities are scheduled. Because these types of activities tend also to be the most significant noise-producing activities, this notice also reduces potential noise impacts to nonparticipants;
- Land-based ordnance detonations occur mostly in Shore Bombardment Area (SHOBA), a designated restricted area far removed from the general public, 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 ES-6 summarizes noise effects and mitigation measures for the No Action, Alternative 1, and Alternative 2.

Table ES-6: Summary of Effects to the Acoustic Environment 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-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 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 hazardous (and typically noise-producing) operations is made available to the public.	

ES 1.5.6 Marine Plants and Invertebrates

Potential impacts of training and RDT&E activities 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 Warning Area 291 (W-291) and all ocean OPAREAs of the SOCAL Range Complex. The resulting expended materials 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.

Sandy beaches are very dynamic habitats and are biologically less diverse than rocky intertidal areas. Localized impacts to benthic infauna along sandy beaches would be expected in some training and testing activities, although recolonization would also be expected relatively soon after the disturbance. Specifically, underwater demolitions and amphibious landings could cause temporary increased turbidity. However, 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.

Construction of a SWM 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.

Two species of concern, the white abalone (Federally listed) and the black abalone (proposed for Federal listing) occur within the SOCAL Range Complex. With respect to species of concern, training and testing activities in the SOCAL OPAREAs may affect the white abalone and the black abalone. The Navy is consulting with the resource agencies to ensure there will be no significant impact to the species. A few of the activities, however, have the potential to affect the species because they occur in or immediately adjacent to 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, Naval Surface Fire Support (NSFS), Insertion/Extraction, and mine training exercises.

Specific impacts to marine plants and invertebrates and a summary of applicable mitigation are listed in Table ES-7.

Table ES-7: Summary of Effects to Marine Plants and Invertebrates by Alternative

Alternative	NEPA (On-Land and U.S. Territorial Waters)	EO 12114 (Non-U.S. Territorial Waters)
No Action Alternative	• Constituents 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.	• 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.
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 Anti-Air Warfare (AAW), Anti-Surface Warfare (ASUW), NSW, and Amphibious Warfare (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.	• 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 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.
Alternative 2 (Preferred Alternative)	• Impacts same as described for No Action Alternative and Alternative 1, plus the following: • Construction of a SWM 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.	• Impacts same as described for No Action Alternative and Alternative 1, plus the following: • Construction of a SWM 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.
Mitigation Measures	• Mitigation measures for underwater detonations, implemented for marine mammals and sea turtles, offer protections to other marine habitats and resources.	

ES 1.5.7 Fish

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, and 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. Based on the limited extent, duration, and magnitude of potential impacts from SOCAL Range Complex training and testing, the adverse effects would be minimal and temporary. Further, mitigation measures for the action would adequately avoid, minimize, mitigate, or otherwise offset the adverse impacts to EFH and Managed Species. See Appendix E for full EFH Assessment.

Common activities were analyzed to determine the effect on fish. Both acoustic (i.e., aircraft, missile, and target overflight; muzzle blast; underwater explosions; shock waves; and sonar) and nonacoustic (i.e., munitions constituents, falling debris, small arms rounds, and chaff and flares) sources showed minimal impacts to fish. Specifically associated with the Preferred Alternative (Alternative 2), potential impacts were analyzed for the installation of a shallow water minefield and a shallow water training range. All impacts were determined to be minimal and of a temporary nature.

Specific impacts to fish and a summary of applicable mitigation are listed in Table ES-8.

Table ES-8: Summary of Effects to Fish by Alternative

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 the water impact of inert mines, inert bombs, and intact missiles and targets. 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 active sonar, effects of sonar used in the ASW and MIW exercises on fish are minimal. • Most SHOBA Operations and AMW 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 Space and Naval Warfare Systems Center (SSC) test that has any potential effects is Underwater Acoustics Testing, which involves mid-frequency active sonar, but effects on fish are minimal (see effects of sonar used in the ASW and MIW exercises, above).	• Relatively small numbers of fish would be killed by shock waves from the water impact of inert mines, inert bombs, and intact missiles and targets. 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 active sonar, effects of sonar used in the ASW and MIW exercises on fish are minimal.

Table ES-8: Summary of Effects to Fish by Alternative (continued)

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.	• 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 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.
Alternative 2 (Preferred Alternative)	• Impacts same as described for No Action Alternative and Alternative 1, plus the following: • Construction of a SWM 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.	• Impacts same as described for No Action Alternative and Alternative 1, plus the following: • Construction of a SWM 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.
Mitigation Measures	• Mitigation measures implemented for marine mammals and sea turtles, also offer protections to habitats associated with fish communities. For example, explosive gunnery rounds and bombs are targeted so as to avoid floating weeds, kelp, and algal mats. No additional mitigation measures are proposed or warranted because no substantial effects on fish or fish habitat were identified.	

ES 1.5.8 Sea Turtles

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. The occurrence of these four species of sea turtles is highly seasonable and variable by location within the SOCAL Range Complex. Their occurrence and the Navy's activities in SOCAL result in a 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 affect listed loggerhead, green, olive ridley, or leatherback sea turtles.

Specific impacts to sea turtles and a summary of applicable mitigation are listed in Table ES-9.

Table ES-9: Summary of Effects to Sea Turtles 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 SWM 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 Measures	• Mitigation measures are in place for active sonar, general maritime procedures, and underwater detonation.	

ES 1.5.9 Marine Mammals

Impacts to marine mammals from Navy activities in the SOCAL Range Complex may result from nonacoustic sources, acoustic sources such as Mid- and High- Frequency Active sonar (MFA sonar/HFA sonar), or effects from underwater detonations. Modeled acoustic 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 applied by the Navy.

ES 1.5.9.1 Potential Nonacoustic Impacts

Impacts to marine mammals from Navy activities in the SOCAL Range Complex may result from nonacoustic sources including ship collisions, entanglement, or falling debris. Although ship strikes with marine mammals have been increasing since the 1950s, Navy ship strikes remain extremely low, likely due to the low number of Navy ships relative to commercial ships, and Navy standard operating procedures such as use of lookouts and ability to maneuver to avoid sighted marine mammals. While marine mammals are susceptible to entanglement and subsequent injury or death, most documented cases of entanglement involve whale encounters with vertical lines of fixed fishing gear. Entanglement in military-related expended items has not been cited as a source of injury or mortality for marine mammals. Due to the low probability of direct strike by any Navy falling debris (from activities such as ASW or missile firings), there would be no impact to marine mammals resulting from direct impact of these expended training materials.

ES 1.5.9.2 Potential Mid- and High-Frequency Active Sonar Effects

No Action Alternative—Acoustic modeling provides an estimate of 99,809 annual exposures to mid- and high-frequency active sonar that could result in a behavioral change (Level B harassment). 9,658 exposures could result in temporary threshold shift (TTS) (auditory) (Level B harassment), and 19 annual exposures could result in injury as permanent threshold shift (PTS) (auditory). The modeled sonar exposure numbers by species are presented in Table 3.9-12. These exposure modeling results are estimates of marine mammal sonar exposures without consideration of standard mitigation and monitoring procedures.

Alternative 1—Acoustic modeling provides an estimate of 106,179 annual exposures to mid- and high-frequency active sonar that could result in a behavioral change. 10,265 exposures could result in TTS (Level B harassment), and 19 annual exposures could result in injury as PTS (Level A).

Alternative 2—Acoustic modeling provides an estimate of 112,884 annual exposures to mid- and high-frequency active sonar that could result in a behavioral change. 10,897 exposures could result in TTS (Level B harassment), and 19 annual exposures could result in injury as PTS (Level A).

ES 1.5.9.3 Potential Underwater Detonation Effects

No Action Alternative—Modeling estimates 1,220 annual exposures to pressure from underwater detonations could result in a behavioral change (Level B harassment), and 893 exposures 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.

Alternative 1— Modeling estimates 1,240 annual exposures to pressure from underwater detonations could result in a behavioral change (Level B harassment), and 1,008 exposures could result in TTS (Level B harassment). Thirty annual exposures could result in slight injury. Ten annual exposures could result in severe injury or mortality.

Alternative 2— Modeling estimates 1,499 annual exposures to pressure from underwater detonations could result in a behavioral change (Level B harassment), and 1,128 exposures could result in TTS (Level B harassment). Thirty-four annual exposures could result in slight injury. Eleven annual exposures could result in severe injury or mortality.

Specific impacts to marine mammals and a summary of applicable mitigation are listed in Table ES-10.

Table ES-10: Summary of Effects to Marine Mammals by Alternative

Alternative	NEPA and EO 12114 (On-Land and U.S. and Non-U.S. Territorial Waters)
No Action Alternative	• **Nonacoustic effects.** No impacts to marine mammals are expected due to nonacoustic activities. • **Potential MFA sonar/HFA sonar effects**. The risk function methodology estimates 99,809 annual exposures to mid- and high-frequency active sonar that could result in a behavioral harassment (Level B harassment), 9,658 exposures that could result in TTS (Level B harassment), and 19 annual exposures that could result in injury as PTS. These exposure modeling results are estimates of marine mammal sonar exposures without consideration of standard mitigation and monitoring procedures. Population level adverse effects are not anticipated. • **Potential underwater detonation effects**. Modeling estimates 1,220 annual exposures to pressure from underwater detonations that could result in sub-TTS (Level B harassment) and 893 annual exposures that 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.
Alternative 1	• **Nonacoustic effects.** No impacts to marine mammals are expected due to nonacoustic activities. • **Potential MFA sonar/HFA sonar effects**. The risk function methodology estimates 106,179 annual exposures to mid- and high-frequency active sonar that could result in a behavioral harassment, 10,265 exposures that could result in TTS (Level B harassment), and 19 annual exposures that could result in injury as PTS. Population level adverse effects are not anticipated. • **Potential underwater detonation effects**. Modeling estimates 1,240 annual exposures to pressure from underwater detonations that could result in sub-TTS (Level B harassment) and 1,008 annual exposures that could result in TTS (Level B harassment). Thirty annual exposures could result in slight injury. Ten annual exposures could result in severe injury or mortality.
Alternative 2 (Preferred Alternative)	• **Nonacoustic effects.** No impacts to marine mammals are expected due to nonacoustic activities. • **Potential MFA sonar/HFA sonar effects**. The risk function methodology estimates 112,884 annual exposures to mid- and high-frequency active sonar that could result in a behavioral harassment, 10,897 exposures that could result in TTS (Level B harassment), and 19 exposures that could result in injury as PTS. Population level adverse effects are not anticipated. • **Potential underwater detonation effects**. Modeling estimates 1,499 annual exposures to pressure from underwater detonations could result in sub-TTS (Level B harassment) and 1,128 annual exposures could result in TTS (Level B harassment). Thirty-four annual exposures could result in slight injury. Eleven annual exposures could result in severe injury or mortality.
Mitigation	• Extensive mitigation measures include personnel training, use of trained lookouts, use of safe speeds by Navy ships, marine mammal avoidance procedures, and numerous measures for specific training activities.

ES 1.5.10 Sea Birds

The SOCAL Range Complex encompasses an important area for foraging and breeding sea birds. Resident sea bird populations depend on coastal islands relatively free from human disturbance and close to important foraging grounds. Additionally, migratory sea birds utilize the productive offshore waters associated with the California Current to forage during wintering and migratory movements. Although the importance of the Southern California Bight (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 and testing activities on these values is not well known.

Threatened and endangered species within the SOCAL Range Complex include: the short-tailed albatross (*Phoebastria albatrus*); marbled murrelet (*Brachyramphus marmoratus);* Xantus's murrelet *(Synthliboramphus hypoleucus)*; Californian brown pelican *(Pelecanus occidentalis californicus)*; and the California least tern *(Sterna antillarum browni)*.

While it is possible that military 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 analysis in this document indicates that the spatial extent of the activity is so small and the surrounding available habitat so wide that sea bird species have ample opportunity to move to adjacent quality habitat, thereby lessening effects. Breeding sea birds have high nesting fidelity and most require some degree of isolation from disturbance and predation to maintain viable breeding success. Since none of the alternatives propose any new or expanded land-based impact areas for air-to-surface and surface-to-surface ordnance or an increase in coastal flight paths near currently documented roosting and breeding sea bird colonies, there would be no increase in the direct or indirect effects on sea bird populations. Based on the analysis of the spatial area available, the limited available data on sea bird populations, professional opinions of subject matter experts who study sea birds in Southern California, and discussions with military operational professionals, it is likely that effects to protected and migratory sea birds 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 sea bird species, poses a minimal potential effect on sea bird populations.

Specific impacts to sea birds and a summary of applicable mitigation are listed in Table ES-11.

Table ES-11: Summary of Effects to Sea Birds 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 sea bird 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 will ensure that the California brown pelican is not in proximity to the overblast pressure prior to underwater demolition activities.	

ES 1.5.11 Terrestrial Biological Resources

The only land area[5] within the SOCAL Range Complex is SCI, so the terrestrial analysis is limited to the activities and species occurring there. SCI supports 5 federally listed terrestrial

[5] Although San Nicolas, Santa Barbara and Santa Catalina Islands are within the SOCAL Range Complex boundary, there are no activities on these islands associated with the Range Complex. Only ASW activities in the ocean surrounding these islands are analyzed in this EIS/OEIS.

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 nonnative 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. Other threatened or endangered species analyzed include the San Clemente sage sparrow, island night lizard, California brown pelican, western snowy plover, island fox, and Santa Cruz Island rock-cress

Many of the more than 40 operations evaluated 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 Section 3.11.11 focuses on resources and operations areas so that the effects of different operations happening at the same place are taken into account.

For the Federally listed endangered and threatened plants and wildlife discussed in this analysis, the Navy has prepared a separate Biological Assessment addressing effects of no action and Proposed Action on SCI and is consulting with U.S. Fish and Wildlife Service (USFWS) in compliance with Section 7 of the Endangered Species Act.

Specific impacts to terrestrial biological resources and a summary of applicable mitigation are listed in Table ES-12.

Table ES-12: Summary of Effects to Terrestrial Biological Resources by Alternative

Alternative	NEPA (On-Land and U.S. Territorial Waters)	EO 12114 (Non-U.S. Territorial Waters)
No Action Alternative	• Impacts are generally minimal 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 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.	• 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.

Table ES-12: Summary of Effects to Terrestrial Biological Resources by Alternative (continued)

Alternative	NEPA (On-Land and U.S. Territorial Waters)	EO 12114 (Non-U.S. Territorial Waters)
Alternative 1	• Compared to No Action, there would be increased frequency of most operations, increased ordnance use, and new established training areas associated with Alternative 1. • Impacts on biological resources would be principally associated with establishment and use of the Assault Vehicle Maneuver Areas (AVMAs), Artillery Maneuver Points (AMPs), and Artillery Firing Points (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 U.S. Marine Corps (USMC) battalion-sized landing, and intensified activities of platoon-sized NSW groups at existing and newly established TARs.	• Impacts generally the same as No Action Alternative.
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. • 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.	• Impacts generally the same as No Action Alternative.
Mitigation Measures	• The Navy has proposed 31 specific measures to avoid, minimize, or compensate for adverse impacts on biological resources including threatened, endangered, and sensitive species and their habitats. The measures include measures to control invasive nonnative 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.	

ES 1.5.12 Cultural Resources

Cultural resources in the SOCAL Range Complex could occur within the waters of the SOCAL OPAREAs or on land at SCI. No traditional cultural resources or prehistoric resources are known to exist within the SOCAL OPAREAs. Submerged cultural resources, such as shipwrecks, are not expected to be affected by military training and RDT&E activities.

Cultural resources on SCI include archeological resources and historic architectural resources. Current and proposed training and testing 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 AVMA activities near 32 archaeological sites within the undisturbed portions of the Old Airfield VC-3 operations area would require consultation and resolution of adverse effects under the National Historic Preservation Act (NHPA) prior to implementation of operations.

Specific impacts to cultural resources and a summary of applicable mitigation are listed in Table ES-13.

Table ES-13: Summary of Effects to Cultural Resources by Alternative

Alternative	NEPA (On-Land and U.S. Territorial Waters)	EO12114 (Non-U.S. Territorial Waters)
No Action Alternative	• The Navy is preparing an Integrated Cultural Resources Management Plan (ICRMP) and a Programmatic Agreement (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 because avoidance conditions and stipulations are followed. 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.

Table ES-13: Summary of Effects to Cultural Resources by Alternative (continued)

Alternative	NEPA (On-Land and U.S. Territorial Waters)	EO12114 (Non-U.S. Territorial Waters)
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 because avoidance conditions and stipulations are followed. 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 are 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 currently unidentified site is determined to be eligible for the NRHP, State Historic Preservation Officer (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.

ES 1.5.13 Traffic

SCI is a military-owned island with no connection to a road network in a regional context. Because only military and military authorized vehicle traffic takes place on SCI, this section addresses only air traffic and marine traffic in and in the vicinity of the SOCAL Range Complex.

Both military and nonmilitary 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. No adverse effects to traffic are expected for any of the alternatives.

Specific impacts to traffic and a summary of applicable mitigation are listed in Table ES-14.

Table ES-14: Summary of Effects to Traffic by Alternative

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 special use airspace for military operations that are not compatible with civilian activity. • Hazardous air operations are communicated to commercial airlines and general aviation by Notices to Airmen (NOTAMs), published by the Federal Aviation Administration (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 Notices to Mariners (NOTMARs), published by the Coast Guard.	• The FAA has established W-289, W-290, and W-291 as special use airspace for military operations that are not compatible with civilian activity. • 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.	• Impacts on traffic under Alternative 1 would be the same as the No Action Alternative.
Alternative 2 (Preferred Alternative)	• Impacts on traffic under Alternative 2 would be the same as the No Action Alternative.	• Impacts on traffic under Alternative 2 would be the same as the No Action Alternative.
Mitigation Measures	• NOTAMs and NOTMARs are published with the appropriate agencies. • Return of SUA to civilian FAA control when not in use for military activities.	

ES 1.5.14 Socioeconomics

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.

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 SCI website (www.scisland.org), and the public is notified via a NOTMAR. These measures provide mariners advance notification of Navy use areas, which allow non-participants to select an alternate destination without appreciable affect to their activities. For example, commercial fishermen will know in advance about potential closures in a specific area. This notification will prevent them from wasting their time and fuel transiting to a closed location and they can plan for an alternate location instead. Upon completion of training, the range would be reopened and fishermen would be able to return to fish in the previously closed area. 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.

Specific impacts to socioeconomic concerns and a summary of applicable mitigation are listed in Table ES-15.

Table ES-15: Summary of Effects to Socioeconomics by Alternative

Alternative	NEPA (On-Land and U.S. Territorial Waters)	EO12114 (Non-U.S. Territorial Waters)
No Action Alternative	• Only military and government employee 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	• Effects are generally the same as the No Action Alternative, except activities may temporarily impact recreational and/or commercial users; however, notices will be posted and alternative locations will be available, which limits long-term effects.	• 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 with the addition of possible commercial fishing gear entanglement as a result of the SWTR installation.	• 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. Types of commercial fishing gear used in the SOCAL Range Complex include: drift gillnets, longline gear, troll gear, trawls, seining, and traps or pots. Damage to fishing gear from entanglement with hydrophones is rare.	

ES 1.5.15 Environmental Justice and Protection of Children

The SOCAL OPAREAs are at-sea. Environmental justice and protection of children is only of concern on SCI; however, 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.

Specific impacts to environmental justice and the protection of children are listed in Table ES-16.

Table ES-16: Summary of Effects to Environmental Justice and Protection of Children by Alternative

Alternative	NEPA (On-Land and U.S. Territorial Waters)	EO12114 (Non-U.S. Territorial Waters)
No Action Alternative	**Environmental Justice** • 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** • Visits by Boy Scouts and Girl Scouts to SCI are controlled, and scheduled/sited to avoid military training activities, proposed activities would not affect transient populations of children on the island.	• No impact
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.	• No impact
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.	• No impact
Mitigation Measures	• None necessary.	

ES 1.5.16 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.

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, NOTMARs, and the Southern California Offshore Range (SCORE) website. Prior public notification of Navy training and RDT&E activities, use of known training areas, avoidance of nonmilitary 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 and are expected to continue to be successful with implementation of alternatives.

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. Specific impacts to public health and safety are listed in Table ES-17.

Table ES-17: Summary of Effects to Public Health and Safety by Alternative

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 nonparticipants. 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 nonparticipants. 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	• Fleet Area Control and Surveillance Facility (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 any 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 used during certain targeting operations. • Hazards of Electromagnetic Radiation (EMR) to Personnel, Ordnance, and Fuel have been determined for EMR sources based on frequency and power output.	

ES 1.6 CUMULATIVE IMPACTS

The analysis of cumulative impacts considers the effects of the Proposed Action in combination with other past, present, and reasonably foreseeable future actions taking place in the project area, regardless of what agency or person undertakes these actions. This EIS/OEIS analyzes cumulative impacts associated with implementation of Navy-sponsored activities and other non-Navy activities in the region. The cumulative project list for SCI includes 25 projects ranging from minor construction to major infrastructure type projects, as well as various military training projects. Other activities included fishing, commercial and recreational marine traffic, oil extraction, liquid natural gas terminal proposals, ocean pollution, coastal development, scientific research, commercial and general aviation, and air quality factors. Potential cumulative impacts resulting from other relevant projects (such as those listed above) combined with the Proposed Action addressed in this EIS/OEIS were determined to be less than significant.

ES 1.7 MITIGATION MEASURES

NEPA regulations require that the Federal action proponent study means to mitigate adverse environmental impacts of the Proposed Action or alternatives (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 [f]). 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, Mitigation Measures.

Effective training and testing 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 and testing. 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. The discussion in Chapter 5 describes mitigation measures applicable to Navy activities in the SOCAL Range Complex.

ES 1.8 OTHER REQUIRED CONSIDERATIONS

ES 1.8.1 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 for the SOCAL Range Complex EIS/OEIS do 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 1.8.2 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 1.8.3 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 1.8.4 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 1.8.5 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 requirements, while addressing potential encroachments that threaten to impact range capabilities.

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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) (Title 42 United States Code [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 United States (U.S.) territory in an Overseas EIS (OEIS). The 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 (Figure 1-1) 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.C. § 5062), which ensures 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 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 surrounding 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."

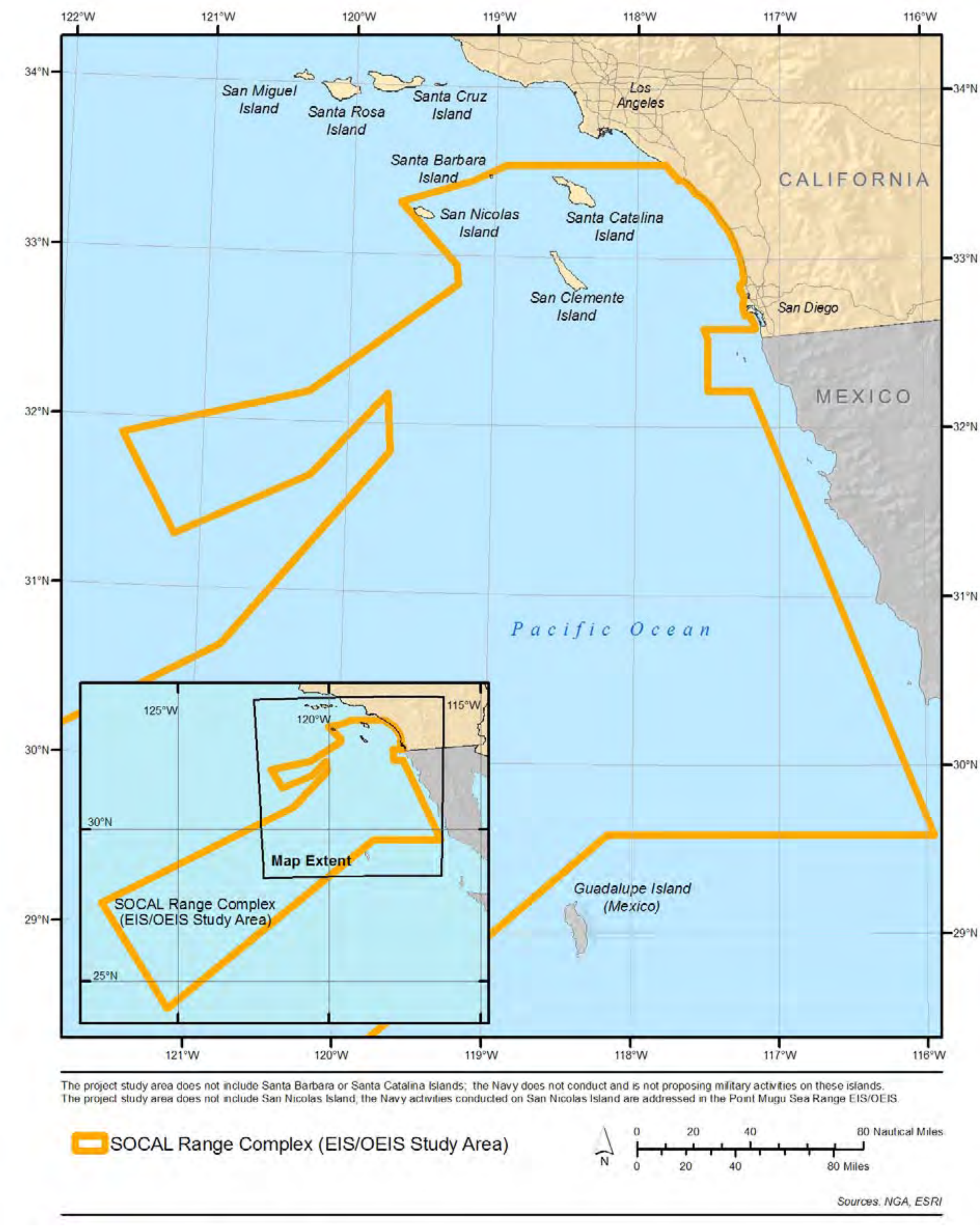

Figure 1-1: Detail of SOCAL Range Complex

This EIS/OEIS provides an assessment of environmental effects associated with current and proposed training and RDT&E activities, force structure (to include new weapons systems and platforms), and range investments in the SOCAL 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 Response 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. For the purposes of this EIS, the No Action Alternative serves as the baseline level of operations on the SOCAL Range Complex, representing the regular and historical level of training and testing activity necessary to maintain Navy readiness. Consequently, the No Action Alternative stands as no change from current levels of training and testing usage. This interpretation of the No Action Alternative is consistent with guidance provided by CEQ (40 Questions #3), which indicates that where ongoing programs continue, even as new plans are developed, "no action" is "no change" from current management direction or level of management intensity.

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 and RDT&E.

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 San Clemente Island (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 Exercises (JTFEX) and Composite Training Unit Exercises (COMPTUEX) conducted in Southern California. The scope of the JTFEX/COMPTUEX EA/OEA includes 14 predeployment exercises conducted from February 2007 to January 2009. The SOCAL Range Complex EIS/OEIS addresses the continuation of these exercises, as well as the Navy and U.S. Marine Corps training that currently occurs or is proposed to occur in ocean areas, airspace, and SCI land areas of the SOCAL Range Complex.

This Final EIS/OEIS was prepared in compliance with NEPA; 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); and 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 nonterritorial ocean areas. This EIS/OEIS satisfies the requirements of both NEPA and EO 12114.

This document also responds to public comments received on the Draft EIS/OEIS.

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 SOCAL 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. The Navy's mission, derived from 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 multiservice (Joint) exercises or predeployment 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 U.S. forces to conduct realistic combat-like training as they undergo all phases of the graduated buildup needed for combat ready deployment. The Navy's ranges and operating areas provide the space necessary to conduct controlled and safe training scenarios representative of those that U.S. 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 multidimensional exercises in complex scenarios. They also provide instrumentation that captures the performance of the Navy's 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 various Navy forces' 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 the U.S. military force transforms 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). Performing all of these functional areas at the same time (as is done while deployed) provides the most training value. Each training event addressed in the EIS/OEIS is categorized under one of the PMARS. Refer to Table 2-7 for a general description of each of these training operations. A more thorough description is provided in Appendix A.

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. Also see Table 2-7 and Appendix A for more information about these RDT&E activities.

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 based on the Combatant Commanders' worldwide requirements and commitments.

[2] The MEU (Special Operations Capable) is a task-organized unit of a type known as a Marine Air Ground Task Force (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.

Predeployment training is governed by the FRTP. The FRTP establishes a training cycle that includes four phases: (1) maintenance; (2) unit-level training; (3) integrated training; and (4) sustainment. 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[3]. 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 Program

The Tactical Training Theater Assessment and Planning (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) ensure 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. The RCD provides guidelines 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;
- Provide range complex sustainable management principles and practices, to include environmental stewardship and community outreach; and
- 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 the following:

[3] National Command Authority (NCA) is a term used by the United States military and government to refer to the ultimate lawful source of military orders. The term refers collectively to the President of the United States (as commander-in-chief) and the United States Secretary of Defense.

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 are also 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 are drawn the Marine component of the ESGs, require ready access to the SOCAL Range Complex to conduct required training. Camp Pendleton is also home to formal military schools, including the Assault Amphibian Vehicle School.

CSGs and ESGs routinely utilize the SOCAL Range Complex in their predeployment certification training. Moreover, the component elements of these war fighting organizations and the formal military schools routinely utilize the SOCAL 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 nontraining 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 San Diego region is home to thousands of military families. The Navy and Marine Corps strive, and in many cases are required, 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 (nearshore or shallow water) areas of the world. Figures 1-2 and 1-3 show the underwater topography, known as bathymetry, of the SOCAL Range Complex. This uneven, mountainous bathymetry is essential to Navy training in ASW. Seamounts such as those depicted in Figure 1-3 are used by submarines to hide or mask their presence, requiring the need to train in this complex ocean environment.

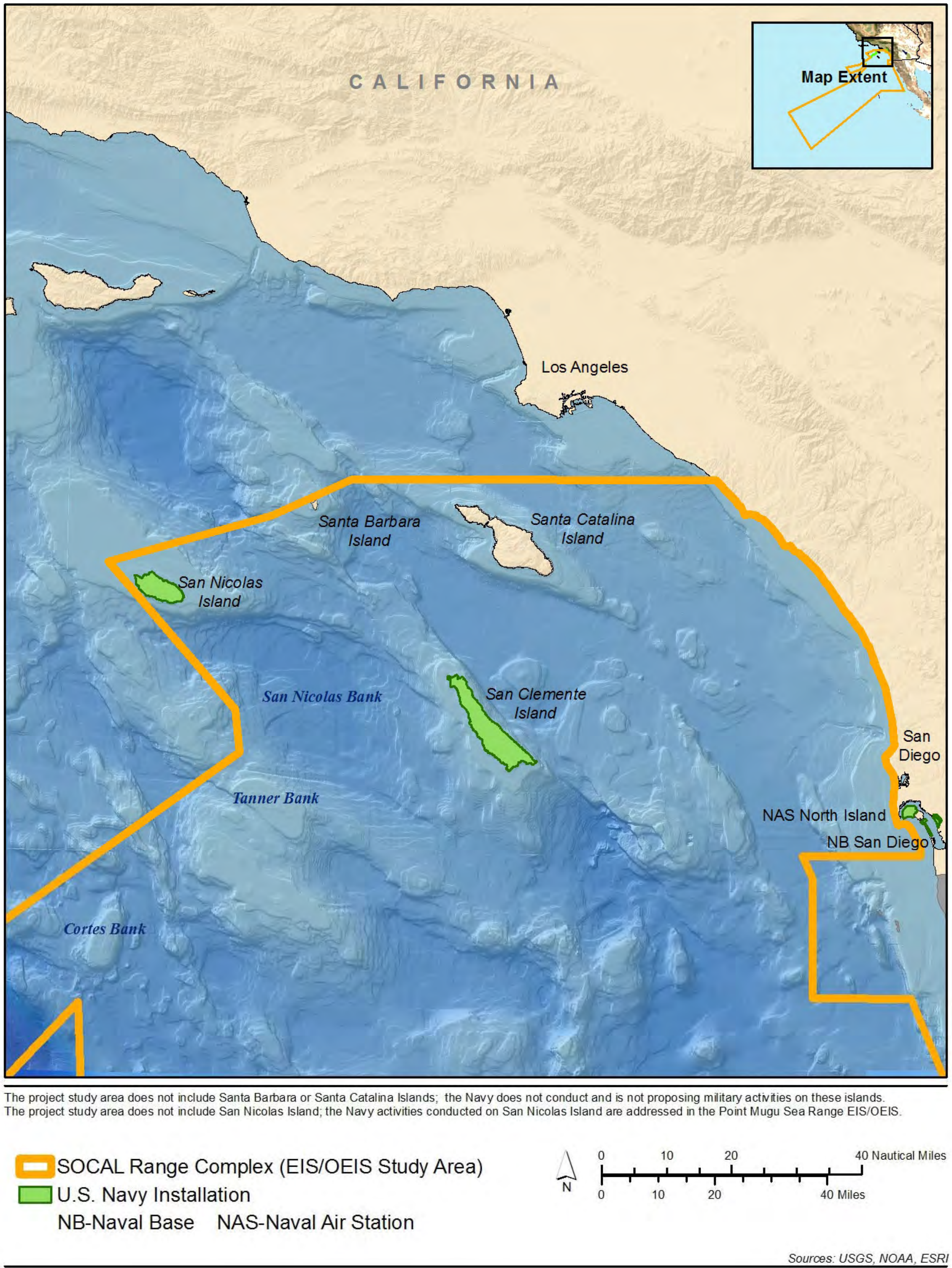

Figure 1-2: Bathymetry and Topography of the SOCAL Range Complex (Northeast)

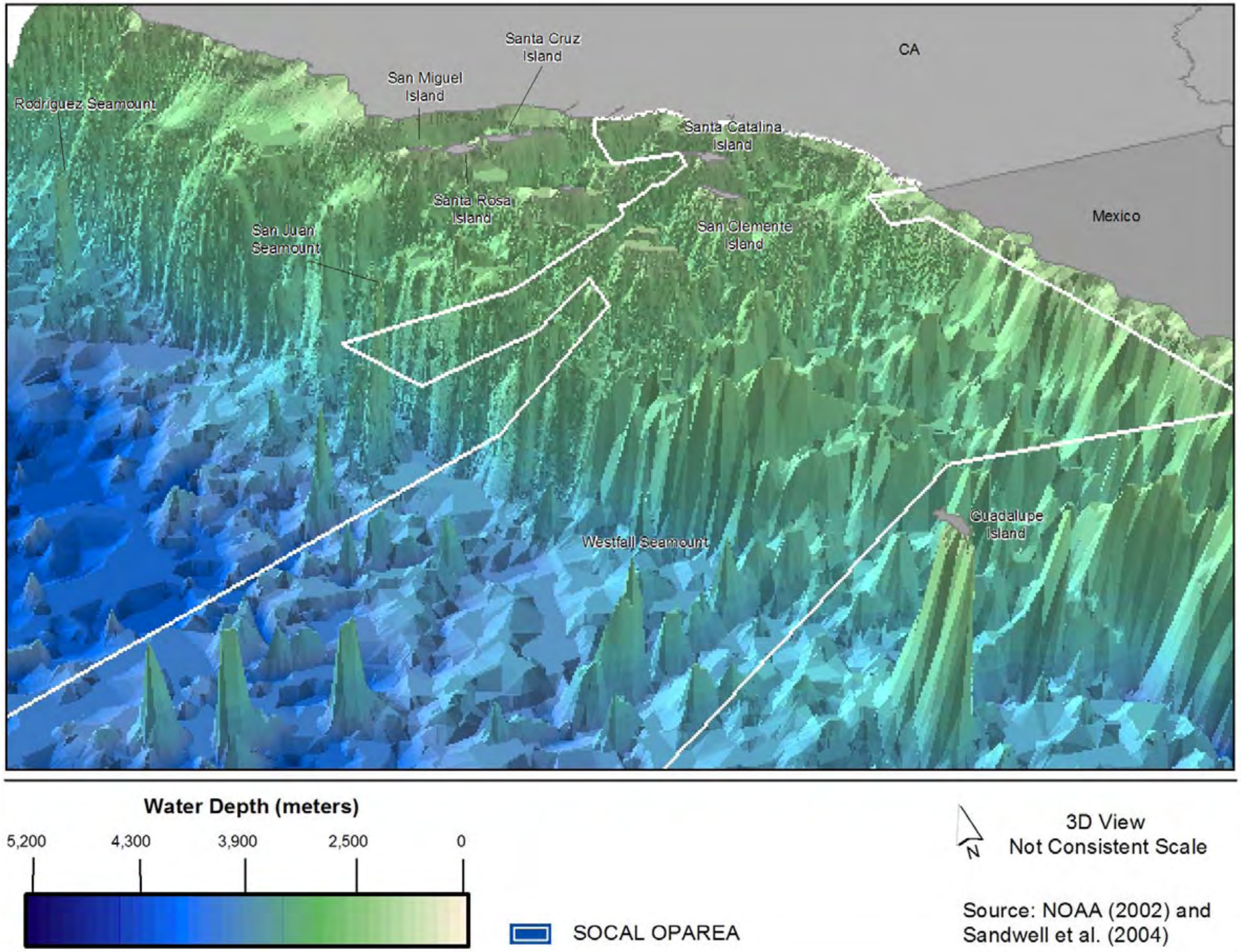

Figure 1-3: Detailed Bathymetry and Topography of the SOCAL Range Complex

The SOCAL Range Complex provides precisely the type of area needed by the Navy to train with mid-frequency active (MFA) sonar. This uneven bathymetry also provides shallow-water areas, specifically in the areas of Tanner Bank and Cortes Bank (Figure 1-2). 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[4] waters. Without the critical training in shallow water 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 is also critical to Strike Group certification, which involves the multidimensional 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 shallow water 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, regarding hostile submarines, is in the shallow water environment at this time. Training in a deep water environment would not provide the unique challenges the Navy faces in the shallow water regions, and would not provide realistic training for expected operational environments. The SOCAL Range Complex provides the terrain and the environment 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, 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[5] 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 is also a factor 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 1-2 and 1-3 graphically depict the shallow water aspects of the SOCAL Range Complex, and its proximity to the Fleet home port of San Diego.

[4] In the context of naval operations, specifically submarine operations, the term "shallow water" is a relative term, denoting depths of up to 400 fathoms (2,400 ft), which are considered "shallow" compared to the depth of the ocean

[5] 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.

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 (SUA), and the land of SCI. The SOCAL Range Complex is situated between Dana Point and San Diego, and extends more than 600 nautical miles (nm) (1,111 kilometers [km]) southwest into the Pacific Ocean (Figure 1-1). The components of the SOCAL Range Complex encompass 120,000 square nautical miles (nm^2) (411,588 square kilometers [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 subcomponent ranges or training areas which are described in detail in Chapter 2.

SOCAL Ocean OPAREAs. 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.

Special Use Airspace. The SOCAL Range Complex includes military airspace designated by the FAA as Warning Area 291, or W-291 (see Figure 2-1 in Chapter 2). W-291 comprises 113,000 nm^2 (387,500 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.

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 1-4.) The Point Mugu Sea Range (PMSR) is composed of ocean areas, including surface and subsurface area and military airspace covering 27,278 nm^2 (93,561 km^2). The PMSR includes sophisticated range instrumentation centered on San Nicolas Island, a Channel Island owned by the Navy. The PMSR 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 (758,000 km^2).

The primary mission of the PMSR 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 PMSR 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 PMSR EIS/OEIS addresses both the RDT&E activities and Fleet training activities that occur on the PMSR. Sonar activities occurring on the southern portion of the PMSR 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 PMSR 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 1-4 depicts the "overlap" area into which such training extends from the SOCAL Range into the PMSR. This area of approximately 1,000 nm^2 (3,430 km^2) is identified in this EIS/OEIS for the limited purpose of analyzing ASW training occurring there.[6]

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 current capabilities of the SOCAL Range Complex constrain the Navy's ability to support required training. There are numerous identified correctable deficiencies at this range that adversely affect the quantity and quality of training activities.[7] Current shortfalls include a limited number of 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 SOCAL 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 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 SOCAL Range Complex is critical to maintaining adequate training capacity for Pacific Fleet forces.

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 it provides, and the range complex shortfalls 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, to include new mine countermeasures training capabilities as part of the Navy's mine countermeasure Master Plan. (see discussion of shortfalls in Section 1.3.4).

[6] 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: 1,000 nm^2).

[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).

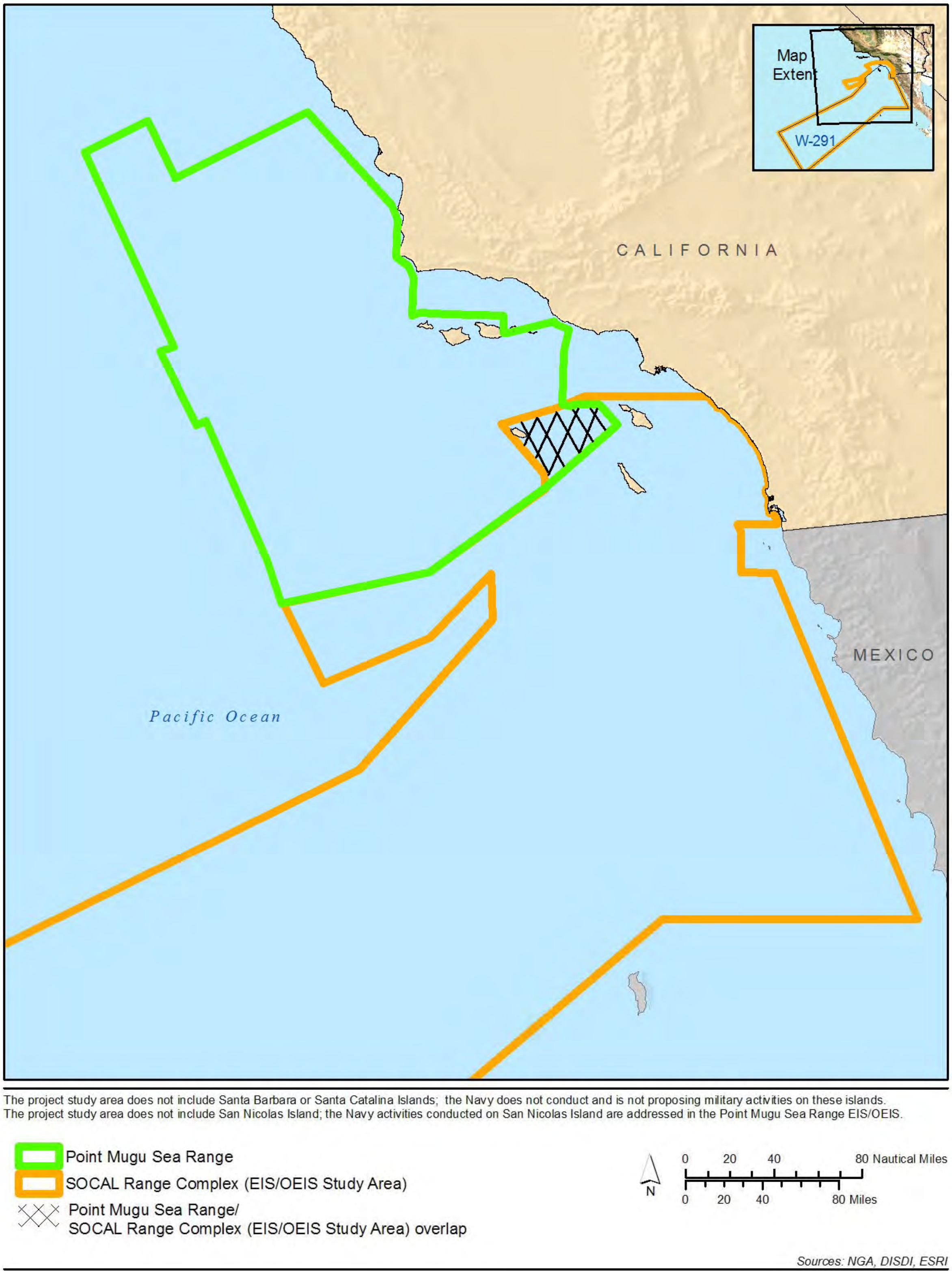

Figure 1-4: SOCAL Range Complex and Point Mugu Sea Range

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).

In this regard, the SOCAL Range Complex furthers the Navy's execution of its roles and responsibilities under Title 10 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;
- 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 such as the Littoral Combat Ship (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 (NEPA) 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[8]. The 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. See Section 1.5.2 for further explanation of EO 12114.

[8] Presidential Proclamation 5928 of 27 December 1988 states in part, "The territorial sea of the United States henceforth extends to 12 nautical miles from the baselines of the United States determined in accordance with international law."

1.5.1 National Environmental Policy Act

The first step in the NEPA process is the preparation of a notice of intent (NOI) to develop the EIS. The NOI is published in the *Federal Register* and provides an overview of the Proposed Action and the scope of the EIS.

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 is 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 through written comments. Comments received from the public as a result of the scoping process will be considered in the preparation of the EIS.

Subsequent to the scoping process, a Draft EIS/OEIS is prepared to assess the potential effects of the Proposed Action and alternatives on the environment. A notice of availability is published in the *Federal Register* and notices are placed in local or regional newspapers announcing the availability of the Draft EIS/OEIS. The Draft EIS/OEIS is to be circulated for review and comment. Public meetings will be held to allow the public to provide comments on the Draft EIS/OEIS.

The Final EIS/OEIS responds to all public comments received on the Draft EIS/OEIS. Responses to public comments may include correction of data, clarifications of and modifications to analytical approaches, and inclusion of additional data or analyses.

Finally, the decision maker will issue a Record of Decision (ROD), usually 30 days after the Final EIS/OEIS is made available to the public. The ROD will summarize the decision maker's decision and identify the selected alternative, describe the public involvement and agency decision-making processes, and present commitments to specific mitigation measures.

During the development of this EIS/OEIS, the Navy complied with all of the processes described here. See Section 10.1 for a summary of the Navy's compliance.

1.5.2 Executive Order 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. For purposes of this EIS/OEIS, areas outside the 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 1-1 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), or both.

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 U.S. 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 are 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 1-1: 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

Table 1-1: Training and RDT&E Analyzed under NEPA and EO 12114 (continued)

Training Operations		NEPA	EO 12114
Strike Warfare (STW)	Bombing Exercise (BOMBEX) - Land	X	
	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	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 in Chapter 6. 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, 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 (2003), EA and Biological Opinion (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 Antiship 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 (CVNs).

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 the Fleet Response 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. For the purposes of this EIS, the No Action Alternative serves as the baseline level of operations on the SOCAL Range Complex, representing the regular and historical level of training and testing activity necessary to maintain Navy readiness. Consequently, the No Action Alternative stands as no change from current levels of training and testing usage.

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:

- Increasing numbers of training operations of the types currently being conducted in the SOCAL Range Complex.
- Expanding 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).
- Expanding 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.
- Installing a shallow water training range (SWTR), a proposed extension into shallow water of the existing instrumented deepwater anti-submarine warfare (ASW) range (known as “SOAR”).
- Conducting operations on the SWTR.
- Increasing Commercial Air Services support for Fleet Opposition Force (OPFOR) and Electronic Warfare (EW) Threat Training.
- Constructing a Shallow Water Minefield, at depths of 250 to 420 feet (ft) (76 to 128 meters [m]) in offshore and nearshore areas in the vicinity of SCI.
- Conducting training on the Shallow Water Minefield.
- Conducting Mine Neutralization Exercises.
- Supporting training for new systems and platforms, specifically, the Littoral Combat Ship (LCS), MV-22 Osprey aircraft, EA-18G Growler aircraft, MH-60R/S Seahawk Multi-mission Helicopter, P-8 Poseidon Multi-mission Maritime Aircraft, Landing Platform-Dock (LPD) 17 amphibious assault ship, DDG 1000 (Zumwalt Class) destroyer, and an

additional Pacific Fleet 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 the 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 Operating Areas 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 square nautical miles (nm^2) (387,500 square kilometers [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 Operating Areas 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 composed of existing land ranges and training areas that are integral to training of Pacific Fleet air, surface, and subsurface units; 1st Marine Expeditionary Force (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 in the SCI. Due to its unique capabilities, SCI supports multiple training activities from every Navy Primary Mission Area (PMAR), and provides critical training resources for Expeditionary Strike Group (ESG), Carrier Strike Group (CSG), and Marine Expeditionary Unit (MEU) certification exercises. SCI land ranges are described in Tables 2-3 and 2-4 and depicted in Figures 2-4 and 2-5.

2.1.4 Overlap with Point Mugu Sea Range for Certain Anti-Submarine Warfare 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 (PMSR). These cross-boundary events are addressed in this EIS/OEIS. As noted, activities occurring on the PMSR are addressed in a separate EIS (see Section 1.3.3), which does not, however, address such cross-boundary ASW training. The area of "overlap" where these training events occur on the PMSR is depicted in Figure 1-5.

Table 2-1: W-291 and Associated OPAREAs

Area Designation	Description
Warning Area (W-291)	W-291 encompasses 113,000 nm^2 (387,500 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 Air-to-Air (A-A) 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 Anti-Air Warfare (AAW), ASW, NSW, underway training, and Independent Steaming Exercises (ISEs) in which ships conduct onboard training, separate from other units. 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 Ranges 1 East and 1 West (MISR-1E/MISR-1W)	MISR-1E and MISR-1W are located about 100 nm (185 km) south and southwest of NBC, and extend from the ocean bottom up to 80,000 ft (24,384 m) 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.
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.

Table 2-1: W-291 and Associated OPAREAs (continued)

Area Designation	Description
Northern Air Operating Area (NAOPA)	The NAOPA is located east of SCI and approximately 30 nm (56 km) west of NBC. It extends from the ocean bottom to 80,000 ft (24,384 m). Exercises in NAOPA include Fleet training, multiunit exercises, and individual unit training. Ordnance 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 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 x 2 nm (1.85 x 3.7 km) area in the waters approximately 1 nm (1.85 km) offshore, west 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.
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 Joint Task Force Exercise (JTFEX) and Composite Training Unit Exercise (COMPTUEX). The SCI Underwater Range lies within OPAREA 3803.
San Clemente Island Underwater Range (SCIUR)	SCIUR is a 25-nm^2 (46.5-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 Mine Laying Exercise (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).

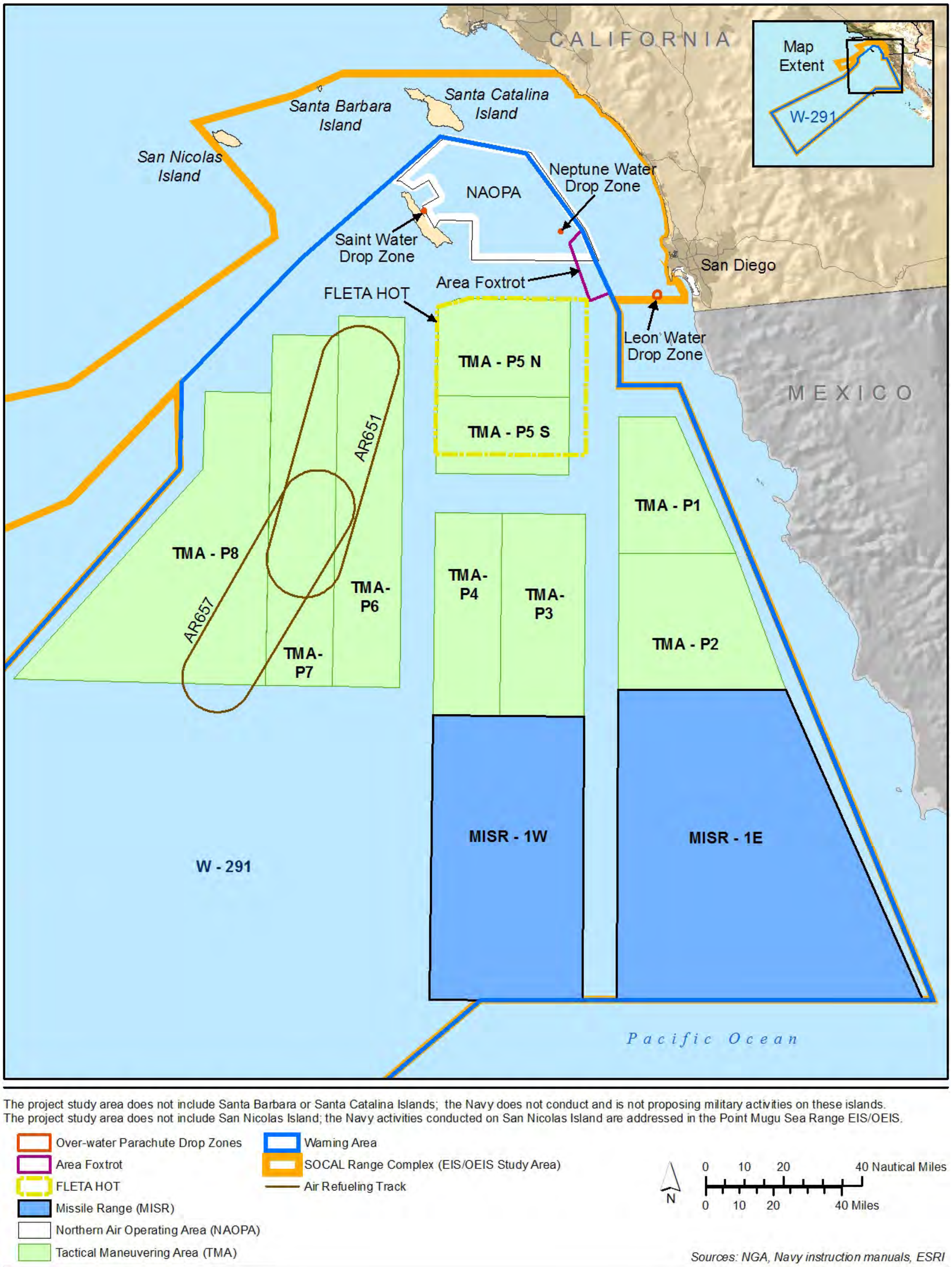

Figure 2-1: SOCAL Range Complex W-291 (portion) and Ocean OPAREAs

Table 2-2: Ocean OPAREAs Outside W-291

Area Designation	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 nm^2 (3,430 km^2) 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

Area Designation	Description
Shore Bombardment Area (SHOBA) Impact Areas	SHOBA is the only eastern Pacific Fleet range 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) (0.4 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. Additional descriptions of each TAR are provided in Table 2-4.
Artillery Firing Points (AFP)	An AFP is a location from which artillery weapons such as the 155-mm 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 High Mobility Many Wheeled Vehicles (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 semiurban 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 x 1,000 ft (305 x 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.

Table 2-4: NSW Training Areas and Ranges on or near San Clemente Island

Name	Description
TAR 1 Demolition Range Northeast Point	This 1.8 acre site includes a state-of-the-art demolition area with OTB capabilities. This TAR includes a safety bunker near the beach and a designated demolition area. No live-fire of small arms is used in TAR 1. All explosives would be non-shrapnel-producing up to 100 lb (45 kg) net explosive weight (NEW). Flares, illumination rounds, and pyrotechnics would also be used.
TAR 2 Graduation Beach Underwater Demolition Range	This TAR provides a state-of-the-art underwater and land demolition area with across the beach capabilities. This 13.8 acre area is currently in use as a land demolition and an underwater demolition range and has been for over 20 years. The site currently includes 10ft x20ft (3m x 6m) temporary structures on existing slabs, and mock mobile missile launch platforms and vehicles. The following site improvements will be made for safety and environmental purposes: erosion control on the access road and in the demolition area, adding a telephone communications line, developing a demolition staging area, and making a demolition preparation area. Live fire use includes blank fire, small arms, simunitions (blanks), short range training rounds, and crew-served weapons. All types of underwater demolitions up to 500 lb (227 kg) NEW and land demolitions up to 100 lb (45 kg) NEW.
TAR 3 BUD/S Beach Underwater Demolition Range	TAR 3 is an underwater demolition range with across the beach capabilities. Blank fire for small arms and crew-served weapons. Up to 5 lbs NEW of non-fragmentation producing land demolitions. All types of underwater demolitions, up to 500 lb (227 kg) NEW. TAR 3 is 4.1 acres in size.
TAR 4 Whale Point/ Castle Rock	Previously used as a demolition range and situated within the old antenna array, TAR 4 constitutes an area of 27.1 acres on the northern tip of SCI. Live-fire and demolition tactical training would be used here. A wide range of explosives are also used in this area, including those up to a maximum of 300 lb (136 kg) NEW, blanks, smoke and grenade simulators, flares and pyrotechnics, and small arms fire up to .50 cal.
TAR 5 West Cove Amphibious Assault Training Area	This area is adjacent to the SCORE Cable Termination Facility. The beach has historically, and is currently being used for insertion/extraction and routine amphibious landings and assaults. Potential uses include: nearshore reconnaissance, shallow water MCM, and insertion/extraction en route to other TARs on SCI. The size of TAR 5 is 2.1 acres. Only blanks are permitted on TAR 5; no live fire or demolitions.
TAR 6 White House Training Area	This site is on a bluff overlooking Wilson Cove. It is improved, contains a concrete pad with a 10ft x20ft (3m x 6m) temporary structure, and mock mobile missile launch platforms and vehicles, and has road access. The size of TAR 6 is 3.3 acres. This TAR is used as a controlled target area and communications base station. No live fire or demolitions. Blanks, simunitions, and pyrotechnics only.
TAR 7 Saint Offshore Parachute Drop Zone (DZ)	This DZ is in the offshore waters opposite Wilson Cove on the lee side of SCI. The purpose is to provide a DZ in offshore area for the parachute insertion of SEAL platoons and equipment. The transit to the beach is less than 3 nm (6 km). No live fire or demolitions.
TAR 8 Westside Nearshore Parachute Drop Zone	This DZ is located on the west side of SCI in the nearshore area. It is used for day and night insertions including parachute drops. No live fire or demolitions.
TAR 9 Photo Lab Training Area	TAR 9 is for training use only. Four buildings currently exist, adequate to provide realistic simulated targets. Some of these buildings are periodically in use by non-NSW units. The size of TAR 9 is 26.3 acres. . No live-fire outside. Blanks and live-fire allowed in close quarter combat facility with portable bullet traps. Small arms up to 5.56mm. Breaching charges (< 1 lb NEW) in designated areas.

Table 2-4: NSW Training Areas and Ranges on or near San Clemente Island (continued)

Name	Description
TAR 10 Demolition Range West	TAR 10 provides a land-based location for safe, operationally realistic live-fire and high explosive demolition training en route from a landing area, on patrol to other land-based TAR objectives with a minimum of environmental constraints. The site must support live-fire training for Immediate Action Drills (IAD) with a minimum of 180 degrees of live-fire, optimum 360 degrees. TAR 10 has a secondary mission of supporting Over-The-Beach (OTB) operations. TAR 10 has an area of approximately 54.9 acres and contains 10ft x20ft (3m x 6m) temporary structures on existing slabs, and mock mobile missile launch platforms and vehicles.
TAR 11 Surveillance Training Area	This 8.8 acre site is used as an objective, a target area for insertion, reconnaissance, and attack. No live-fire or demolitions are allowed. Smoke, flares, pyrotechnics, and all types of blanks are authorized.
TAR 12 Radar Site Training Area	This small target area high on the bluff overlooking NOTS Pier, on the site of an abandoned RDT&E radar facility. TAR 12 provides an objective close to the shore in close proximity to RDT&E facilities to simulate a realistic adversary target. The size of TAR 12 is 5.1 acres. No demolitions, flares, or pyrotechnics. Smoke and blanks only.
TAR 13 Randall Radar Site Training Area	This site is on the Eastern Escarpment. The area contains an abandoned bunker with attendant facilities. The bunker was previously used for weapons system development. The size of TAR 13 is 17.1 acres. TAR 13 provides a bunker area to conduct tactical land demolitions training and CQC. No external firing of live weapons. Small arms to include 5.56mm, 7.62mm, and .45 cal with bullet traps. Land demolitions under 5 lb (2 kg) NEW.
TAR 14 VC-3 Onshore Parachute Drop Zone “Twinky”	The Drop Zone, named “Twinky,” is off the north end of the VC-3 northwest/southeast abandoned runway. Its use coincides with the use of VC-3, which includes parachute drops, patrolling, and related tactical operations. TAR 14 activities include land-based parachute drops, static line and free-fall, day and night. All types of weapons up to 7.62mm fired in an easterly direction are allowed. Also, land demolitions up to 100 lb (45 kg) NEW, Flares, illumination, and pyrotechnics are used here.
TAR 15 VC-3 Airfield Training Area	TAR 15 is an abandoned airfield, now used for SEAL platoon land raids, airfield attack training, and a Center of Excellence for UAV training and testing. The size of TAR 15 is 770.8 acres. All types of weapons up to 7.62mm fired in an easterly direction are allowed. Also, land demolitions up to 100 lb (45 kg) NEW, Flares, illumination, and pyrotechnics are used here.
TAR 16 South VC-3 (Missile Impact Range)	The Missile Impact Range is currently used for testing JSOW and Tomahawk Missiles and can be used by special ops forces as a parachute drop zone and tactical air assault area. At the target, special ops forces would place explosive charges, demolish the target, and extract from the area via beach, airlift, or existing roads. TAR 16 is 54.2 acres. Small arms including 5.56mm and 7.62mm rifles, machine guns, and .50 cal sniper and crew served weapons mounted on vehicles. Flares, pyrotechnics, and tracers. Demolitions up to 1,000 lb (454 kg) NEW.
TAR 17 Eel Point Tactical Training Range	TAR 17 provides a shore-based location for safe, operationally realistic live-fire and high explosive demolition training for “actions at the objective” and support amphibious landings, Over-the-Beach operations and patrol to other land-based TARs. Existing facilities within the area include a gate and a target building. All types of explosives (25 lb [11 kg] maximum), 5.56mm and 7.62mm rifles and machine guns, .50 caliber (cal) sniper/standoff, flares and pyrotechnics would be used and all explosives would be non-shrapnel-producing explosives.

Table 2-4: NSW Training Areas and Ranges on or near San Clemente Island (continued)

Name	Description
TAR 18 Close Quarter Battle Training Complex	TAR 18 provides a set of moveable target buildings that realistically simulate a terrorist camp (hostage location) for SEAL training. The proposed design would support four different types of CQC scenarios at one time. The size of TAR 18 is 0.6 acres. 5.56mm, 9mm, and small demolition charges under 5 lb (11 kg) NEW. All weapons firing is to be inside non-ballistic walls with berms surrounding the complex.
TAR 19 Simulated POW Camp and SAM Site	TAR 19 provides a site that realistically simulates a Prisoner of War (POW) holding camp (hostage location) in the immediate vicinity of a Surface-to-Air Missile site for SEAL training. The size of TAR 19 is 2.4 acres. No live-fire. Blank 5.56mm, 7.62mm, 9mm, simunitions, smoke grenades, booby traps, and small demolition charges under 1 lb NEW. Only blanks are used in TAR 19.
TAR 20 Pyramid Cove Training Area	This site is located in SHOBA and has been used extensively over the past decade for Naval Special Warfare training. TAR 20 provides a tactical firing area close to the shoreline for water and land use. Live-fire and inert training munitions; small arms, .50 cal rifle, .50 cal machine gun on boats, 40mm, 25mm, 60mm, 81mm, 105mm, 127 mm (5 inch naval gunfire mounted on destroyer), 155 mm, AT-4, and MK-19; land demolitions 100 lb (45 kg) NEW onshore; no underwater demolitions. Firing in 360 degrees. Flares, illumination, tracers and pyrotechnics.
TAR 21 Horse Beach Cove raining Area	TAR 21 is an 88.1 acre site that provides an area close to the shoreline for day and night raids, insertion and extraction in close proximity to a CQC target. Live-fire and inert training munitions; small arms, 9mm,,5.56, 7.62, .50 cal, and training practice (not dud producing) 40mm; land demolitions up to 100 lb (45 kg) NEW and underwater demolitions up to 20 lb (9 kg) NEW. Flares, illumination, tracers, and pyrotechnics. Weapons firing in 360 degrees.
TAR 22 China Cove Training Area	TAR 22 provides a 289 acre area close to the shoreline for day and night raids and stand-off weapons employment in Impact Area II. Live-fire and inert training munitions; small arms, .50 cal, 30 mm, 40mm, AT-4, 105mm, 127 mm (naval gunfire), 155 mm, Stinger Missile, and Light Anti-tank Weapon (LAW); land demolitions up to 500 lb (225 kg) NEW onshore in an extension of Impact Area IIA (designated for heavy ordnance use) to the shoreline; no underwater demolitions. Also, flares, illumination, tracers and pyrotechnics.

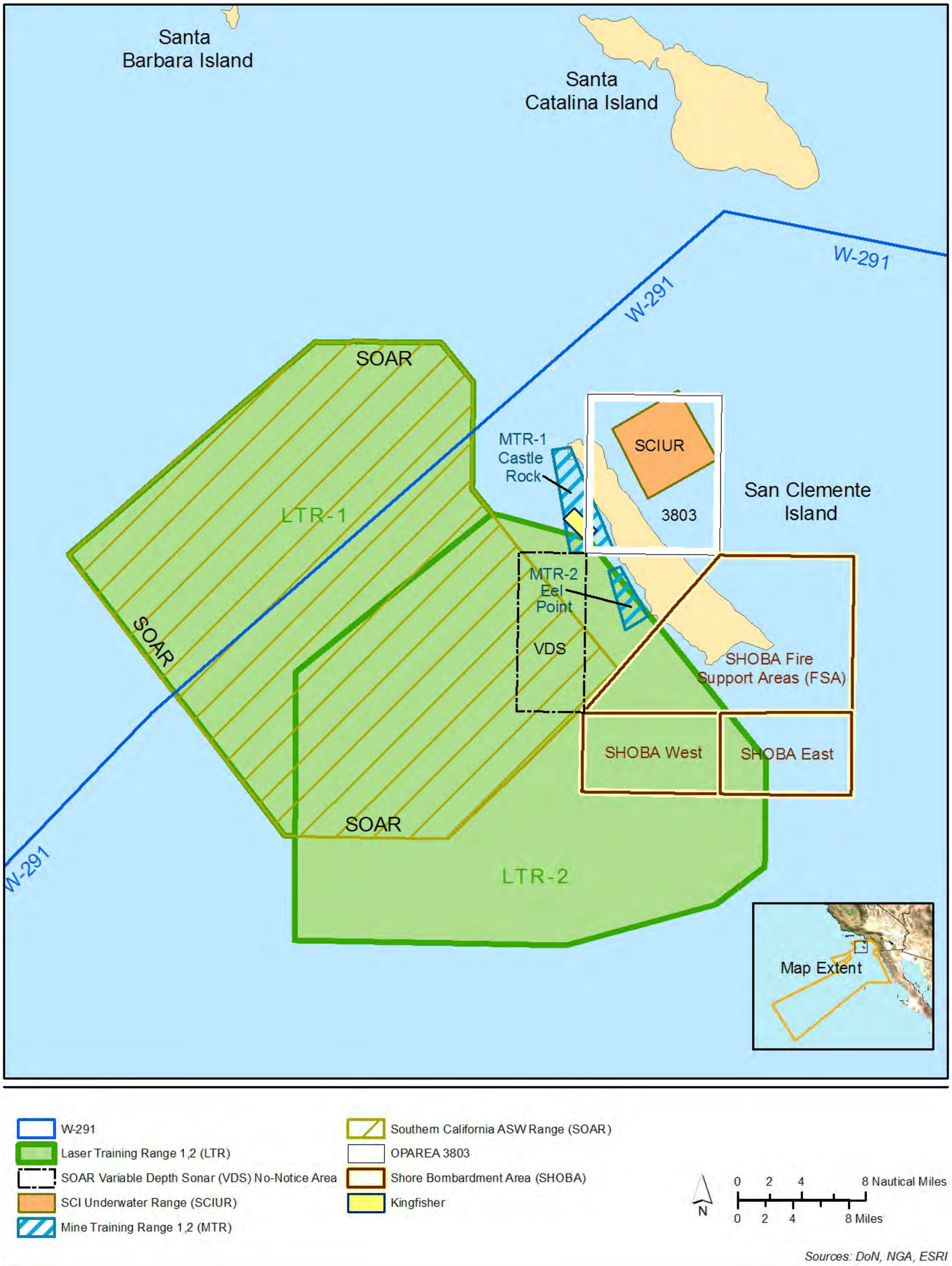

Figure 2-2: San Clemente Island Nearshore Range Areas

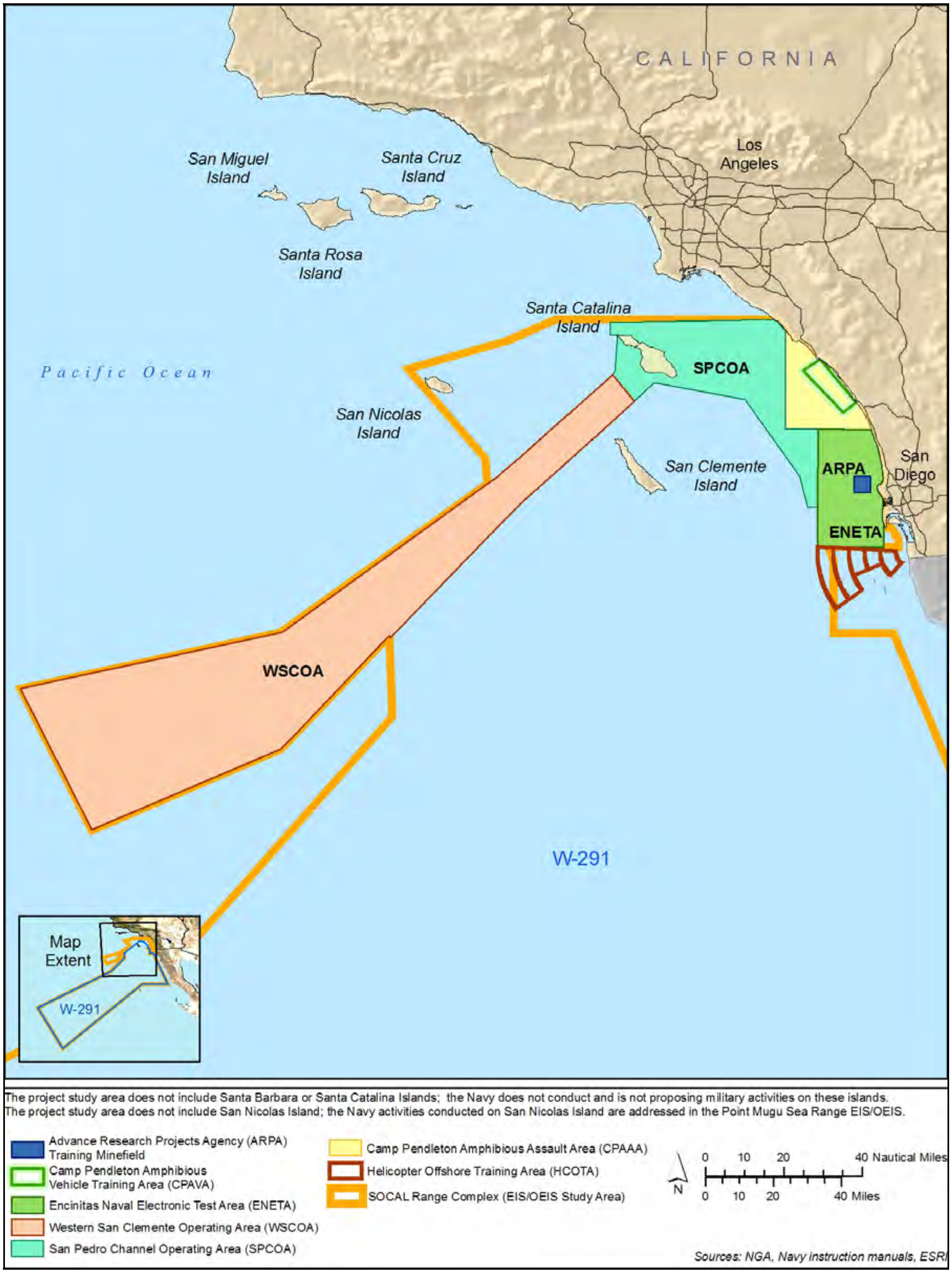

Figure 2-3: Ocean OPAREAs Outside W-291

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

Figure 2-5: San Clemente Island: Roads, Artillery Firing Points, and 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 historical level of activity on the SOCAL Range Complex to support this type of training and exercises. In other words, the EIS/OEIS baseline, or No Action Alternative, represents 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 and Fleet Response Plan (FRP), including surge;
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 the Navy's 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 [f]). Each of the alternatives 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 to 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 in part 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 U.S., 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 on the West Coast of the U.S.; SHOBA is the only range on the U.S. west coast 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, schools, and aircraft units and Marine Corps forces stationed there.
- Proximity to military families, in light of the readiness benefits derived from minimizing the length of time Sailors and Marines spend deployed away from home.
- Training environment (bathymetry, topography, and weather) that maximizes the realism of training.

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 affords this level of operational support and comprehensive integration for range activities. There is no other potential location where land ranges (such as provided by SCI and MCB Camp Pendleton), OPAREAs, undersea terrain and ranges, and military airspace are part of or within range of a single range complex. The SOCAL Range Complex with its supporting operational environments allows multidimensional training and RDT&E 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 resources comparable to the SOCAL Range Complex elsewhere on the East or West Coast of the U.S., or in the Pacific Ocean. Established sites of the Hawaii Range Complex (HRC) and the Northwest Training Range Complex (NWTRC) already are used extensively for some training and RDT&E activities. These range complexes, however, do not provide the capability to support all of the types of training and RDT&E 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 utilize the SOCAL Range Complex. Based on the same considerations of cost, distance, and disruption, 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 and RDT&E

The Navy’s requirements for training have been developed through many years of iteration to ensure Sailors and Marines 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. Navy has identified training requirements to acquire war fighting proficiency. 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. Similarly, RDT&E conducted on the SOCAL Range Complex is necessary to ensure the latest technology is available to the Sailors that go into harm’s way. Reduced RDT&E could translate into military equipment that is not adequately tested before being used in combat.

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

Training and RDT&E requirements are determined by a number of factors. The composition of the force to be trained or the system to be tested, the nature of its mission upon deployment, the time available to conduct testing and training, range requirements and required environment, and the commander’s assessment of priorities are all factors that determine the nature and scope of a given training program, RDT&E activity, 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, and conduct multiple training events simultaneously. As a result, any alternative that would impose limitations on training or testing locations within the SOCAL Range Complex would be inadequate.

As explained in Section 1.2.3, the SOCAL Range Complex provides a unique training and RDT&E environment necessary for mission-essential testing and training. Terrain provided by bathymetry and subsurface features of the Range Complex OPAREAs are vital to effective submarine and ASW training and testing. 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 areas used in conjunction with ocean OPAREAs and SUA to provide an integrated training and RDT&E capability. The geographic convergence of these several features provides the necessary venue for multidimensional 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 or RDT&E activities within the SOCAL Range Complex would likewise not be acceptable. As explained in Section 1.2.1, predeployment training is governed by the Navy's FRTP. The FRTP sets the deployment training cycle for Strike Groups, which are 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. Likewise, development cycles of new technology drive the timing of test events. Changes or delays in these schedules could create significant backlogs in testing programs. 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 or RDT&E 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 already uses computer-simulated training, and conducts command and control exercises without operational forces (constructive training) whenever 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 presently 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 ability to develop battle-ready proficiency 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
- Interplay between ASW teams in the strike group.

Currently, these factors cannot be adequately simulated to provide the fidelity and level of training necessary to safely and effectively use active sonar. Further, like any perishable skill, employment of active sonar is a 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 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
- 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 the 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.

Each of the alternatives is discussed in the following sections.

2.3 NO ACTION: CURRENT TRAINING AND RDT&E 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 and RDT&E activities 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 2-7 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 coordinated major range training events, such as JTFEX, which may involve thousands of participants over several weeks.

Over the years, the tempo and types of training and RDT&E activities have fluctuated within the SOCAL Range Complex due to changing requirements, the introduction of new technologies, the dynamic nature of international events, 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 FRP. 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 capabilities. Nevertheless, it provides a valuable baseline against which to assess Alternative 1 and Alternative 2.

2.3.1 SOCAL Range Complex Operations Descriptions

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 1.2.1 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 2-7 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 is the 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 Training (AAW)

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 mock 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 Training (ASW)

ASW involves helicopter and maritime patrol aircraft (MPA), 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 a submarine, to the extent that the submarine generates noise. However, as newer and quieter submarines are built and exported to many nations, the effectiveness of passive detection has been reduced. Active sonar is now the only effective means for locating quiet, modern submarines because active sonar is not dependent on the source noise of the contact.

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, which is essential to U.S. ship survivability. There are three types of active sonar: low-frequency, mid-frequency, and high-frequency. Table 2-5 lists the various sonars and sound sources used in SOCAL.

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. The Navy will have as many as four ships that are equipped with low-frequency sonar, although only two would be operational at any one time. Currently there are two such equipped Navy vessels; 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 included 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. High-frequency sonar is used primarily for determining water depth, hunting mines, and guiding torpedoes.

Mid-frequency active (MFA) sonar operates between 1 and 10 kHz, enabling operators to detect underwater objects at greater distances than with high-frequency active sonar, but shorter than low-frequency active sonar. Because of this detection ranging capability, MFA sonar 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 number 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 MFA sonar. If a Strike Group does not demonstrate MFA sonar proficiency, it cannot be certified as fully 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, coordinated ASW training exercises involving active sonar are conducted in coordinated, at-sea operations during multidimensional 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 multidimensional battlespace.

ASW sonar systems are deployed from certain classes of surface ships, submarines, helicopters, and fixed-wing maritime patrol aircraft (MPA) (Table 2-5). 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 2-5.

Table 2-5: ASW Sonar Systems and Sound Sources Used in SOCAL

System	Frequency	Associated Platform
AN/SQS-53	MF	DDG and CG hull-mounted sonar
AN/SQS-56	MF	FFG hull-mounted sonar
AN/AQS-13 or AN/AQS-22*	MF	Helicopter dipping sonar
AN/BQQ-10**	MF	Submarine hull-mounted sonar
AN/BQQ-15	MF	Submarine navigational sonar
Tonal sonobuoy (DICASS) (AN/SSQ-62)	MF	Helicopter and MPA deployed
MK-48 Torpedo	HF	Submarine fired exercise torpedo
MK-46 Torpedo	HF	Surface ship and aircraft fired exercise torpedo
EER/IEER source sonobuoy (AN/SSQ-110A)	Impulsive, broadband	MPA deployed explosive source sonobuoy
AN/SLQ-25 (NIXIE)***	MF	DDG, CG, and FFG towed array

CG – Guided Missile Cruiser; DDG – Guided Missile Destroyer; DICASS – Directional Command-Activated Sonobuoy System; EER/IEER – Extended Echo Ranging/Improved Extended Echo Ranging; FFG – Fast Frigate; HF – High-Frequency; MF – Mid-Frequency; MPA – Maritime Patrol Aircraft.

*The AN/AQS-22, which will replace the less powerful AN/AQS-13, was modeled for all helicopter dipping sonar.

**The AN/BQQ-10 is modeled for the BQQ-5

*** NIXIE is an ASW countermeasure used by ships

2.3.1.3 Anti-Surface Warfare Training (ASUW)

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 is also 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 that has been cleaned and environmentally remediated. The vessel 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 (VBSS) exercises.

2.3.1.4 Amphibious Warfare Training (AMW)

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 1,000 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 Training (EC)

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 Training (MIW)

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 contact with an enemy ship, or until destroyed or removed. Naval mines can be laid by minelayers, other ships, submarines, or airplanes. MIW training includes Mine Countermeasures (MCM) Exercises and Mine Laying Exercises (MINEX).

2.3.1.7 Navy and Marine Corps Special Operations Training

NSW forces (Sea, Air, Land [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.

Special operations forces from Marine Corps Special Operations Command (MARSOC) also conduct training in SOCAL, although on a smaller scale than NSW training. MARSOC training requirements and activities are similar to those of NSW forces.

2.3.1.8 Strike Warfare Training (STW)

STW operations include training of fixed-wing fighter/attack aircraft in delivery of precision guided munitions, nonguided munitions, rockets, and other ordnance against land targets in all weather and light conditions. Training events typically involve a strike mission with a flight of four or more aircraft. The strike mission practices attacks on "long-range targets" (i.e., those geographically distant from friendly ground forces), or 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 practiced, 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 United States 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 San Clemente Island 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 essentially limited 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 Research Development Test & Evaluation Events

Space and Naval Warfare Systems Center (SSC) Pacific conducts RDT&E, engineering, and Fleet support for command, control, and communications systems and ocean surveillance. SSC Pacific'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 (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. NUWC also provides engineering and technical support for ASW programs and exercises, designs 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 requirements for the composition and mission capabilities of deployable naval units, which maintain flexibility in the organization and training of forces. Central to these requirements 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.

Navy defines the “baseline” composition of deployable naval forces. The baseline is 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. Composition of the Strike Groups and Strike Forces is discussed below.

2.3.2.1 Carrier Strike Group Baseline

- One Aircraft Carrier
- One Carrier Air Wing
  - Four Strike Fighter Squadrons
  - One Electronic Combat Squadron
  - One Airborne Early Warning (AEW) 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 logistics support ship

2.3.2.2 Expeditionary Strike Group Baseline

- Three Amphibious Ships

  - Landing Craft, Utility (LCU)
  - Landing Craft, Air Cushioned (LCAC)
  - Amphibious Assault Vehicle (AAV) or Expeditionary Fighting Vehicle (EFV)
- Three Surface Combatant Ships
- Three Combat Helicopter Detachments
- One attack submarine
- One Marine Expeditionary Unit (Special Operations Capable) of 2,200 Marines
  - Ground Combat and Combat Logistics Elements
  - Composite aviation squadron of fixed-wing aircraft and helicopters

2.3.2.3 Surface Strike Group Baseline

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

2.3.2.4 Expeditionary Strike Force

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

2.3.3 Coordinated, Multidimensional 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 predeployment 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 coordinated exercises are described in Section 2.3.3.2.

To facilitate analysis, this EIS/OEIS examines the individual activities of each coordinated 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, coordinated unit training exercise or major range event can be constructed.

2.3.3.1 Major Range Events

The Navy conducts large-scale exercises, also called major range events, in the SOCAL Range Complex. These exercises are required for predeployment 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 eight major range events per year in the SOCAL Range Complex.

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 composed 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 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 the following:

- **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.
- **Joint Task Force Exercise (JTFEX).** The JTFEX is a dynamic and complex major range event that is the culminating exercise in the Integrated 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 PMSR, 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). Table 2-6 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.

Table 2-6: 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 a portion of the PMSR 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

2.3.3.2 Coordinated Unit-Level Training Events

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

- **Ship ASW Readiness and Evaluation Measuring (SHAREM)**. SHAREM events allow the Navy 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 the SOCAL Range Complex.
- **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 in support of FRP surge requirements. 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 the SOCAL Range Complex.

- **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 in the SOCAL Range Complex.

Table 2-7 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 2-4, and Figures 2-1 through 2-5.

Table 2-7: 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 (TMA 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-mm 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

Table 2-7: SOCAL Range Complex—Operations by Warfare Area and Location (continued)

Navy Warfare Area	No.	Operation Type	Summary	Location of Activity
Anti-Submarine Warfare	**6**	Anti-Submarine Warfare Tracking Exercise - Helicopter	Trains helicopter crews in anti-submarine search, detection, localization, classification, and track. Two primary targets are used: recoverable MK 30 and expendable MK 39. The target simulates a submarine at varying depths and speeds. MH-60 crews drop sonobuoys to detect and localize the target.	SOCAL OPAREAs, PMSR
	7	Anti-Submarine Warfare Torpedo Exercise - Helicopter	Trains MH-60 crews in employment of air-launched torpedoes. Aircrew drops an inert, running exercise torpedo or a nonrunning practice torpedo against ASW targets.	SOAR, SWTR, SCIUR
	8	Anti-Submarine 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, PMSR
	9	Anti-Submarine 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 nonrunning practice torpedo against ASW targets.	SOAR, SWTR, SOCAL Waters
	10	Anti-Submarine 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	Anti-Submarine 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. Ship crews and MH-60 helicopter crews employ sensors to detect and localize the target.	SOCAL OPAREAs, PMSR

Table 2-7: SOCAL Range Complex—Operations by Warfare Area and Location (continued)

Navy Warfare Area	No.	Operation Type	Summary	Location of Activity
Anti-Submarine Warfare (cont.)	**12**	Anti-Submarine Warfare Torpedo Exercise - Surface	Trains ship crews in anti-submarine search, detection, localization, classification, track, and attack. One or more torpedoes are dropped/fired. Includes Integrated ASW Course Phase 2 (IAC II).	SOAR, SWTR, SCIUR
	13	Anti-Submarine Warfare Tracking Exercise - Submarine	Trains submarine crews in ASW using passive sonar (active sonar use is tactically proscribed). No ordnance expended.	SOCAL OPAREAs, PMSR
	14	Anti-Submarine Warfare Torpedo Exercise - Submarine	Submarine exercise training Tactical Weapons Proficiency, lasting 1-2 days, with multiple firings of exercise torpedoes. Attacking submarines use only passive sonar.	SOCAL OPAREAs
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

Table 2-7: SOCAL Range Complex—Operations by Warfare Area and Location (continued)

Navy Warfare Area	No.	Operation Type	Summary	Location of Activity
Anti-Surface Warfare (cont.)	**18**	Air-to-Surface Gunnery Exercise	Trains helicopter crews in daytime aerial gunnery operations with the GAU-16 (.50-caliber) 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-caliber machine guns.	W-291, SHOBA
	20	Sink Exercise (SINKEX)	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, 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 multiple impacts.	W-291
Amphibious Warfare	**21**	Naval Surface Fire Support	Trains ship crews in naval gunnery against shore targets. Trains Naval Gunfire Spotters located ashore to direct the fires of naval guns.	SHOBA, SWTR
	22	Expeditionary Fires Exercise	U.S. Marine Corps (USMC) field training in integration of close air support, naval gunfire, artillery, and mortars.	SCI, SHOBA, Fire Support Areas (FSAs) off SHOBA
	23	Expeditionary Assault - Battalion Landing	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

Table 2-7: SOCAL Range Complex—Operations by Warfare Area and Location (continued)

Navy Warfare Area	No.	Operation Type	Summary	Location of Activity
Amphibious Warfare (cont.)	**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.	West Cove, Impact Areas, Horse Beach Cove, AVMC, 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 Waters
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, SWTR, ARPA, Shallow Water Minefield
	29	Mine Neutralization	Not currently conducted (see discussion under Alternative 1, Section 2.4.1.2)	See Section 2.4.1.2
	30	Mine Laying	Trains fighter/attack and patrol aircraft crews in aerial mine laying.	MTRs, SWTR, Pyramid Cove
Naval Special Warfare	**31**	NSW Land Demolition	Trains NSW personnel in construction, emplacement, and safe detonation of explosives for land breaching and demolition of buildings and other facilities.	Impact Areas, Demolition Range (SWAT 1), Basic Training Site (BTS) Demolition Pit and Grenade Range (SWAT 2), TARs (1, 2, 3, 4, 10, 13-22)
	32	Underwater Demolition-Single Point Source Charge	Trains NSW personnel to construct, emplace, and safely detonate single charge explosives for underwater obstacle clearance.	NW Harbor (TAR 2 and 3), Horse Beach Cove (TAR 21), SOAR, SWTR, in SWAT offshore waters
	33	Underwater Demolition Multiple Charge - Mat Weave and Obstacle Loading	Trains NSW personnel to construct, emplace, and safely detonate multiple charges laid in a pattern for underwater obstacle clearance.	NW Harbor (TAR 2 and 3), SWAT

Table 2-7: SOCAL Range Complex—Operations by Warfare Area and Location (continued)

Navy Warfare Area	No.	Operation Type	Summary	Location of Activity
Naval Special Warfare (cont.)	34	Small Arms Training and GUNEX	Trains NSW personnel in employment of small arms up to .50 cal.	SCI TARs, SWATs, MOUT, SHOBA, Breaching Facilities, FLETA HOT, BTS
	35	Land Navigation	Trains NSW personnel in land navigation techniques.	SCI
	36	NSW UAV/UAS Operations	Trains NSW personnel in employment of unmanned aerial vehicles over land areas.	SCI, SWTRs and airspace
	37	Insertion/Extraction	Trains NSW personnel in covert insertion and extraction into target areas, using boats, aircraft, and parachutes.	SCI and littoral waters and airspace
	38	NSW Boat Operations	Trains NSW Special Boat Teams in open-ocean operations, and firing from boats, including into land impact areas of SCI.	SCI and littoral waters and airspace
	39	SEAL Platoon Operations	Provides SEAL Platoon live-fire training in special operations tactics, techniques, and procedures.	SCI
	40	NSW Direct Action	Trains 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
Strike	41	Bombing Exercise (Land)	Trains 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	Trains aircrews, submarine, and NSW forces in rescue of military personnel in a simulated hostile area.	SCI
Explosive Ordnance Disposal	43	Explosive Ordnance Disposal SCI	Trains 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)

Table 2-7: SOCAL Range Complex—Operations by Warfare Area and Location (continued)

Navy Warfare Area	No.	Operation Type	Summary	Location of Activity
RDT&E	**46**	Ship Torpedo Tests	Test event for reliability, maintainability, and performance of nonrunning and running torpedo exercises used in training (REXTORPS and EXTORPS) and operational torpedoes.	SOAR, SCIUR, 3803, SWTR
	47	Unmanned Underwater Vehicles (UUVs)	Development and operational testing of UUVs.	NOTS Pier Area, SWTR, 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.	North Light Pier, 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.	Mine Training Ranges, SCIUR, SOAR, SWTR
	51	Missile Flight Tests	Missile testing; land attack missiles launched from within SOCAL Range Complex, impact at SCI or at range complex outside SOCAL Range Complex.	SCI, W-291
	52	NUWC Underwater Acoustics Testing	Test events to evaluate acoustic and nonacoustic ship sensors.	SCIUR
	53	Other Tests	Diverse RDT&E activities.	SOAR, SHOBA, Kingfisher, OPAREA 3803, SWTR, Shallow Water Minefield
Major Range Events	**NA**	Major Exercises	Composed of multiple range events, identified above.*	SOCAL Range Complex PMSR (ASW)

*As discussed in Section 2.3.3, major range events are composed 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 Department of Defense (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, EA-18G Growler, MH-60R/S Seahawk Multimission Helicopter, P-8 Poseidon Maritime Multimission Aircraft, Landing Platform-Dock [LPD] 17 amphibious assault ship, and 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.[1]

While Alternative 1 would partially meet the Navy's purpose and need, Alternative 1 does not enhance 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 capabilities.

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 2-9 identifies the proposed increases in such training events.

2.4.1.1 Large Amphibious Landings at San Clemente Island

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 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 no more than 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 a 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

[1] 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.

would include amphibious vehicle assault, reconnaissance, helicopter assault, combat engineer training, and armored vehicle operations.

A battalion-sized exercise 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 2-8, and depicted in Figure 2-6.

Eight new Marine Corps training activities are embedded in the Large Amphibious Landings conducted at SCI. The new activities are:

- Reconnaissance
- Helicopter Assault
- Armored Operations
- Amphibious Assault Operations
- Combat Engineer Operations
- AAAV/EFV Assault
- EFV Company Assault
- Assault Amphibian School

These activities are described in greater detail in Appendix A.

Table 2-8: 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 (AMPs)	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.

2.4.1.2 Advanced Extended Echo Ranging (AEER) Operations

The Advanced Extended Echo Ranging (AEER) program examines improvements in both long-range shallow and deep water ASW search using active sources (Air Deployable Low Frequency Projector [ADLFP], Advance Ranging Source [ARS]) and passive sonobuoy receivers (Air Deployed Active Receiver, or ADAR). The signal processing is provided by research conducted under the Advanced Multi-static Processing Program (AMSP).

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

The proposed AEER system is similar to the existing EER/IEER system. The AEER system will use the same ADAR sonobuoy as the acoustic receiver and will be used for a large area ASW search capability in both shallow and deep water. However, instead of using an explosive AN/SQS-110A as an impulsive source for the active acoustic wave, the AEER system will use a battery powered (electronic) source for the AN/SSQ-125 sonobuoy. The output and operational parameters for the AN/SSQ-125 sonobuoy (source levels, frequency, wave forms, etc.) are classified, however, this sonobuoy is intended to replace the EER/IEER's use of explosives and is scheduled to be deployed in 2009. Acoustic impact analysis for the AN/SSQ-125 in this document assumes a similar per-buoy effect as that modeled for the DICASS sonobuoy. IOC for the AEER system is unknown.

2.4.1.3 Mine Countermeasure Exercises

Mine Countermeasures (MCM) exercises would involve training using Organic Mine Countermeasures (OMCM) systems employed by surface ships and helicopters in simulated threat minefields with the goal of clearing a safe channel through the minefield for the passage of friendly ships or amphibious landing craft. Once a mine shape is detected, classified, and identified, the mine can then be neutralized (simulated with a training neutralizer or tactically with live ordnance).

The LCS, when configured with the MC Mission Package, would be configured to operate with one or more of the following systems:

Organic Airborne Mine Countermeasure (OAMCM) systems operated from the MH-60S:

- **AN/AQS-20 Mine Hunting System**. The AQS-20 is an active high-resolution, side looking, multibeam sonar system used for mine hunting of mine threats within the water column and along the ocean bottom. A small diameter electromechanical cable is used to tow the rapidly deployable system that provides real-time sonar images to operators in the helicopter. The AQS-20 uses a high frequency (>200 kHz) sonar system. Due to the very high frequency of this sound source (beyond hearing sensitivities of marine mammals), and MIW operations over a much smaller spatial extent within SOCAL, the Navy, with concurrence of NMFS, did not include this sonar system in acoustic impact analysis.
- **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. This system does not introduce any sound into the water.
- **AN/ALQ-220 Organic Airborne Surface Influence Sweep (OASIS)**. OASIS is a helicopter deployed, towed-body, 10 ft (3 m) in length and 20 inches (51 centimeters) in diameter, that is self-contained, allowing for the emulation of magnetic and acoustic signatures of the ships. The magnetic influence portion of this sensor does not introduce sound into the water. The acoustic influence portion of this sensor, Mk-104 acoustic signal generator, introduces sound similar to typical ship generate sounds.
- **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, which expends itself during the mine destruction process. This systems produces small underwater detonations from low-weight charges (<3 lb).
- **AN/AWS-2 Rapid Airborne Mine Clearance System (RAMICS)**. RAMICS is a helicopter-borne weapon system that fires a 30 mm projectile from a gun or cannon to

neutralize surface and near-surface mines. RAMICS uses LIDAR technology to detect mines. This system uses a solid, non-explosive round. Effects would be similar to those discussed for other small arms and weapons systems.

Seaborne MCM systems operated from the LCS:

- **Remote Minehunting System (RMS).** The RMS is an unmanned, semisubmersible vehicle that tows the AN/AQS-20 Mine Hunting System used on the MH-60S (see above). The RMS includes a shipboard launch and recovery system.
- **Unmanned Surface Vehicle (USV) with Unmanned Surface Sweep System (US^3)**. The USV configured with the US^3 is an OASIS-like sweep system used to conduct influence sweeping against magnetic and acoustic influence mines. The magnetic influence portion of this sensor does not introduce sound into the water. The acoustic influence portion of this sensor, Mk-104 acoustic signal generator, introduces sound similar to typical ship generate sounds.
- **Battlespace Preparation Autonomous Underwater Vehicle (BPAUV)**. The BPAUV is an autonomous undersea vehicle designed for wide-area bottom mapping, reconnaissance, and minehunting missions. The BPAUV will carry high-resolution, multi-beam side-scan sonar sensors. BPAUV can also perform bathymetry and hydrographic surveys in preparation of MCM operations. The BPAUV uses high frequency (>200 kHz) sonar systems. Due to the very high frequency of this sound source, beyond hearing sensitivities of marine mammals, and operations over a much smaller spatial extent within SOCAL, the Navy, with concurrence of NMFS, did not include this sonar system in acoustic impact analysis.

MCM 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. The forward-looking sonar is used to detect underwater objects, while the side-looking sonar provides information used to classify any detected objects.

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

- Pyramid Cove
- Northwest Harbor
- Kingfisher Training Range
- MTR-1
- MTR-2
- 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 needed 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 needed 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

<u>Aircraft Carrier USS CARL VINSON</u>

The Navy currently bases two NIMITZ Class Aircraft Carriers (CVNs), USS NIMITZ (CVN 68) and USS RONALD REAGAN (CVN 76), at Naval Base Coronado; USS ABRAHAM LINCOLN (CVN 72) at Naval Station Everett, and USS JOHN C STENNIS (CVN 74) at Naval Station Bremerton. The Navy has announced that in early 2010 it proposes to homeport a fifth 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.

<u>Littoral Combat Ship</u>

The 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 is planning to 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.

<u>MV-22 Osprey</u>

The MV-22 is a tilt rotor Vertical/Short Take-Off and Landing (V/STOL), multimission 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 two 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 Multimission Helicopter

The MH-60R/S Seahawk Multimission Helicopter is a planned conversion of existing SH-60B and SH-60F helicopters. Primary missions include troop transport, vertical replenishment (supply of seaborne vessels by helicopter), and MIW. These aircraft will feature advanced sensors and weapons systems including 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, antiship 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, multimission 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.

Expeditionary Fighting Vehicle

The Expeditionary Fighting Vehicle (EFV) is the Marine Corps replacement for the Amphibious Assault Vehicle (AAV). The EFV is a self-deploying, high water speed, armored amphibious vehicle capable of transporting Marines from ships located beyond the horizon to inland objectives. The EFV is an armored, fully tracked infantry combat vehicle that will be operated and maintained by a crew of three Marines, and has a troop capacity of 17 Marines with their individual combat equipment. The EFV, unlike its predecessor, the AAV, is equipped with a stabilized turret containing a 30mm cannon and a 7.62mm machine gun, both of which can be fired while the vehicle is on the move, either on land or at sea.

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 deployed MCM systems (RMS); USV; BPAUV; and submarine-deployed MCM systems (LMRS). These systems are described in Section 2.4.1.2 in the context of proposed mine countermeasure exercises.

2.4.3 Summary: Proposed Increases in Additional Operations

Table 2-9 compares the No Action Alternative baseline and the Alternative 1 proposed changes in training and RDT&E operations in the SOCAL Range Complex..

Table 2-9: 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 (TMA 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	Anti-Submarine Warfare Tracking Exercise - Helicopter	SOCAL OPAREAs, PMSR	544	1,690
	7	Anti-Submarine Warfare Torpedo Exercise - Helicopter	SOAR, SWTR, SCIUR	187	245
	8	Anti-Submarine Warfare Tracking Exercise - Maritime Patrol Aircraft	SOCAL OPAREAs, PMSR	25	28
	9	Anti-Submarine Warfare Torpedo Exercise - Maritime Patrol Aircraft	SOAR, SWTR, SOCAL Waters	15	16
	10	Anti-Submarine Warfare EER / IEER sonobuoy employment	SOCAL Waters	2	3
	11	Anti-Submarine Warfare Tracking Exercise – Surface	SOCAL OPAREAs, PMSR	847	900
	12	Anti-Submarine Warfare Torpedo Exercise - Surface	SOAR, SWTR, SCIUR	21	25

Table 2-9: Baseline and Proposed Increases in Operations: Alternative 1 (continued)

Navy Warfare Area	No.	Operation Type	Location of Activity	# of Operations per Year	
				No Action (baseline)	Alt 1
Anti-Submarine Warfare (continued)	**13**	Anti-Submarine Warfare Tracking Exercise - Submarine	SOCAL OPAREAs, PMSR	34	40
	14	Anti-Submarine Warfare Torpedo Exercise - Submarine	SOCAL OPAREAs	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, SWTR Nearshore	47	50
	22	Expeditionary Fires Exercise	SCI, SHOBA, Fire Support Areas (FSAs) off SHOBA	6	7
	23	Expeditionary Assault - Battalion Landing	SHOBA, SWTR Nearshore, AVMC, MIR, VC-3, NALF, Eel Cove, West Cove, Wilson Cove	0	1
	24	USMC Stinger Firing Exercise	SHOBA	0	3
	25	Amphibious Landings and Raids (on SCI)	West Cove, Impact Areas, Horse Beach Cove, AVMC, NW Harbor	7	34
	26	Amphibious Operations - CPAAA	CPAAA	2,205	2,271
Electronic Combat	**27**	Electronic Combat Operations	SOCAL Waters	748	755
Mine Warfare	**28**	Mine Countermeasures	Kingfisher, SWTR, ARPA, Shallow Water Minefield	44	46
	29	Mine Neutralization	See Section 2.4.1.2	0	732
	30	Mine Laying	MTRs, SWTR, Pyramid Cove	17	17

Table 2-9: Baseline and Proposed Increases in Operations: Alternative 1 (continued)

Navy Warfare Area	No.	Operation Type	Location of Activity	# of Operations per Year	
				No Action (baseline)	Alt 1
Naval Special Warfare	31	NSW Land Demolition	Impact Areas, Demolition Range (SWAT 1), BTS, Demolition Pit and Grenade Range (SWAT 2), TARs (1, 2, 3, 4, 10, 13-22)	90	101
	32	Underwater Demolition - Single Point Source Charge	NW Harbor (TAR 2 and 3), Horse Beach Cove (TAR 21), SOAR, SWTR, in SWAT offshore waters	72	85
	33	Underwater Demolition Large Charges - Mat Weave and Obstacle Loading	NW Harbor (TAR 2 and 3), SWAT	14	16
	34	Small Arms Training and GUNEX	SCI TARs, SWATs, MOUT, SHOBA, Breaching Facilities, FLETA HOT, BTS	171	205
	35	Land Navigation	SCI and littoral waters and airspace	99	118
	36	NSW UAV/UAS Operations	SCI	72	1176
	37	Insertion/Extraction	SCI	5	10
	38	NSW Boat Operations	SHOBA, MIR	287	320
	39	SEAL Platoon Operations	SCI	340	512
	40	NSW Direct Action	SCI	156	163
Strike Warfare	41	Bombing Exercise (Land)	SOCAL OPAREAs, W-291	176	197
	42	Combat Search & Rescue	SCI (NALF)	7	8
Explosive Ordnance Disposal	43	Explosive Ordnance Disposal SCI	SOAR, SCIUR, 3803, SWTR nearshore	4	5
U.S. Coast Guard	44	Coast Guard Training	NOTS Pier Area, SWTR, SOAR	1,022	1,022
Air Operations - Other	45	NALF Airfield Activities	SCIUR	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

Table 2-9: Baseline and Proposed Increases in Operations: Alternative 1 (continued)

Navy Warfare Area	No.	Operation Type	Location of Activity	# of Operations per Year	
				No Action (baseline)	Alt 1
RDT&E (continued)	49	Ocean Engineering	North Light Pier, NOTS Pier Area	242	242
	50	Marine Mammal Mine Shape Location/Research	Mine Training Ranges, SCIUR, SOAR, SWTR	5	20
	51	Missile Flight Tests	SCI, W-291	5	15
	52	NUWC Underwater Acoustics Testing	SCIUR	44	83
	53	Other Tests	SOAR, SHOBA, Kingfisher, OPAREA 3803, SWTR, Shallow Water Minefield	36	15
Major Range Events	As discussed in Section 2.3.3, major range events are composed 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 (PREFERRED ALTERNATIVE): 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 2-9).
- 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 2-10 compares the No Action Alternative baseline and Alternative 1 with the proposed increases in operations in the SOCAL Range Complex under Alternative 2.

Table 2-10: 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 (TMA 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	Anti-Submarine Warfare Tracking Exercise - Helicopter	SOCAL OPAREAs, PMSR	544	1,690	1,690
	7	Anti-Submarine Warfare Torpedo Exercise - Helicopter	SOAR, SWTR, SCIUR	187	245	245
	8	Anti-Submarine Warfare Tracking Exercise - Maritime Patrol Aircraft	SOCAL OPAREAs, PMSR	25	28	29
	9	Anti-Submarine Warfare Torpedo Exercise - Maritime Patrol Aircraft	SOAR, SWTR, SOCAL OPAREAs	15	16	17
	10	Anti-Submarine Warfare EER / IEER sonobuoy employment	SOCAL OPAREAs	2	3	3
	11	Anti-Submarine Warfare Tracking Exercise - Surface	SOCAL OPAREAs, PMSR	847	900	900
	12	Anti-Submarine Warfare Torpedo Exercise - Surface	SOAR, SWTR, SCIUR	21	25	25
	13	Anti-Submarine Warfare Tracking Exercise - Submarine	SOCAL OPAREAs, PMSR	34	40	40
	14	Anti-Submarine Warfare Torpedo Exercise - Submarine	SOCAL OPAREAs	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
	18	Air-to-Surface Gunnery Exercise	W-291	47	50	60

Table 2-10: Baseline and Proposed Increases in Operations: Alternative 2 (cont'd)

Navy Warfare Area	No.	Operation Type	Location of Activity	# of Operations		
				No Action (baseline)	Alt 1	Alt 2
Anti-Surface Warfare (cont.)	**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, SWTR Nearshore	47	50	52
	22	Expeditionary Fires Exercise	SCI, SHOBA, Fire Support Areas (FSAs) off SHOBA	6	7	8
	23	Expeditionary Assault - Battalion Landing	SHOBA, SWTR Nearshore, AVMC, MIR, VC-3, NALF, Eel Cove, West Cove, Wilson Cove	0	1	2
	24	Stinger Firing Exercise	SHOBA	0	3	4
	25	Amphibious Landings and Raids (on SCI)	West Cove, Impact Areas, Horse Beach Cove, AVMC, NW Harbor	7	34	66
	26	Amphibious Operations - CPAAA	CPAAA	2,205	2,271	2,276
Electronic Combat	**27**	Electronic Combat Operations	SOCAL Waters	748	755	775
Mine Warfare	**28**	Mine Countermeasures	Kingfisher, SWTR, ARPA, Shallow Water Minefield	44	46	48
	29	Mine Neutralization	See Section 2.4.1.2	0	732	732
	30	Mine Laying	MTRs, SWTR, Pyramid Cove	17	17	18
Naval Special Warfare	**31**	NSW Land Demolition	Impact Areas, Demolition Range (SWAT 1), BTS, Demolition Pit and Grenade Range (SWAT 2), TARs (1, 2, 3, 4, 10, 13-22)	354	674	674
	32	Underwater Demolition - Single Charge	NW Harbor (TAR 2 and 3), Horse Beach Cove (TAR 21), SOAR, SWTR, in SWAT offshore waters	72	85	85
	33	Underwater Demolition - Mat Weave	NW Harbor (TAR 2 and 3), SWAT	14	16	18
	34	Small Arms Training	SCI TARs, SWATs, MOUT, SHOBA, Breaching Facilities, FLETA HOT, BTS	171	205	205
	35	Land Navigation	SCI and littoral waters and airspace	99	118	118
	36	NSW UAV / UAS Operations	SCI	72	1176	1176
	37	Insertion/Extraction	SCI	5	10	15

Table 2-10: Baseline and Proposed Increases in Operations: Alternative 2 (cont'd)

Navy Warfare Area	No.	Operation Type	Location of Activity	# of Operations		
				No Action (baseline)	Alt 1	Alt 2
Naval Special Warfare (cont.)	38	NSW Boat Operations	SHOBA, MIR	287	320	320
	39	SEAL Platoon Operations	SCI	340	512	668
	40	NSW Direct Action	SCI	156	163	190
Strike	41	Bombing Exercise (Land)	SOCAL OPAREAs, W-291	176	197	216
	42	Combat Search & Rescue	SCI (NALF)	7	8	8
Explosive Ordnance Disposal	43	Explosive Ordnance Disposal SCI	SOAR, SCIUR, 3803, SWTR	4	5	10
U.S. Coast Guard	44	Coast Guard Operations	NOTS Pier Area, SWTR, SOAR	1,022	1,022	1,022
Air Operations - Other	45	NALF Airfield Activities	SCIUR	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	North Light Pier, NOTS Pier Area	242	242	242
	50	Marine Mammal Mine Shape Location/Research	Mine Training Ranges, SCIUR, SOAR, SWTR	5	20	30
	51	Missile Flight Tests	SCI, W-291	5	15	20
	52	NUWC Underwater Acoustics Testing	SCIUR	44	83	139
	53	Other Tests	SOAR, SHOBA, Kingfisher, OPAREA 3803, SWTR, Shallow Water Minefield	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 enhance range capabilities to adequately support training for the expanding missions and roles of the SOCAL Range Complex. Investment recommendations were based on capability shortfalls (or gaps) (see Section 1.3.4) and were assessed using the Navy and Marine Corps range-required capabilities as defined by the Required Capabilities Document (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

Commercial Air Services are services provided by nonmilitary aircraft in contracted support of military training activities; examples of support include air refueling, target towing, and simulation of threat aircraft. Under the Proposed Action, an increase in Commercial Air Services would be implemented. To provide the required training for CSGs and ESGs, a corresponding increase in Commercial Air Services acting as OPFOR would be required. This enhancement would increase the number of supersonic and subsonic aircraft within the SOCAL Range Complex. 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 Fiscal Year (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 versus. 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-U.S. built aircraft and, as such, their capabilities and limitations vary greatly from their U.S. 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 U.S. basing structure, the loss of Fleet aircraft funding, the capabilities common among U.S. fighter aircraft, and geographical distances between bases of different fighter aircraft, DACT for U.S. fighters is extremely limited and almost nonexistent against non–U.S.-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 Fleet Response Plan (FRP) for six West Coast CSGs, and (3) the acknowledgement that a percentage of ACM operations would be a one-for-one swap between Navy aircraft and an OPFOR aircraft.

2.5.2.2 Shallow Water Minefield

As a result of the risk to Navy vessels from moored mines, the Navy has identified a requirement for increased mine countermeasure training. Consequently, the Navy has a need to expand its use of the two existing shallow water minefields in support of MCM training, and develop two additional training minefields in the SOCAL Range Complex. Currently, the Navy conducts Small Object Avoidance (SOA) training in two existing ranges: the Kingfisher Range off SCI and the ARPA Training Minefield off La Jolla. SOA operations have three objectives: (1) mine detection and avoidance, (2) navigation and reporting, and (3) in the future, more advanced, safe, multiple avoidance training by finding a “safe route” through the minefield. Military personnel use onboard sonar to search for, detect, and avoid mine-like shapes; in the future, remote off-board systems will be used (see RMS discussion below).

Used since 1996, the Kingfisher Range is a 1-nm (1.8-km) by 2-nm (3.6-km) area northwest of Eel Point, approximately 1 nm (1.8 km) offshore. There are more than a dozen “mine-like” shapes moored to the ocean bottom by cables and coming within 50 ft (15 m) of the surface. U.S. ship participants consist of CGs, DDs, DDGs, and FFGs equipped with AN/SQS-53 and AN/SQS-56 active sonar. In the future, Kingfisher would support MH-60S training using AN/AQS-20 minehunting sonar.

The ARPA off La Jolla has historically been used for shallow water submarine and UUV Small Object Avoidance and MCM training, and is the desired location for expanding mine avoidance and MCM training. ARPA supports the shallow water minefield submarine MCM training requirement for a depth of 250 to 420 ft (76 to 128 m), and a sandy bottom and flat contour in an area relatively free from high swells and waves. Mine shapes are approximately 500 to 700 yds (457 to 640 m) apart and 30 to 35 in (76 to 89 cm) in size, and consist of a mix of recoverable/replaceable bottom shapes (~10 cylinders weighed down with cement) and moored shapes (~15 shapes, with no bottom drilling required for mooring). Shapes typically need maintenance or cleaning every 2 years.

Use of the shallow water minefield would be expanded from its current use by submarines and UUV to include surface ships and helicopters. Ships, submarines, UUVs, and aircraft would continue to operate a mix of mid- to high-frequency navigation/mine detecting sonar systems that are either platform based or remotely operated. Once located, mine neutralization of permanent shapes by explosive shaped-charge, ordnance, or removal would be by simulation only. Typical submarine usage would vary between 5 and 10 training operations per year, lasting up to 8 hours per day for a 2-day event. Training would occur at both basic and advanced levels and in accordance with the tactical Weapons Certification Program. LCS MCM training usage would utilize the OAMCM systems employed from the MH-60S as well as the RMS, BPAUV, and USV deployed directly from the LCS. The RMS is an unmanned, semisubmersible vehicles that will be deployed from both the DDG-51 Class and the LCS.

The Navy proposes to establish an offshore shallow water minefield on Tanner Banks. The training area would be approximately 2 nm (3.6 km) by 3 nm (5.6 km) in size. Mines would be placed on the ocean floor, with a total of 15 mine shapes in three rows of five. This offshore field would be utilized by surface ships deploying the RMS and BPAUV to detect, classify, and localize underwater mines. The RMS and BPAUV are launched and recovered by the host ship using a davit system. After deployment, the host ship will stand off while the RMS enters the target zone to perform reconnaissance for mines. An area search is conducted following an operator-programmed search pattern. The RMS searches using low-power acoustic sonar, towed by the UUV itself. A typical RMS training mission will last for approximately 8 hours.

To support MIW training requirements in shallow water, the Navy proposes to establish shallow water minefields within SOCAL. Planned minefields include one off the southern end of SCI and one offshore of Camp Pendleton in the CPAAA. These mine training ranges will support MIW training for MH-60S helicopters, LCS, and M-Class ships. MH-60S helicopters include an OAMCM package that requires a shallow water range (40-150 ft) (12-46 m) for deploying recoverable shapes and live ordnance usage. Three of the five OAMCM systems would be deployed in the shallow water minefield off SCI: AMNS for searching and neutralizing, ALMDS for detecting, and RAMICS for neutralizing surface and near-surface mines. AMNS searches, locates and neutralizes mines. ALMDS is capable of detecting, locating and classifying floating and shallow water mines. RAMICS provides helicopters with the capability of neutralizing surface and near-surface mines. LCS and MH-60S MCM systems to be deployed at CPAAA include: OASIS, AN/AQS-20 (MH-60 and RMS), ALMDS, BPAUV, USV Sweep, and AMNS (inert). OASIS simulates the magnetic and acoustic signature of ships; AN/AQS-20 is a high-frequency sonar system used to locate mines; ALMDS detects and classifies mines; USV Sweep simulates the magnetic and acoustic signatures of ships; BPAUV locates mines; and AMNS locates and simulates neutralizing. AMNS systems deployed in the CPAAA would be inert. MH-60S shallow water minefield operations are anticipated to reach 680 annual training operations. Each training exercise would last about 2 hours. MCM-1 Class ships would employ mine detection and location training exercises off SCI and in the CPAAA.

If in the future the Navy no longer has a requirement for MCM training or no longer uses the shallow water minefield for training, then the Navy will comply with applicable Federal environmental planning and regulatory requirements pertaining to the disposition of these facilities.

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, identifies criteria for the SWTR. Criteria include the following:

- Shallow water (less than 500 ft [152 m])
- Located within existing OPAREA and beneath SUA
- Capability to interface with air and surface tracking systems to permit the conduct of multidimensional 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. Based on the criteria above, 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 250-nm^2 (463-km^2) area to the west of the already instrumented (deep water) section, in the area of Tanner/Cortes Banks, and one 250-nm^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 MFA sonar.

The proposed instrumentation would be in the form of undersea cables and sensor nodes, similar to instrumentation currently in place in SOAR. 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 eight trunk cables to a land-based facility where the collected range data would be used to evaluate the performance of participants in shallow water (120-ft to 600-ft deep) training exercises. The basic proposed features of the instrumentation and construction follow.

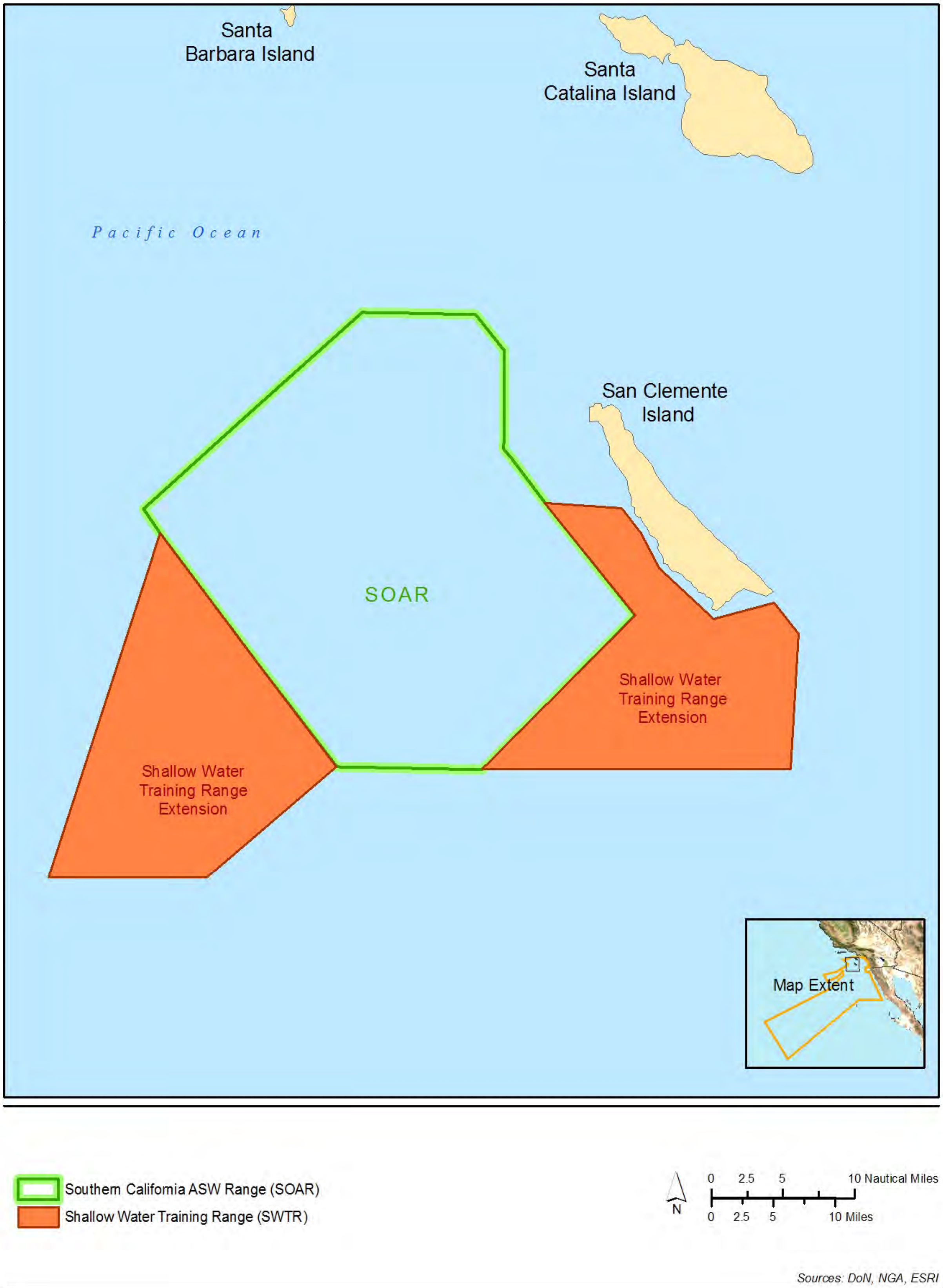

Figure 2-7: Proposed Location of Shallow Water Training Range Extensions of the SOAR

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 specific information is described below:

- The SWTR extension would consist of no more than 500 sensor nodes spread on the ocean floor over a 500-nm^2 area. The distance between nodes would vary between 0.5 nm and 3 nm, depending on water depth. Each sensor node would be similar in 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 to 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 an interconnect cable (standard submarine telecommunications cable with diameters less than 1 inch). Approximately 900 nm of interconnect would be deployed.
- A series of sensor nodes would be connected via the interconnect cable to underwater junction boxes located in diver-accessible water depths. A junction box is rectangular in shape with dimensions of 10 to 15 ft (3 to 4.5 m) on each side. The junction boxes would connect to a shore-based facility via trunk cables (submarine cables up to 2-inch diameter with additional data capacity). The trunk cables eliminate the need to have numerous interconnect cables running to shore. Up to eight trunk cables with a combined length of 375 nm would be employed. Trunk cables would be protected in the seashore area by horizontal directionally drilled pipes running beneath the shoreline.
- The interconnecting cables and trunk cables would be deployed using a ship with an overall length of 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 seashore area, would terminate in Southern California Offshore Range's (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 Range Operations Center (ROC) on Naval Air Station North Island (NASNI). The adjacent SOAR has a single junction box located outside the nearshore area and places the trunk cable in a horizontal directionally drilled bore that terminates onshore. The size of the SWTR may require up to eight junction boxes and eight 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 minimum 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 to 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 backup 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.

The Navy 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.

If in the future the Navy no longer has a requirement for instrumented training or no longer uses the SWTR for training, then the Navy will comply with applicable federal environmental planning and regulatory requirements pertaining to the disposition of the associated instrumentation and facilities.

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3.0 Affected Environment and Environmental Consequences

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 the National Environmental Policy Act (NEPA) of 1969 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 Preliminary Final 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 Resources (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 and 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 Operating Areas [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 (Mitigation Measures).

Included in the resource-specific assessments of potential impacts is a discussion of cumulative impacts on that resource. The discussion under the Affected Environment sections includes past and present environmental impacts. The approach taken in the analysis of cumulative impacts follows the objectives of NEPA, 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 Section 3.4, 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 (SCB) 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 the 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 1990s, 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 flow concentrates in these cracks and widens 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

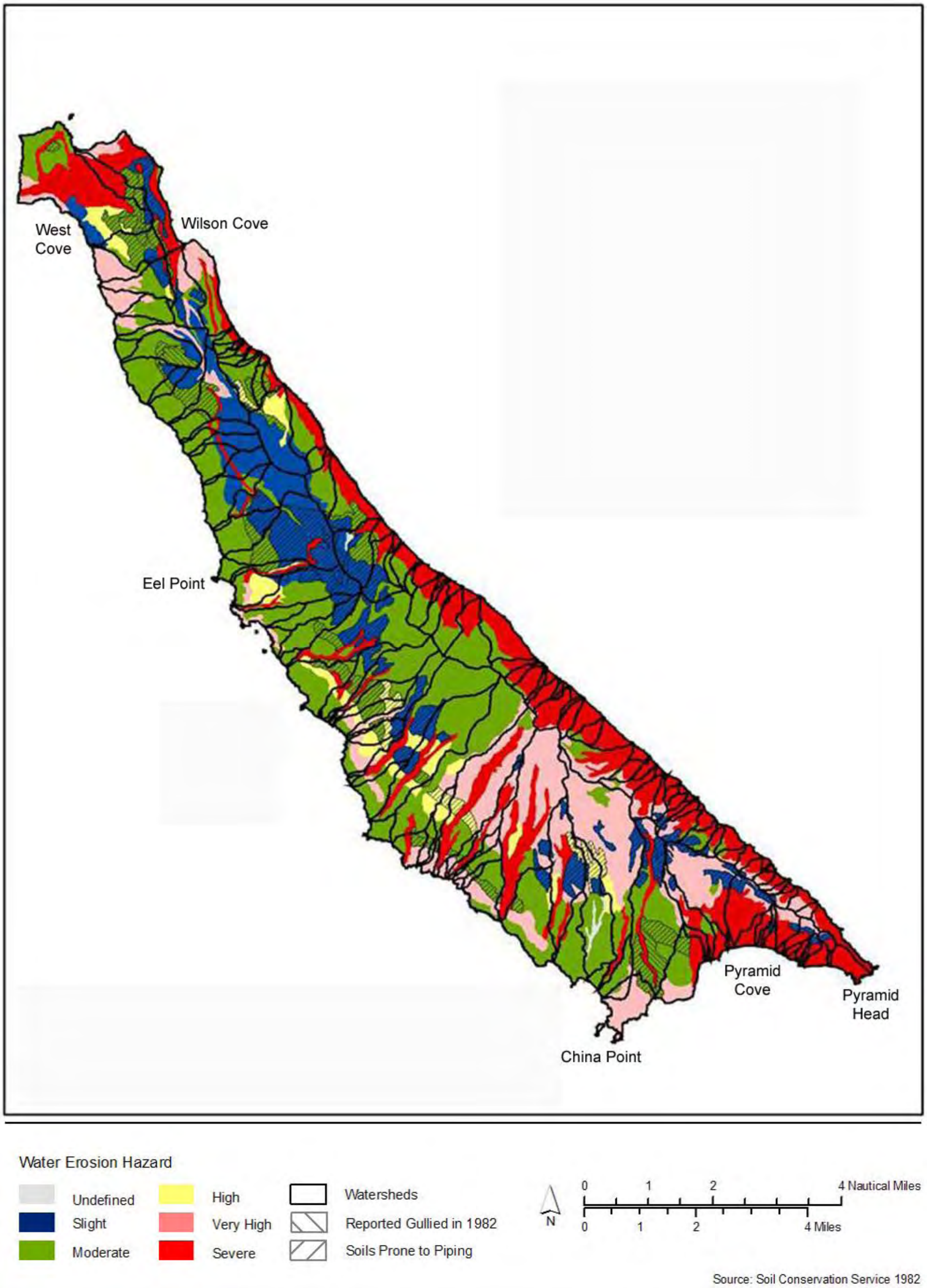

Figure 3.1-2: Water Erosion Potential

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

3.1.1.2.1 Erosion

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 implements 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). INRMP 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.

3.1.1.2.2 Expended Materials

Expended projectiles from small arms accumulate in the impact berms on small arms ranges. These projectiles may contain lead, antimony, copper, and other heavy metals. The Navy currently removes spent projectiles and fragments from the impact berms. This measure reduces the potential for expended training materials to contaminate soil on the small arms ranges.

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.

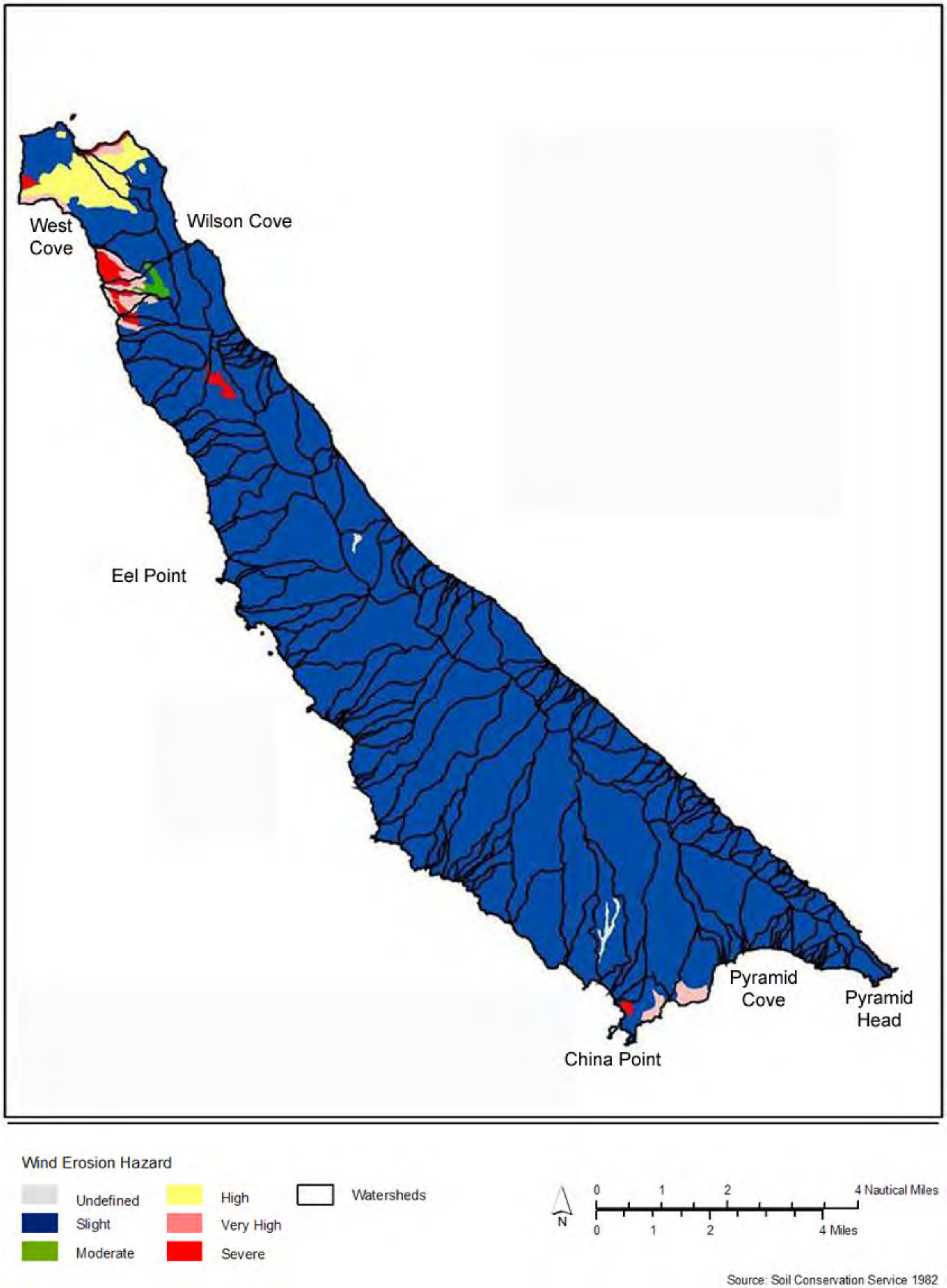

Figure 3.1-3: Wind Erosion Potential

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.

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, an 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 (UAV) training, Combat Search and Rescue (CSAR), Radio Frequency (RF) 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 more than 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 to 2007 (FY2005-2007). In addition, many training events include range clearance 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 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 disturbances 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 4 ft 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 reestablish 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.

3.1.2.2.4 Amphibious Warfare

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, 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 (in) 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-in 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 is already 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

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-in/54-caliber (cal) 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. Nearshore 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.

United States Marine Corps 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 noncohesive nature of sand, wave action, and frequent winds.

3.1.2.2.5 Naval Special Warfare

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—Basic Underwater Demolition/Sea, Air, Land

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.

Naval Special Warfare Group ONE Sea Air Land 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 (OTB), strategic reconnaissance, direct action tactical training, immediate action drills, small arms live-fire, Military Operations in Urban Terrain, helicopter landings, UAV, 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 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 minimis 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.

3.1.2.2.6 Strike Warfare

Soils on SCI are affected by bombs dropped by aircraft during Air Strikes. In this exercise, three types of bombs are typically used: the nonexplosive 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 nonexplosive 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 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.

3.1.2.2.7 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.

3.1.2.2.8 Noncombat Operations—Explosive Ordnance Disposal

Under the No Action Alternative, EOD includes five 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-in/54-cal 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.

3.1.2.2.9 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 more than 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 FY2005 – FY2007, 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 Assault Vehicle Maneuver Area (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 address the impacts of the individual activities proposed under Alternative 1 on the soils of SCI.

3.1.2.3.1 Shore Bombardment Area 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, 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 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 5-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 islandwide 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 3.1.2.2.3.

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 (IOA) 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 Artillery Maneuver Points (AMPs) and Artillery Firing Points (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 islandwide 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.

United States Marine Corps 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—Basic Underwater Demolition/Sea, Air, Land

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.

Naval Special Warfare Group ONE Sea Air Land 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 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 effects 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 islandwide 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 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

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 Noncombat 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-in/54-cal 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 more than 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 FY2005 – FY2007, 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 address 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 3.1.2.2.3. 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.

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, 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 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.

United States Marine Corps 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 an 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, 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—Basic Underwater Demolition/Sea, Air, and Land

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.

Naval Special Warfare Group ONE Sea Air Land 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 postexercise range clearance 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 islandwide 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 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

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/ac (16 kg/ha) per year would be deposited on the range by RDT&E activities.

3.1.2.4.6 Noncombat 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-in/54-cal 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

Biannual UXO sweeps and range clearance 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

Ongoing 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 Office (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 nonwetland 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 IOA, 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 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 bioengineered structures to reduce soil erosion and off-site 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 of, 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 be limited to designated areas.	• All operations are within the territory limits of the U.S.; E.O. 12114 does not apply.

Table 3.1-1: Summary of Effects by Alternative (cont'd)

Alternative	NEPA (On-Land and U.S. Territorial Waters)	EO12114 (Non-U.S. Territorial Waters)
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. • Biannual sweeps and range clearance after exercises.	• All operations are within the territory limits of the U.S.; E.O. 12114 does not apply.

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3.2 Air Quality

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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 United States (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 nonattainment 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 nonattainment areas for that pollutant. Nonattainment areas may be classified as basic, serious, severe, or extreme nonattainment areas for a given criteria pollutant. Nonattainment 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 μg/m^3)
	8-Hour	0.08 ppm		0.070 ppm (137 μg/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 μg/m^3)	Same as Primary Standard	0.030 ppm (56 μg/m^3)
	1-Hour	-		0.18 ppm (338 μg/m^3)
Sulfur Dioxide (SO_2)	Annual Average	80 μg/m^3 (0.03 ppm)	-	-
	24-Hour	365 μg/m^3 (0.14 ppm)	-	0.04 ppm (105 μg/m^3)
	3-Hour	-	1300 μg/m^3 (0.5 ppm)	-
	1-Hour	-	-	0.25 ppm (655 μg/m^3)
Suspended Particulate Matter (PM_{10})	24-Hour	150 μg/m^3	Same as Primary Standard	50 μg/m^3
	Annual Arithmetic Mean	-		20 μg/m^3
Fine Particulate Matter ($PM_{2.5}$)	24-Hour	35 μg/m^3	Same as Primary Standard	-
	Annual Arithmetic Mean	15 μg/m^3		12 μg/m^3
Lead (Pb)[note 7]	30-Day Average	-	-	1.5 μg/m^3
	Calendar Quarter	1.5 μg/m^3	Same as Primary Standard	-
Hydrogen Sulfide (HS)	1-Hour	No Federal Standards		0.03 ppm (42 μg/m^3)
Sulfates (SO_4)	24-Hour			25 μg/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 μg/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.

Note: μg/m^3 = milligrams per cubic meter
Source: CARB 2007a, USEPA 2005.

[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.

[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 a source of carbon dioxide (CO_2) and minor amounts of nitrous oxide (N_2O) and methane (CH_4), which are considered greenhouse gases (GHGs). 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 nautical miles (nm) (5.5 kilometers [km]) 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.

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

[2] The regulations of the CARB define "California Coastal Waters" as 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 Operating Areas

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 manmade activities. The following discussion describes some of these factors.

The SCAB is composed 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 CO, NO_x, and ROGs. 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 composed 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 in the state. San Diego 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).

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 semipermanent 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./hour (hr.) (8.2 meters (m)/second [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 nonattainment 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 nonattainment area for the 8-hour NAAQS for O_3, a serious nonattainment area for CO, a maintenance area for NO_2, a serious nonattainment area for PM_{10}, and a nonattainment 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 nonattainment 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 inches (in.) (10 to 23 centimeters [cm]) annually. The mean temperature is 62.2 degrees Fahrenheit (^{o}F) (16.8 degrees Celsius [^{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 nonattainment area for the 8-hour NAAQS for O_3, a serious nonattainment area for CO, a maintenance area for NO_2, a serious nonattainment area for PM_{10}, and a nonattainment 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 nonattainment 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 Stimulator (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

Nonstationary 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 SIP emissions budget and are discussed below.

State Implementation Plan: Emissions from Military Activities at San Clemente Island 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 Mean Sea Level [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 Amphibious Assault Vehicles (AAVs) with Expeditionary Fighting Vehicles (EFVs). The SIP budget includes emissions for Fiscal Years (FY) 2007-2008, and additional emissions for FY2009 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
Naval Auxiliary Landing Field (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 (MT) in 2004, and total U.S. emissions were estimated at 7,074 million MT.

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 Complex 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 Executive Order (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 (914 m) 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 (914 m) 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 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 nonattainment areas within the Region of Influence (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 are 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.

SCI NALF 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 nonmilitary 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

All tactical submarines in the U.S. Fleet are nuclear powered. 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

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 CARB emission factors 2007 data 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 (mi.) (8 kilometers [km]) 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 Operating Areas

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 (22.2 km) of SCI and those emissions occurring within 12 nm (22.2 km) 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 on SCI associated with the No Action Alternative are presented in Table 3.2-5. 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 nonattainment 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 have 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 Chapter 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 San Pedro Channel Operating Area (SPCOA) and Camp Pendleton Amphibious Assault Area (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 San Clemente Island Range Complex (SCIRC), offshore of Marine Corps Base (MCB) Camp Pendleton and Silver Strand Training Complex (SSTC), in the northern portion of W-291, Northern Air Operating Area (NAOPA), Advance Research Projects Agency (ARPA), Encinitas Naval Electronic Test Area (ENETA), and potentially those emissions occurring within the Western San Clemente Operating Area (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, Fleet Training Area (FLETA) HOT, and Missile Range (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 NO_x 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 Operating Areas

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) versus 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.

3.2.2.3.2 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 MT in 2004, and total U.S. emissions were estimated at 7,074 million MT. 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 Operating Areas

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 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.

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**

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 MT in 2004, and total U.S. emissions were estimated at 7,074 million MT. 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 Shallow Water Training Range

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, the area over which the activities would occur would involve an area of 500 nm^2 versus 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 nonattainment 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 nonattainment area for the Federal 8-hour ozone standard, a maintenance area for NO_2, and a nonattainment 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 (NO_x and ROGs)	25 tons (22,680 kilogram [kg]) per year
NO_2	100 tons (90,720 kg) per year
CO	100 tons (90,720 kg) per year
PM_{10}	70 tons (63,504 kg) per year

It should be noted that should the SCAB be redesignated as an extreme nonattainment 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 nonattainment 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, volatile organic compounds (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, NO_x (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 nonattainment 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” nonattainment 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 nonattainment 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 to 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 nonattainment 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 composed 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 nonattainment 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, NO_x, 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 rules. HAPs are emitted from a variety of processes that are associated with SOCAL Range Complex activities, including combustion sources and ordnance use. Trace amount of HAPs are emitted from sources participating in 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} lb of individual HAP per item for cartridges to 10^{-4} to 10^{-13} lb 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 3.2.1.1.2 and 3.2.1.2.2, 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 Standard Operating Procedures (SOPs) and Best Management Practices (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 SCAB. 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 SCAB. Operational activities within the SOCAL OPAREAs would also contribute emissions to the air in the SDAB 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, discussed in this section, 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 outlined below in Table 3.2-15.

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 Alternative 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 extreme nonattainment 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 SCIRC. The Proposed Action under Alternative 1 would therefore conform with the SIP under the General Conformity Rule.	• 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.

Table 3.2-15: Summary of Effects by Alternative (cont'd)

Alternative	NEPA (On-Land and U.S. Territorial Waters)	EO 12114 (Non-U.S. Territorial Waters)
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 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 groundwater 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 are also 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, semisolid, 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 United States (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 of 1990 (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 Resource Conservation and Recovery Act

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 Code of Federal Regulations [C.F.R.] 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
- Smoke canisters

The MMR defines training; Research, Development, Test, and Evaluation (RDT&E); and clearance of Unexploded Ordnance (UXO) 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 nonmunitions 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 Comprehensive Environmental Response, Compensation, and Liability Act

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 Toxic Substances Control Act

TSCA (15 U.S.C. 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 U.S. Environmental Protection Agency (USEPA) characterizing the toxicity of the substance. TSCA also regulates the disposal of polychlorinated biphenyls (PCBs).

3.3.2.1.4 Emergency Planning and a Community Right-to-Know Act

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 Oil Pollution Act of 1990

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 (SPCC) 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 (EO) 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 (DTSC) 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 (DEH) , 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 (Title19, California Code of Regulations [CCR] Section 2620 et seq.)
Hazardous Waste Control Act	Regulates the generation, transportation, storage, treatment, and disposal of hazardous materials (Title 22, CCR Section 66260 et seq.)
Safe Drinking Water and Toxic Enforcement Act	Regulates the discharge of contaminants to groundwater (California Government Code, Chapter 7)
Emergency Services Act	Similar to the Federal Emergency Planning and Community Right-to-Know Act (Title 27, CCR)

3.3.3 Affected Environment

3.3.3.1 Southern California Operating Areas

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 off-loaded 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 (SCB). 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 onboard, 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

Shipboard Management of Hazardous Materials

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 (CWA) prohibition against discharge of harmful quantities of hazardous substances into or upon U.S. waters out to 200 nautical miles (nm) (371 kilometers [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 5 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.

Storage

Navy ships are not allowed to discharge overboard untreated, used, or excess hazardous materials generated aboard ship within 200 nm (370 km) of the coast. Ships must retain used and excess hazardous materials onboard 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. EO 12856, EO 13101, and Chapter 4 of OPNAVINST 5090.1C also cover pollution prevention requirements. The regulation's major pollution prevention requirements are as follows:

> 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 SCI. 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 liters [L]]) for an extremely hazardous substance) include fire-fighting foam, 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 facility has seven ammunition storage sites (magazines). All ordnance is ground transported from Red Label areas (ordnance loading pad) at the southern end of the airfield and VC-3, 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 gal. (2.44 million 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

RCRA (see Section 3.3.2.1.1) requires cradle-to-grave management of designated hazardous wastes, and the procedures in OPNAVINST5090.1C reflect that requirement. 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 (TSD) 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.

Small Arms Range Management

Small arms ammunition may contain heavy metals, such as lead, antimony, and copper, that could be hazardous to biological organisms if released into the environment at substantial concentrations. The Navy currently employs basic Best Management Practices (BMPs) on its small arms ranges, such as the removal of spent lead projectiles and fragments from impact berms. These practices reduce the amounts of potentially hazardous substances that are released into the environment.

Otto Fuel Management

Otto fuel is used to power recoverable torpedoes used in training exercises. At the conclusion of a training activity, when a torpedo is recovered, residual amounts of Otto fuel are recovered and reclaimed in accordance with current Naval Sea Systems Command (NAVSEA) procedures. This practice reduces the quantities of such wastes generated by training activities in SOCAL Range Complex (Range Complex).

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

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 5 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 an RCA of SCI. The RCA included Pre-site Visit Information Collection, On-site Visit Information Collection and Review, and preparation of a final report. Operational range site models were developed for Special Warfare Training Areas (SWATs) 1 and 2, Missile Impact Range (MIR), and Shore Bombardment Area (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 FY 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 (ft) (0.05 meters [m]) 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 ft [1.6 m] below the ground surface). Perchlorate could migrate horizontally in groundwater for a distance of up to 300 m (984 ft) beyond the boundary of the Impact Area over 400 years at a concentration of up to 0.6 micrograms per liter (μg/L). 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 trinitrotoluene (TNT) concentrations at the SHOBA shoreline could be up to 4.3 milligrams per liter (mg/L) and that perchlorate concentrations could be up to 0.001 μg/L. 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 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

Explosives in modern military ordnance are generally solid-cast explosive fills formed by melting the constituents and pouring them into steel or aluminum casings. Trinitrotoluene (TNT) is a nitroaromatic compound that has been used by the U.S. Navy as an explosive since 1912. TNT manufacturing in the U.S. has ceased, and it’s use in military munitions is being phased out. 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 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 ft 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, ammonium 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
Note: NA = Not Applicable

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 percent 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

Note: <0.0 = not detected above the applicable detection limit.
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 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

Note: ppm = parts per million
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 to 0.17 parts per million (ppm).
- On the 40-mm grenade range, RDX was detected at 0.01 to 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 to 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 and Low-Order Detonations

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
Note: NA = Not Applicable

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 (NBC) 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 Operating Areas

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 off-loaded 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

Shore Bombardment Area

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 (STW), 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 7 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 nonexplosive 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 (EC), Land Demolition, and Combat Search and Rescue (CSAR) 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 (OTB) 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 nontoxic 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 noncombat operations include four 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 NSW, 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

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), Unmanned Area Vehicle (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)	NA	NA	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
Note: NA = Not Applicable

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 nonhazardous. 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 areas of high contaminant concentrations 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 areas of concentrated 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 area of high contamination concentrations 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 concentrations 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 heavily used 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.

3.3.4.3 Alternative 1

3.3.4.3.1 SOCAL Operating Areas

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.

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

3.3.4.3.2 San Clemente Island

Hazardous Materials

Shore Bombardment Area

Missiles, Rockets, and Aerial Targets

The missiles and aerial targets used in SHOBA consist of NSW Stinger training against Ballistic Aerial Target Systems (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 7 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 1 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 nonexplosive 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 nonexplosive 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 9 percent of these wastes would consist of lead oxide.

Amphibious Warfare

Amphibious warfare activities vary from small boat raids to larger events with several Amphibious Assault Vehicles (AAVs) or Landing Craft Air Cushions (LCACs). High explosive ordnance is not expended in the 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 (T) (27 metric tons [MT]) of solid and liquid detonation products on SCI. Of this amount, the lead in the ammunition would be about 12 T (11 MT). 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

Noncombat 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 (usualy 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.

Research, Development, Test, and Evaluation

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)	1,821 (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)

Note: NA = Not Applicable
Source: DoN 1996, DoN 1998, DoN 2002

Hazardous Wastes

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.

Summary

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 nonhazardous. Several thousand pounds of lead would be deposited on SCI ranges as a result of Navy training activities; this amount would increase by about 10 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.

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

3.3.4.4.1 SOCAL Operating Areas

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.

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 3 significant digits to indicate their relative imprecision. lb = pound, yr = year.

Source: DoN 2007.

3.3.4.4.2 San Clemente Island

Hazardous Materials

Shore Bombardment Area

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 1 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 nonexplosive 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 EC 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 2,140 grenades. Use of this ammunition would deposit approximately 36 tons (33 metric tons) of solid and liquid detonation products on the range. Of this amount, the lead in the ammunition would be more than 14 tons (13 metric tons).

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

Noncombat 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.

Research, Development, Test, & Evaluation

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.

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)

Note: NA = Not Applicable
Source: DoN 1996, DoN 1998, DoN 2002

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 nonhazardous. Several thousand pounds of lead would be deposited on SCI ranges as a result of Navy training activities; this amount would increase by about 50 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.

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.

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.

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 nonhazardous 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%. • 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%. • 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.] Section [§] 1251 et seq.), and the Safe Drinking Water Act (SDWA) (42 U.S.C. § 300f et seq.). The principal state of California 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 (U.S.) 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 the Department of Defense (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, Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), the Coastal Zone Management Act (CZMA), and Oil Pollution Act of 1990 (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 3-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 kilometer [km]) or to the 300-ft (91-meter [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

3.4.1.1 SOCAL Operating Areas

The physical oceanography of the SOCAL Range Complex (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 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 San Clemente Island (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 3 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

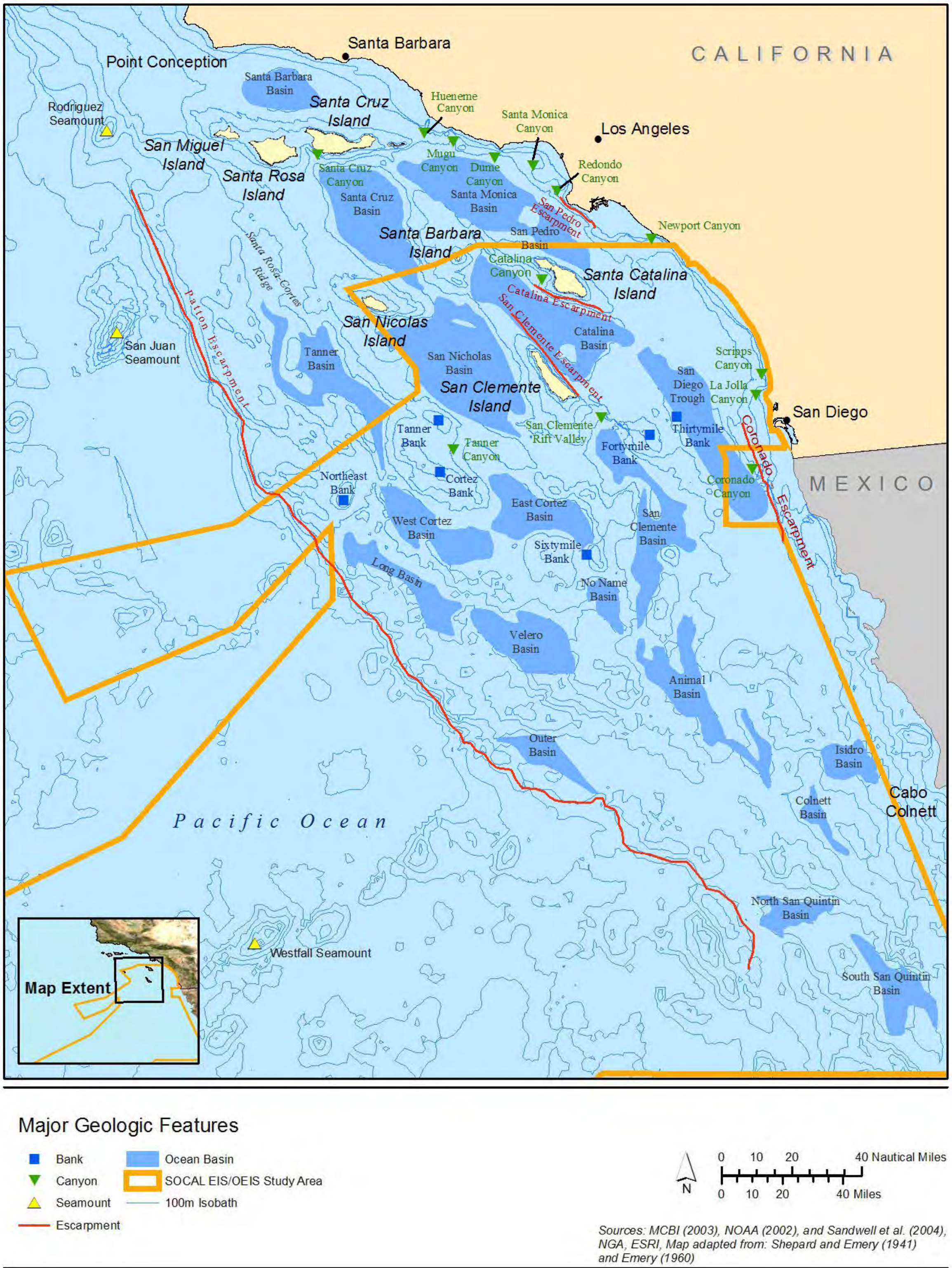

Figure 3.4-2: Major Geological Features of the SOCAL OPAREAs and Vicinity

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 3.4-2). 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 countercurrent 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.

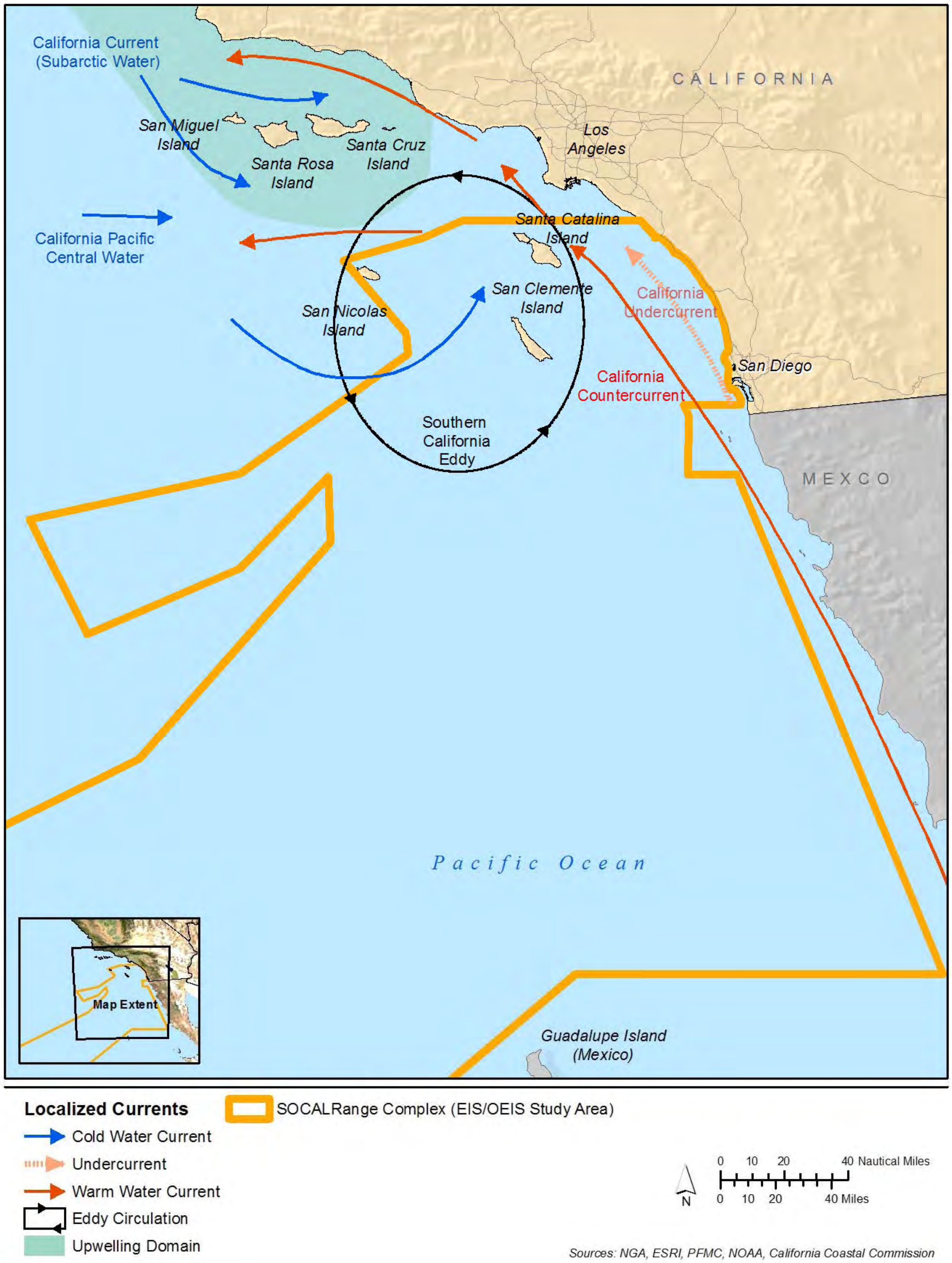

Figure 3.4-3: California Current and Countercurrent Impact on Southern California Bight

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 nearshore, 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 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 (T) per year for the island (DoN 2006).

3.4.2.1.4 Bottom Composition

In the SCB, bottom substrate is heavily influenced by local subsurface 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 3 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-Southern Oscillation (commonly referred to simply as El Nino), Pacific Decadal Oscillation, and global warming. The recurring El Nino 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 degrees north [°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 seawater 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 2 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 increase. 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 nonhazardous 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)	**Grey Water**
U.S. Waters (0-3 nm)	No discharge.	If vessel is equipped to collect grey water, 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 (Nonplastic)**
U.S. Waters (0-3 nm)	Discharge allowed if waste has no visible sheen. If equipped with Oil Content Monitor (OCM), discharge < 15 parts per million (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 3 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 - nondetectable 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.

3.4.2.1.7 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 nonexplosive practice munitions (considered to be hazardous materials because they contain explosives or propellants), and nonmunition 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.

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 - nondetectable concentration; NA - not available; TEQ - toxicity equivalency factor.

Sources: DoN 2006, NOAA 1999.

3.4.2.1.8 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 Chief of Naval Operations' Instructions (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 nearshore coastal waters of SCI include municipal and domestic water supply; groundwater recharge supply; contact water recreation; noncontact 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 California Water Code (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 3.4-1).

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 7 inches (in.) (18 centimeters [cm]) (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; noncontact 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

Discharges to Marine Waters

The Los Angeles RWQCB administers the Navy's NPDES permits for SCI. The Navy is permitted to discharge an average of 25,000 gallons (gal.) per day (gpd) (95,000 liters [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 (BMPs).

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 2 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 (IRP) 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 explosive ordnance disposal (EOD) sweeps to remove unexploded ordnance (UXO) 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 3.4.2.2.1).

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 (C.C.R.) would be appropriate for this analysis.

Current and proposed activities that could affect nonmarine water resources are limited to deposition of constituents of training and testing materials on surface soils on SCI. There are no known potable groundwater aquifers on SCI.

3.4.3.2 No Action Alternative

3.4.3.2.1 SOCAL Operating Areas

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 nonexplosive 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	Constituents 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 T (25 metric tons [MT]) per year (TPY) of mostly nontoxic metals in bottom sediments in the SOCAL OPAREAs.

Missile Exercises (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

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. None 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. Gun Exercises (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 Bombing Exercises (BOMBEXs), FA-18 aircraft use MK-82 high explosive and BDU-45 nonexplosive practice bombs to attack surface targets. The No Action Alternative includes one Sinking Exercise (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

Amphibious Warfare (AMW) training uses ships, aircraft, and amphibious vehicles, but no training materials are used in the water. Naval Surface Fire Support (NSFS), Expeditionary Fires Exercise (EFEX), and other AMW exercises direct the expenditure of ordnance into the land area of the Shore Bombardment Area (SHOBA). These activities are included in the discussion below of water effects from land activities.

Electronic Combat

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 (EW) 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 nonexplosive 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 3-ft 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 nontoxic. 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 nonhazardous, including magnesium oxide, sodium carbonate, carbon dioxide, and water. Small amounts of metals are used to give flares and other pyrotechnic 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

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 nontoxic 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-18A1s, and 12 MK-62s 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 (NSW) 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 pounds [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 to -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 nonhazardous (e.g., carbon monoxide [CO], CO_2, hydrogen [H_2], water [H_2O], nitrogen [N_2], and ammonia [NH_3]). For example, exploding 500 lb (218 kg) of Composition 4 (C4), which is 91 percent Royal Demolition Explosive (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 return to the bottom and currents disperse 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 6 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.

United States Coast Guard Operations

United States Coast Guard (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 (cal) 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 nonrunning 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 Tests

This activity involves one support ship and two UUVs. UUV operations are primarily in shallow waters off Naval Ordnance Test Station (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 / Quality Control Tests

All of the Navy's QA/QC testing is conducted on the eastern side of SCI, involving an aircraft dropping the sonobuoys, a surface ship, and support personnel at 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 Acoustics Tests

NUWC Acoustics Tests impacts are similar to ASW training. These tests involve Weapon System Accuracy Trials (WSATs), Sensor Accuracy Tests (SATs), At-Sea Bearing Accuracy Tests (ASBATs), Acoustic Trials, and Special Tests. Torpedoes are only used during WSATs, 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, 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	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.

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., 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.

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
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. NA – not applicable.

Source: DoN 1996a, DoN 1998, DoN 2002

For example, if the 267 T (243 MT) of ordnance in this category are distributed evenly over about 24,000 square nautical miles (nm^2) (82,300 square kilometers [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 in. (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 materials are nontoxic 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 nonexplosive 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**	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	0.4 / 0.2	2 / 1	NA	5 / 2	24 / 11
AGM-114B	**14**	3 / 1	4 / 2	NA	NA	NA	19 / 9	26 / 12
Standard Missiles	**5**	601 / 273	5 / 2	0.4 / 0.2	NA	NA	56 / 25	662 / 300

Note: BQM-74 not listed because 100 percent of these targets are normally recovered. NA-Not Available
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 to 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 in. (0.14 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 nonexplosive 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, in 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 predetermined 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 Used in SOCAL

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 gal. (48 kg) 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 5 percent of the fuel comprises PAHs (PAHs such as acenaphthene generally make up less than 4 percent of fuel oil, and naphthalene is generally less than 1 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 [mi.] per hour [hr.] 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 3 ft (1 m) of the water column is affected. Based on these assumptions, the affected surface area is about 10,600 square feet (ft^2) (985 square meters [m^2]) and the affected volume of seawater is 2.5 x 10^5 gal. (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 sublethal 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 µg/L 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 nontoxic 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 nonhazardous 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 none recovered.

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 a soluble salt that dissociates into bromine and lithium ions in seawater. Bromine and lithium are the 7th 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 LiBr 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.
- Sulfur dioxide (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 [mg/L]) 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 amounts 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 $LiSO_2$, 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 7 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 1 to 8 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	NA

[1] Concentration (µg/L) of metal released into 1 cubic meter from a single scuttled seawater battery. NA-Not Applicable
[2] Sources: SWRCB 2001,USEPA 2005.

Sonobuoys contain other metal and nonmetal 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 oz. (20 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 unionized 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 grams per liter [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 nonmetal 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 8 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 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 3 significant digits.

Source: DoN 1996a, DoN 1998, DoN 2002

Environmental effects of the Navy's sonobuoy QA/QC 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 nontoxic 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 ppm 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 nonexplosive 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 SOCAL

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 Exercise Torpedo (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 FY04, all torpedoes were retrieved. Residual OTTO fuel is recovered from retrieved torpedoes and reclaimed in accordance with current Naval Sea Systems Command (NAVSEA) procedures. If any torpedoes 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 FY1989 and FY1996 (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.

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 µg/L, or approximately 1 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 1 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 1 µg/L, or approximately 1 ppb (DoN 1996b). An estimated 3.87 µg of HCN can be discharged into the marine environment if the Buoyancy Subsystem (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 nonhazardous 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 1 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 T (15 MT) 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 3 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 EXTORPs 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 Resource Conservation and Recovery Act (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 (ft^3) (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

A small percentage of the explosive training items, generally less than 5 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 subsurface 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 T (380 MT) 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 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 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 per ac (about 10/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, historical 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 nonhazardous (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 nonhazardous.[1] The steel and metal alloys are relatively insoluble, but seawater will eventually oxidize the expended training material into benign byproducts (e.g., iron and aluminum).

Expeditionary Firing Exercise

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 5-in. 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 remobilization 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 nonhazardous (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 inorganic forms of lead in surface soils are relatively insoluble in water and runoff is contained within the berm.

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[1] Steel may contain boron, chromium, cobalt, molybdenum, nickel, selenium, titanium, tungsten, or vanadium to improve its strength or corrosion resistance.

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 Training

Unmanned Aerial Vehicle (UAV) training involves minimal ordnance, smoke, and lasers, and has no effects on water resources.

Naval Special Warfare Group ONE Sea, Air, Land 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 nonhazardous (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.

<u>Strike Warfare</u>

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), nonexplosive 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 T (144 MT) 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.

Noncombat 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 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, research and development (R&D) test support, medical evacuation, and supply and personnel flights. Under the No Action Alternative, NALF experiences about 26,376 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 Environmental Assessment (EA) in 1996 which resulted in a Finding of No Significant Impact (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 nonexplosive 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 (LASM)	5	751	341	6	3	0.5	0.2	70	32

Note: NA - not available.

3.4.3.3 Alternative 1

3.4.3.3.1 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 (SAM) exercises would increase from one under the No Action Alternative to four 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 Alternative) and targets (about 1,080 versus about 900 under No Action Alternative) 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 Alternative 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

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 1 percent. Deployment of Smokey SAMs, chaff, and flares are the only ancillary activities that could affect water quality, and the 1-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 mine countermeasures 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 Shallow Water Training Range-Offshore (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 predetermined 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.

United States Coast Guard Operations

USCG operations are described in Chapter 2, Description of Proposed Actions and Alternatives. 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-cal 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 7. Only 4 of the tests would include a torpedo firing, 2 running MK-54s, and 2 nonrunning 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 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 (10 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/ Quality Control 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.

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 T (265 MT). 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 materials are nontoxic 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.

Table 3.4-16: Estimated Expended Training Materials in SOCAL, 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 3 significant digits to indicate their relative imprecision. NSW activities not included because expended training materials would be negligible. NA-Not Applicable

Source: SOCAL Operations Data Book. 2007. DoN.

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.

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. An estimated 601 MK-30 targets would be used, and all would be recovered. Thus under Alternative 1, the number of expended EMATTs would increase by 421, 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.

Table 3.4-17: Estimated Missile Constituents under Alternative 1

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)

Notes: All BQM-74s are recovered, so aerial targets are not included in this table. NA-Not applicable

Source: DoN 1996a, DoN 1998, DoN 2002

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 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 3 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 (1.7 km^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 3 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 subsurface 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 T (500 MT) 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 ft^3 (119 kg per million m^3)of sediment. Depending on the density of bottom sediments, the concentration of expended training materials would be about 69 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 T/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.

3.4.3.3.2 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. Groundwater quality is not considered to be an issue because groundwater on SCI is nonpotable.

Amphibious Warfare

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

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 battalion landing (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.

United States Marine Corps 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 nonexplosive 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 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 Assault Vehicle Maneuver Road (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 School Battalion Operations

The Assault Amphibian (AA) School Battalion Operation would be introduced to SCI under Alternative 1 with 10 proposed operations. In the AA School Battalion Operation, two Landing Craft Air Cushions (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 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.

Naval Special Warfare Group ONE Sea, Air, Land Platoon Operations

Under Alternative 1, 16 new Training Areas and Ranges (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, Seal Delivery Vehicle (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 4-percent increase, but they would be organized into the three 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 Alternative 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.

Noncombat 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 San Clemente Island Airfield Operations

Under Alternative 1, approximately 28,000 NALF operations would occur, a 6-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.

United States Coast Guard 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-cal 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 nearshore 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.

3.4.3.4 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.

3.4.3.4.1 SOCAL Operating Areas

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 7 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 lb 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.

Naval Special Warfare 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.

United States Coast Guard Operations

USCG operations are described in Chapter 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-cal 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 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/Quality Control 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, 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 3 significant digits to indicate their relative imprecision. NA-Not Applicable

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 T (268 MT). 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 T [268 MT] 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 nontoxic 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 3 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 1,510 EMATTs per year would be used under Alternative 2. An estimated 600 MK-30 targets would be used, and all would be recovered. Thus under Alternative 2, the number of expended EMATTs would increase by about 421, an approximately 39 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 3 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 per 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 T (520 MT) 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 per 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 ft^3 (81 kg per million m^3) of sediment. Depending on the density of bottom sediments, the concentration of expended training materials would be about 70 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 per 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.

3.4.3.4.2 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 groundwater on SCI is nonpotable.

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

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 battalion landing (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 occur under the No Action Alternative. The battalion landing 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 battalion landing could accelerate erosion and transport substantial amounts of sediment into marine waters. Conversely, dry weather or light rains after a battalion landing would allow areas of disturbed soil to recover.

United States Marine Corps 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 four vehicles and five 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 BATS or RPVs, and continue flying out to sea. If this occurred, the missile would expend all its fuel, leaving only the missile casing and nonexplosive 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.

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 (two rather than one). 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 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.

Naval Special Warfare Group ONE Sea Air, Land 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, 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.

Noncombat Operations

Explosive Ordnance Disposal

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 nonhazardous 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 SCI Airfield Operations

Under Alternative 2, about 33,000 air operations would occur compared with about 26,376 under the No Action Alternative, a 25-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.

United States Coast Guard 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-cal 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 National Environmental Policy Act (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 groundwater 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 groundwater 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, 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. • With regard to reducing or avoiding water quality degradation from the expenditure of training materials, management practices include EOD sweeps to remove UXO 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.	• 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, 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.

3.5 Acoustic Environment

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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 San Clemente Island (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.

The lands surrounding the NALF that lie within the 65 through 85 decibel, A-weighted (dBA), Day-Night Average Sound Level (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.

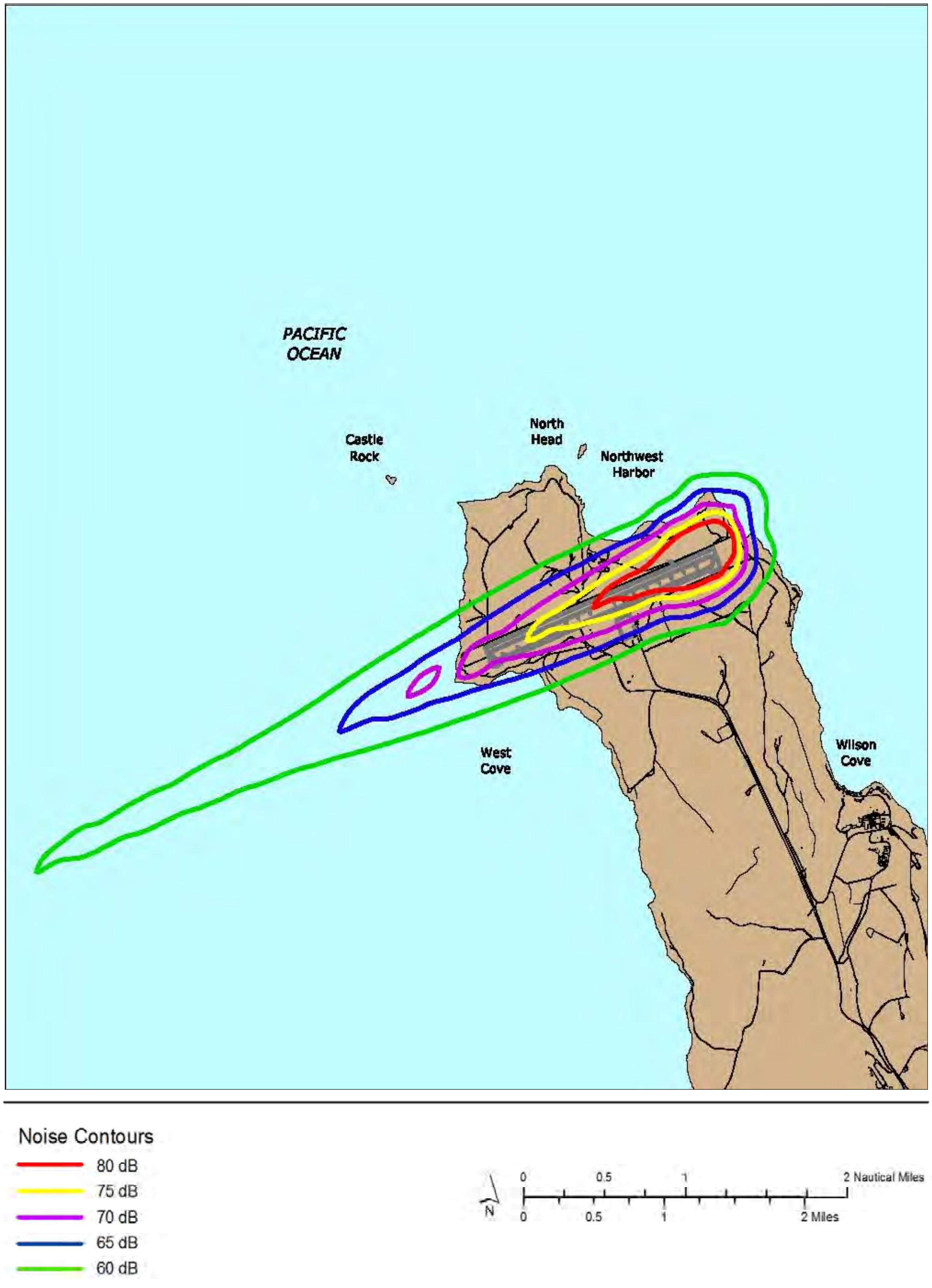

Figure 3.5-1: Noise Contours at NALF SCI (L_{DN})

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 decibel (dB) at the source at launch. Sound levels decrease to 92 dB at 1,200 feet (ft) (370 meters [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., maximum sound level, minimum sound level [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, Training Area and Range (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 Standard Operating Procedures (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, Notice to Mariners (NOTMARs), and Notice to Airmen (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 (Cultural Resources).

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 Southern California (SOCAL) Operating Areas (OPAREAs) and on SCI, especially live firing of weapons and aircraft operations, are sources of intrusive noise. SCI is off-limits to nonmilitary 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 nonmilitary 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 nonmilitary 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 ft) than the EA-6B aircraft now used extensively for training in the SOCAL Range Complex (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 1 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 Shallow Water Training Range (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 25 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 (nonparticipants) 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 Southern California (SOCAL) Range Complex (Range Complex), which encompasses the surface and subsurface ocean Operating Areas (OPAREAs), over-ocean military airspace, and San Clemente Island (SCI). This section specifically addresses marine invertebrates and flora. The marine plants and invertebrates are addressed in Section 3.6; fish and commercial harvesting of marine invertebrates are addressed in Section 3.7, sea turtles in Section 3.8, marine mammals in Section 3.9, and sea birds in Section 3.10. Threatened and endangered species, as defined by the United States (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 Operating Areas

3.6.1.1.1 Existing Conditions

Offshore Environment

Marine Flora

Most of the marine flora in the offshore environment of the Range 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 Southern California Bight (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 and 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 degrees north [°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 492 to 656 ft (150 and 200 meters [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 164 to 492 ft (50 to 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 coastal pelagic species (CPS) species (CDFG 2005, Zieberg et al. 2006). During daylight, the pelagic market squid occurs at depths between 1,640 and 2,625 ft (500 and 800 m) (PFMC 1998) and moves to the surface to feed at night. While spawning can occur from May through October for 1- to 3-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 from 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 percent 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, sea grass, and kelp forest habitat. A brief description of each of these habitats is provided below.

Intertidal habitats of the SOCAL Range Complex are semidiurnal (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, sea stars, 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 percent of the shoreline and approximately 23 percent 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 percent of the San Diego County coastline and the remaining 86 percent 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 6-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 and biological 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 and sea spray. 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 (e.g., *Endocladia muricata*, *Gelidium* spp *Mastocarpus papillatus*); 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 (in.) (10 millimeters [mm]) 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 grams carbon (gC)/square meters [m^2]/year [yr], making it one of the most productive habitats in the ocean (Zimmerman 2003). In San Diego Bay, eelgrass covers approximately 440 hectares (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 Bureau of Land Management (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/hard-bottom community data for the SOCAL OPAREAs. A few locations of deep-sea corals are known; however, live/hard-bottom 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.), heterokontophytes (formerly 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 heterokontophyte commonly known as kelp. Kelp attaches to rocky substrates at subtidal depths and forms 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 in 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 1 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).

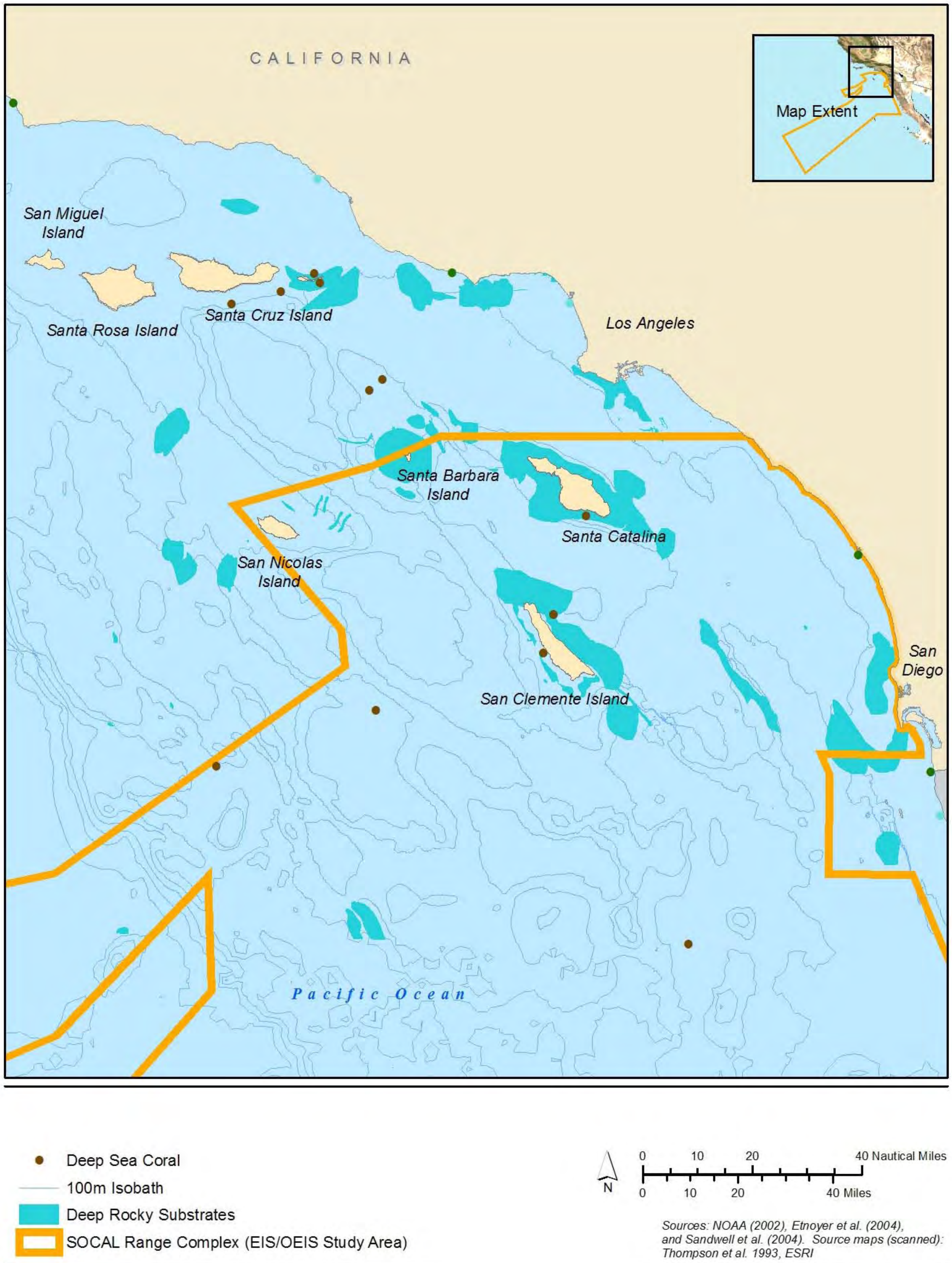

Figure 3.6-3: Live Hardbottom Community Locations

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 State Water Resources Control Board (SWRCB) has also designated stretches of the island's coastline as an Area of Special Biological Significance (ASBS). The kelp habitat associated with San Clemente Island is subject to both recreational and commercial harvest and is managed by the California Department of Fish and Game (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 (ac) (13,960 to 4,532 to 2,953 ha), respectively (Leet et al. 2001). In the SOCAL OPAREAs, kelp habitats of concern include 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 (33 ft [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 hard-bottom 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 (EO) 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 EO 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, noncalcified Octocorals (soft corals) and Gorgonian corals, all growing in the 0- to 300-ft-depth range. Deep water (300- to 3,000-ft-depth range) precious corals and other deep-water coral communities will only be considered in the case of a Sinking Exercise (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 in. (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 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 in./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 ft (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 and 100 hertz (Hz) for three species of cephalopods. Lovell et al. (2005) concluded that at least one species from the invertebrate sub-phylum of crustacean (*Palaemon serratus*), is sensitive to the motion of water particles displaced by low-frequency sounds ranging from 100 Hz up to 3000 Hz. 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 is 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 micro-Pascal (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 3 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 3 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 (nonmotile) 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, SCI Marine Resources

	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
	Heterokontophyta (formerly 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
	Jania sp.	red algae

Table 3.6-1: List of Intertidal and Subtidal Organisms, SCI Marine Resources (cont'd)

	Scientific Name	Common Name
Plants	**Phaeophyta (continued)**	
	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

Table 3.6-1: List of Intertidal and Subtidal Organisms, SCI Marine Resources (cont'd)

	Scientific Name	Common Name
Animals	**Arthropoda (continued)**	
	Ligia occidentalis	rock louse
	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 square miles ($mi.^2$) (24.1 km^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 $mi.^2$ (9.1 km^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

The Navy has no mitigation measures in place specifically for marine plants and invertebrates. However, marine plants and invertebrates benefit from the following measures in place to protect marine mammals and sea turtles (see Section 5.8). 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 yards (yd) (585 m) of known or observed 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 kelp beds, floating plants, or algal mats. For air-to-surface missile exercises, the buffer zone is extended to 1,800 yds (1,646 m) around 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. National Oceanographic and Atmospheric Administration (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, many are located within the boundaries of the SOCAL Range Complex (NOAA 2004a). Figure 3.6-6 depicts the MMAs in and around SOCAL.

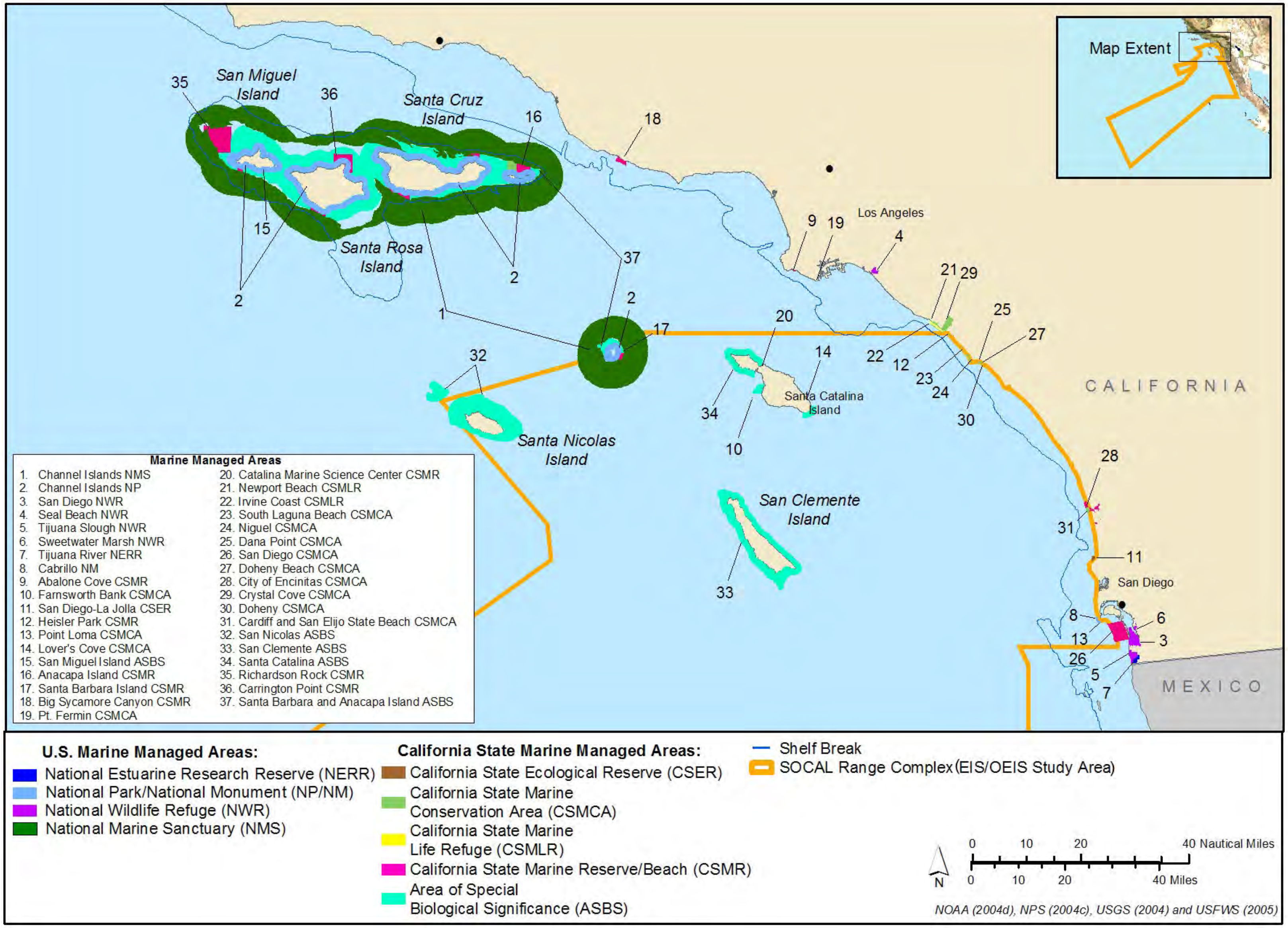

Figure 3.6-6: Locations of U.S. Federal Marine Managed Areas (MMA) and California State MMAs in SOCAL and vicinity

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 nautical miles (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 National Marine Sanctuary (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 CINMS 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 C.F.R. § 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 C.F.R. § 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 DoD. 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 composed of 160 acres of the southernmost 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 nonmajor U.S.-owned lands (rocks, islands, etc.) along the coast of California from mean high tide out to a distance of 12 nm (22 kilometers [km]) 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 ac (1,009 square kilometers [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 [3,825.6 ha]), Seal Beach NWR (911 ac [368.7 ha]), Tijuana Slough NWR (1,051 ac [425.3 ha]), and Sweetwater Marsh NWR (316 ac [146.1 ha])—lies at several locations along the coast of Southern California; some of these locations are in the vicinity of the SOCAL Range Complex. This wildlife refuge 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-ac reserve contains a variety of habitats, including salt marshes, mudflats, beaches, dunes, riparian zones, and coastal sage environments and is home to several Federal endangered and threatened shorebirds and salt marsh 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 geographical information system (GIS) data have 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 percent hard-bottom habitat. This reserve is frequently used as a tourist destination in the summer months.

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-m^2 (2.1-km^2) refuge consists of 50-percent hard-bottom and 50-percent soft-bottom 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-percent hard-bottom and 10-percent soft-bottom 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) beach 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 endangered 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 in. (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 ac (0.5 ha) of habitat. The mean density calculated from these data was 6.7 white abalone per ac (range 0 to 24.2 per ac) with densities at Tanner and Cortes Banks being the highest.

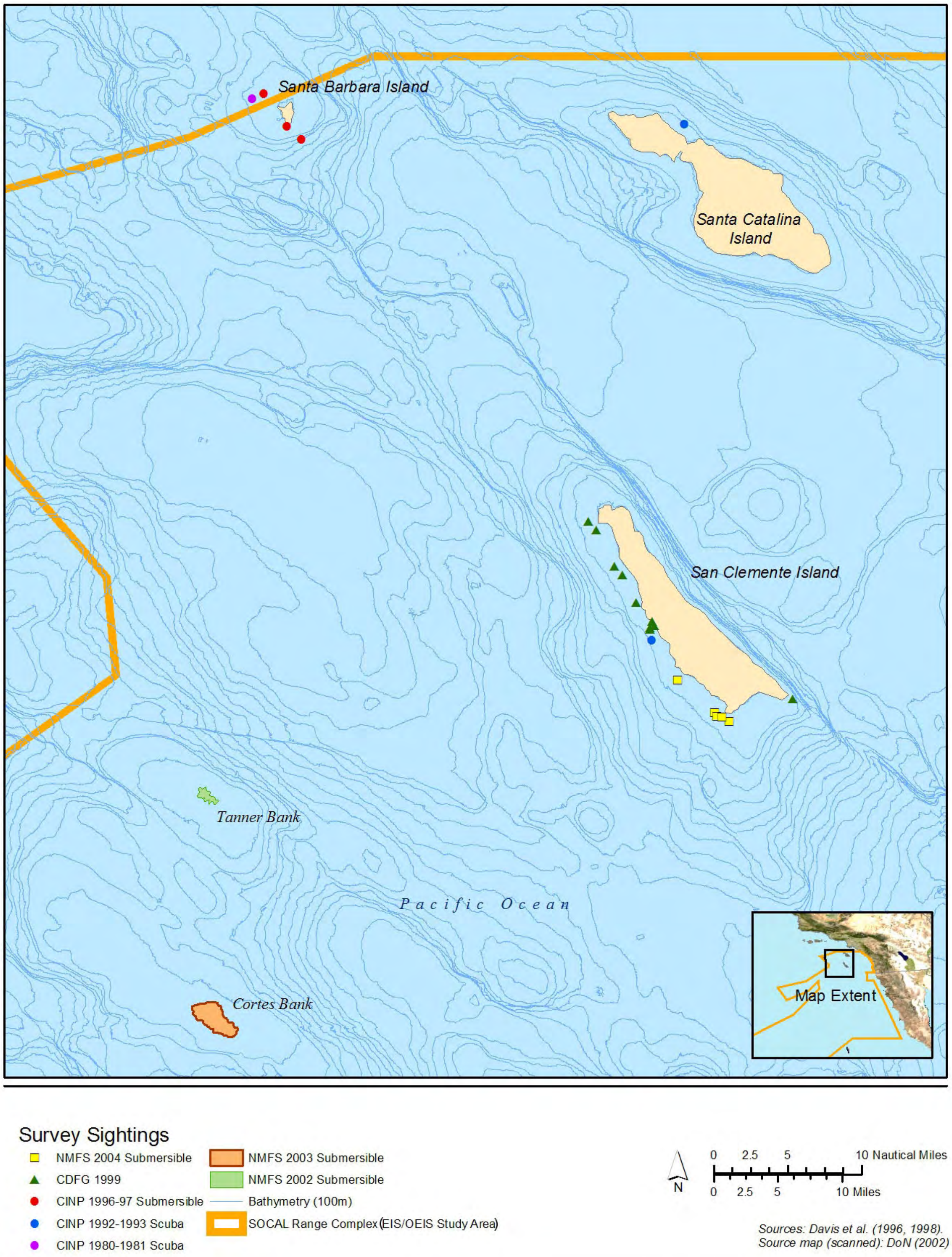

Figure 3.6-7: Locations of White Abalone in the SOCAL OPAREAs and Vicinity

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. 2006). 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 10-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 remotely operated vehicle 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 ac (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's Candidate Species list on June 23, 1999 (64 FR 33466), transferred to NMFS's 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 Endangered Species Act (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 occurs rarely 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 seastars, 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 (Haaker et al. 1992, Richards and Davis 1993, Lafferty and Kuris 1993). The cause of Withering Syndrome 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 Withering Syndrome 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 ac (9,150 m^2).

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 sea birds 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
- Exceedance of National Ambient Water Quality Criteria (NAWQC) or *Ocean Plan* standards for water quality (see Section 3.4)
- Exceedance 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 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 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 (Warning Area 291 [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 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 the Southern California ASW Range (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 lb (41,199 kg) of sonobuoy debris would accumulate on the ocean bottom within the SOCAL OPAREAs annually (see Section 3.1, Geology and Soils). The area of SOAR is 670 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 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 exceed 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 yr (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 yr (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-yr period, the total deposition of lead on the seafloor from solder and ballast weights would amount to 115,228 lb (52,376 kilogram [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 in. (10 centimeters [cm]) of ocean sediments (assuming a dry weight mass of 800 kg/cubic meter [m^3]) would amount to an average concentration of 1.89 milligram (mg)/kg. This concentration is 4 percent of the ER-L for lead in sediments, which equals 46.7 parts per million (ppm, 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 3.4.3).

- Most of the expended exhaust products would be nontoxic, with the exception of cyanide, which, based on a U.S. Environmental Protection Agency (USEPA) criterion of 1 part per billion (ppb), 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 nontoxic, 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 Exercise (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 yr. 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 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. This activity is not concentrated in any one area but takes place throughout the SOCAL Range Complex.

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. This activity is not concentrated in any one area but takes place throughout the SOCAL Range Complex.

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-in 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 ft] 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 the Shore Bombardment Area (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, Hazardous Materials, 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 ft^2, 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 predisturbance 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 Naval Surface Fire Support (NSFS) 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 (AAVs) (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 beaches, 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 FY2004, 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 nontoxic. 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 nonhazardous, 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 FY2004, 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 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 nonhazardous 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.

Unmanned Area Vehicle (UAV)/Unmanned Aerial System (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 Silver Strand Training Complex (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 affect marine biological resources; therefore, impacts are anticipated to be minimal.

Sea, Air, Land (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 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 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.

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 Ballistic Aerial Target System (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 to 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

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 nonrunning 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 10 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 Naval Ordnance Test Station (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 FY2004, 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 Anti-Submarine Warfare (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 QA 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 Self-Contained Underwater Breathing Apparatus (SCUBA) divers or with Remotely Piloted Vehicles (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 FY2004, 242 operations were conducted, utilizing 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. Space and Naval Warfare Systems Center (SPAWAR) trains and deploys marine mammals (dolphins and sea lions) 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 five times in the No Action Alternative. The Joint Standoff Weapon (JSOW) missile testing program at SCI was the subject of an Environmental Assessment (EA) (NAWCWPNS, 1994) which resulted in a Finding of No Significant Impact (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 Undersea Warfare (USW) exercises and test programs. It also provides engineering and technical support for 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 yr. 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 yr., 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 (μm) 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 nm^2) would have no effects on white abalone.

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.

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 hydrogen ion concentration (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.

Mine Training. During mine training exercises, inert mine shapes are dropped from aircraft into specific Mine Training Ranges (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 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 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. 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. 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 Withering Syndrome, and results from islandwide 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 Department of Defense (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 Organic Mine Countermeasure (OMCM) systems.

3.6.2.4.1 SOCAL Range Complex

Anti-Air Warfare 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 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

ASUW 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

AMW 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 AMW 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 U.S. Marine Corps (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 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 (RAMICS). Live-fire operations would be conducted at SCI in one of the MTRs. Nonfiring 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 30-mm 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 Special Warfare Training Area (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 Projects 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 predetermined 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 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, with 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 5 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 5 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 be 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

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 FY2004. These tests include evaluations of a defensive torpedo against an incoming offensive torpedo threat. The 9- to 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.

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 QA/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.

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 San Clemente Island Airfield Activities

Under Alternative 1, the number of Naval Auxiliary Landing Field (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

Based on knowledge of future requirements for the use of new platforms and weapons systems, the use and usage areas will remain similar to platforms that they are replacing. Therefore, the Navy concludes that 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 different impacts than those analyzed in this EIS/OEIS.

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 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 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

AMW 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 AMW 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 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.

Noncombat 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

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 San Clemente Island 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

Based on knowledge of future requirements for the use of new platforms and weapons systems, the use and usage areas will remain similar to platforms that they are replacing. Therefore, the Navy concludes that 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 different impacts than those analyzed in this EIS/OEIS.

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 to 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 2 by 2 nm (3.7x3.7 km) and optimally 3 by 3 nm (5.6x5.6 km). Mine shapes would be approximately 600 yd. (549 m) apart and 30 to 35 in. (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 Section 3.6.1.5.1 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 in. [20 cm], which is twice the width 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 recolonize 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, or 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 3.6.2.2), 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 (Sea Birds) 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, 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 Southern California (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 Operating Areas

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 Niño 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 percent of the total fish species reported and 50 percent of the families (Cross and Allen 1993, Horn et al. 2006). Mesopelagic and bathypelagic (>550 m) fish fauna comprise 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 in 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 Complex in 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. Department of the Navy (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 E – Essential Fish Habitat (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 San Clemente Island (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.

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.

SOCAL Range Complex (EIS/OEIS Study Area)
CA Dept. of Fish and Game (CDFG) Catch Blocks
Warning Area

N
0 10 20 40 Nautical Miles
0 10 20 40 Miles

Sources: CA Dept. of Fish and Game, NGA, ESRI

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	37.1656 04	7,437,305	91,902,096	7.5
All Other Invertebrates	4,508,756	25,867,385	14.8	3,198,996	36,941,056	8.0
Total Invertebrate Landings[1]	**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

[1] Life history and habitat for marine invertebrates are discussed in Section 3.6.

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 (yd²). Mean abundance of fish was 231 per acre (ac) (93 hectares [ha]) at 10 ft (3 m) and 608 per ac 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

Species	Depth	
	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 ac compared to 2,506 fish per ac 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 ac (1290 per ha) to 816 per ac,(330 per ha) and bottom fish from 1,650 per ac (667 per ha) to 804 per ac (325 per ha) (Bodkin 1988). Total (midwater and bottom fish) biomass was reduced from 1,426 pounds (lb) (647 kilograms [kg]) per ac to 585 lb (265 kg) per ac. 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 (for examples see Figures 3.6-2, 3.6-4, and 3.6-5). 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 lb (4,438 kilogram [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.

Ninety six[2] 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 lb (47,173 MT [MT]) in 2002 to 29.4 million lb in 2002. The highest total catches were in 2002 and 2005. A high catch of Pacific sardine (37.2 million lb [16,873 MT]) and squid (53.5 million lb [24,267 MT]) in 2002, and a high catch of squid (63.4 million lb [28,757 MT]) in 2005 contributed strongly to those years' high catches (Table 3.7-7).

[2] Block numbers 737-745, 756-768, 801-814, 821-834, 842-854, 860-873, 877-893, 897, and 950

Table 3.7-7: Annual Catch of Fish and Invertebrates in SOCAL, 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

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)

The average annual catch of crustaceans is about half lobster (average 343,289 lb [155 MT] per year) and half spot prawns (average 263,802 lb [120 MT] 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 SOCAL from 2002 to 2005

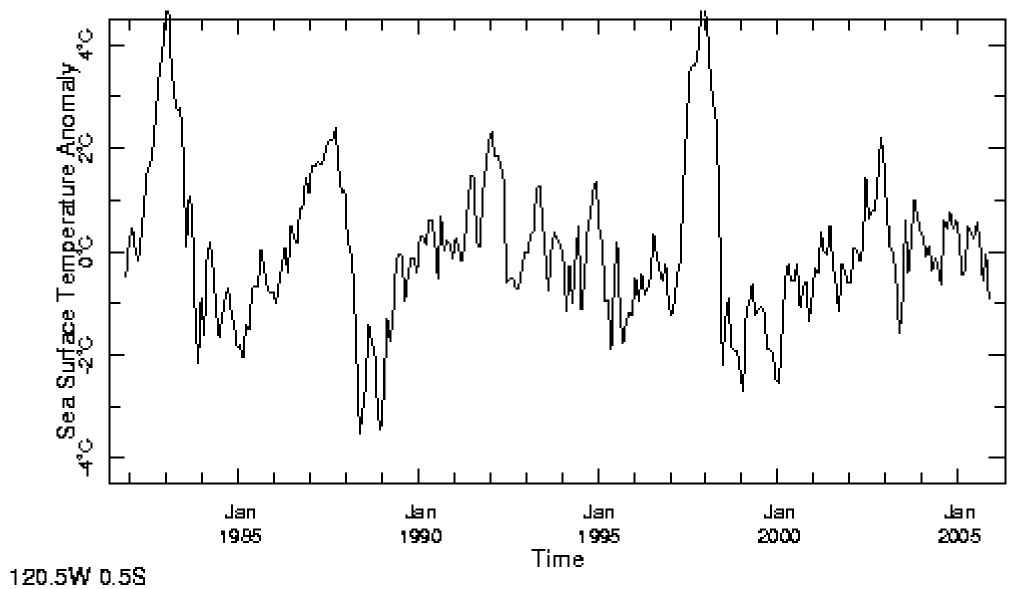
	Pounds Landed			
Species	**Winter**	**Spring**	**Summer**	**Fall**
Tuna, yellowfin	20,700	1,189	523,556	3,863
Tuna, bluefin	0	3,207	505,071	6,435
Tuna, albacore	21	834,925	941,901	234,340
Other tuna	0	0	1,051,369	11,145
Mackerel, Pacific	3,756,415	2,231,904	16,170,186	5,430,490
Mackerel, jack	2,133,770	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 catches 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 SOCAL

	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 3.7-8 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.

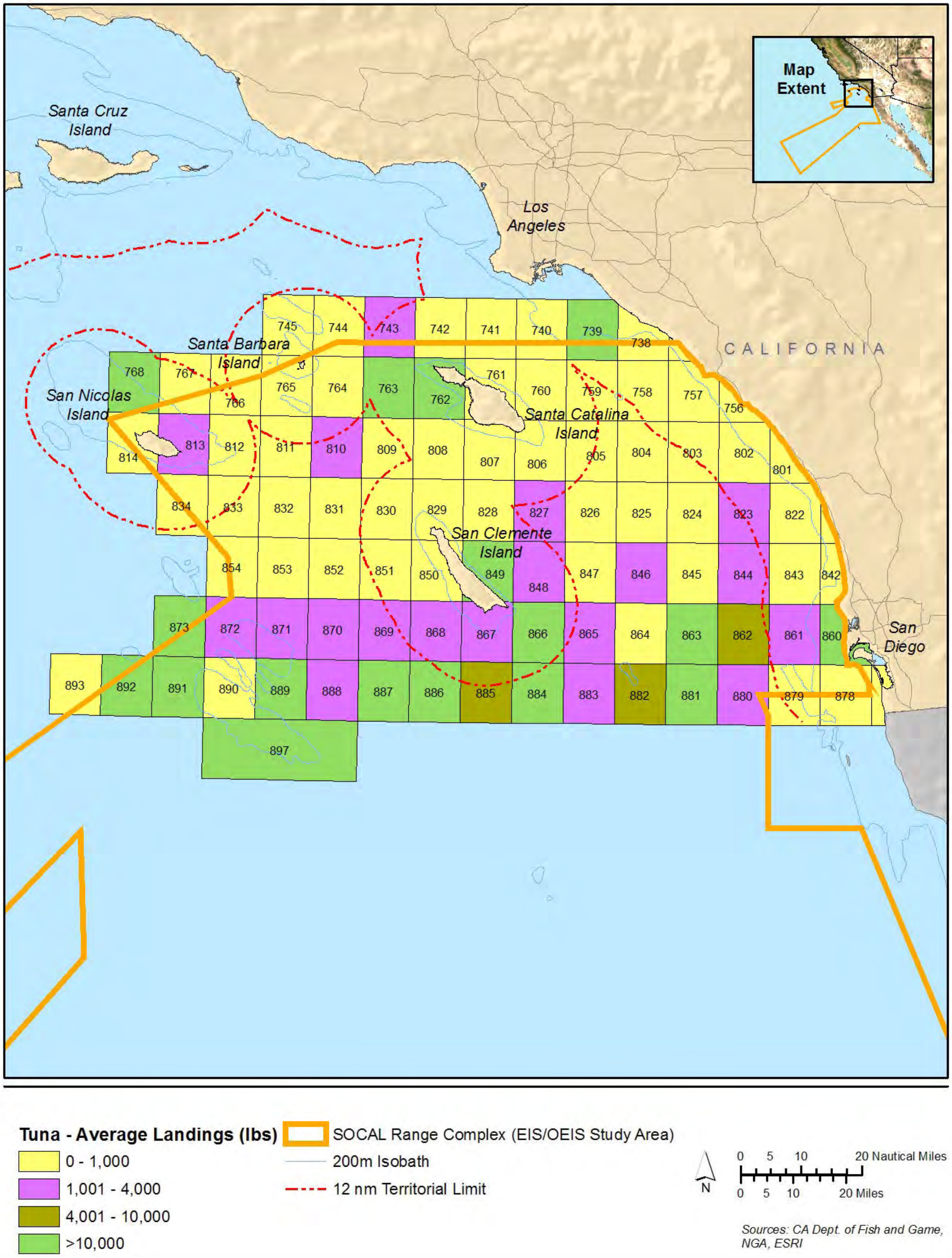
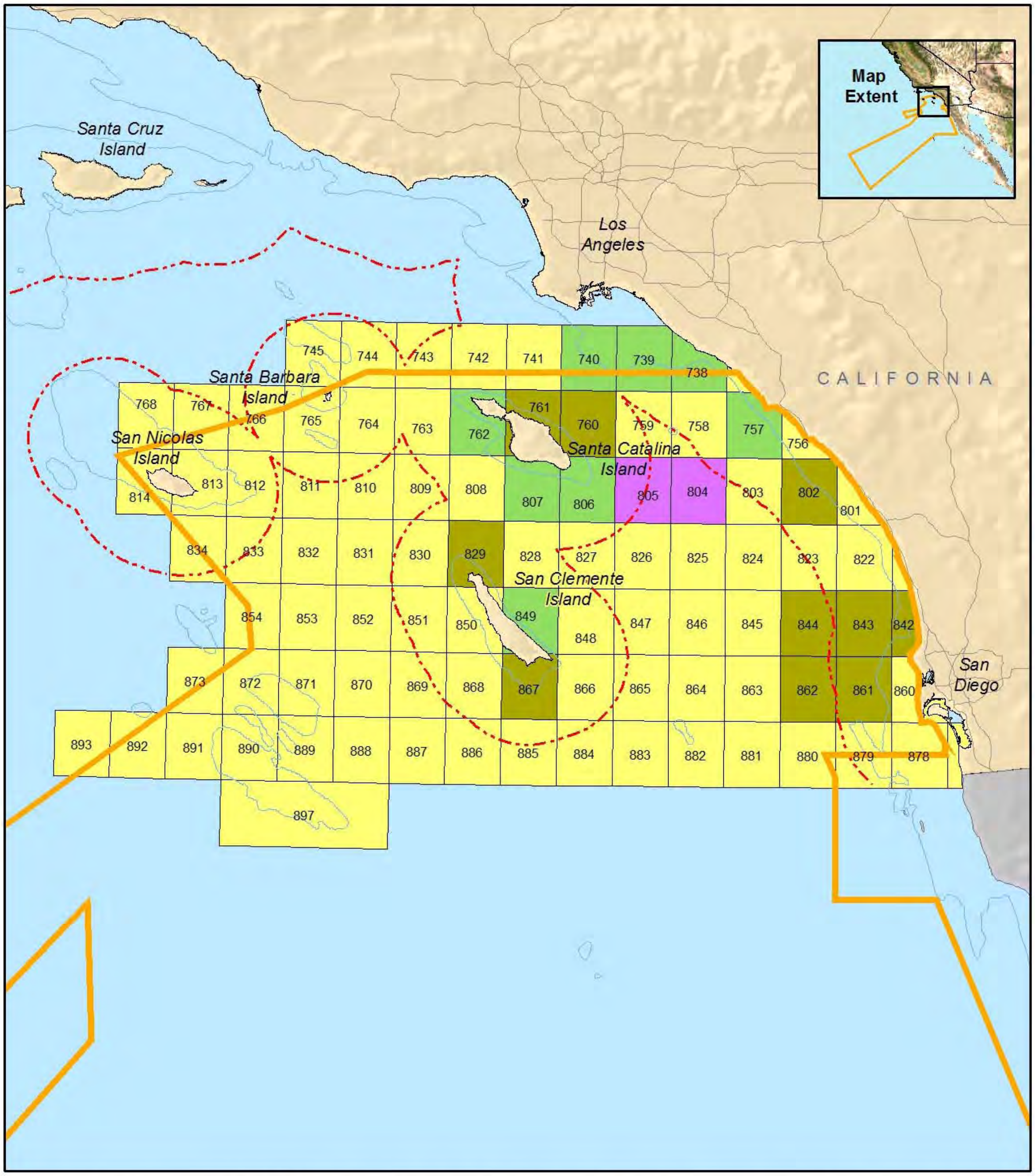


Figure 3.7-3: Average Annual Catch of Species of Tuna in Each CDFG Statistical Block in SOCAL, 2002–2005



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.

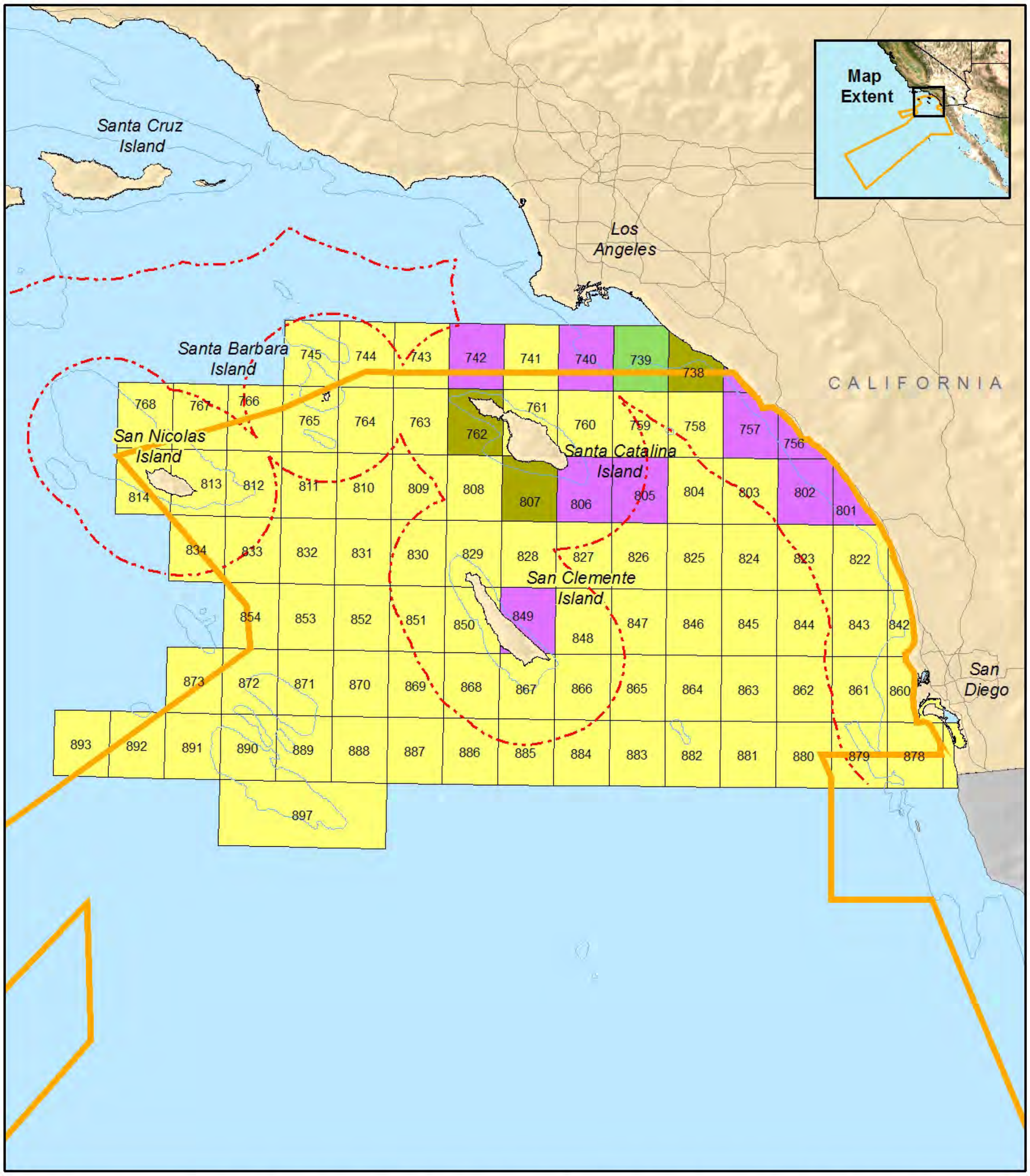
Mackerel - Average Landings (lbs)
- 0 - 1,0000
- 10,001 - 20,000
- 20,001 - 80,000
- >80,001

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 3.7-4: 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

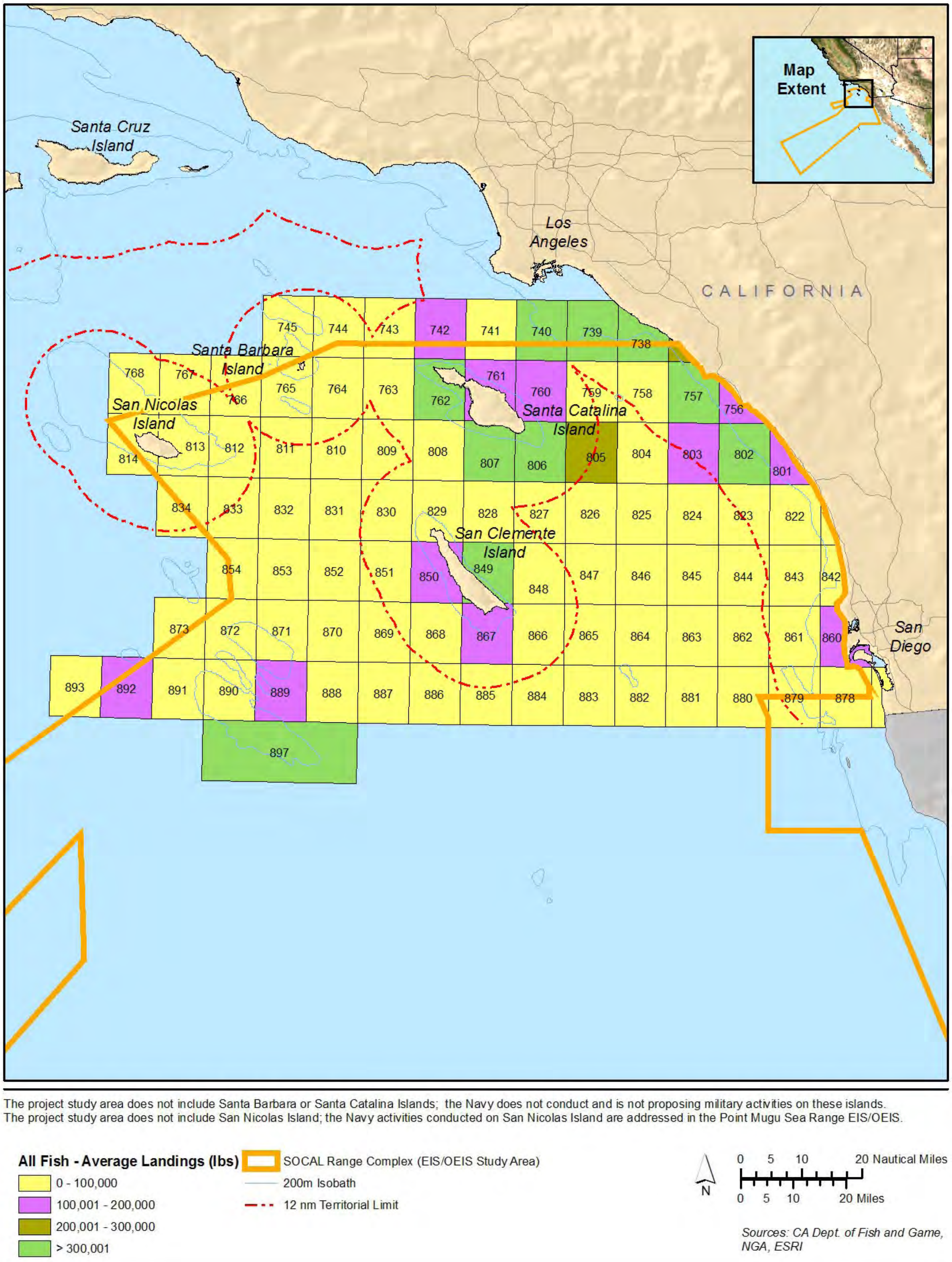
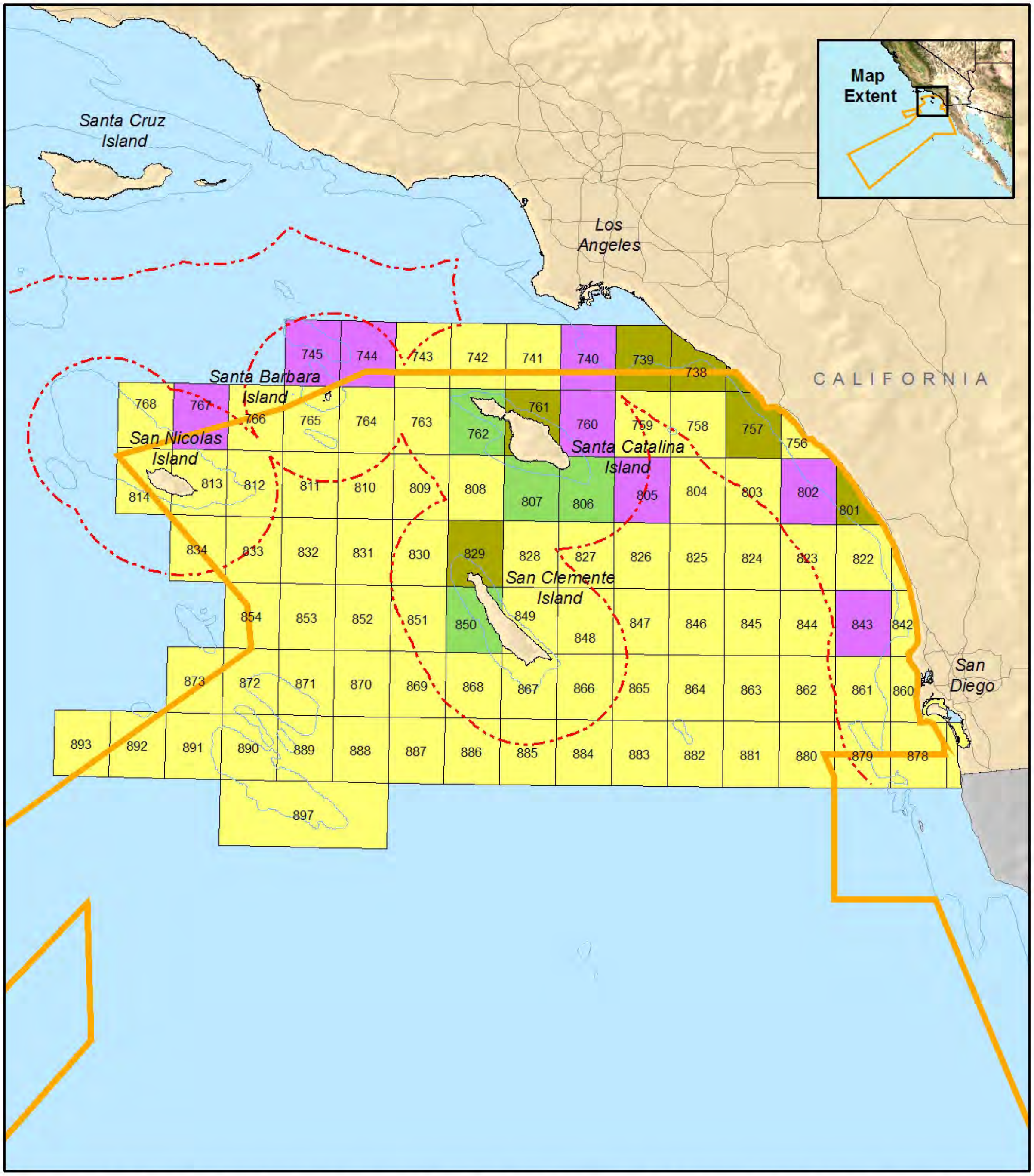


Figure 3.7-6: Average Annual Catch of All Fish Species in Each CDFG Statistical Block in the SOCAL OPAREAs, 2002–2005



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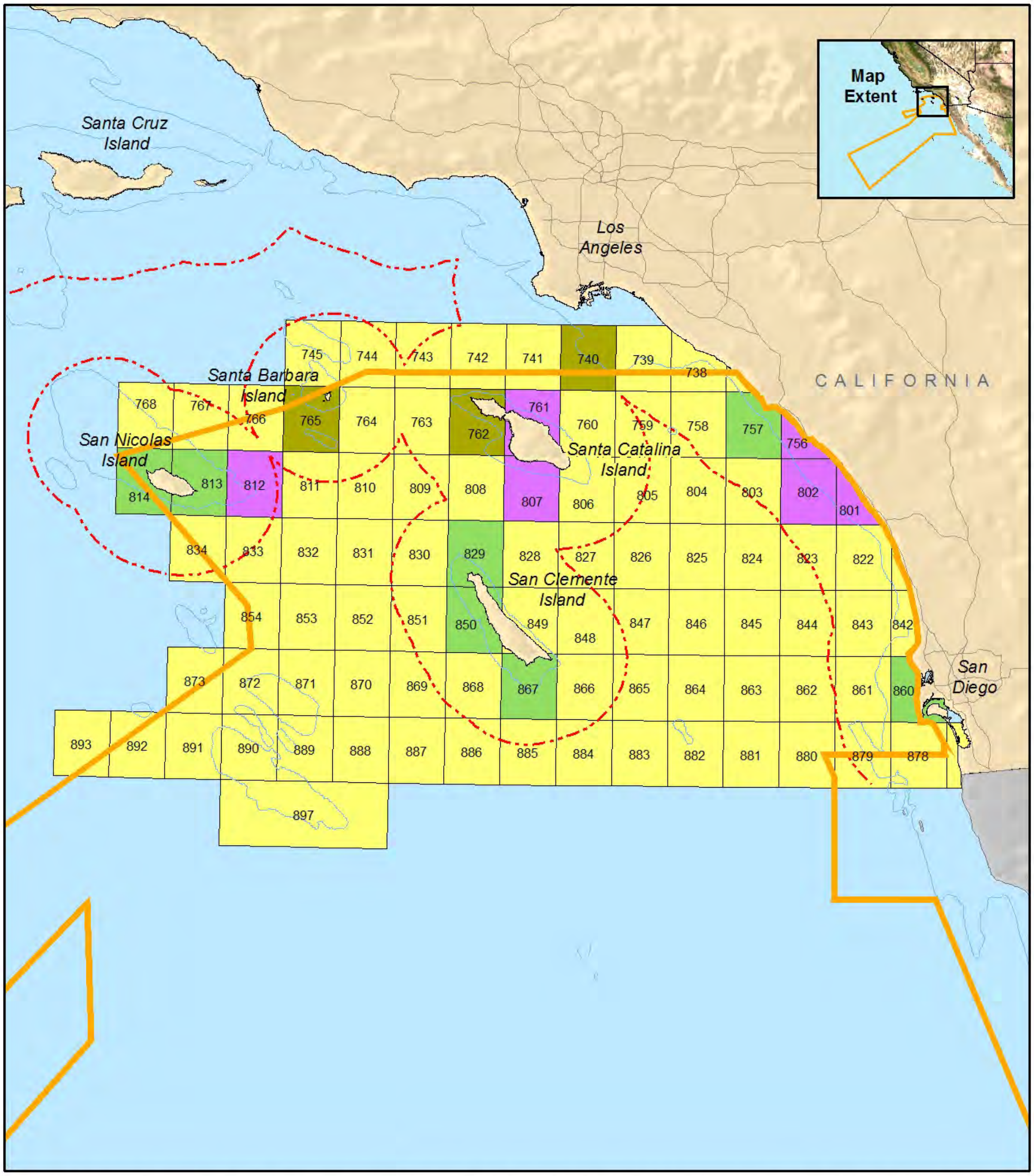
Squid - Average Landings (lbs)
- 0 - 100,000
- 100,001 - 400,000
- 400,001 - 1,500,000
- > 1,500,001

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



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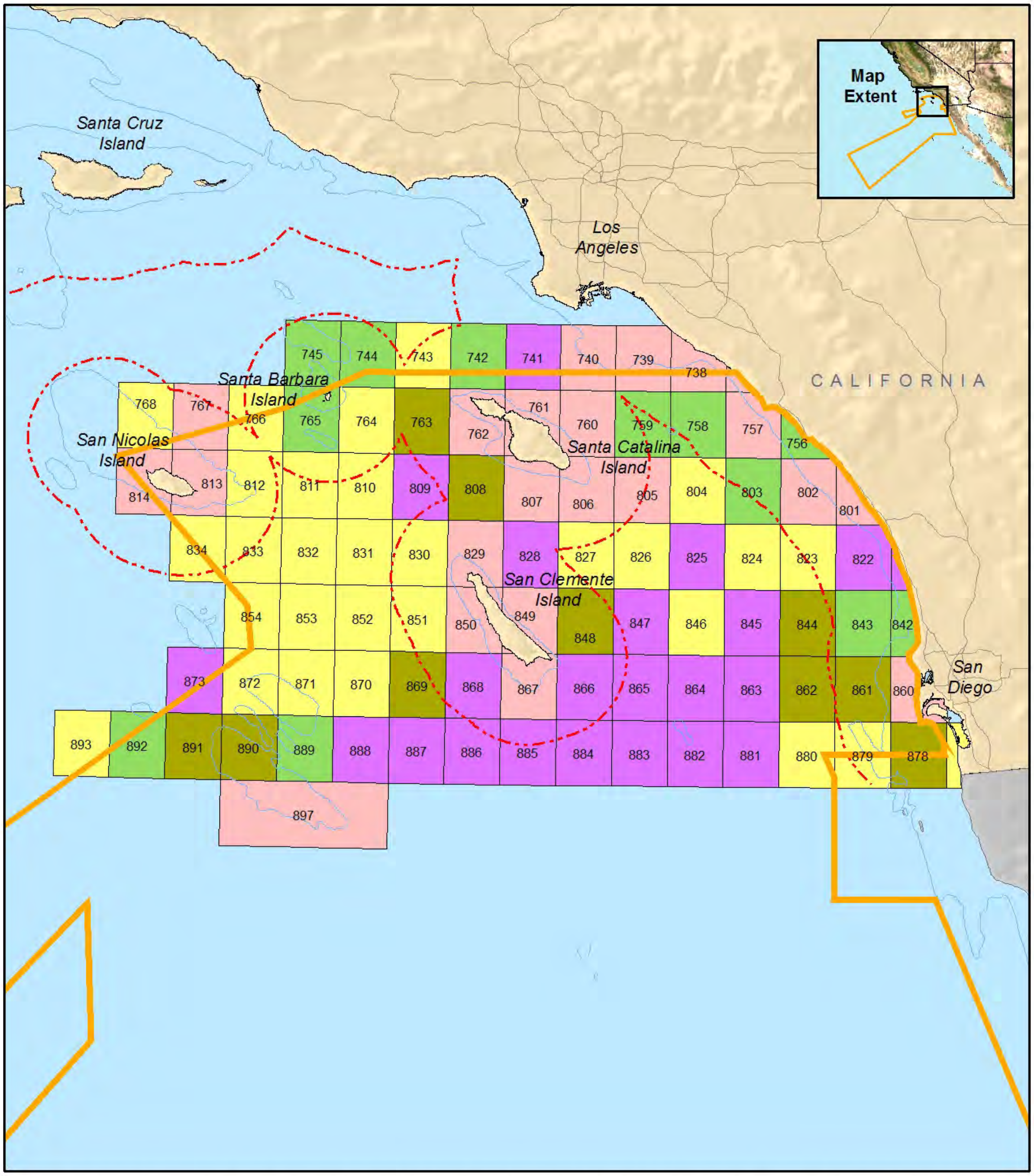
Urchins - Average Landings (lbs)
- 0 - 10,000
- 10,001 - 30,000
- 30,001 - 90,000
- > 90,001

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

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 Code of Federal Regulations [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 Southern California Offshore Range (SCORE) website, Notice to Mariners (NOTMARs), and Notice to Airmen (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.

Special Areas – Essential Fish Habitat

The Magnuson-Stevens Fisheries Conservation and Management Act (MSFCMA) (16 United States Code [U.S.C.] Section [§] 1801 et seq.), mandates identification and conservation of 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, hardbottom, structures underlying the waters, and associated biological communities.

A habitat type is also identified to focus conservation efforts: Habitat Areas of Particular Concern (HAPCs). 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 National Oceanographic and Atmospheric Administration (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 m (1,914 fathoms) are designated as EFH for groundfish managed species (seamounts out to 200 nautical miles [nm] or 370 kilometers [km] offshore are also included). The Pacific Groundfish FMP divides EFH into seven composite habitats including their waters, substrates, and biological communities, and includes:

- 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 Exclusive Economic Zone (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 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 (Convention). 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-mi. 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 United States (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 nondetectable 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 kilohertz (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?

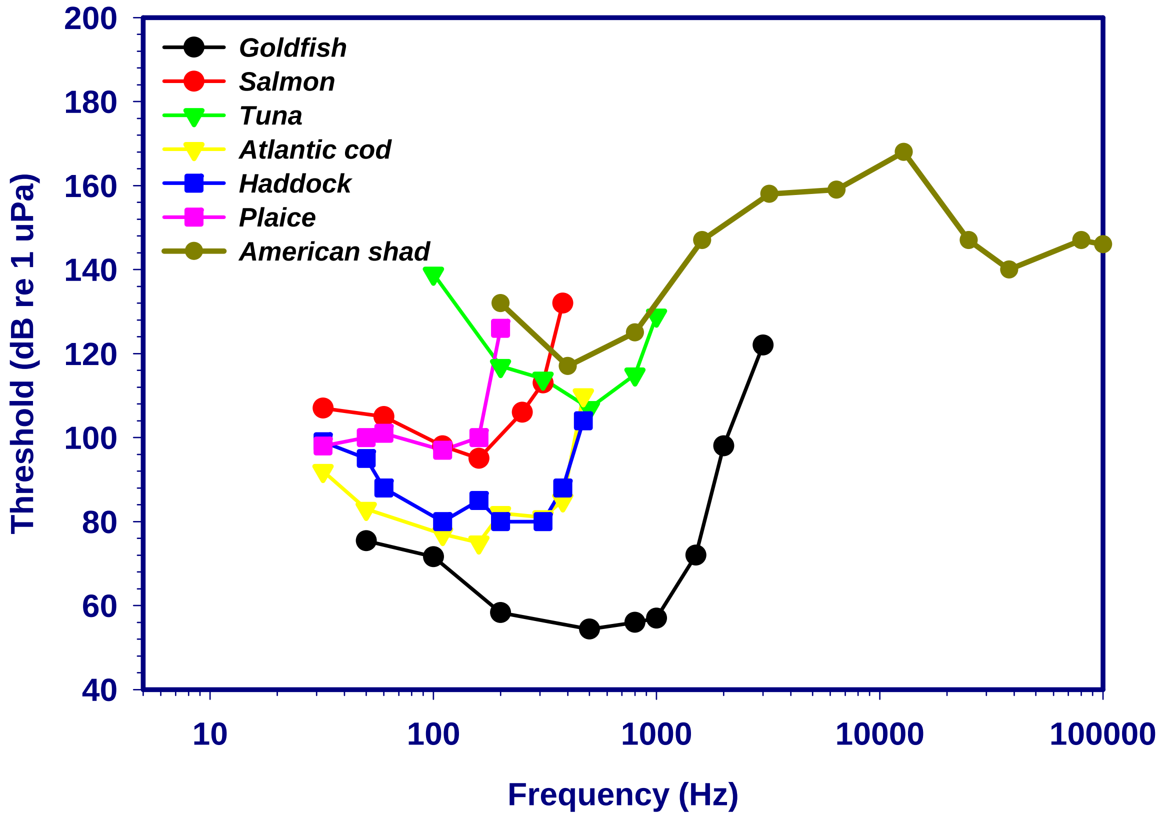
Basic data on hearing provides information about the range of frequencies that a fish can detect, and the lowest sound level that an animal is able to detect at a particular frequency. This level is often called the "threshold." Sounds that are above threshold are detectable by fish. It therefore follows 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).

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.



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)

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 nonspecialists) 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 nearby 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, Popper 1980), 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 subfamily 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 overdriven 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 decibels (dB) re 1 µPa, which likely only allows for detection of odontocete's clicks at distances no greater than 33 to 98 ft (10 to 30 m) (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 nonexistent (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 nonreproductive 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 too 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 wider 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 nearby 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.
- As indicated above, Table 3.7-10 provides data for all marine fish species studies to date to provide information on the current state of the knowledge on fish hearing. In presenting this assessment and evaluation of environmental consequences associated with the proposed action and alternatives, the Navy is aware that many of the individual species or families on the table may not occur in the SOCAL OPAREAs, however, the information is considered the most relevant for a comprehensive assessment of fish hearing, and it is noted that several species (e.g., Pacific herring and bluefin, yellowfin and skipjack tuna) do occur specifically within the study area for this EIS/OEIS.

- Table 3.7-10: Marine Fish Hearing Sensitivity

Family	Description of Family	Common Name	Scientific Name	Hearing Range (Hz) Low	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*[3]	50	1,000	100	Popper and Tavolga 1981
Batrachoididae	Toadfishes	Midshipman[4]	*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
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

[3] Formerly *Arius felis*
[4] Data obtained using saccular potentials, a method that does not necessarily reveal the full bandwidth of hearing.

Table 3.7-10: Marine Fish Hearing Sensitivity (continued)

Family	Description of Family	Common Name	Scientific Name	Hearing Range (Hz)		Best Sensitivity (Hz)	Reference
				Low	High		
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
Lutjanidae	Snappers	Schoolmaster snapper	*Lutjanus apodus*	100	1,000	300	Tavolga and Wodinksy 1963
Myctophidae[5]	Lanternfishe s	Warming's lanternfish	*Ceratoscopelus warmingii*	Specialist			Popper 1977
Pleuronectidae	Flatfish[6]	Dab	*Limanda limanda*	30	270	100	Chapman and Sand 1974
		European plaice	*Pleuronectes platessa*	30	200	110	

[5] 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.
[6] Note, data for these species should be expressed in particle motion since it has no swim bladder. See Chapman and Sand, 1974 for discussion.

Table 3.7-10: Marine Fish Hearing Sensitivity (continued)

Family	Description of Family	Common Name	Scientific Name	Hearing Range (Hz)		Best Sensitivity (Hz)	Reference
				Low	High		
Pomadasyidae	Grunts	Blue striped grunt	*Haemulon sciurus*	100	1,000		Tavolga and Wodinsky 1963
Pomacentridae	Damselfish[7]	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
		Beaugregory[8]	*Stegatus leucostictus*[*]	100	1,200	500-600	Myrberg and Spires 1980
		Dusky damselfish	*Stegastes adustus*[*, 9]	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

[7] 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).
[8] Similar results in Tavolga and Wodinsky 1963.
[9] Formerly *Eupomacentrus dorsopunicans*.

Table 3.7-10: Marine Fish Hearing Sensitivity (continued)

Family	Description of Family	Common Name	Scientific Name	Hearing Range (Hz) Low	Hearing Range (Hz) High	Best Sensitivity (Hz)	Reference
Sciaenidae		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
		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.

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*

Table 3.7-11: Common and Scientific Names of Fishes Mentioned in the Text (cont'd)

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*

Table 3.7-11: Common and Scientific Names of Fishes Mentioned in the Text (continued)

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*

3.7.1.1.3 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).

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).

Figure 3.7-12: Adult Steelhead Trout Potential Marine Habitat Range in the SOCAL OPAREAs and Vicinity

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 SCB, 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 ESUs of chinook salmon in Washington, Oregon, Idaho, and California. Each ESU is treated as a separate species under the ESA. Listing status varies by ESU, some are listed as endangered and others do not warrant listing. 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 SCB, given the lack of observations or incidences of bycatch in Southern California fisheries, they are likely rare visitors to the area.

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.

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 nonacoustic 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 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 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. 2008). 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 nonauditory 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 9 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 to 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 nonauditory tissues. One study tested effects of seismic airguns, a highly impulsive and intense sound source, while the other study examined the effects of low-frequency 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. 2008) 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 cubic inch (in^3) (12,000 cubic centimeters [cc]) calibrated airgun array. And, unlike earlier studies, the received exposure levels were not only determined for root mean square sound pressure level, but also for peak sound levels and for Sound Exposure Levels (SELs) (e.g., average mean peak Sound Pressure Level (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 study of low-frequency sonar) 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 Low-Frequency Sonar on Fish

Popper et al. (2007) studied the effect of low-frequency sonar on hearing, the structure of the ear, and select nonauditory systems in the rainbow trout (*Oncorhynchus mykiss*) and channel catfish (*Ictalurus punctatus*) (also Halvorsen et al. 2006).

The 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 low-frequency 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 low-frequency 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 nonauditory tissues to determine any nonhearing 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 low-frequency 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 outdoors, 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 to 20 dB of hearing loss immediately after exposure to the low-frequency 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 centimeters [cm] [0.79 to 2 in]), Atlantic cod

(*Gadus morhua*) (standard length 2 and 6 cm [0.79 to 2.4 in]), saithe (*Pollachius virens*) (4 cm [1.6 in]), and spotted wolffish (*Anarhichas minor*) (4 cm [1.6 in]) at different developmental stages.

Fish were placed in plastic bags 3 m from the sonar source and exposed to between 4 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 postexposure 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 low-frequency sonar study (Popper et al., 2007) or the study of effects of seismic airguns on hearing (Popper et al. 2005, Song et al. 2008), 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 nonauditory 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 low-frequency 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 to 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 percent decrease in rockfish (*Sebastes* sp.) catch when the area of catch was exposed to a single airgun emission at 186 to 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 Mid-Frequency Active (MFA) sonar 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 nonspecialist and marine species. Tavolga (1974a, b) studied the effects of noise on pure-tone detection in two nonspecialists 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 sites (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 nonbiological 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 3 to 4 nm (5 to 8 km) 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 nonacoustic 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 to 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 Nonauditory 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” preexposure 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

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 about 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 nonauditory 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 nonmortality damage in the short term 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 millisecond [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 grams (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 [pounds per square inch per millisecond]), which caused 50 percent 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 nonexistent. 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 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 impacts on the behavior of fish will be few, and are more likely to be none.

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 in response 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, 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; Mine Laying 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 to 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 at 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 328 ft (100 m) and 185 dB re 1 µPa at ~18 ft (5.5 m). The resulting ensonified areas (semicircles with radii of 100 and 5.5 m) would be 0.015 square kilometer (km^2) and ~50 square meters (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).

Table 3.7-12: Impulses that Would Cause No Injury or Mortality

	Body Mass			Habitat			Injury (Impulse Pascal·seconds)		
Species	Lb	Kg	Swim Bladder	Inshore	Offshore	Water Column	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	NA	NA	NA
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 - reduced, N - none, Y - has swim bladder, NA – not applicable, no swim bladder.
Results derived from applying Yelverton's (1981) equations to typical fish weights.
Table limited to common species of fish that occur in the SOCAL Range Complex and that have swim bladders.

There are three underwater explosive exercises conducted in Northwest Harbor: the single-charge exercise, the multiple-charge obstacle loading exercise, and the multiple-charge mat-weave exercise. Measurements of the propagated pressures in live-fire tests during single-charge, multiple-charge obstacle loading, and multiple-charge mat-weave 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 single-charge, multiple-charge obstacle loading, and multiple-charge mat-weave 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 single-charge exercises, measurements of propagated peak-peak pressures at about 1000 ft (304.8 m) for 15 lb (6.8 kg) charges detonated in 15 ft (4.6 m) of water—on and 2 ft (0.6 m) off the bottom at both sites—produced peak-pressures that were only about one-fourth 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 1,000-ft distances. Off-bottom 15-lb charges in 15 ft of water produced between 43- and 67-percent 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-percent greater peak-pressure than a similar on-bottom charge as measured at about 190 ft distance. The single-charge exercises in the proposed action only use on-bottom positions and the multiple-charge mat-weave 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 single-charge detonations and both the multiple-charge obstacle loading and MW detonations, the deeper measuring gauges 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 multiple-charge obstacle loading exercise, the deepest gauges were at 79 and 66 percent of the water depth at about 800- and 1,800-ft distances, respectively. These gauges 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 gauges in the upper half of the column. In the multiple-charge mat-weave exercise, the effect was not seen at about 1,000 ft distance, but a similar trend was seen at about 2,300 ft. While the data are suggestive of a general trend for VSW detonations and VSW propagation, the deepest gauges 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 multiple-charge obstacle loading and multiple-charge mat-weave 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 multiple-charge obstacle loading exercise with 16, 20-lb charges of C4, measurements at about the 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 multiple-charge obstacle loading 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 multiple-charge obstacle loading exercises at that site. For the multiple-charge mat-weave exercise, the measured peak-pressures at about 1,000 ft were those that would be expected from only a few pounds of trinitrotoluene (TNT) at that distance. In the multiple-charge mat-weave 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 multiple-charge mat-weave 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.

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 3.7-13. 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.

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.

Table 3.7-13: Impulses (Pa·s) Causing 50 Percent 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)

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 frequency modulated [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 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 that 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 584 ft (178 m) and to a depth of 748 ft (228 m) (if the sonar is placed 164-ft [50-m] deep). Lowering the source level by 25 dB reduced the ranges by over a 328 ft (100 m). For an FM-signal, injury was predicted to occur over a radius of 184 ft (56 m) and to a depth of 358 ft (106 m). Lowering of the source level of the FM-signal by 25 dB reduced the ranges by over 164 ft (50 m). 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 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 the type considered to cause most impact, CW signals, will rarely be used.

Table 3.7-14: Frequency Bands for Which a Juvenile Herring Is Likely to Be Affected During the Use of CW-Sonar Signals

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

Note: 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).

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 Low-Frequency Active (LFA) 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.

3.7.2.1.5 Nonacoustic 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 nontoxic 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 Operating Areas

Anti-Air Warfare 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 3.7.2.1.4, 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 3.7.2.1.4, and impacts are expected to be minimal.

Missile 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 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, Section 3.7.2.1.2, and Section 3.7.2.1.4.

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 greater than 10 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 Glide Bomb Unit (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 to 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 at 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 3.7.2.1.3, and 3.7.2.1.4, 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 U.S. Environmental Protection Agency (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.

Amphibious Warfare

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 3.7.2.1.4 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 Section 3.7.2.1.3, 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), First Marine Expeditionary Force (I MEF), Assault Amphibian School Battalion, Boat Company 5th Marine Regiment, and 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 3.7.2.1.4, and impacts are expected to be minimal.

Electronic Warfare

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 3.7.2.1.4, and impacts are expected to be minimal.

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 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 Southern California ASW Range (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, 3.7.2.1.2, and 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 Fiscal Year (FY)2004, 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, 3.7.2.1.3, and 3.7.2.1.4, and impacts are expected to be minimal.

Naval Special Warfare Training

NSW Center Underwater Demolitions. Navy SEAL underwater demolitions training takes place in shallow waters, primarily in Northwest Harbor at depths of 5 to 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.

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 percent 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).

Table 3.7-15: Net Explosive Weight, 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

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 Silver Strand Training Complex (SSTC). No aspects of this operation affects 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 3.7.2.1.4, 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.

Strike

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 Shore Bombardment Areas (SHOBA), and aspects of the exercise that have potential effects on fish are aircraft overflights. Aircraft overflights are discussed in Section 3.7.2.1.4, 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 3.7.2.1.4 and impacts are expected to be minimal.

Research, Development, Test and Evaluation

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 3.7.2.1.4. The MK-54 torpedoes and MK-30 and MK-39 EMATT acoustic training targets are considered to have nonproblematic 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 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 nonproblematic. 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.

<u>Naval Auxiliary Landing Field San Clemente Island Airfield Activities</u>

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 3.7.2.1.4, and impacts are expected to be minimal.

3.7.2.2.2 Rare, Threatened, and Endangered Species

<u>Steelhead and Other Anadromous Species</u>

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 (mi.) (14 km) south of Laguna Beach and 7.5 mi. (12 km) north of Camp Pendleton) in December 2002 (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 fish are believed to inhabit nearshore coastal waters, which have access to streams that are used for spawning. Therefore, operations within the SOCAL OPAREAs are not likely to affect anadromous species and consultation under the Endangered Species Act (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 C.F.R. 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 here, with a more detailed analysis in Appendix E – EFH Assessment. Adverse effects on EFH and Managed Species could result from the activities associated with the Proposed Action. Based on the limited extent, duration, and magnitude of potential impacts from SOCAL Range Complex training and testing, the adverse effects would be minimal and temporary. Further, mitigation measures for the action would adequately avoid, minimize, mitigate, or otherwise offset the adverse impacts to EFH and Managed Species.

3.7.2.3 Alternative 1

Alternative 1 is a proposal designed to meet Navy and Department of Defense (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 Multimission Helicopter. Force structure changes associated with new weapons systems would include Offensive Mine Countermeasure (OMCM) systems.

3.7.2.3.1 SOCAL Operating Areas

Anti-Air Warfare Training

AAW Operations are conducted more often in Alternative 1 than in the No Action Alternative (Table 2-8). 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.

Anti-Submarine Warfare Training

ASW Operations are conducted more often in Alternative 1 than in the No Action Alternative (Table 2-8). 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.

Anti-Surface Warfare Training

ASUW Operations are conducted more often in Alternative 1 than in the No Action Alternative (Table 2-8). 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, ASUW 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

AMW Operations are conducted more often in Alternative 1 than in the No Action Alternative (Table 2-8). 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 U.S. Marine Corps (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, nonreusable Ballistic Aerial Target System (BATS) or small, gasoline-powered, remotely piloted vehicles (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 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 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 Organic Airborne Mine Countermeasures (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 Special Warfare Training Area (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 Training

NSW Operations are conducted more often in Alternative 1 than in the No Action Alternative (Table 2-8). 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. 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-Combat 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 Operations increase in Alternative 1 than in the No Action Alternative (Table 2-8). 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 SCI Airfield Activities

Under Alternative 1, the number of NALF operations would increase from 26,376 under 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 Multimission 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 effects on EFH and Managed Species could result from the activities associated with Alternative 1 (see Appendix E – EFH Assessment). Based on the limited extent, duration, and magnitude of potential impacts from SOCAL Range Complex training and testing, the adverse effects would be minimal and temporary. Further, mitigation measures for the action would adequately avoid, minimize, mitigate, or otherwise offset the adverse impacts to EFH and Managed Species.

3.7.2.4 Alternative 2

3.7.2.4.1 SOCAL OPAREAs

Anti-Air Warfare Training

AAW Operations are conducted more often in Alternative 2 than in the No Action Alternative (Table 2-9). 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 Training

ASW Operations are conducted more often in Alternative 2 than in the No Action Alternative (Table 2-9). 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

ASUW Operations are conducted more often in Alternative 2 than in the No Action Alternative (Table 2-9). 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, ASUW 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

AMW Operations are conducted more often in Alternative 2 than in the No Action Alternative (Table 2-9). 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 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

New minefields would become operational under Alternative 2. In addition to the planned minefield at Tanner Banks, additional minefields would include one off the southern end of SCI and one offshore of Camp Pendleton in the CPAAA. These mine training ranges will support MIW training for ships, submarines, and aircraft. Some of the increases described below will occur on the new training minefields.

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 Training

NSW Operations are conducted more often in Alternative 2 than in the No Action Alternative (Table 2-9). 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. 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. 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 Operations increase in Alternative 2 from the No Action Alternative (Table 2-9). 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 San Clemente Island 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 Multimission 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 40 to 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 2 by 2 nm (3.7x3.7 km) and optimally 3 by 3 nm (5.6x5.6 km). Mine shapes would be approximately 600 yards (549 m) apart and 30 to 35 in. (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 3.6.2.5 (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 effects on EFH and Managed Species could result from the activities associated with Alternative 2 (see Appendix E – EFH Assessment). Based on the limited extent, duration, and magnitude of potential impacts from SOCAL Range Complex training and testing, the adverse effects would be minimal and temporary. Further, mitigation measures for the action would adequately avoid, minimize, mitigate, or otherwise offset the adverse impacts to EFH and Managed Species.

3.7.3 Mitigation Measures

Mitigation measures for activities implemented for marine mammals and sea turtles, also offer protections to habitats associated with fish communities. For example, explosive gunnery rounds and bombs are targeted so as to avoid floating weeds, kelp, and algal mats. No additional mitigation measures are proposed or warranted because no substantial effects on fish or fish habitat were identified. Sea turtle and marine mammal mitigation measures are found in Section 5.8.

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 AMW 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 Space and Naval Warfare System (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).	• 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. • Adverse impacts to EFH would be minimal and temporary.

Table 3.7-16: Fish Summary of Effects (continued)

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.	• 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.
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.	• 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.

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 overharvesting (Natural Research Council 1990; Eckert 1995). As a result, all six species of sea turtles found in United States (U.S.) waters are currently listed as either threatened or endangered under the Endangered Species Act (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. Most sea turtle species have a tough outer shell and grow to a large size as adults; mature leatherback turtles (*Dermochelys coriacea*) can weigh up to 2,091 pounds (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 8 to 10 weeks 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 renest 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 mydas*), olive ridley (*Lepidochelys olivacea*), and leatherback (*Dermochelys coriacea*). None of the four species is known to nest on Southern California beaches. Nesting by 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 Southern California (SOCAL) Range Complex is designated as an area of primary occurrence for all sea turtle species (DoN 2005); although their presence within the SOCAL Range Complex 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 feet (ft) (50 meters [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 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 2007a). The breeding populations off Florida and the Pacific coast of Mexico are listed as endangered, whereas all others are classified as threatened. Climate change and fisheries bycatch may continue to affect nesting and foraging of this species (NMFS and USFWS 2007).

Green turtle hatchlings are 2 inches (in.) (50 millimeters [mm]) long, and weigh approximately one ounce (oz.) (28 grams [g]). Growth rates of juveniles, subadults, and adult green turtles measured at seven resident sites in the Hawaiian Archipelago revealed substantial variation; with annual growth rates ranging from highs of 1.8 in. to 2.5 in. (4.5 cm to 6.25 cm) at one location to lows of 0.1 in. to 0.6 in. (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 50 years of age. Adults can grow to more than 3 ft (0.91 m) long (straight carapace length [SCL]) and weigh 300 to 350 lb (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 to 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 transoceanic migrations (e.g., Ascension Island–Brazil). Hatchlings are epipelagic (surface dwelling in the open sea) for approximately 1 to 3 years. Hatchlings live in bays and along protected shorelines, and feed during the day on seagrass and algae (Bjorndal 1982). Juvenile and subadult 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 minutes (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 to 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 Angeles 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 as endangered throughout its range in June 1970 (Federal Register Vol. 35 No. 106 pp 8491-8498). Critical habitat has not been identified for this species in the Pacific, largely because nesting areas are not known and important foraging areas have not been identified (NMFS and USFWS 2007b).

Leatherback hatchlings are approximately 2 to 3 in. (50-77 cm) in length and weigh approximately 1.4 to 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 0.7 and 1.2 in. (1.9 and 3.0 cm) in length and 3.3 and 6.0 lb (1.5 and 2.7 kg) in weight, respectively. This equates to an average growth rate of approximately 0.8 in (2.0 cm) SCL and 3.3 lb (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 6.5 ft (2 m) and weigh almost 2,100 lb (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). Sarti Martinez et al. (2007) reported a decline of tens of thousands of nests in the 1980's to only 120 nests at four study beaches in 2004.

The leatherback is the 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 4 years (Musick and Limpus 1997). Postnesting adult leatherbacks appear to migrate along bathymetric contours from 650 to 11,500 ft (200 to 3,500 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 3,280 ft (1,000 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 to 14.5 minutes per dive, with a maximum of 42 minutes (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 61 degree Fahrenheit (ºF) (16 degree Celsius [ºC]) 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 27 nautical miles (nm) (50 kilometers [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 San Clemente Island (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 to 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 including nesting beaches (NMFS 2002c; NMFS and USFWS 2007c).

At emergence, hatchlings average 1.8 in. (45 mm) in length and weigh approximately 0.04 lb (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 lb (113 kg).

The global population of loggerhead turtles is estimated at 43,320 to 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 328 ft (100 m); 70 percent of the dives were no deeper than 16 ft (5 m) (Polovina et al. 2003). Off Japan, virtually all the dives of two loggerheads between nesting were shallower than 98 ft (30 m) (Sakamoto et al., 1993). Routine dives can last 4 to 172 minutes (Byles 1988; Sakamoto et al. 1990; Renaud and Carpenter 1994). Small juvenile loggerheads live at or near the surface; for the 6 to 12 years spent at sea as juveniles, they spend 75 percent of their time in the top 16 ft (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 to 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 to 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 16 nm (30 km) offshore and extending out at least another 16 nm (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 8- to 32-in (20- to 80-cm) shell length (mean = 24 in [60 cm]); no hatchlings or mature adults were present. Concentrations ranged from 0.3 to 1.5 turtles per square nautical mile (nm^2) (1.0 to 5.0 per square kilometer [km^2]) 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 coast 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 to 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 overharvesting of olive ridleys in Mexico, which caused a severe population decline (NMFS and USFWS 2007d).

Hatchlings emerge weighing less than 1 oz. (<28 g) and measuring about 1.5 in. (3.8 cm). Adult turtles are relatively small, weighing on average around 100 lb (45 kg). Olive ridleys reach sexual maturity in 15 years. The size and morphology of the olive ridley varies from region to region. Nesting females vary in size between 22 and 31 in. (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 postnesting 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 percent of their time is spent at depths greater than 328 ft (100 m) (Eckert et al. 1986; Polovina et al. 2003). In the eastern tropical Pacific Ocean, at least 25 percent of their total dive time is spent in the permanent thermocline, located at 66 to 328 ft (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 328 ft (100 m); 70 percent of the dives were no deeper than 16 ft (5 m) (Polovina et al. 2003).

Females and males begin to aggregate in "reproductive patches" near their nesting beaches 2 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 to 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 National Marine Fisheries Service (NMFS)/Southwest Fisheries Science Center (SWFSC) dolphin surveys during July to 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, ~1,620 nm (3,000 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 three are in northern Baja and 71 are in southern Baja with the rest nesting on mainland areas (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 areas 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 1,080 nm (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 was 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 ~0.5 nm (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 distal end of 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 loggerhead sea turtles is 100 to 800 Hz, with an upper limit of about 2,000 Hz (Lenhardt 1994). In general the effective range of hearing for green and loggerhead sea turtles is 100 to 500 Hz (Ridgway et al. 1969; Moein 1994; Moein et al. 1994; Bartol and Ketten 2003). 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 hertz (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 decibels (dB) in air. 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 micro-Pascal (µPa) (Lenhardt 1994).

3.8.1.2 Current Mitigation Measures

The comprehensive suite of protective measures and Standard Operating Procedures (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 postexercise 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 and 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.
- Commanding Officers (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 yards (yd.) (183 m) 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-millimeter (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 yd. (585 m) of known or observed floating weeds and kelp, and algal mats.
- A 600-yd. (550 m) radius buffer zone will be established around the intended target.
- From the intended firing position, lookouts will survey the buffer zone for sea turtles prior to commencement and during the exercise as long as practicable.

Surface-to-Surface Gunnery (nonexplosive 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 yd. (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, lookouts will survey the buffer zone for sea turtles prior to commencement and during the exercise as long as practicable.
- When manned, 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 nonexplosive rounds)

- Vessels will orient the geometry of gunnery exercises in order to prevent debris from falling in the area of sighted 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 sea turtles.
- Target towing aircraft shall maintain a lookout. If a sea turtle is sighted in the vicinity of the exercise, the lookout on the aircraft towing the target will immediately notify the firing vessel in order to secure gunnery firing until the area is clear.

Air-to-Surface Gunnery (explosive and nonexplosive 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 yd. (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 to 1,500 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 nonexplosive 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, lookouts will survey for floating kelp, which may be inhabited by immature sea turtles. Ordnance shall not be targeted to impact within 1,000 yd. (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 (nonexplosive bombs and cluster munitions, rockets)

- If surface vessels are involved, 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 yd. (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 nonexplosive)

- Ordnance shall not be targeted to impact within 1,800 yd. (1646 m) of known or observed floating kelp, which may be inhabited by immature sea turtles.
- Aircraft will visually survey the target area for sea turtles. Visual inspection of the target area will be made by flying at 1,500 feet (457 m) 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 yd. (1,646 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-yd. arc radius around the detonation site.

Preexercise Surveys

For Demolition and Ship Mine Countermeasures Operations, the preexercise 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.

Postexercise Surveys

Surveys within the same radius shall also be conducted within 30 minutes after the completion of the explosive event. Any marine mammal or sea turtle appearing in the area will be observed for signs of possible injury. Possibly injured marine mammals or turtles are reported to the Commander, Naval Region Southwest Environmental Director and the San Diego Detachment office of Commander, Pacific Fleet.

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, sea turtles 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.

Sinking Exercise

The selection of sites suitable for Sinking Exercises (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 (C.F.R.) Section (§) 229.2), and the identification of areas with a low likelihood of encountering ESA-listed species, including sea turtles. The MPRSA permit requires vessels to be sunk in waters which are at least 9,000 ft (2,743 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).

San Clemente Island Very Shallow Water Underwater Detonations Mitigation Measures

- For each exercise, the safety-boat with an observer is launched 30 or more minutes prior to detonation and moves through the area around the detonation site. The task of the safety observer is to augment a shore observer's visual search of the mitigation zone for marine mammals and turtles. The safety-boat observer is in constant radio communication with the exercise coordinator and shore observer.

- At least 10 minutes prior to the planned initiation of the detonation event-sequence, the shore observer, on an elevated on-shore position, begins a continuous visual search with binoculars of the mitigation zone. At this time, the safety-boat observer informs the shore observer if any marine mammal or turtle has been seen in the zone and, together, both search the surface within and beyond the mitigation zone for marine mammals and turtles.

- The shore observer will indicate that the area is clear of animals after 10 or more minutes of continuous observation with no marine mammals or turtles having been seen in the mitigation zone or moving toward it.

- The observer will indicate that the area is not clear of animals any time a marine mammal or turtle is sited in the mitigation zone or moving toward it and, subsequently, indicate that the area is clear of animals when the animal is out and moving away and no others have been sighted.

- Initiation of the detonation sequence will only begin on receipt of an indication from the shore observer that the area is clear of animals and will be postponed on receipt of an indication from that observer that the area is not clear of animals.

- Following the detonation, visual monitoring of the mitigation zone continues for 30 minutes for the appearance of any marine mammal or turtle in the zone. Any marine mammal or sea turtle appearing in the area will be observed for signs of possible injury. Possibly injured marine mammals or turtles are reported to the Commander, Naval Region Southwest Environmental Director and the San Diego Detachment office of Commander, Pacific Fleet.

Mine Countermeasures Activities Outside of Very Shallow Depth

- **Exclusion Zones**

  All mine warfare and mine countermeasure activities 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 yd. radius around the detonation site.

- **Preexercise Surveys**

  For demolition and Ship Mine Countermeasure (SMCM) activities, preexercise surveys 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.

- **Postexercise Surveys**

  Surveys within the same radius shall also be conducted within 30 minutes after the completion of the explosive event. Any marine mammal or sea turtle appearing in the area will be observed for signs of possible injury.

- **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.

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.

3.8.2 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 (MFA) sonar events is primarily based on the hearing sensitivities of each species. While there is no established criteria for harm or harassment under the ESA, the potential for physiological effects from MFA sonar such as temporary or permanent threshold shifts exists, and can be used as a criterion for evaluating MFA sonar 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 MFA sonar 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 2,000 Hz with best sensitivity between 200 to 800 Hz (Ridgway et al. 1969; Lenhardt 1994). As such, noise sources within the frequency range of MFA sonar 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 MFA sonar sources. As previously mentioned, sea turtles hear in the range of 30 to 2,000 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 kilohertz [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, and 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 and Sea Turtles

Harassment Level	Criterion	Threshold
Mortality	Onset of Severe Lung Injury	Goertner Modified Positive Impulse Indexed to 31 psi-ms
Level A Harassment 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 Noninjury	Onset Temporary Threshold Shift (TTS)	182 dB re 1 μPa^2-s Energy Flux Density level in any 1/3-octave band at frequencies above 100 Hz for sea turtles
Noninjury	Onset Temporary Threshold Shift (Dual Criteria)	23 psi peak pressure level (for small explosives)
Noninjury	Sub-TTS Behavioral Disturbance	177 dB re:1μPa^2-s (Energy Flux Density) for multiple successive explosions

psi-ms = pounds per square inch-milliseconds, μPa^2-s = squared micropascal-second

There are two criteria for noninjurious harassment including temporary threshold shifts (TTS), which is a temporary, recoverable, loss of hearing sensitivity (NMFS 2001; DoN 2001a) and a sub-TTS behavioral disturbance for multiple successive explosions. The criterion for TTS is 182 dB re 1 squared micropascal-second (μPa^2-s) 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). The second threshold, termed "sub-TTS," applies to multiple explosions in succession. The sub-TTS threshold is used to account for behavioral disturbance significant enough to be judged as harassment, but occurring at lower sound energy levels than those that may cause TTS. The criteria for sub-TTS behavioral disturbance is 177 dB re:1 μPa^2-s (Energy Flux Density).

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 analogous data in chelonids, the criteria developed for marine mammals are 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 setup 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 (<1,000 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 to 1,000 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 1,000 Hz. They demonstrated that loggerheads hear well between 250 and 1,000 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 airgun 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 MFA sonar that has the lowest operating frequency operates at a center frequency of 3.5 kHz. Sea turtles hear in the range of 30 Hz to 2 kHz 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 (Lenhardt 1994), which is only slightly lower than the operating levels of the sonar. It is not believed that a TTS 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 TTS 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 MFA 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 Anti-Submarine Warfare (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 (review by Viada et al. 2008). Most information comes from studies of the use of explosives to remove offshore oil rigs in the Gulf of Mexico (Klima et al. 1988; Gitschlag and Herczeg 1994) and one study by the US Navy (O'Keefe and Young 1984). Results vary depending on the size and type explosive used and the water depth. Klima et al. (1994) reported that sea turtles ranging in size from 1.3 to 15.0 lbs (0.59 to 6.8 kg) were uninjured when 138 to 322 ft (42 to 98 m) with detonations of 203 lbs (92 kg). Okeefe and Young (1984) reported that sea turtles beyond 2000 ft (680 m) were uninjured with an underwater detonation of 1,200 lbs (544 kg).

Analysis of data on the propagation effects of underwater detonations in very shallow water (VSW) indicates that such detonations would not have adversely affect the annual recruitment or survival of any sea turtle species and stocks.

Naval Special Warfare (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 a 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.

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 ASW Training Targets (EMATT).

Range debris is highly unlikely to affect sea turtles in the SOCAL Range 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 42 lb (19 kg) 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 0.5 ft [0.2 m] 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 low.

Torpedo Flex Hoses. Improved flex hoses or strong flex hoses will be expended during torpedo exercises. Department of the Navy (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 sink 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 in. (12 by 91 centimeters [cm]) and weigh approximately 21 lb. EMATTs are much smaller than sonobuoys and Acoustic Device Countermeasures (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, expendable bathythermographs, acoustic device countermeasure, or targets. The low density of sea turtles in the SOCAL Range Complex would make it unlikely that falling debris would strike sea turtles.

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 turtles 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. According to the National Research Council of the National Academies (NRC, 2003 Department Fisheries and Oceans 2004), there is very little information available regarding the hearing capability of marine invertebrates. No effects to marine invertebrates are anticipated from active sonar since acoustic transmissions are brief in nature and invertebrates are unlikely to hear it. Underwater detonations may cause some affects to invertebrates or algae but only in a small area.

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 MFA sonar sources. It is unlikely that sea turtles can detect sounds in the frequency range of this sonar and therefore increased MFA sonar training 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, Air-to-Surface Missile Exercises (A-S MISSILEX), Surface-to-Surface Missile Exercises (S-S MISSILEX), Bombing Exercises (BOMBEX), and Surface-to-Surface Gunnery Exercises (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 Nonacoustic Impacts

Nonacoustic impacts on sea turtles 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 sea turtles, given the extensive mitigation measures in effect to avoid such an event. Based on these SOPs, 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 MFA 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 Nonacoustic Impacts

Nonacoustic impacts on sea turtles 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 sea turtles, given the extensive mitigation measures in effect to avoid such an event. Based on these SOPs, 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 Installation

Once underway during hydrophone array installation for the Shallow Water Training Range (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 of the rigidity of the cable that is designed to lay extended on the sea floor and would not 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 3.8.1.1.1, 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 ESA. None of the four species is known to nest on Southern California beaches. Regular nesting by 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 Range Complex 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 combine 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 affect listed loggerhead, green, olive ridley, or leatherback sea turtles.

3.8.3 Mitigation Measures

3.8.3.1 ASW Operations

Mitigation measures for marine mammals (Section 3.9.10) provide similar mitigative effects for sea turtles. These mitigations include general maritime measures of lookout training and collision avoidance. Also, exercise specific measures are used for active sonar training, and activities involving explosive and nonexplosive ordnance.

3.8.3.2 Mine Countermeasures Activities Outside of Very Shallow Depth

3.8.3.2.1 Exclusion Zones

All mine warfare and mine countermeasure activities 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 yd. radius around the detonation site.

3.8.3.2.2 Preexercise Surveys

For demolition and Ship Mine Countermeasure (SMCM) activities, preexercise surveys 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.

3.8.3.2.3 Postexercise Surveys

Surveys within the same radius shall also be conducted within 30 minutes after the completion of the explosive event. Any marine mammal or sea turtle appearing in the area will be observed for signs of possible injury.

3.8.3.2.4 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.

3.8.4 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 National Environmental Policy Act (NEPA) and Executive Order (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 effects 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.

3.9.1.1 Marine Mammal Distribution, Movement and Habitat Partitioning

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 (Bjørge 2002; Bowen et al. 2002; Forcada 2002; Stevick et al. 2002). Most information on marine mammal distribution has been obtained from shipboard and aerial observations, which provide a very limited perspective on their life at or near the surface and little insight into their behavior under the water where some species, particularly cetaceans, spend up to 90 percent of their time (e.g., Costa 1993).

Our knowledge of marine mammal habitats is often quite limited. Poor definition of spatiotemporal scales is the primary cause for confusion and disagreement among studies about factors that associate with marine mammal (in particular, cetacean) distribution (e.g., Jaquet 1996; Jaquet et al. 1996; Gregr and Trites 2001; Hamazaki 2002; Ferguson 2005). Marine mammals may not respond to instantaneous changes in ocean conditions. Instead, there might be a time lag between the change of oceanographic conditions and top-level predator responses. Time lags are particularly important when proxies such as chlorophyll data are used to indicate whale habitat (e.g., Littaye et al. 2004; Ferguson 2005). It is not the primary producers themselves that the whales eat but the squid and mesopelagic fishes several trophic levels higher up that may have a time lag. Time lapses before energy and nutrients from the primary producers climb the food chain up to cetacean prey species. For baleen whales feeding on zooplankton, which are trophically close to primary production, this lag may be on the order of several weeks, whereas the lag might be considerably greater for sperm whales where the primary prey (cephalopods) are removed from primary production by approximately 4 months (Jaquet et al. 1996; Gregr and Trites 2001). Littaye et al. (2004) determined that while food availability at a particular time and place was thought to be a function of environmental conditions occurring in previous months, fin whales in the Mediterranean adapted their movements and group size directly to prey availability instead of instantaneous environmental conditions. Integrated approaches are underway in some areas to examine the temporal and spatial relationship of marine mammals to the structure and variability of their habitat (e.g., Croll et al. 1998). Efforts are also underway in habitat modeling, which predicts potential habitat in unsurveyed areas based on the relationships between species' presence and the environmental parameters observed in surveyed areas (e.g., Gregr and Trites 2001; Hamazaki 2002; Littaye et al. 2004; Ferguson 2005; Hastie et al. 2005; Laran and Gannier 2005; Panigada et al. 2005; Kaschner et al. 2006; Monestiez et al. 2006; Redfern et al. 2006; Becker 2007).

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 (e.g., Forney 2000; Gregr and Trites 2001; MacLeod and Zuur 2005). For example, although 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* spp. occupy a separate dietary niche from bottlenose whales (*Hyperoodon*) and Cuvier's beaked whales (*Ziphius*) although these species share much of the same overall 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.

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). 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). Pregnant females are believed to lead the migration to and from high-latitude feeding grounds. However, not all baleen whales within any given population migrate. Some individual gray, fin, Bryde's, minke, and blue whales may stay in a specific area year-round.

Cetacean movements can also reflect the distribution and abundance of prey (Gaskin 1982; Payne et al. 1986; Kenney et al. 1996). Cetacean movements have been linked to indirect indicators of prey, such as temperature variations, sea-surface chlorophyll 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). Oceanographic frontal features tend to be ephemeral in space and time, shifting geographically by 5 to 540 nm (10 to 1,000 kilometers [km]) depending on the season, year, and climate events (Thurman 1997).

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. Small-scale hydrographic fronts may act as convergence zones (Etnoyer et al. 2004). For instance, bottlenose dolphins have demonstrated a spatial association with the area near the surface features of tidal intrusion fronts, which could be related to increased foraging efficiency resulting from the accumulation of prey in the frontal region (Mendes et al. 2002).

Long-ranging movements are quite common in pinnipeds; northern elephant seals (*Mirounga angustirostris*) are good examples since they make extensive foraging migrations (Stewart and Huber 1993; Kovacs 2002). 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 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). Not all pinniped species are migratory. For example, the harbor seal is littoral in distribution and nonmigratory; this species breeds and feeds in the same general area (usually within 25 nm [46 km]) area throughout the year (Bigg 1981; Jeffries et al. 2000).

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). Based on current data on human population growth and marine mammal fisheries interactions, DeMaster et al. (2001) predicted that in the future the most common types of competitive interactions will 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, reflect both foraging ecology and the need to return to land for the purposes of breeding and molting. Like cetaceans, pinnipeds are often associated with either transient (oceanographic features such as frontal systems) or nontransient 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 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 33 feet (ft) (10 meters [m]) deep during daylight hours.

Seasonal changes in oceanographic conditions and ice cover condition affect the distribution of pinnipeds in the pack ice (Forcada 2002). Haul-out by ice-associating pinnipeds seems to be affected by both weather and time of day during breeding and molting periods (Moulton et al. 2000). 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 (*Phoca vitulina*), tidal stage has a significant effect on haul-out behavior (Schneider and Payne 1983). Human disturbance can affect haul-out behavior by causing seals to return to the water, thereby reducing the amount of time mothers spend nursing pups (Schneider and Payne 1983; Moulton et al. 2000).

Climatic fluctuations have produced a growing concern about the effects of climate change on marine mammal populations (Learmonth et al. 2006). Responses of marine mammals to climate change are difficult to interpret due to the confounding effects of natural responses and human influences. Large-scale climatic events may affect the distribution and abundance of marine mammal species, either directly or indirectly, through alterations of habitat characteristics and distribution (Harwood 2001; Forcada et al. 2005; Keiper et al. 2005; MacLeod et al. 2005; Shelden et al. 2005; Simmonds and Isaac 2007). 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. Reduced foraging success, increased nutritional stress, and higher mortality have been reported for various pinniped species during cyclic warming periods (e.g., Feldkamp et al. 1991; Ono et al. 1993; Hayward 2000; Le Boeuf and Crocker 2005). Decreased squid abundance during El Niño events has been suggested as a cause for the shifts in marine mammal distribution and abundance; for example, short-finned pilot whales virtually disappeared from the Santa Catalina Island area and were 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 due to an influx of warm-water species coupled with the persistence of temperate species typically found off central California (Benson et al. 2002). Cerchio et al. (2005) noted negative impacts on individual condition and reproduction for humpback whales, notably, a low reproductive success. Climate variation may also influence social organization through changes in prey availability, as noted in Pacific Northwest killer whales that tended to occur in smaller groups when there was less salmon available (Lusseau et al. 2004). Recent work on common dolphins in the eastern tropical Pacific (ETP) also suggests that animals cross stock boundaries during periods of significant environmental change (e.g., El Niño), moving to areas of lower-quality habitat when preferred habitat is reduced (Danil and Chivers 2005). 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 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
- 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.

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 Southern California Bight (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 (Largier et al. 1996; DoN 2000).

Of the 43 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 18 year-round species, 6 migratory species, and 19 infrequent or rare species, (Dailey et al. 1993; Forney and Barlow 1998; U.S. Department of the Navy [DoN] 2002; 2005c; Carretta et al. 2007; Barlow and Forney 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). 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). 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 NMFS. The status of populations of cetaceans, pinnipeds, and a single mustelid species that occur in the SOCAL Range Complex is briefly presented below and described in more detail in Section 3.9.2, 3.9.3, and 3.9.4.

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 10 marine mammal species listed as endangered under the 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).

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—In the North Pacific, the International Whaling Commission (IWC) began management of commercial whaling for blue whales in 1969; blue whales were fully protected from commercial whaling in 1976 (Allen 1980). 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. 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. Critical habitat for the blue whale has not been designated.

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). The population estimate for this stock of blue whales is 1,368 (Coefficient of Variation [CV] = 0.22) individuals (Carretta et al. 2008). 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).

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—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).

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 north or south). 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; DoN 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). 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 Range Complex. 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 (DoN 1998), but were most common during July–September (Hill and Barlow 1992; Mangels and Gerrodette 1994; Teranishi et al. 1997; Larkman and Veit 1998; DoN 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).

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 3.9-2).

Reproduction/Breeding—The eastern North Pacific stock feeds in waters from California to Alaska in summer and fall, and 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 >328 ft (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 ~ 98 ft. 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 ~ 98 ft. 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 0-52 ft., 9% in 56-105 ft. , 13% in >105 ft.

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 108 nm (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. Based on vocalizations and anatomy, blue whales are assumed to hear only low-frequency sounds below 400 Hz (Croll et al. 2001; Stafford and Moore 2005; Oleson et al. 2007).

In terms of functional hearing capability blue whales belong to the low-frequency group, which have the best hearing ranging from 7 Hz to 22 kHz (Southall et al. 2007). Exposure to mid-frequency active sonar that is below or high-frequency active sonar that is above the functional hearing capability of blue whales may not elicit a behavioral response since the respective frequencies are outside the functional hearing range of the animal. If the animal does react to sound outside their functional hearing range, their response may be less severe when compared to their response to a sound that is within their functional hearing range. Because risk function methods do not necessarily exclude sonar frequencies that are outside a species functional hearing range, blue whale behavioral exposures in Tables 3.9-12 through 3.9-21 may be an overestimate.

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 large whales such as the blue whale may often die later and drift far enough not to strand on land after ship strikes, it is difficult to estimate the numbers of blue whales killed and injured in that manner. 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). From September to December 9, 2007 there were six reports of floating blue whale carcasses of which four were confirmed (2 in Santa Barbara Ship Channel, 1 near San Clemente and 1 in Long Beach Harbor). Three of the four carcasses were shipstrikes as evidenced by physical findings at necropsy (2-fractures and hemorrhage) and geographic location (1-which was presumed to have fallen off bow in Long Beach harbor). From August to October 2007, there were also increased numbers of blue whales observed feeding in and around the Santa Barbara Ship Channel (Berman 2008).

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.

3.9.2.1.2 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 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. 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). 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 and most recent estimate for the California/Oregon/Washington Stock is 2,636 (CV = 0.18) individuals (Barlow and Forney 2008; Table 3.9-2).

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 California Worldwide, 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 Range Complex 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 3.9-2).

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 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 (<328 ft.) and night dives were deeper (>738 ft.), 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 (<164); 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 <164 ft., 23% at 164-738 ft.(covering the ascent and descent times) and 33% at >738 ft.

Acoustics—Fin whales produce calls with the lowest frequency and highest source levels of all cetaceans. Infrasonic (10-60 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 decibels (dB) *re* 1 micro-Pascal (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 µPa-1 m over a range of 15 to 28 Hz and could be detected up to 56 kilometers (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. as cited in DoN 2005). 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 sound sensitivity of fin whales, experts 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).

In terms of functional hearing capability fin whales belong to the low-frequency group, which have the best hearing ranging from 7 Hz to 22 kHz (Southall et al. 2007). Exposure to mid-frequency active sonar that is below or high-frequency active sonar that is above the functional hearing capability of fin whales may not elicit a behavioral response since the respective frequencies are outside the functional hearing range of the animal. If the animal does react to sound outside their functional hearing range, their response may be less severe when compared to their response to a sound that is within their functional hearing range. Because risk function methods do not necessarily exclude sonar frequencies that are outside a species functional hearing range, fin whale behavioral exposures in Tables 3.9-12 through 3.9-21 may be an overestimate.

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.

Ship Strikes—Recent studies of ship strikes and fin whales suggest that it is predominately immature whales that are involved (Panigada et al. 2006; Douglas et al. 2008). Ship strikes on whales have increased since 1980 due to the increase in commercial cargo ships and increases in the speed of those ships (Laist et al. 2001; Douglas et al. 2008). Crews on large commercial ships are not always aware of the strike when it happens as evident by the several ships that have entered harbors with fin whales stuck on the ship's bow (Douglas et al. 2008). Suggestions have been proposed to increase the number of lookouts on commercial ships to avoid collisions with whales (Capoulade 2002). 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).

3.9.2.1.3 Humpback Whale (*Megaptera novaeangliae*) California/Oregon/Washington

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. The IWC first protected humpback whales in the North Pacific in 1966. They are also protected under the Convention on International Trade in Endangered Species (CITES).

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 stocks are recognized by NMFS and include the Central North Pacific Stock, the Western North Pacific Stock and the California/Oregon/Washington Stock. 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. The NMFS Stock Assessment Report estimated of population size for the California/Oregon/Washington Stock is 1,391 (CV = 0.13; Carretta et al. 2008). Calambokidis et al. (2008) estimated that 1,400 to 1,700 humpback whales use the California/Oregon waters.

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 3.9-2).

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 <131 ft. (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 <13 ft., 25% at 13-67 ft., 7% at 68-116 ft., 4% at 117-165 ft., 6% at 166-329 ft., 7% at 330-493 ft., 8% at 494-657 ft., 6% at 658-984 ft., and <1% at >984 ft. (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 on breeding grounds (Matilla et al. 1987; Helweg et al. 1992; Clark and Clapham 2004). 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 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 to 173 decibels (dB) re 1 µPa suggest that their hearing may also extend to 24 kHz (Au et al. 2006). Female vocalizations appear to be simple; Simão and Moreira (2005) noted little complexity. The male song, however, is complex and changes between seasons. 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 (DoN 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).

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. Research by Au et al., (2001, 2006) off Hawaii indicated the presence of high-frequency harmonics in humpback whale vocalizations at 24 kHz. While recognizing this was the upper limit of the recording equipment, it does not demonstrate that humpbacks can actually hear those harmonics, which may simply be correlated harmonics of the frequency fundamental in the humpback "song". 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.

Stimpert et al. (2007) reported a unique signal, a "megapclick" click train, using sound recording dive tags (D-Tags) with a received level of 143 and 154 dB re 1 mPa and most energy below 2 kHz. The function of these nighttime sounds is unknown but may assist in foraging.

In terms of functional hearing capability humpback whales belong to low-frequency cetaceans which have the best hearing ranging from 7 Hz to 22 kHz (Southall et al. 2007). Exposure to mid-frequency active sonar that is below or high-frequency active sonar that is above the functional hearing capability of humpback whales may not elicit a behavioral response since the respective frequencies are outside the functional hearing range of the animal. If the animal does react to sound outside their functional hearing range, their response may be less severe when compared to their response to a sound that is within their functional hearing range. Because risk function methods do not necessarily exclude sonar frequencies that are outside a species functional hearing range, humpback whale behavioral exposures in Tables 3.9-11 through 3.9-17 may be an overestimate.

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 (NOAA 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 five 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 nine 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).

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).

3.9.2.1.4 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. Sei whales are listed as endangered under the ESA and 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. 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. 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). 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 2006e). The most current population estimate for sei whales in the entire North Pacific (from 1977) is 9,110 (NMFS 2006e). The current estimate for sei whales in the Eastern North Pacific stock in the waters of California/Oregon/Washington is 46 (CV=0.61) individuals (Carretta et al. 2008).

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 2006e). 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 (DoN 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 (DoN 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 3.9-2).

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 consist of paired sequences (0.5 to 0.8 seconds [sec], separated by 0.4 to 1.0 sec) of 7 to 20 short (4 milliseconds [ms]) 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 Hz and source level of 156 ±3.6 dB re 1 µPa at 1 meter (m) (McDonald et al. 2005). Calls recorded off the Hawaiian Islands consisted of downsweeps from 100 Hz to 44 Hz over 1.0 sec and low-frequency calls with downsweeps from 39 Hz to 21 Hz over 1.3 seconds (Rankin and Barlow 2007a). Sei whales off the east coast of the U.S. produced single calls that ranged from 82 to 34 Hz over 1.4 s period (Baumgartner et al. 2008).

While no data on hearing ability for this species are available, Ketten (1997) hypothesized that mysticetes have acute infrasonic hearing.

In terms of functional hearing capability sei whales belong to low-frequency cetaceans which have the best hearing ranging from 7 Hz to 22 kHz. There are no tests or modeling estimates of specific sei whale hearing ranges. Exposure to mid-frequency active sonar that is below or high-frequency active sonar that is above the functional hearing capability of sei whales may not elicit a behavioral response since the respective frequencies are outside the functional hearing range of the animal. If the animal does react to sound outside their functional hearing range, their response may be less severe when compared to their response to a sound that is within their functional hearing range. Because risk function methods do not necessarily exclude sonar frequencies that are outside a species functional hearing range, sei whale behavioral exposures in Tables 3.9-12 through 3.9-21 may be an overestimate.

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 nine 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).

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.

3.9.2.1.5 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 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. 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.

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. 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). 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). 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).

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). The NMFS Stock Assessment

Report provides an estimate of 2,853 (CV=0.25) sperm whales for the California/Oregon/Washington Stock (Carretta et al. 2008).

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 m in depth. 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 <328 ft. and as shallow as 131 ft. (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 3.9-2).

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 3,281-4,921 ft. 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 (33 ft.) 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 >2,625 ft. 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, 0-656 ft. = 2.5 minutes one direction (which correlates well with the descent/ascent rates provided) and therefore 5 minutes for both directions; and for 659-1,313 ft., 1,314-1,970 ft. and 1,971-2,625 ft. Therefore, the depth distribution for sperm whales based on information in the Amano paper is: 31% in <33 ft., 8% in 33-657 ft., 9% in 658-1,312 ft., 9% in 1,314-1,970 ft., 9% in 1,971-2,625 ft. and 34% in >2,625 ft. 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). 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 (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). Franzis and Alexidou (2008) were able to match codas to specific behaviors. They recorded three coda types that included a dive cycle coda, social coda and an alarm coda. 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 and has some ultrasonic hearing (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).

Sperm whales functional hearing range is estimated to occur between approximately 150 Hz and 160 kHz, placing them in the mid-frequency cetacean group (Southall 2007). The lower end of the sperm whale functional hearing range is of lower frequency than the lowest mid-frequency active sonar frequency analyzed in this EIS. However, the overall sperm whale hearing range generally intersects SOCAL Range Complex mid- and high-frequency sonars. The intersection of common frequencies between sperm whale functional hearing and mid- and high-frequency sonars suggests that more often than not there is a potential for a behavioral response. But as a result of having a functional range lower than the mid-frequency active sonars, there is still some likelihood low-frequency vocalizations and sound-dependent behaviors may not be disrupted or may only be partially disrupted or masked. In the Caribbean, 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. The pulses were surmised to have originated from submarine sonar signals given that no vessels were observed. 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. Behavioral observations have been made whereby 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, and then ignored the signal completely (André et al. 1997).

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 five 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 five 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.

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 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 (C.F.R.) (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 United States (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 percent 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 SOCAL 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) 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 (SCB) (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 Marine 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 3.9-2), 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 2.5 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 55 ft. and maximum dive depth 269 ft. 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 52 ft., but the majority of time was spent <13 ft.; nearly all of the migration time was spent <67 ft. Once the seal arrived at Isla Guadalupe, the majority of dives occurred from dusk through dawn. Most dives were shallow (<67 ft.), and mean dive depth was 46 ft. Based on this limited dataset, the following are estimates for depth distribution: daytime: 90% at 0-13 ft.; 10% at 13-269 ft.; nighttime: 75% at <13 ft.; 25% at 13-269 ft.

Acoustics—Guadalupe fur seals produce a variety of airborne sounds. Younger animals produce barks, roars, and coughs; adult males most often make barks and puffs; and females with pups used bawls (Peterson et al. 1968; Belcher and Lee 2002). Many of these sounds consist of multiple harmonics with frequencies less than 7 kHz and dominant frequencies below 1 kHz (Peterson et al. 1968). Male Guadalupe fur seals are quite vocal during the breeding season and make four different call types, especially when male-male interactions ensue (Croxall and Gentry 1987). The full threat call is roughly 2 sec in duration and is aurally tonal (to humans) with a fundamental frequency below 1 kHz (Croxall and Gentry 1987). The other three call types include the boundary bluff, the bark, and the growl—all call types seem correlated to some form of territorial behavior. Females produce a pup attraction call and female attraction calls, each seemingly pulsed with the fundamental frequency below ~2 kHz (Croxall and Gentry 1987). The other three call types include the boundary bluff, the bark, and the growl - all call types seem correlated to some form of territorial behavior. Females produce a pup attraction call and female attraction calls, each seemingly pulsed with the fundamental frequency below ~2 kHz (Croxall and Gentry 1987).

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).

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).

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 U.S. Fish and Wildlife Service (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. 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). 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—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). Currently the sea otter population is estimated to be 3,026 from the spring 2007 survey, an increase of 12.4 percent 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— 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 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 San Clemente Island (SCI) (only three sightings) (Leatherwood et al. 1978). As the population has increased, its range has also expanded (USFWS 2007.

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 throughout 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 82 ft. though individuals have been sighted foraging in waters with a bottom depth as great as 118 ft. (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 328 ft. (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 <3 ft., 50% at 3-164 ft.

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 0.5 nm (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).

Impacts of human activity Harvesting for pelts during the 1700s and 1800s decimated sea otter numbers throughout their range (Kenyon 1975). In 1914, the total California population was estimated to be approximately 50 individuals (Kenyon 1975), but recovery has occurred since they were protected. The number of sea otters counted during California spring surveys steadily increased from 1985 until 1995, when 2,377 otters were counted (USFWS 2003). However, in subsequent years, a declining trend has been noted.

The depressed population growth rate is largely due to elevated mortality, with infectious disease being the single most important known cause of mortality (Estes et al. 2003a; Kreuder et al. 2003).

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) with most whales assumed to be in Alaskan waters (Wade et al. 2006). 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 (144°W 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 percent between 1970 and 1987 (LeBoeuf et al. 1991). Pup counts at this location have declined steadily at approximately 5 percent 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 subadult 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 Nonthreatened or Nonendangered 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 10 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*), pantropical 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 Unlisted Marine Mammal Species Potentially Occurring in the SOCAL Range Complex

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 13,000 (CV=0.20) individuals, with only an estimated 12 (CV=2.0) individuals in California, Oregon, and Washington waters (Carretta et al. 2007) although recent surveys have not observed any Bryde's whales in Southern California (Barlow and Forney 2007; Forney 2007) and was taken out of the 2008 draft Stock Assessment Report (Carretta et al. 2008).

Distribution—The Bryde's whale is found in tropical and subtropical waters, generally not moving poleward of 40 degrees 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).

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 3.9-2).

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 sec; and they are produced in extended sequences (Oleson et al. 2003).

There is no information on the hearing of Bryde's whales, but Ketten (1997) hypothesized that mysticetes have acute infrasonic hearing.

In terms of functional hearing capability Bryde's whales belong to low-frequency cetaceans which have the best hearing ranging from 7 Hz to 22 kHz. There are no tests or modeling estimates of specific Bryde's whale hearing ranges. Exposure to mid-frequency active sonar that is below or high-frequency active sonar that is above the functional hearing capability of Bryde's whales may not elicit a behavioral response since the respective frequencies are outside the functional hearing range of the animal. If the animal does react to sound outside their functional hearing range, their response may be less severe when compared to their response to a sound that is within their functional hearing range. Because risk function methods do not necessarily exclude sonar frequencies that are outside a species functional hearing range, Bryde's whale behavioral exposures may be an overestimate.

3.9.3.1.2 Gray Whale (*Eschrichtius robustus*) Eastern North Pacific

Population Status—Population estimates of the Eastern North Pacific stock of gray whales during the period of 1993-2002 varied from 18,178 to 29,758 (Anglis and Outlaw 2007). The peak number occurred in 1997/1998 but lower numbers in subsequent years may have been a result of sampling variation or a change in the proportion of animals migrating past the central California survey site (Hobbs and Rugh 1999). In addition, there was a period of high mortality in 1999/2000 (Gulland et al. 2005). The Eastern North Pacific stock was believed to consist of 18,813 (CV=0.07) individuals in 2002 (Anglis and Allen 2008).

Distribution—The gray whale makes a well-defined seasonal north-south migration. 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 south and follow the shoreline south to breeding grounds on the west coast of Baja California (Braham 1984; Rugh 1984). The average gray whale migrates 4,050-5,400 nm at a rate of 80 nm/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). Whales make the northbound migration from February to May (Rugh 2001).

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 (DoN 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 (Table 3.9-2).

Life history—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 (DoN 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 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 164-197 ft. 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 1,640 ft. or more before resurfacing to breathe. The maximum known dive depth is 558 ft. (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 <328 ft. 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 (<10 ft. depth) and near the bottom (extremely nearshore in a protected bay with mean dive depth of 59 ft., range 46-72 ft. depth). There was very little time spent in the water column between surface and bottom. Based on this very limited information, the following is a rough estimate of depth distribution for gray whales: 50% at <13 ft. (surface and interventilation dives), 50% at 13-59 ft.

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 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).

3.9.3.1.3 Minke Whale (*Balaenoptera acutorostrata*) California/Oregon/Washington Stock

Population Status—The population abundance for offshore California/Oregon/Washington stock is estimated to be 823 (CV=0.56) minke whales with 226 (CV=1.02) in Southern California waters (Barlow and Forney 2007). The NMFS Stock Assessment Report gives an estimate of 806(CV=0.63) minke whales in the California/Oregon/Washington stock (Carretta et al. 2008).

Distribution—In the Northeast Pacific Ocean, minke whales range from the Chukchi Sea south to Baja California (Leatherwood et al. 1987). 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. 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 SCB 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 (DoN 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 OEIS/EIS study area 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 3.9-2).

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 ~67 ft., while foraging dives were to 213 ft. Based on this very limited depth information, rough estimates for % of time at depth are as follows: 53% at <67 ft. and 47% at 67-213 ft.

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) and 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 (Rankin and Barlow 2003).

While no data on hearing ability for this species are available, Ketten (1997) hypothesized that mysticetes have acute infrasonic hearing.

In terms of functional hearing capability minke whales belong to low-frequency cetaceans which have the best hearing ranging from 7 Hz to 22 kHz. There are no tests or modeling estimates of specific minke whale hearing ranges. Exposure to mid-frequency active sonar that is below or high-frequency active sonar that is above the functional hearing capability of minke whales may not elicit a behavioral response since the respective frequencies are outside the functional hearing range of the animal. If the animal does react to sound outside their functional hearing range, their response may be less severe when compared to their response to a sound that is within their functional hearing range. Because risk function methods do not necessarily exclude sonar frequencies that are outside a species functional hearing range, minke whale behavioral exposures may be an overestimate.

3.9.3.1.4 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). The NMFS Stock Assessment Report estimates that there 540 (CV=0.54) Baird's beaked whales in the waters of California, Oregon, and Washington (Carretta et al. 2008).

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 (DoN 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 3.9-2).

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 (<1,312 ft.) and deep dives (>2,625 ft.) 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 0-132 ft., 39% at 134-2,625 ft., 27% at >2625 ft. 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).

There is no information on the hearing of Baird's beaked whales; therefore, information is provided from other beaked whale species. 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).

Beaked whales functional hearing range is estimated to occur between approximately 150 Hz and 160 kHz, placing them in the mid-frequency cetacean group (Southall 2007) though the best hearing is presumed to occur at ultrasonic frequencies (MacLeod 1999; Ketten 2000). However, due to their physiology, they may be more sensitive than other cetaceans to low-frequency sounds as well (MacLeod 1999; Ketten 2000). The only direct measure of beaked whale hearing is from a stranded juvenile Gervais' beaked whale using auditory evoked potential techniques (Cook et al. 2006). The hearing range was 5 to 80 kHz, with greatest sensitivity at 40 and 80 kHz (Cook et al. 2006). Some have proposed a potential association between beak whale strandings and Navy activities, noting five recurring factors in common with each stranding event: use of mid-frequency sonar, beaked whale presence, surface ducts, steep bathymetry, and constricted channels with limited egress. These five factors would not occur simultaneously within the SOCAL Range Complex. Exposure to mid-frequency active sonar that is below or high-frequency active sonar that is above the functional hearing capability of beaked whales may not elicit a behavioral response since the respective frequencies are outside the functional hearing range of the animal. If the animal does react to sound outside their functional hearing range, their response may be less severe when compared to their response to a sound that is within their functional hearing range. Because risk function methods do not necessarily exclude sonar frequencies that are outside a species functional hearing range, beaked whale behavioral exposures may be an overestimate.

3.9.3.1.5 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. 2008). Due to their coastal habitat, this population of bottlenose dolphins is outside of the areas used for training activities and therefore, they were not modeled for the active sonar or underwater detonations.

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 SCB 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). Because this stock is found only near shore, and outside of the areas used for training activities, they were not modeled for active sonar or underwater detonations.

At Sea Density Estimates—At sea density 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). 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). 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).

Much of what is known about temporary threshold shifts (TTS) in hearing for cetaceans has come from experimentally induced TTS 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 and its use in developing onset of TTS and permanent threshold shift (PTS) thresholds are described in section 3.9.7.1.3.

3.9.3.1.6 Bottlenose Dolphin, Offshore (*Tursiops truncatus*) California/Oregon/ Washington Offshore Stock

Population Status—Population size for the California/Oregon/Washington bottlenose dolphin offshore stock is estimated to be 2,026 (CV=0.54) bottlenose dolphins with 1,831 (CV=0.47) individuals in Southern California waters (Barlow and Forney 2007). The NMFS Stock Assessment Report estimates there are 3,495 (CV=0.31) offshore bottlenose dolphins in the waters of California, Oregon, and Washington (Carretta et al. 2008).

Distribution—Offshore bottlenose dolphins are thought to have a continuous distribution in California (Mangels and Gerrodette, 1994). They have been found in the SCB 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 OEIS/EIS study area 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 3.9-2).

Reproduction/Breeding—Newborn calves are seen through out the year and may be influenced by productivity and food abundance (Urian et al. 1996).

Diving Behavior—Offshore bottlenose dolphins in the Bahamas dove to depths below 1,476 ft. and for over five min during the night but dives were shallow (<164 ft.) during the day (Klatsky et al. 2007). In contrast, the dives of offshore bottlenose dolphins off the east coast of Australia were mostly within 16 ft. of the surface (approximately 67% of dives) with the deepest dives to only 492 ft. (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 <164 ft., 4% at >164 ft.; nightime: 51% at <164 ft., 8% at 164-329 ft., 19% at 330-821 ft., 13% at 822-1,476 ft. and 9% at >1,476 ft. 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.

Functional hearing for bottlenose dolphins is estimated to occur between approximately 150 Hz and 160 kHz, placing them in the mid-frequency cetacean group (Southall 2007) with peaks in sensitivity at 25 and 50 kHz (Nachtigall et al. 2000). Bottlenose dolphins communicate via clicks and whistles at frequency ranges that overlap mid-frequency active sonar though best hearing sensitivity aligns more with that of high-frequency sonar. Signature whistles, which identify individual dolphins and are a dominant characteristic of communications between mothers and calves, range from 3.4 to 14.5 kHz, comparable to the 1 to 10 kHz range of mid-frequency active sonar. Potential Level B exposures from mid-frequency active sonar could therefore result in impaired communication between mother and calf pairs. In addition, experiments support the likelihood that some high-frequency active sonar frequencies could result in a behavioral response. Observed changes in behavior in one bottlenose dolphin were induced with an exposure to a 75 kHz one-second pulse at 178 dB re 1 μPa-m (Ridgway et al. 1997; Schlundt et al. 2000).

Exposure to mid-frequency active sonar that is below, or high-frequency active sonar that is above, the functional hearing capability of bottlenose dolphins may not elicit a behavioral response since the respective frequencies are outside the functional hearing range of the animal. If the animal does react to sound outside their functional hearing range, their response may be less severe when compared to their response to a sound that is within their functional hearing range. Because risk function methods do not necessarily exclude sonar frequencies that are outside a species functional hearing range, bottlenose dolphin behavioral exposures may be an overestimate. Any behavioral responses that do occur are not expected to be long-term due to the likely low received level of acoustic energy and relatively short duration of potential exposures. Thus, interruptions in communication and other activities would be temporary.

3.9.3.1.7 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). The NMFS Stock Assessment Report estimates there are 2,830 (CV=0.73) Cuvier's beaked whales in the waters of California, Oregon, and Washington (Carretta et al. 2008).

Distribution—Little is known about the habitat preferences of any beaked whale. Based on current knowledge, beaked whales normally inhabit deep ocean waters (>6,562 ft.) or continental slopes (656-6,562 ft.), and only rarely stray over the continental shelf (Pitman 2002). Cuvier's beaked whale generally is sighted in waters >656 ft. deep, and is frequently recorded at depths >3,281 ft. (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 advantage 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 3.9-2).

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 (0-7 ft.) 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 656 ft. depth categories between surface and 3,510 ft.) which equals ~five min per 656 ft. The five-minute value was applied to each 656 ft. depth category from 1,312-3,510 ft.; for the 7-722 ft. 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 <7 ft., 29% at 7-722 ft., 4% at 724-1,313 ft., 4% at 1,315-1,970 ft., 4% at 1,9712-2,626 ft., 5% at 2,627-3,510 ft. and 27% in >3,510 ft.

Acoustics—MacLeod (1999) suggested that beaked whale species use frequencies of between 300 Hz and 129 kHz for echolocation, and between 2 and 10 kHz for social communication. Recent information showed that Cuvier's beaked whales produce echolocation clicks at frequencies from 20 to 70 kHz (Zimmer et al. 2005) and only echolocated below 656 ft (200 m) (Tyack et al. 2006). 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). Soto et al. (2006) reported changes in vocalizations during diving on close approaches of large cargo ships which may have masked their vocalizations.

There is no information on the hearing abilities of Cuvier's beaked whales; therefore, information on another beaked whale species is presented here. 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.

Beaked whales functional hearing range is estimated to occur between approximately 150 Hz and 160 kHz, placing them in the mid-frequency cetacean group (Southall 2007) though the best hearing is presumed to occur at ultrasonic frequencies (MacLeod 1999; Ketten 2000). However, due to their physiology, they may be more sensitive than other cetaceans to low-frequency sounds as well (MacLeod 1999; Ketten 2000). The only direct measure of beaked whale hearing is from a stranded juvenile Gervais' beaked whale using auditory evoked potential techniques (Cook et al. 2006). The hearing range was 5 to 80 kHz, with greatest sensitivity at 40 and 80 kHz (Cook et al. 2006). Some have proposed a potential association between beak whale strandings and Navy activities, noting five recurring factors in common with each stranding event: use of mid-frequency sonar, beaked whale presence, surface ducts, steep bathymetry, and constricted channels with limited egress. These five factors would not occur simultaneously within the SOCAL Range Complex. Exposure to mid-frequency active sonar that is below or high-frequency active sonar that is above the functional hearing capability of beaked whales may not elicit a behavioral response since the respective frequencies are outside the functional hearing range of the animal. If the animal does react to sound outside their functional hearing range, their response may be less severe when compared to their response to a sound that is within their functional hearing range. Because risk function methods do not necessarily exclude sonar frequencies that are outside a species functional hearing range, beaked whale behavioral exposures may be an overestimate.

3.9.3.1.8 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 with (Barlow and Forney 2007). The NMFS Stock Assessment Report estimates there are 48,376 (CV=0.24) Dall's porpoises in the waters of California, Oregon, and Washington (Carretta et al. 2008).

There is 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). Dall's porpoise 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 degrees Celsius (°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 eight 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 3.9-2).

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 110 ft. (S.D. = + 78 ft.) 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 33 ft. totaled 2.11 min, dives to >197 ft. totaled 0.4 min, and dives with bottom time between 135 and 197 ft. totaled 1.83 min. The remaining time can be assumed to be spent diving between 36 and 131 ft.

Based on this information, the depth distribution can be estimated as 39% at <3 ft., 8% at 3-33 ft., 45% at 33-131 ft., and 8% at >131 ft.

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.

3.9.3.1.9 Dwarf Sperm Whale (*Kogia sima*) California/Oregon/Washington Stock

Population Status—The two species of Kogia, dwarf and pygmy sperm 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 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, noncontiguous 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). Based on historical stranding records and surveys in Southern California, sightings of *Kogia* were probably pygmy sperm whales rather than the dwarf sperm whale (Carretta et al. 2007). Based on the rarity of this species within the SOCAL Range Complex it was not included in the exposure modeling.

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). This species was not included in exposure modeling.

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 is 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). Based on historical stranding records and surveys in Southern California, sightings of *Kogia* were probably pygmy sperm whales rather than the dwarf sperm whale (Carretta et al. 2007). Based on the rarity of this species it was not included in the exposure modeling.

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 <7 ft., 41% at 7-234 ft., 2% at 235-657 ft., 4% at 658-1,313 ft., 4% at 1,315-1,970 ft., 4% at 1,971-2,740 ft. and 19% at >2,740 ft.

Acoustics—There is no information available on dwarf sperm whale vocalizations. 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).

In terms of functional hearing capability pygmy and dwarf sperm whales belong to high-frequency cetaceans which have the best hearing ranging from 200 Hz to 180 kHz. An auditory brainstem response study indicates that pygmy sperm whales (similar to dwarf sperm whale) have their best hearing between 90 and 150 kHz (Ridgway and Carder 2001). Exposure to mid-frequency active sonar that is below or high-frequency active sonar that is above the functional hearing capability of pygmy or dwarf sperm whales may not elicit a behavioral response since the respective frequencies are outside the functional hearing range of the animal. If the animal does react to sound outside their functional hearing range, their response may be less severe when compared to their response to a sound that is within their functional hearing range.

3.9.3.1.10 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 within Hawaii (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). 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. Based on the rarity of this species in the SOCAL Range Complex it was not included in the exposure modeling.

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). They are considered very rare in the SOCAL Range Complex (DoN 2005).

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 and their clicks are 25 to 30 kHz and 95 to 130 kHz (Thomas et al. 1990; Richardson et al. 1995). The source level for echolocation clicks are 220 to 228 dB re 1 µPa-m peak to peak at 25-30 and 95-130 kHz (Kamminga and van Velden 1987; Thomas and Turl 1990).

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. Nachtigall and Supin (2008) showed that false killer whales are able to adjust their hearing of echolocation signals to compensate for distance and size (i.e. more sensitive hearing for smaller returning echos).

3.9.3.1.11 Killer Whale (*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 (this includes all offshore and transient stocks) along the coasts of California, Oregon, and Washington is estimated to be 353 (CV=0.29) individuals (Carretta et al. 2008).

Distribution—Killer whales from the Eastern North Pacific Southern Offshore Stock, range from Washington to the SCB 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), although killer whales could theorectically be sighted throughout the year (Black et al. 1997). 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).

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 3.9-2).

Reproduction/Breeding—There is no information on 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 866 ft., and males dove more frequently and more often to depths >328 ft. 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 >98 ft. and 96% of time at depths 0-98 ft.

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). 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 and 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). Behavioral differences such as the type of prey, fish or marine mammals, that pods of killer whales feed on will affect the frequency of echolocation clicks. Fish eating killer whales in British Columbia produced echolocation clicks 27 times more often than marine mammal eating killer whales (Barrett-Lennard et al. 1996).

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).

Functional hearing for killer whales is estimated to occur between approximately 150 Hz and 160 kHz placing them in the mid-frequency cetacean group (Southall 2007). Killer whales can hear a frequency range of 1 to 100 kHz and are most sensitive at 20 kHz (Szymanski et al. 1999). Social sounds range from 0.5 to 25 kHz with the dominant frequency range between 1 to 6 kHz. This overlap with mid-frequency active and high-frequency active sonar frequencies suggests a potential for SOCAL Range Complex sonar to interfere with sounds associated with social behavior. Foraging frequencies for one study noted a center frequency ranging from 45 to 80 kHz, which overlaps well with high-frequency active sonar. Thus, use of either mid-frequency active or high-frequency active sonar could overlap a part of this species' broad functional hearing and communication range. High-frequency active frequencies above 80 kHz may or may not result in a response. If a killer whale does react to sound outside their functional hearing range, their response may be less severe when compared to their response to a sound that is within their functional hearing range.

3.9.3.1.12 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 (Black et al. 1997).

Distribution—Little is known about the movements and range of the Eastern Pacific Transient stock (Caretta et al. 2007).

At Sea Density Estimates—Densities were not derived for this stock.

Reproduction/Breeding—There is no information the reproductive behavior of killer whales in this area.

Diving Behavior—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 are assumed to be similar to the population of killer whales described in the section on the killer whale offshore stock. Behavioral differences such as the type of prey, fish, or marine mammals that pods of killer whales feed on will affect the frequency of echolocation clicks. Fish-eating killer whales in British Columbia produced echolocation clicks 27 times more often than marine mammal-eating killer whales (Barrett-Lennard et al. 1996).

3.9.3.1.13 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. The population size is estimated to be 21,902 (CV=0.50) individuals (Barlow and Forney 2007) although the NMFS Stock Assessment Report estimates there are 15,335 (CV=0.56) long-beaked common dolphins in the waters of California (Carretta et al. 2007). Long-beaked common dolphins were a strategic stock under the MMPA but that designation was removed in 2008 (Carretta et al. 2008). The numbers of the short-beaked common dolphins 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), but long-beaked common dolphins have decreased.

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 nautical miles (nm) (92.5 km) of shore (Barlow et al. 1997, Bearzi 2005, 2006; 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 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 3.9-2).

Reproduction/Breeding—The peak calving season occurs from spring to 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 30 to 164 ft. (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 656 ft. but that most dives occur in less than 328 ft.

Based on this limited information, depth distribution is estimated as: 100% at 0-656 ft.

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 echolocation clicks 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 (Popov and Klishin 1998).

3.9.3.1.14 Mesoplodont Beaked Whales (*Mesoplodon* spp.) California/Oregon/Washington

Population Status—Mesoplodonts are difficult to distinguish in the field. Five species of Mesoplodont 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). The NMFS Stock Assessment Report estimates there are 1,024 (CV=0.77) Mesoplodont species in the waters of California, Oregon, and Washington (Carretta et al. 2008).

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 3.9-2).

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 to 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 (0-7 ft.) 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 (number of 230 ft. depth categories between surface and 2,749 ft.), which equals 1.7 min per 230 ft. The 1.7 min value was applied to each 230 ft. depth category from 236-2,749 ft.; for the 7-230 ft. 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 <7 ft., 41% in 7-230 ft, 2% at 236-656 ft., 4% at 659-1,312 ft., 4% at 1,316-1,969 ft., 4% at 1,972-2,740 ft., and 19% at >2,740 ft.

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 the frequency range of 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).

There is no information on the hearing of these *Mesoplodon* species although 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).

Beaked whales functional hearing range is estimated to occur between approximately 150 Hz and 160 kHz, placing them in the mid-frequency cetacean group (Southall 2007) though the best hearing is presumed to occur at ultrasonic frequencies (MacLeod 1999; Ketten 2000). However, due to their physiology, they may be more sensitive than other cetaceans to low-frequency sounds as well (MacLeod 1999; Ketten 2000). The only direct measure of beaked whale hearing is from a stranded juvenile Gervais' beaked whale using auditory evoked potential techniques (Cook et al. 2006). The hearing range was 5 to 80 kHz, with greatest sensitivity at 40 and 80 kHz (Cook et al. 2006). Some have proposed a potential association between beaked whale strandings and Navy activities, noting five recurring factors in common with each stranding event: use of mid-frequency sonar, beaked whale presence, surface ducts, steep bathymetry, and constricted channels with limited egress. These five factors would not occur simultaneously within the SOCAL Range Complex. Exposure to mid-frequency active sonar that is below or high-frequency active sonar that is above the functional hearing capability of beaked whales may not elicit a behavioral response since the respective frequencies are outside the functional hearing range of the animal. If the animal does react to sound outside their functional hearing range, their response may be less severe when compared to their response to a sound that is within their functional hearing range. Because risk function methods do not necessarily exclude sonar frequencies that are outside a species functional hearing range, beaked whale behavioral exposures may be an overestimate.

3.9.3.1.15 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 (Barlow and Forney 2007). The 2008 Stock Assessment Report estimates a population of 12,876 (CV=0.30; Carretta et al. 2008).

Distribution—This species is endemic to the North Pacific Ocean, and is found primarily in temperate (8–19ºC [46.4-66.2ºF]) 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 3.9-2).

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 656 ft. 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 33 ft. 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 (0-1,312 ft.) waters. Prey distribution during the day is estimated at 1,312-2,297 ft.

Based on these data, the following are very rough order estimates of time at depth: daytime: 100% at 0-156 ft.; nighttime: 100% at 0-1,312 ft.

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 for echolocation clicks 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.

3.9.3.1.16 Pacific White-Sided Dolphin (*Lagenorhynchus obliquidens*) California/Oregon/ Washington

Population Status—No population trends have been observed in California or adjacent waters. The size of the California/Oregon/Washington Stock is estimated to be 23,817 (CV=0.36) individuals (Barlow and Forney 2007). The NMFS Stock Assessment Report estimates there are

20,719 (CV=0.22) Pacific white-sided dolphins in the waters of California, Oregon, and Washington (Carretta et al. 2008).

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 3.9-2).

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 427 ft. depth to take advantage of the deep scattering layer closer to the surface and during the day in shallower depths (<213 ft.) 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 0-213 ft.; night time – 100% at 0-427 ft.

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 with the greatest sensitivities from 4 to 128 kHz. Below 8 Hz and above 100 kHz, this dolphin's hearing was similar to that of other toothed whales.

3.9.3.1.17 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. Based on the rarity of this species within the SOCAL Range Complex, it was not included in the exposure modeling.

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. 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).

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 dolphins 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). 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). Data from Atlantic spotted dolphins are provided to fill in the gaps of acoustic information for pantropical spotted dolphins. Echolocation clicks measured in wild Atlantic spotted dolphins showed bimodal ranges of 40 and 50 kHz and a high-frequency peak between 110 and 130 kHz, with a source level of 210 dB re 1 µPa-m (Au and Herzing 2003).

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 ear anatomy to other delphinids.

Functional hearing for pantropical spotted dolphins is estimated to occur between approximately 150 Hz and 160 kHz, placing them in the mid-frequency cetacean group (Southall 2007). Pantropical spotted dolphins communicate, feed, and socialize via clicks and whistles at frequency ranges that overlap mid-frequency active sonar, though best hearing sensitivity aligns more with that of high-frequency sonar. Pantropical spotted dolphin whistles have a frequency range of 3.1 to 21.4 kHz (Thomson and Richardson 1995), which overlaps well with mid-frequency active sonar, while clicks are bimodal with peaks at 40 to 60 kHz and 120 to 140 kHz and more aligned with high-frequency sonar (Schotten et al. 2004). Potential Level B exposures from mid-frequency active and high-frequency sonar could therefore result in impaired communication, changes in foraging and social interaction. However, any behavioral responses are not expected to be long-term due to the likely low received level of acoustic energy and relatively short duration of potential exposures. Thus, interruptions in communication and other activities would be temporary.

3.9.3.1.18 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 unknown (Carretta et al. 2008). Barlow and Forney (2007) estimated the *Kogia* spp. population at 1,237 (CV=0.45). This estimate did not differentiate between the two species of *Kogia*, but dwarf sperm whales are rarely observed in California waters and therefore this estimate is most likely pygmy sperm whales.

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).

At Sea Density Estimates—Pro-rated densities incorporating vessel survey results from 1986-2005 resulted in densities of 0.0013785 for warm and cold water seasons (Table 3.9-2).*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).

3.9.3.1.19 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). The NMFS Stock Assessment Report estimates there are 11,621 (CV=0.17) Risso's dolphins in the waters of California, Oregon and Washington (Carretta et al. 2008).

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). Risso's dolphins are found in the SOCAL Range Complex throughout the year (Carretta et al. 2000). 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 3.9-2).

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 1,148 ft. and 3,199 ft. 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 1,969-2,625 ft. 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 <164 ft., 15% at 167-656 ft., 15% at 659-1,312 ft., 10% at 1,316-1,969 ft. and 10% at >1,969 ft.

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. 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; Madsen et al. 2004).

The range of hearing in two Risso's dolphins (one infant and one adult was 1.6 to 150 kHz with maximum sensitivity occurring between 8 and 64 kHz (Nachtigall et al. 1995, 2005).

Functional hearing for Risso's dolphins is estimated to occur between approximately 150 Hz and 160 kHz, placing them in the mid-frequency cetacean group (Southall 2007). Nachtigall et al. (1995; 2005) measured hearing in an adult and an infant Risso's dolphin. The adult hearing ranged from 1.6 to 100 kHz and was most sensitive between 8 and 64 kHz. The infant could hear frequencies ranging from 4 to 150 kHz, with best sensitivity at 90 kHz, well above mid-frequency active sonar frequencies but well within the high-frequency active sonar frequency range. With regard to mid-frequency active sonar, exposure numbers for Risso's dolphins may be overestimated given that some functional hearing and communication frequencies do not overlap with mid-frequency active sonar frequencies. However, the intersection of common frequencies between Risso's dolphin best hearing sensitivity and high-frequency active sonar suggests that more often than not there is a potential for a behavioral response.

3.9.3.1.20 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. Based on the rarity of this species within the SOCAL Range Complex it was not included in the exposure modeling.

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). 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 little published information on the hearing ability of this species. Preliminary data from Cook et al. (2005) showed that rough-tooth dolphins hear from 5to 80 kHz (80 kHz was the upper limit tested) and probably higher frequencies.

Functional hearing for rough-toothed dolphins is estimated to occur between approximately 150 Hz and 160 kHz, placing them in the mid-frequency cetacean group (Southall 2007). Scientists have determined the rough-toothed dolphin can detect sounds between 5 and 80 kHz and probably much higher (Cook et al. 2005). The echolocation frequency range (0.1 to 200 kHz) of this species has some overlap with mid-frequency active and high-frequency active sonar. However, lower echolocation ranges of rough-toothed dolphins are below that of SOCAL Range Complex mid-frequency active sonar, and disruption of communication in Level B exposure zones may be moderated. Exposure to mid-frequency active sonar that is below or high-frequency active sonar that is above the functional hearing capability of rough-toothed dolphins may not elicit a behavioral response since the respective frequencies are outside the functional hearing range of the animal. If the animal does react to sound outside their functional hearing range, their response may be less severe when compared to their response to a sound that is within their functional hearing range. Because risk function methods do not necessarily exclude sonar frequencies that are outside a species functional hearing range, rough-toothed dolphin behavioral exposures may be an overestimate.

3.9.3.1.21 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). The NMFS Stock Assessment Report estimates there are 392,733 (CV=0.18) short-beaked common dolphins in the waters of California, Oregon, and Washington (Carretta et al. 2008). 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).

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 300 nm (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 eastern tropical Pacific ocean, 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 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 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 3.9-2).

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 30-164 ft. 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 656 ft., but there have been no detailed studies of diving behavior.

Based on this limited information, depth distribution is estimated as: 100% at 0-656 ft.

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 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.

3.9.3.1.22 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). The NMFS Stock Assessment Report estimates there are 245 (CV=0.97) short-finned pilot whales in the waters of California, Oregon, and Washington (Carretta et al. 2008).

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).

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 3.9-2).

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 66-180 ft. 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 118 ft. and >90% of dives were within 39-56 ft.

Based on this information, the following are estimates of time at depth for both species of pilot whale: 60% at <23 ft., 36% at 23-56 ft. and 4% at 59-2,717 ft.

Acoustics—Short-finned pilot whale whistles 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). Echoclocation clicks range from 30 to 60 kHz with peak to peak source level of 180 dB re 1 μPa-m (Evans 1973).

There are no published hearing data available for this species.

Functional hearing for pilot whales is estimated to occur between approximately 150 Hz and 160 kHz, placing them in the mid-frequency cetacean group (Southall 2007). Short-finned pilot whale whistles and clicks have a dominant frequency range of 2 to 14 kHz and 30 to 60 kHz. Communication frequencies for pilot whales therefore align well with both mid-frequency active and high-frequency active sonar frequencies. High-frequency active sonar frequencies above 60 kHz may or may not result in a response. If a pilot whale does react to sound outside their functional hearing range, their response may be less severe when compared to their response to a sound that is within their functional hearing range. Thus, for mid-frequency active sonar, exposure estimates may be an overestimate.

3.9.3.1.23 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. The spinner dolphin is not listed as endangered under the ESA, and is not considered to be depleted or strategic under the MMPA. Based on the rarity of this species within the SOCAL Range Complex, it was not included in the exposure modeling.

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—Spinner dolphins produce whistles in the range of 1 to 22.5 kHz with the dominant frequency being 6.8 to 17.9 kHz, above that of the active sonar frequencies, although their full range of hearing may extend down to 1 kHz or below as reported for other small odontocetes (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). Spinner dolphins consistently produce whistles with frequencies from 1 kHz to as high as 16.9 to 17.9 kHz, with a maximum frequency for the fundamental component at 24.9 kHz (Bazúa-Durán and Au 2002; Lammers et al. 2003 Richardson et al. 1995; Nedwell et al. 2004). Peak to peak source levels between 195 and 222 dB have been recorded for spinner dolphin clicks (Schotten et al. 2004).

There is no information on hearing for this species although the full range of hearing may extend down to 1 kHz or below as reported for other small odontocetes and up to at least 65 kHz based on their echolocation clicks (Richardson et al. 1995a; Nedwell et al. 2004; Bazúa-Durán and Au 2002).

Spinner dolphins are assumed to belong to the mid-frequency functional hearing group, though no data on their hearing exists. Spinner dolphins are known to produce sounds ranging from 1 to 160 kHz. Spinner dolphin whistles have been consistently recorded as high as 16.9 to 17.9 kHz, which is above frequencies for mid-frequency active sonar but within the range for high-frequency active sonar. Exposure to mid-frequency active sonar that is below or high-frequency active sonar that is above the functional hearing capability of spinner dolphins may not elicit a behavioral response since the respective frequencies are outside the functional hearing range of the animal. If the animal does react to sound outside their functional hearing range, their response may be less severe when compared to their response to a sound that is within their functional hearing range. Because risk function methods do not necessarily exclude sonar frequencies that are outside a species functional hearing range, spinner dolphin behavioral exposures may be an overestimate.

3.9.3.1.24 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). According to the NMFS Stock Assessment Report. the size of the California/Oregon/Washington Stock is 17,925 (CV=0.37) individuals (Carretta et al. 2008).

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.

At Sea Density Estimates—Pro-rated densities incorporating vessel survey results from 1986-2005 resulted in densities of 0.0175442 for warm season and 0.0107019cold water seasons (Table 3.9-2).

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 is 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).

Functional hearing for striped dolphins is estimated to occur between approximately 150 Hz and 160 kHz, placing them in the mid-frequency cetacean group (Southall 2007). Kastelein et al. (2003) determined the hearing sensitivity of a single striped dolphin to range from 0.5 to 160 kHz with best sensitivity at 64 kHz. Assuming this study may be applicable to striped dolphins in general, the frequency of best sensitivity for this species is much higher than the range of frequencies for mid-frequency active sonar but aligns well with that of high-frequency active sonar. Dominant frequencies of whistles ranged from 8 to 12.5 kHz (Thomson and Richardson 1995). Exposure numbers for striped dolphins may be overestimated given that some functional hearing and communication frequencies do not overlap with mid-frequency active sonar. However, the intersection of common frequencies between striped dolphin functional hearing and high-frequency active sonar suggests that more often than not there is a potential for a behavioral response.

3.9.3.1.25 Ziphiid Whales (Unknown *Ziphius spp.*)

Population Status—Population size is unknown and these may likely be Cuvier's beaked whales but often are difficult to distinguish at sea.

Distribution—Little is known about the habitat preferences of any beaked whale. Based on current knowledge, beaked whales normally inhabit deep ocean waters (>6,562 ft.) or continental slopes (656-6,562 ft.), and only rarely stray over the continental shelf (Pitman 2002). Cuvier's beaked whale generally is sighted in waters >656 ft. deep, and is frequently recorded at depths >3,281 ft. (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.

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 0.0008214 for warm and cold water seasons (Table 3.9-2).

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 (0-7 ft.) 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 656 ft. depth categories between surface and 3,510 ft.) which equals ~five min per 656 ft. The five-minute value was applied to each 656 ft. depth category from 1,312-3,510 ft.; for the 7-722 ft. 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 <7 ft., 29% at 7-722 ft., 4% at 724-1,313 ft., 4% at 1,315-1,970 ft., 4% at 1,9712-2,626 ft., 5% at 2,627-3,510 ft. and 27% in >3,510 ft.

Acoustics—MacLeod (1999) suggested that beaked whale species 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 656 ft (200 m) (Tyack et al. 2006). 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).

There is no information on the hearing abilities of Cuvier's beaked whales; therefore, information on another beaked whale species is presented here. 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.

Beaked whales functional hearing range is estimated to occur between approximately 150 Hz and 160 kHz, placing them in the mid-frequency cetacean group (Southall 2007) though the best hearing is presumed to occur at ultrasonic frequencies (MacLeod 1999; Ketten 2000). However, due to their physiology, they may be more sensitive than other cetaceans to low-frequency sounds as well (MacLeod 1999; Ketten 2000). The only direct measure of beaked whale hearing is from a stranded juvenile Gervais' beaked whale using auditory evoked potential techniques (Cook et al. 2006). The hearing range was 5 to 80 kHz, with greatest sensitivity at 40 and 80 kHz (Cook et al. 2006). Some have proposed a potential association between beak whale strandings and Navy activities, noting five recurring factors in common with each stranding event: use of mid-frequency sonar, beaked whale presence, surface ducts, steep bathymetry, and constricted channels with limited egress. These five factors would not occur simultaneously within the SOCAL Range Complex. Exposure to mid-frequency active sonar that is below or high-frequency active sonar that is above the functional hearing capability of beaked whales may not elicit a behavioral response since the respective frequencies are outside the functional hearing range of the animal. If the animal does react to sound outside their functional hearing range, their response may be less severe when compared to their response to a sound that is within their functional hearing range. Because risk function methods do not necessarily exclude sonar frequencies that are outside a species functional hearing range, beaked whale behavioral exposures may be an overestimate.

3.9.3.2 Unlisted Marine Mammal Species Not Likely to Occur in the SOCAL Range Complex

3.9.3.2.1 Melon-Headed Whale (*Peponocephala electra*)

The likelihood of a melon-headed whale being present in the action area is extremely low. The melon-headed whale is a tropical species that is extralimital and has only been sighted at the southwest boundary of the SOCAL Range Complex (DoN 2005). 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.

3.9.3.2.2 Pygmy Killer Whale (*Feresa attenuata*)

The likelihood of a pygmy killer whale being present in the action area is extremely low. The pygmy killer whale is a tropical species that is extralimital and has only been sighted at the southwest boundary of the SOCAL Range Complex (DoN 2005). 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.

3.9.4 Nonthreatened and Nonendangered 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), otariids (sea lions and fur seals), and odobenids (walrus). Only two of the families, phocids and otariids, are currently 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, 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 outcompeted 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 124,000 (Carretta et al. 2008).

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 percent on San Nicolas Island, and the remaining seals (1 percent) use Santa Rosa, 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).

At Sea Density Estimates—Pro-rated densities incorporating survey results from Carretta et al. (2007) and Lowry (2002) resulted in densities of 0.042 for warm water season and 0.025 for the cold water season (Table 3.9-2).

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. 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 population estimate of the California Stock is 34,233 (Carretta et al. 2008).

Distribution—Harbor seals are considered abundant throughout most of their range from Baja California to the eastern Aleutian Islands. The SCB 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, San Clemente, and Santa Catalina islands within the SOCAL Range Complex, but most harbor seals haul out further north.

At Sea Density Estimates—Pro-rated densities incorporating survey results from Lowry (2005) resulted in densities of 0.019 for the warm and cold water seasons (Table 3.9-2).

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 is in late January, and pups start to become weaned in May. Breeding occurs between late March and early May.

Diving Behavior—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 at frequencies from 1 to 180 kHz however best hearing is below 60 kHz with peak hearing sensitivity 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 to 7 hours of intermittent broadband continuous construction noise (sandblasting; 200 to 2000 Hz at 95 to 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.

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 California sea lion population estimate for the U.S. Stock is 238,000 (Carretta et al. 2008).

Distribution—Nearly all of the U.S. Stock (more than 95 percent) 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).

At Sea Density Estimates—Pro-rated densities incorporating survey results from Lowry and Maravilla-Chavez (2005) resulted in densities of 0.805 for warm water season and 0.87 for the cold water season (Table 3.9-2).

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 Behavior—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). Peak sensitivities in air are shifted to lower frequencies; the effective upper hearing limit is approximately 36 kHz (Schusterman 1974). 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.

3.9.4.1.4 Northern Fur Seal (*Callorhinus ursinus*) San Miguel Island Stock

Population 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 OEIS/EIS study area, is not considered depleted or strategic under the MMPA.

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 population estimate for the San Miguel Island Stock is 9,424 (Carretta et al. 2008).

Distribution—The Eastern Pacific Stock spends May to 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 to 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 five 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).

At Sea Density Estimates—Pro-rated densities incorporating survey results from NMFS 2006 and Carretta et al. (2007) resulted in densities of 0.027 for warm and cold water seasons (Table 3.9-2).

Reproduction/Breeding—The northern fur seal pupping and mating season begins in June and continues through July (Bonnell et al. 1978).

Diving Beheavior—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) 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 lists marine mammal species found in SOCAL and provides abundance estimates of each.

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-Apr
ESA-Listed Species								
Mysticetes								
Blue whale *Balaenoptera musculus*	1,368 (0.22)	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*	2,636 (0.15)	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*	46[3] (0.61)	Eastern North Pacific	0 (7 Bryde's or Sei Whales)[4]	E, D, S	May be increasing	Rare; Less than three sightings within the last 30 years	UNK	UNK
Odontocete								
Sperm whale *Physeter macrocephalus*	2,853 (0.25)	California, Oregon, & Washington	607 (0.57)	E, D, S	Unknown	Common year round; More likely in waters > 1,000 m, most often > 2,000 m	YES MORE	YES LESS
Pinnipeds								
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*	3,681	California, Oregon, & Washington		T, D	Decreasing	Very rare; Summer distribution is north of 36^{o}N; last seen in northern Channel Islands in 1998	NO	NO

Table 3.9-1: Summary of Marine Mammal Species Found in Southern California Waters (continued)

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
ESA-Listed Species (continued)								
Mustelid								
Southern sea otter *Enhydra lutris*	2,359	California	~29 (from ground surveys)	T, D SNI trans-located population is not considered threatened	Increasing	Main distribution at San Nicolas Island north of the SOCAL Range Complex is translocated population of approximately 29 animals is experimental population not considered endangered	YES	YES
Non–ESA-Listed Species								
Mysticetes								
Bryde's whale *Balaenoptera edeni*	13,000 (estimated)	Eastern Tropical Pacific	0 (7 Bryde's or sei Whales)[4]		Unknown	Rare; Only one confirmed sighting in California	UNK	UNK
Gray whale *Eschrichtius robustus*	18,813 (0.07)	Eastern North Pacific	Population migrates through SOCAL		Increasing ~ 2.5%	Transient during seasonal migrations	NO	YES
Minke whale *Balaenoptera acutorostrata*	806 (0.63)	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*	540 (0.54)	California, Oregon, & Washington	127 (1.14)		Unknown	Rare	UNK	UNK
Bottlenose dolphin coastal *Tursiops truncatus*	323 (013)	California Coastal	323 (0.12)		Stable	Limited, small population within one km of shore	YES	YES
Bottlenose dolphin offshore *Tursiops truncatus*	3,495 (0.31)	California Offshore	1,831 (0.47)		No Trend	Common	YES	YES

Table 3.9-1: Summary of Marine Mammal Species Found in Southern California Waters (continued)

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
Non–ESA-Listed Species (continued)								
Odontocetes (continued)								
Cuvier's beaked whale *Ziphius cavirostris*	2,830 (0.73)	California, Oregon, & Washington	911 (0.68)		Unknown	Uncommon; seaward of 1000 m; only limited sightings in winter	YES	UNK
Dall's porpoise *Phocoenoides dalli*	48,376 (0.24)	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	Eastern Tropical Pacific	Unknown		Unknown	Uncommon; warm water species; although stranding records from the Channel Islands	UNK	UNK
Killer whale offshore *Orcinus orca*	353 (0.29)	Eastern North Pacific	30 (0.73)		Unknown	Uncommon; occurs infrequently; more likely in winter	Rare	YES
Killer whale transient *Orcinus orca*	346	Eastern North Pacific	Unknown		Unknown	Uncommon; occurs infrequently; more likely in winter	Rare	YES
Long-beaked common dolphin *Delphinus capensis*	15,335 (0.56)	California	17,530 (0.57)		Varies by oceanographic conditions	Common; more inshore distribution	YES	YES
Melon-headed whale *Peponocephala electra*	Unknown	Tropical	Extralimital		Unknown	Extralimital within the south-west boundary of the SOCAL Range Complex		
Mesoplodont beaked whales Five *Mesoplodon spp.*	1,024 (0.77)	California, Oregon, & Washington	132 (0.96)		Unknown	Rare; seaward of 500-1000 m; limited sightings	UNK	UNK
Northern right whale dolphin *Lissodelphis borealis*	12,876 (0.30)	California, Oregon, & Washington	1,172 (0.52)		No Trend	Common; cool water species; more abundant Nov-Apr	YES	YES

Table 3.9-1: Summary of Marine Mammal Species Found in Southern California Waters (continued)

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
Non–ESA-Listed Species (continued)								
Odontocetes (continued)								
Pacific white-sided dolphin *Lagenorhynchus*	20,719 (0.22)	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 killer whale *Feresa attenuata*	Unknown	Tropical	Extralimital		Unknown	Extralimital within the south-west boundary of the SOCAL Range Complex		
Pygmy sperm whale *Kogia breviceps*	Unknown	California, Oregon, & Washington	0		Unknown	Rare; seaward of 500-1000 m; limited sightings over entire SCB	UNK	UNK
Risso's Dolphin *Grampus griseus*	11,621 (0.17)	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*	487,622 (0.26)	California, Oregon, & Washington	165,400 (0.19)		Varies with oceanographic conditions	Common; one of the most abundant SOCAL dolphins; higher summer densities	YES MORE	YES LESS
Short-finned pilot whale *Globicephala macrorhynchus*	245 (0.97)	California, Oregon, & Washington	118 (1.04)		Unknown	Uncommon; more common before 1982	UNK	UNK
Spinner dolphin *Stenella longirostris*	Unknown	Tropical and warm temperate	Unknown		Unknown	Rare	RARE	RARE
Striped dolphin *Stenella coeruleoalba*	17,925 (0.37)	California, Oregon, & Washington	12,529 (0.28)		No Trend	Occasional visitor; cool water oceanic species	NO	RARE

Table 3.9-1: Summary of Marine Mammal Species Found in Southern California Waters (continued)

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
Non–ESA-Listed Species (continued)								
Pinnipeds								
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*	124,000	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*	238,000	U.S. Stock	All pupping occurs in Southern California and Baja Mexico		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 Calif. 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] Abundance is for the California/Oregon/Washington surveys.

[4].Seven whales were identified as either Bryde's or Sei whales but could not be identified to the species level.

[5] Lowry and Carretta (2003)

[6] 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.

3.9.4.2 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.

California Sea Lion

The general biology, seasonal distribution, and movements of California sea lions in Southern California are described in Section 3.9.4.1.3. 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) (Table 3.9-1). 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 3.9-1 and Table 3.9-2). 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. 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) (Table 3.9-2). 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). 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 (DoN 1998), and numbers hauled out are variable. 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

The general biology, seasonal distribution, and movements of northern elephant seals in Southern California are described in Section 3.9.4.1.1. 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 3.9-2). 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.

Source: Caretta et al. 2000 and Maravilla-Chavez (in press)

Figure 3.9-1: California Sea Lion SCI Haul-out Locations

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).

Table 3.9-2: Activities Of Pinnipeds Throughout The Year At San Clemente Island

.	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.

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.

Source: Caretta et al. 2000 and Lowry 2002

Figure 3.9-2: Northern Elephant Seal SCI Haul-out Locations

Harbor Seal

The general biology, seasonal distribution, and movements of harbor seals in Southern California are described in Section 3.9.4.1.2 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 3.9-3). 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. Lowry (2003) reported 115 harbor seals at seven haul out sites on San Clemente Island in May of 2002.

Northern Fur Seal

The general biology, seasonal distribution, and movements of northern fur seals in Southern California are described in Section 3.9.4.1.4 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

The general biology, seasonal distribution, and movements of Guadalupe fur seals in Southern California are described in Section 3.9.2.1.6. 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 fur 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.).

Source: Caretta et al. 2000 and Lowry and Carretta 2003

Figure 3.9-3: Harbor Seal SCI Haul-out Locations

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 3.9.2.2.2).

Sea Otter

The distribution and life history of sea otters in California is described in Section 3.9.2.1.7. 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).

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 percent 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 percent 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.

Density estimates are typically derived for large areas by NMFS, for instance the California and Point Conception south stratas presented in Forney and Barlow (2007). Often scientific information on smaller scale distribution and density within discrete areas such as the SOCAL modeling areas used in the acoustic impact analysis is lacking and larger scale densities have to be used as an approximate.

For the purposes of this analysis, we have adopted a conservative approach to underwater noise and marine mammals:

- Cetaceans – assume 100 percent of time is spent underwater and therefore exposed to underwater sound.
- Pinnipeds – adjust densities to account for time periods spent at breeding areas, haul-outs, etc. (see Appendix F); but for those animals in the water, assume 100 percent of time is spent underwater and therefore exposed to underwater sound.
- Sea otters – assume 100 percent 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 nearshore 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 >3,281 ft (1000 m) north of 30°N. Gray whale densities were taken from Carretta et al. (2000), and are applicable for January to 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° N and 34° N, and in longitude by 120° 30' W and 116° 30' W. Area 8 is not shown on Figure 3.9-4.

Pinniped at-sea density is not often available because pinniped abundance is obtained via shore counts of animals at known rookeries and haul-outs. 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 adhered 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.

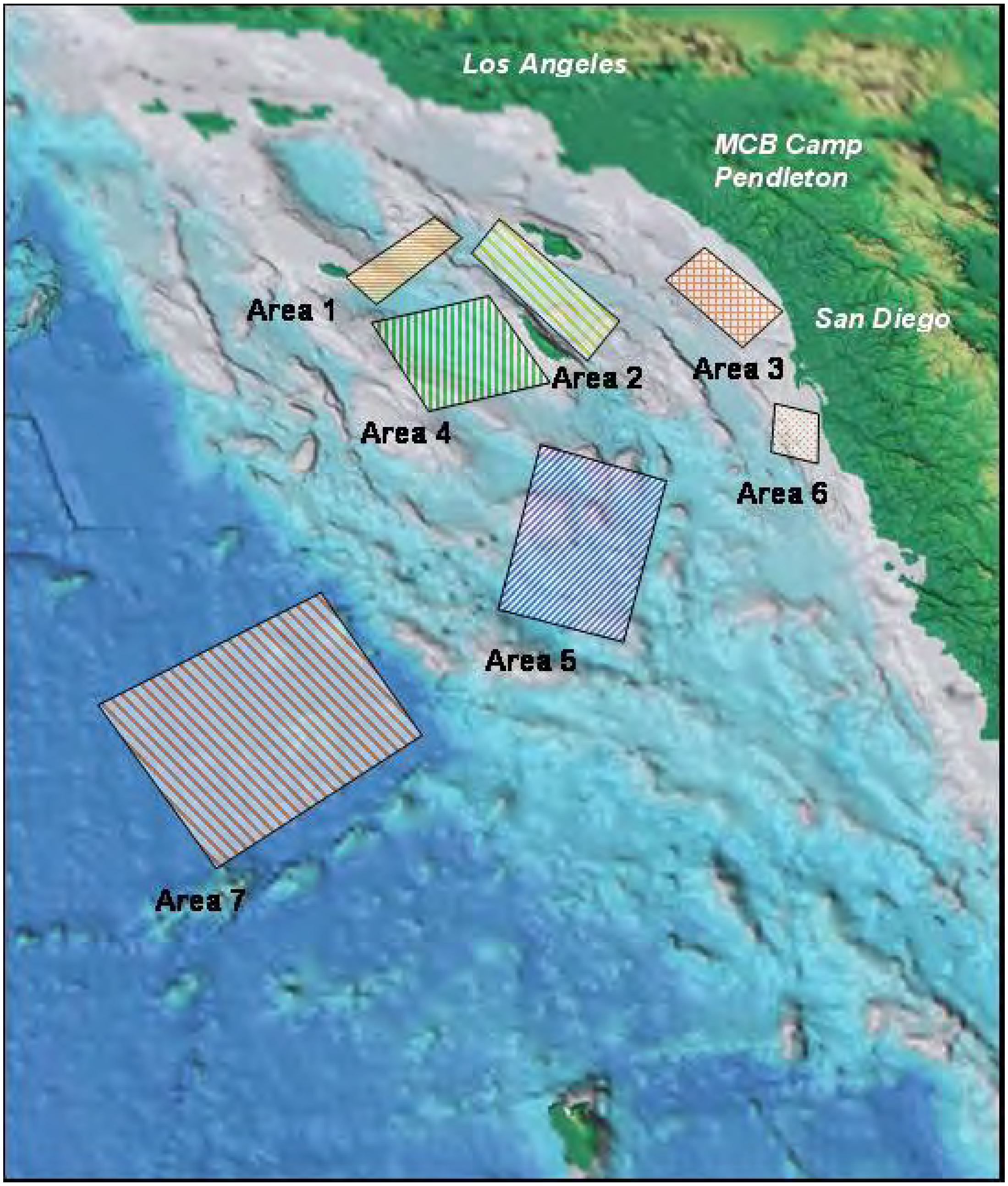

Figure 3.9-4: Sonar Model Areas

Note: Area 8 (not depicted) includes all areas outside the seven depicted areas that are within the quasi-rectangular region bounded in latitude by 29° N and 34° N, and in longitude by 120° 30' W and 116° 30' W.

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 Southern California region for which densities are available is included in 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. Density estimates are typically derived for large areas by NMFS, for instance the All California and Point Conception south stratas presented in Forney and Barlow 2007. Often scientific information on smaller scale distribution and density within discrete areas such as the SOCAL modeling areas used in the acoustic impact analysis is lacking and larger scale densities have to be used as an approximate.

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 (<2,625 ft [800 m]) and others regularly diving to <656 ft (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 (3-D) 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 SOCAL Operating Area (OPAREA) lists 43 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 3.9-3.

Table 3.9-3: Summary of Marine Mammal Densities Used for Exposure Modeling

Species Name	Warm Season[1] density/km^2	Cold Season[1] 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)	

Table 3.9-3: Summary of Marine Mammal Densities Used for Exposure Modeling (continued)

Species Name	Warm Season[1] density/km^2	Cold Season[1] 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

[1]Warm Season (May-October) density/km^2, Cold Season (November-April) density/km^2

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 the impedance of water is close to that of the tissues of a cetacean, the outer ear is not required to transduce sound energy as it does when sound waves travel from air to fluid (inner ear). Sound waves traveling through the inner ear cause the basilar membrane to vibrate. Specialized cells, called hair cells, respond to the vibration and produce nerve pulses that are transmitted to the central nervous system. 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 (Pickles 1998; Tyack 1999). Baleen whales have inner ears that appear to be specialized for low-frequency hearing. Conversely, dolphins and porpoises have ears that are specialized to hear high frequencies.

Measured data on the hearing abilities of cetaceans are sparse and are nonexistent 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.

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). 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. 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) and harmonics of the frequency fundamental measured up to 24 kHz (Au et al. 2001, 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; Au et al. 2006). 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. 2001a). 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; Rankin and Barlow 2003).

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).

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 mid-frequency active (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 frequencies from 1 to 180 kHz although most functional hearing is likely below 75 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).

Southall et al (2007) has provided a comprehensive review of marine mammal acoustics including designating functional hearing groups. Table 3.9-4 presents the functional hearing groups and representative species or taxonomic groups for each although most species found in SOCAL fall in the first two groups, low-frequency cetaceans (baleen whales) and mid-frequency cetaceans (odontocetes).

Table 3.9-4: Summary of the Five Functional Hearing Groups of Marine Mammals (Based on Southall et al. 2007)

Functional Hearing Group	Estimated Auditory Bandwidth	Species or Taxonomic Groups
Low Frequency Cetaceans (Mysticetes–Baleen whales)	7 Hz to 22 kHz (best hearing is generally below 1000 Hz, higher frequencies result from humpback whales)	All baleen whales
Mid/High Frequency Cetaceans (Odontocetes)	150 Hz to 160 kHz (best hearing is from approximately 10-120 kHz)	Most delphinid species including rough-toothed, bottlenose, spinner, common, Fraser's, dusky, hourglass, Peale, white-beaked and white-sided, Risso's and right whale dolphins; medium and large odontocete whales including melon-headed pygmy killer, false killer, killer whale, pilot sperm whale, beluga whale, narwhal, and beaked whales
High-frequency cetaceans (Odontocetes)	200 Hz to 180 kHz (best hearing is from approximately 10-150 kHz)	Porpoise species including the harbor, finless, and Dall's porpoise; river dolphins including the Baiji, Ganges, Amazon river dolphins; the dwarf and pygmy sperm whales), and Commerson's, Heaviside, and Hector's dolphins
Pinnipeds in water	75 Hz to 75 kHz (best hearing is from approximately 1-30 kHz)	All seals, fur seals, sea lions, and walrus
Pinnipeds in air	75 Hz to 30 kHz (best hearing is from approximately 1-16 kHz)	All seals, fur seals, sea lions, and walrus

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 Assessing Marine Mammal Responses to 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). The MMPA authorization request evaluates the potential for the specific Navy acoustic sources used in the SOCAL Range Complex to result in harassment of marine mammals.

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 3.9-5) 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. As shown on the figure, the Navy has developed acoustic models to predict when Navy training and Research, Development, Test, and Evaluation (RDT&E) activities could result in injury or behavioral disturbance. Total energy models are used to predict exposures that could result in either behavioral effects or physiological effects resulting in injury or temporary physiological changes. Risk function models using sound pressure levels are used to predict exposures that could result in behavioral effects.

Each exposure could result in a wide range of potential direct physiological effects, which could then lead to a behavioral response. For the purposes of this analysis all PTS exposures are assumed to result in injury (MMPA Level A harassment), and all TTS exposures are assumed to result in significant behavioral effects (MMPA Level B harassment). (See Section 3.9.7.3 for a full explanation of Level A and Level B harassment.) The other physiological effects are also considered in the analysis, although it is unlikely that they rise to the level of injury. The potential direct effects of physiological responses which may lead to behavioral exposures are considered in light of the biology and ecology of each species in order to arrive at the mode of action or result of the potential direct effect. The intensity of the resulting mode of action can then be used to determine if the natural behavioral patterns are abandoned or significantly altered.

Finally, the physiological and behavioral responses are reviewed in light of the population effects in order to determine the potential for effects on stocks or species.

Estimating potential acoustic effects on cetaceans entails answering the following questions:

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, season, and time of the action are important:

- 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 for consideration and to estimate the distribution of those species.
- 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.
- What are the potential effects of sound on the species present? This requires an analysis of the manner in which sound interacts with the physiology of marine mammals and the potential responses of those animals to sound. Section 3.9.7.1 presents the conceptual framework used in this OEIS/EIS to evaluate the potential effects of sound on marine mammal physiology and behavior. When possible, specific criteria and numeric values are derived to relate acoustic exposure to the likelihood of a particular effect.
- How many marine mammals are predicted to be harmed or harassed? This requires potential effects to be evaluated within the context of the existing regulations. Section 3.9.7.2 reviews the regulatory framework and premises upon which the effects analyses in this OEIS/EIS are based. Numeric criteria for MMPA harassment are presented in Section 3.9.7.3. Section 3.9.9 discuss the anticipated acoustic effects to ESA-listed and non-listed marine mammals, respectively.

3.9.7.1 Conceptual Biological Framework

The regulatory language of the MMPA and ESA requires that all anticipated responses to sound resulting from Navy exercises in the SOCAL Range Complex be considered relative to their potential impact on animal growth, survivability, and reproduction. Although a variety of effects may result from an acoustic exposure, not all effects will impact survivability or reproduction (e.g., short-term changes in respiration rate would have no effect on survivability or reproduction). Whether an effect significantly affects a marine mammal must be determined from the best available science regarding marine mammal responses to sound.

A conceptual framework has been constructed (Figure 3.9-5) to assist in ordering and evaluating the potential responses of marine mammals to sound. Although the framework is described in the context of effects of sonar on marine mammals, the same approach could be used for fish, turtles, sea birds, etc. exposed to other sound sources (e.g., impulsive sounds from explosions); the framework need only be consulted for potential pathways leading to possible effects.

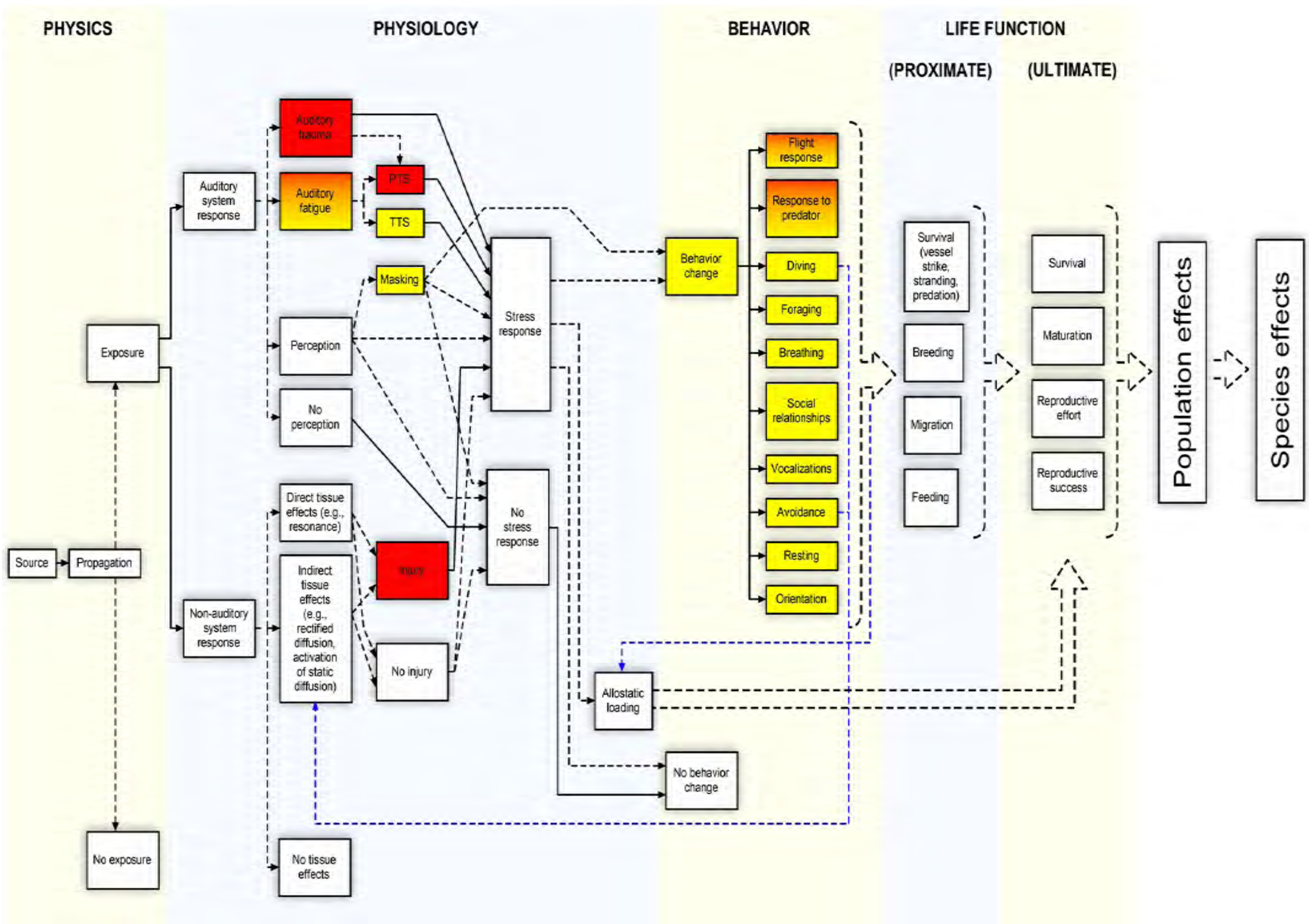

Figure 3.9-5: Conceptual Model for Assessing Effects of MFA Sonar Exposures on Marine Mammals.

3.9.7.1.1 Organization

The framework is a “block diagram” or “flow chart”, organized from left to right, and grossly compartmentalized according to the phenomena that occur within each. These include the physics of sound propagation (Physics block), the potential physiological responses associated with sound exposure (Physiology block), the behavioral processes that might be affected (Behavior block), and the life functions that may be immediately affected by changes in behavior at the time of exposure (Life Function – Proximate). These 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 are those items which “will” happen, dotted lines are those which “might” happen, but which must be considered (including those hypothesized to occur but for which there is no direct evidence). Blue dotted lines indicate instances of “feedback,” where the information flows back to a previous block. Some boxes are colored according to how they relate to the definitions of harassment in the MMPA, with red indicating Level A harassment (injury) and yellow indicating Level B harassment (behavioral disturbance) (Section 3.9.7.3).

The following sections describe the flowthrough of the framework, starting with the production of a sound, and flowing through marine mammal exposures, responses to the exposures, and the possible consequences of the exposure. Along with the description of each block an overview of the state of knowledge is described with regard to marine mammal responses to sound and the consequences of those exposures. Application of the conceptual framework to impact analyses and regulations defined by the MMPA and ESA are discussed in subsequent sections.

3.9.7.1.2 Physics

Sounds emitted from a source propagate through the environment to create a spatially variable sound field. To determine if an animal is “exposed” to the sound, the received sound level at the animal’s location is compared to the background ambient noise. An animal is considered exposed if the predicted received sound level (at the animal’s location) is above the ambient level of background noise. If the animal is determined to be exposed, two possible scenarios must be considered with respect to the animal’s physiology: responses of the auditory system and responses of nonauditory system tissues. These are not independent pathways and both must be considered since the same sound could affect both auditory and nonauditory tissues.

3.9.7.1.3 Physiology

Auditory System Response

The primary physiological effects of sound 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 outer and middle ears to fluids within the inner ear. 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 overstimulation by noise exposure (Yost 1994).

Potential auditory system effects are assessed by considering the characteristics of the received sound (e.g., amplitude, frequency, duration) and the sensitivity/susceptibility of the exposed animals. Some of these assessments can be numerically based, while 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 a sound exposure are discussed here in order of increasing severity, progressing from perception of sound to auditory trauma.

No Perception

The received level is not of sufficient amplitude, frequency, and duration to be perceptible to the animal; i.e. the sound is not audible. By extension, this cannot result in a stress response or a change in behavior.

Perception

Sounds with sufficient amplitude and duration to be detected within the background ambient noise are assumed to be perceived (i.e., sensed) by an animal. This category includes sounds from the threshold of audibility through the normal dynamic range of hearing. 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. Within this conceptual framework, a sound capable of auditory masking, auditory fatigue, or trauma is assumed to be perceived by the animal.

Information on hearing sensitivity exists for approximately 25 of the nearly 130 species of marine mammals. Within the cetaceans, these studies have focused primarily on odontocete species (e.g., Szymanski et al. 1999; Kastelein et al. 2002a; Nachtigall et al. 2005; Yuen et al. 2005; Houser and Finneran 2006). Because of size and availability, direct measurements of mysticete whale hearing are nearly nonexistent (Ridgway and Carder 2001). Measurements of hearing sensitivity have been conducted on species representing all of the pinniped families (Phocidae, Otariidae, Odobenidae, Schusterman et al., 1972; Moore and Schusterman 1987; Terhune 1988; Thomas et al. 1990a; Turnbull and Terhune 1990; Kastelein et al. 2002b; Wolski et al. 2003; Kastelein et al. 2005). Hearing sensitivity measured in these studies can be compared to the amplitude, duration and frequency of a received sound, as well as the ambient environmental noise, to predict whether or not an exposed marine mammal will perceive a sound to which it is exposed.

The features of a perceived sound (e.g., amplitude, frequency, duration, temporal pattern) are also used to judge whether the sound exposure is capable of producing a stress response (see Section 3.9.7.1.5). 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, to the animal, of the exposure). Although preliminary because of the small numbers of samples collected, different types of sounds (impulsive vs. continuous broadband vs. continuous tonal) have been shown to produce variable stress responses in marine mammals. Belugas demonstrated no catecholamine response to the playback of oil drilling sounds (Thomas et al. 1990) but showed an increase in catecholamines following exposure to impulsive sounds produced from a seismic water gun (Romano et al. 2004). A dolphin, exposed to the same seismic water gun signals, did not demonstrate a catecholamine response but did demonstrate an elevation in aldosterone, a hormone that has been suggested as being a significant indicator of stress in odontocetes (St. Aubin and Geraci 1989; St. Aubin et al. 2001). Increases in heart rate were observed in dolphins to which conspecific calls were played, although no increase in heart rate was observed when tank noise was played back (Miksis et al. 2001). Collectively these results suggest a variable response that depends on the characteristics of the received signal and prior experience with the received signal.

Audible natural and artificial sounds can potentially result in auditory masking, a condition that occurs when a sound interferes with an animal's ability to hear other sounds. Masking occurs when the perception of a sound is interfered with by a second sound and the probability of masking increases as the two sounds increase in similarity. It is important to distinguish auditory fatigue, which persists after the sound exposure, from masking, which occurs during the sound exposure. Critical ratios have been determined for pinnipeds (Southall et al. 2000; Southall et al. 2003) and detections of signals under varying masking conditions have been determined for active echolocation and passive listening tasks in odontocetes (Johnson 1971; Au and Pawloski

1989; Erbe 2000). These studies provide baseline information from which the probability of masking can be estimated. The potential impact to a marine mammal depends on the type of signal that is being masked; important cues from conspecifics, signals produced by predators, or interference with echolocation are likely to have a greater impact on a marine mammal when they are masked than will a sound of little biological consequence.

Unlike auditory fatigue, which always results in a localized stress response (see Section 3.9.7.1.5) 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 and the signal that is being masked. 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 most intense underwater sounds in the proposed action area are those produced by sonars and other acoustic sources that are in the mid-frequency or higher range. The sonar signals are likely within the audible range of most cetaceans, but are very limited in the temporal, frequency, and spatial domains. In particular, the pulse lengths are short, the duty cycle low, the total number of hours of operation per year small, and the tactical sonars transmit within a narrow band of frequencies (typically less than one-third octave). Finally, high levels of sound are confined to a volume around the source and are constrained by attenuation at mid and high frequencies, as well as by limited beam widths and pulse lengths. For these reasons, the likelihood of sonar operations causing masking effects is considered negligible in this OEIS/EIS.

Auditory Fatigue

The most familiar effect of exposure to high-intensity sound is hearing loss, meaning an increase in the hearing threshold. This phenomenon is called a noise-induced threshold shift (NITS), 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). The distinction between PTS and TTS is based on whether there is a complete recovery of a TS following a sound exposure. If the TS eventually returns to zero (the threshold returns to the preexposure value), the TS is a TTS. If the TS does not return to zero but leaves some finite amount of TS, then that remaining TS is a PTS. Figure 3.9-6 (Two Hypothetical Threshold Shifts) shows one hypothetical TS that completely recovers, a TTS, and one that does not completely recover, leaving some PTS.

Although both auditory trauma and fatigue may result in hearing loss, the mechanisms responsible for auditory fatigue differ from auditory trauma and would primarily consist of metabolic fatigue and exhaustion of the hair cells and cochlear tissues. Note that the term "auditory fatigue" is often used to mean "TTS"; however, in this OEIS/EIS we use a more general meaning to differentiate fatigue mechanisms (e.g., metabolic exhaustion and distortion of tissues) from trauma mechanisms (e.g., physical destruction of cochlear tissues occurring at the time of exposure). Auditory fatigue may result in PTS or TTS but is always assumed to result in a stress response. The actual amount of threshold shift depends on the amplitude, duration, frequency, and temporal pattern of the sound exposure.

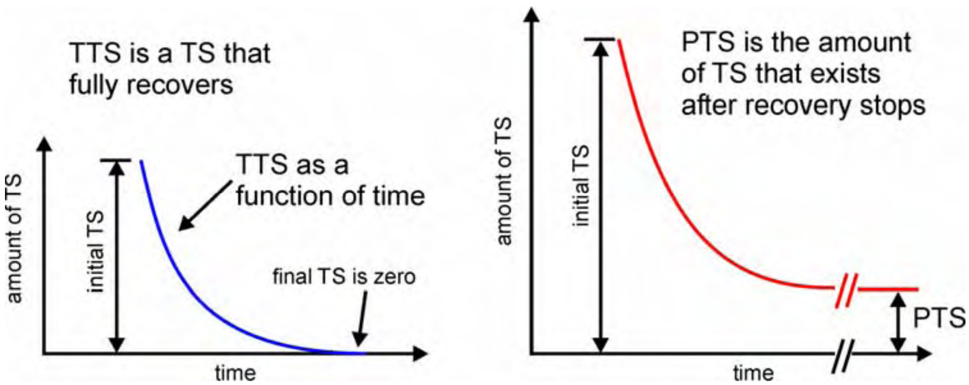

Figure 3.9-6: Two Hypothetical Threshold Shifts

There are no PTS data for cetaceans or pinnipeds; however, a number of investigators have measured TTS in cetaceans (Schlundt et al. 2000, 2006; Finneran et al. 2000, 2002, 2005, 2007; Nachtigall et al. 2003, 2004) and pinnipeds (Kastak et al. (1999, 2005). In the cetacean studies, hearing thresholds were measured in trained dolphins and belugas 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 TTS data show the following, for the species studied and (nonimpulsive) mid-frequency sounds of interest in this OEIS/EIS:

- 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 during the quiet period between exposures) (Kryter et al. 1966; Ward 1997).
- Sound pressure level (SPL) by itself is not a good predictor of onset-TTS, since the amount of TTS depends on both SPL and duration.
- Exposure energy flux density level (EL) is correlated with the amount of TTS and is a good predictor for onset-TTS from single, continuous exposures with variable durations. This agrees with human TTS data presented by Ward et al. (1958, 1959).

The most relevant TTS data for analyzing the effects of mid-frequency sonars are from Schlundt et al. (2000, 2006) and Finneran et al. (2005). These studies point to an energy flux density level of 195 dB re 1 μPa^2-s as the most appropriate predictor for onset-TTS in dolphins and belugas from a single, continuous exposure in the mid-frequency range. This finding is supported by the recommendations of a panel of scientific experts formed to study the effects of sound on marine mammals (Southall et al. 2007).

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. 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.

In contrast to TTS data, PTS data do not exist and are unlikely to be obtained for marine mammals. Differences in auditory structures and the way that sound propagates and interacts with tissues prevent terrestrial mammal PTS thresholds from being directly applied to marine mammals; however, the inner ears of marine mammals are analogous to those of terrestrial mammals. Experiments with marine mammals have revealed similarities between marine and terrestrial mammals with respect to features such as TTS, age-related hearing loss, ototoxic drug-induced hearing loss, masking, and frequency selectivity. Therefore, 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 additional exposure, above the onset-TTS exposure, necessary to reach the maximum allowable amount of TTS (assumed here to indicate PTS). This requires 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 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 (Ward et al. 1958, 1959, 1960; Miller et al. 1963; Kryter et al. 1966). A conservative assumption is that continuous-type exposures producing TSs of 40 dB or more always result in some amount of PTS.

The TTS growth rate as a function of exposure EL is nonlinear; the growth rate at small amounts of TTS is less than the growth rate at larger amounts of TTS. In other words, the curve relating TTS and EL is not a straight line but a curve that becomes steeper as EL and TTS increase. This means that the relatively small amounts of TTS produced in marine mammal studies limit the applicability of these data to estimate the TTS growth rate—since the amounts of TTS are generally small the TTS growth rate estimates would likely be too low. Fortunately, data exist for the growth of TTS in terrestrial mammals at higher amounts of TTS. Data from Ward et al. (1958, 1959) reveal a linear relationship between TTS and exposure EL, with growth rates of 1.5 to 1.6 dB TTS per dB increase in EL. Since 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 would be 34 dB divided by 1.6 dB/dB, or approximately 20 dB. Therefore, exposures with ELs 20 dB above those producing TTS may be assumed to produce a PTS. For an onset-TTS exposure with EL = 195 dB re 1 μPa^2-s, the estimate for onset-PTS would be 215 dB re 1 μPa^2-s. This extrapolation process and the resulting TTS prediction is identical to that recently proposed by a panel of scientific experts formed to study the effects of sound on marine mammals (Southall et al. 2007). The method predicts larger (worse) effects than have actually been observed in tests on a bottlenose dolphin (Schlundt et al. [2006] reported a TTS of 23 dB (no PTS) in a bottlenose dolphin exposed to a 3 kHz tone with an EL = 217 dB re 1 μPa^2-s).

Auditory Trauma

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. The potential for trauma is related to the frequency, duration, onset time, and received sound pressure as well as the sensitivity of the animal to the sound frequencies. Because of these interactions, the potential for auditory trauma will vary among species. Auditory trauma is always injurious, but could be temporary and not result in permanent hearing loss. Auditory trauma is always assumed to result in a stress response.

Relatively little is known about auditory system trauma in marine mammals resulting from known sound exposure. A single study spatially and temporally correlated the occurrence of auditory system trauma in humpback whales with the detonation of a 5000-kilogram (kg) explosive (Ketten et al. 1993). The exact magnitude of the exposure in this study cannot be determined and it is possible that the trauma was caused by the shock wave produced by the explosion (which would not be generated by a sonar). There are no known occurrences of direct auditory trauma in marine mammals exposed to tactical sonars.

3.9.7.1.4 Nonauditory System Response

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 on the mechanical properties of the tissues and their function. Each of the potential responses may or may not result in a stress response.

Direct Tissue Effects

Direct tissue responses to sound stimulation may range from tissue trauma (injury) to mechanical vibration with no resulting injury. Any tissue injury would produce a stress response whereas noninjurious stimulation may or may not.

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 sonars 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 was not likely to have caused the Bahamas stranding (NOAA 2002b). The frequencies at which resonance was predicted to occur were below the frequencies utilized by the sonar systems employed. Furthermore, air cavity vibrations, even at resonant frequencies, were not considered to be of sufficient amplitude to cause tissue damage, even under the worst-case scenario in which air volumes would be undamped by surrounding tissues and the amplitude of the resonant response would be maximal. These same conclusions would apply to other actions involving mid-frequency tactical sonar.

Indirect Tissue Effects

Based upon the amplitude, frequency, and duration of the sound, it must be assessed whether exposure is sufficient to indirectly affect tissues. For example, one suggested (indirect) cause of injury to marine mammals is rectified diffusion (Crum and Mao 1996), the process of increasing the size of a bubble by exposing it to a sound field. Under this hypothesis, one of three things could happen: (1) bubbles grow to the extent that tissue hemorrhage (injury) occurs; (2) bubbles develop to the extent that a complement immune response is triggered or the 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 upon what is known about the specific process involved.

Rectified diffusion 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). The dive patterns of some marine mammals (for example, beaked whales) are theoretically predicted to induce greater supersaturation (Houser et al. 2001b). 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 (DCS).

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 microbubbles 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.

Recent research with ex vivo supersaturated tissues suggested that sound exposures of ~215 dB re 1 µPa would be required before microbubbles became destabilized and grew (Crum et al. 2005). Assuming spherical spreading loss and a nominal sonar source level of 235 dB re 1 µPa, a whale would need to be within 33 ft (10 m) of the sonar dome to be exposed to such sound levels. Furthermore, tissues were supersaturated by exposing them to pressures of 400 to 700 kPa for periods of hours and then releasing them to ambient pressures. Assuming the equilibration of gases with the tissues occurred when the tissues were exposed to the high pressures, levels of supersaturation in the tissues could have been as high 400 to 700 percent. These levels of tissue supersaturation are substantially higher than model predictions for marine mammals (Houser et al. 2001b). It is improbable that this mechanism is responsible for stranding events or traumas associated with beaked whale strandings. Both the degree of supersaturation and exposure levels observed to cause microbubble destabilization are unlikely to occur, either alone or in concert.

Yet another hypothesis has speculated 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; Fernandez et al. 2005). This is accounted for in the conceptual framework via a feedback path from the behavioral changes of “diving” and “avoidance” to the “indrect tissue response” block. In this scenario, the rate of ascent would need to be sufficiently rapid to compromise behavioral or physiological protections against nitrogen bubble formation. Recent modeling suggests that unrealistically rapid rates of ascent from normal dive behaviors are unlikely to result in supersaturation to the extent that bubble formation would be expected in beaked whales (Zimmer et al. 2007). Recently, Tyack et al. (2006) suggested that emboli observed in animals exposed to mid-frequency range sonar (Jepson et al. 2003; Fernandez et al., 2005) could stem instead from a behavioral response that involves repeated dives shallower than the depth of lung collapse. Given that nitrogen gas accumulation is a passive process (i.e., nitrogen is metabolically inert), a bottlenose dolphin was trained to repetitively dive a profile predicted to elevate nitrogen saturation to the point that nitrogen bubble formation was predicted to occur. However, inspection of the vascular system of the dolphin via ultrasound did not demonstrate the formation of even asymptomatic nitrogen gas bubbles (Houser et al. 2007). There is considerable disagreement among scientists as to the likelihood of this phenomenon (Piantadosi and Thalmann 2004; Evans and Miller 2003). 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; Fernandez et al. 2005), nitrogen bubble formation as the cause of the traumas has not been verified. The presence of bubbles postmortem, particularly after decompression, is not necessarily indicative of bubble pathology. Prior experimental work has demonstrated the post-mortem presence of bubbles following decompression in laboratory animals can occur as a result of invasive investigative procedures (Stock et al. 1980).

Additionally, the fat embolic syndrome identified by Fernández et al. (2005) is the first of its kind. The pathogenesis of fat emboli formation is as yet undetermined and remains largely unstudied, and it would therefore be inappropriate to causally link it to nitrogen bubble formation. Because evidence of nitrogen bubble formation following a rapid ascent by beaked whales is arguable and requires further investigation, this EIS/OEIS makes no assumptions about it being the causative mechanism in beaked whale strandings associated with sonar operations. No similar findings to those found in beaked whales stranding coincident with sonar activity have been reported in other stranded animals following known exposure to sonar operations. By extension, no marine mammals addressed in this OEIS/EIS are given differential treatment due to the possibility for acoustically mediated bubble growth.

No Tissue Effects

The received sound is insufficient to cause either direct (mechanical) or indirect effects to tissues. No stress response occurs.

3.9.7.1.5 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 the conceptual framework and discussions of allostasis and allostatic loading in this OEIS/EIS, 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), the hypothalamic-pituitary-adrenal (HPA) axis (Reeder and Kramer 2005), or through oxidative stress, as occurs in noise-induced hearing loss (Henderson et al. 2006). 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 lipid for energy. The HPA response is ultimately defined by increases in the secretion of the glucocorticoid steroid hormones (e.g. cortisol, aldosterone). 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 almost immediately and are used or cleared by the system quickly, whereas glucocorticoid 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. Prior experience with a stressor may be of particular importance as repeated experience with a stressor may dull the stress response via acclimation (St. Aubin and Dierauf 2001). 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 it 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.

Marine mammals naturally experience stressors within their environment and as part of their life histories. Changing weather and ocean conditions, exposure to diseases and naturally occurring toxins, lack of prey availability, social interactions with conspecifics, and interactions with predators all contribute to the stress a marine mammal experiences. In some cases, naturally occurring stressors can have profound impacts on marine mammals; for example, chronic stress, as observed in stranded animals with long-term debilitating conditions (e.g., disease), has been demonstrated to result in an increased size of the adrenal glands and an increase in the number of epinephrine-producing cells (Clark et al. 2006). Anthropogenic activities have the potential to provide additional stressors above and beyond those that occur naturally. Potential stressors resulting from anthropogenic activities must be considered not only as to their direct impact on the animal but also as to their cumulative impact with environmental stressors already experienced by the animal.

Studies on the stress response of odontocete cetaceans to acute acoustic stimuli were previously discussed (Section 3.9.7.1.5); Thomas et al. 1990; Miksis et al. 2001; Romano et al. 2004). Other types of stressors include the presence of vessels, fishery interactions, acts of pursuit and capture, the act of stranding, and pollution. In contrast to the limited amount of work performed on stress responses resulting from sound exposure, a considerably larger body of work exists on stress responses associated with pursuit, capture, handling, and stranding. Pursuit, capture, and short-term holding of belugas has been observed to result in a decrease in thyroid hormones (St. Aubin and Geraci, 1988) and increases in epinephrine (St. Aubin and Dierauf 2001). In dolphins the trend is more complicated with the duration of the handling time potentially contributing to the magnitude of the stress response (St. Aubin et al. 1996; Ortiz and Worthy 2000; St. Aubin 2002). Elephant seals demonstrate an acute cortisol response to handling, but do not demonstrate a chronic response; on the contrary, adult females demonstrate a reduction in the adrenocortical response following repetitive chemical immobilization (Engelhard et al. 2002). With respect to anthropogenic sound as a stressor, the current limited body of knowledge will require extrapolation from species for which information exists to those for which no information exists.

The stress response may or may not result in a behavioral change, depending on the characteristics of the sound and the experience, gender, and life history stage of the exposed animal. However, provided a stress response occurs, it is assumed 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 which 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 (see below).

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, the conclusion from within the conceptual framework is that the exposure does not contribute to the allostatic load. Additionally, without a stress response or auditory masking, it is assumed that there is no change in behavior. Conversely, any immediate effect of exposure that produces an injury (i.e., red boxes on Figure 3.9-2) or auditory fatigue is assumed, within this OEIS/EIS, to also produce a stress response and to contribute to the allostatic load.

3.9.7.1.6 Behavior Block

Acute stress responses may or may not result in a behavioral reaction. However, all changes in behavior are expected to result from an acute stress response. This expectation is conservatively based on the assumption that some form of physiological trigger must exist for an anthropogenic stimulus to alter a biologically significant 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 (Section 3.9.9.2.2).

Numerous behavioral changes can occur as a result of stress responses resulting from acoustic exposure and the flow chart lists only those that might be considered the most common types of response for a marine animal. For each potential behavioral change, the magnitude of the change and the severity of the response need to be estimated. Certain conditions, such as a flight response, might have a probability of resulting in injury. For example, a flight response, if significant enough, could lead to a stranding event. Under the MMPA such an event precipitated by anthropogenic noise would be considered a Level A harassment (Section 3.9.7.3). 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 (Section 3.9.7.3). All behavioral disruptions also have the potential to contribute to the allostatic load. This secondary potential is signified by the feedback from the collective behaviors to allostatic loading (Physiology block).

The response of a marine mammal to an anthropogenic sound source will depend on the frequency content, duration, temporal pattern, and amplitude of the sound as well as the animal's prior experience with the sound and the context in which the sound is encountered (i.e., what the animal is doing at the time of the exposure). The direction of the responses can vary, with some changes resulting in either increases or decreases from baseline (e.g., decreased dive times and increased respiration rate). Responses can also overlap; for example, an increased respiration rate is likely to be coupled to a flight response. Differential responses between and within species are expected since hearing ranges vary across species and the behavioral ecology of individual species is unlikely to completely overlap.

A review of marine mammal responses to anthropogenic sound was first conducted by Richardson and others (1995). A more recent review (Nowacek et al. 2007) addresses studies conducted since 1995 and focuses on observations where the received sound level of the exposed marine mammal(s) was known or could be estimated. The following sections provide a very brief overview of the state of knowledge of behavioral responses as they are listed in Figure 3.9-10. The overviews focus on studies conducted since 2000 but are not meant to be comprehensive; rather, they provide an idea of the variability in behavioral responses that would be expected given the differential sensitivities of marine mammal species to sound and the wide range of potential acoustic sources to which a marine mammal may be exposed. Estimates of the types of behavioral responses that could occur for a given sound exposure should be determined from the literature that is available for each species, or extrapolated from closely related species when no information exists.

Flight Response—A flight response is a dramatic change in normal movement to a directed and rapid movement away from the perceived location of a sound source. Relatively little information on flight responses of marine mammals to anthropogenic signals exists, although observations of flight responses to the presence of predators have occurred (Connor and Heithaus 1996). Flight responses have been speculated as being a component of marine mammal strandings associated with sonar activities (Evans and England 2001).

Response to Predator—Evidence suggests that at least some marine mammals have the ability to acoustically identify potential predators. For example, harbor seals that reside in the coastal waters off British Columbia are frequently targeted by certain groups of killer whales, but not others. The seals discriminate between the calls of threatening and nonthreatening killer whales (Deecke et al. 2002), a capability that should increase survivorship while reducing the energy required for attending to and responding to all killer whale calls. The occurrence of masking or hearing impairment provides a means by which marine mammals may be prevented from responding to the acoustic cues produced by their predators. Whether or not this is a possibility depends on the duration of the masking/hearing impairment and the likelihood of encountering a predator during the time that predator cues are impeded.

Diving—Changes in dive behavior can vary widely. They may consist of increased or decreased dive times and surface intervals as well as changes in the rates of ascent and descent during a dive. Variations in dive behavior may reflect interruptions in biologically significant activities (e.g., foraging) or they may be of little biological significance. Variations in dive behavior may also expose an animal to potentially harmful conditions (e.g., increasing the chance of ship-strike) or may serve as an avoidance response that enhances survivorship. The impact of a variation in diving resulting from an acoustic exposure depends on what the animal is doing at the time of the exposure and the type and magnitude of the response.

Nowacek et al. (2004) reported disruptions of dive behaviors in foraging North Atlantic right whales when exposed to an alerting stimulus, an action, they noted, that could lead to an increased likelihood of ship strike. However, the whales did not respond to playbacks of either right whale social sounds or vessel noise, highlighting the importance of the sound characteristics in producing a behavioral reaction. Conversely, Indo-Pacific humpback dolphins have been observed to dive for longer periods of time in areas where vessels were present and/or approaching (Ng and Leung 2003). In both of these studies, the influence of the sound exposure cannot be decoupled from the physical presence of a surface vessel, thus complicating interpretations of the relative contribution of each stimulus to the response. Indeed, the presence of surface vessels, their approach and speed of approach, seemed to be significant factors in the response of the Indo-Pacific humpback dolphins (Ng and Leung 2003). Low-frequency signals of the Acoustic Thermometry of Ocean Climate (ATOC) sound source were not found to affect dive times of humpback whales in Hawaiian waters (Frankel and Clark 2000) or to overtly affect elephant seal dives (Costa et al. 2003). They did, however, produce subtle effects that varied in direction and degree among the individual seals, illustrating the equivocal nature of behavioral effects and consequent difficulty in defining and predicting them.

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 (Jepson et al. 2003). Although hypothetical, the potential process is controversial and under debate in the scientific community..

Foraging—Disruption of feeding behavior can be difficult to correlate with anthropogenic sound exposure, so it is usually inferred by observed displacement from known foraging areas, the appearance of secondary indicators (e.g., bubble nets or sediment plumes), or changes in dive behavior. Noise from seismic surveys was not found to impact the feeding behavior in western gray whales off the coast of Russia (Yazvenko et al. 2007) and sperm whales engaged in foraging dives did not abandon dives when exposed to distant signatures of seismic airguns (Madsen et al. 2006). Balaenopterid whales exposed to moderate low-frequency signals similar to the ATOC sound source demonstrated no variation in foraging activity (Croll et al. 2001), whereas five out of six North Atlantic right whales exposed to an acoustic alarm interrupted their foraging dives (Nowacek et al. 2004). Although the received sound pressure level at the animals was similar in the latter two studies, the frequency, duration, and temporal pattern of signal presentation were different. These factors, as well as differences in species sensitivity, are likely contributing factors to the differential response. A determination of whether foraging disruptions incur fitness consequences will require information on or estimates of the energetic requirements of the individuals and the relationship between prey availability, foraging effort and success, and the life history stage of the animal.

Breathing—Variations in respiration naturally vary with different behaviors and variations in respiration rate as a function of acoustic exposure can be expected to co-occur with other behavioral reactions, such as a flight response or an alteration in diving. However, respiration rates in and of themselves may be representative of annoyance or an acute stress response. Mean exhalation rates of gray whales at rest and while diving were found to be unaffected by seismic surveys conducted adjacent to the whale feeding grounds (Gailey et al. 2007). Studies with captive harbor porpoises showed increased respiration rates upon introduction of acoustic alarms (Kastelein et al. 2001; Kastelein et al. 2006a) and emissions for underwater data transmission (Kastelein et al. 2005). However, exposure of the same acoustic alarm to a striped dolphin under the same conditions did not elicit a response (Kastelein et al. 2006a), again highlighting the importance in understanding species differences in the tolerance of underwater noise when determining the potential for impacts resulting from anthropogenic sound exposure.

Social Relationships—Social interactions between mammals can be affected by noise via the disruption of communication signals or by the displacement of individuals. Disruption of social relationships therefore depends on the disruption of other behaviors (e.g., caused avoidance, masking, etc.) and no specific overview is provided here. However, social disruptions must be considered in context of the relationships that are affected. Long-term disruptions of mother/calf pairs or mating displays have the potential to affect the growth and survival or reproductive effort/success of individuals, respectively.

Vocalizations—Vocal changes in response to anthropogenic noise can occur across the repertoire of sound production modes used by marine mammals, such as whistling, echolocation click production, calling, and singing. Changes may result in response to a need to compete with an increase in background noise or may reflect an increased vigilance or startle response. For example, in the presence of low-frequency active (LFA) sonar, humpback whales have been observed to increase the length of their 'songs' (Miller et al. 2000; Fristrup et al. 2003), possibly due to the overlap in frequencies between the whale song and the LFA sonar. A similar compensatory effect for the presence of low-frequency vessel noise has been suggested for right whales; right whales have been observed to shift the frequency content of their calls upward while reducing the rate of calling in areas of increased anthropogenic noise (Parks et al. 2007). Killer whales off the northwestern coast of the U.S. have been observed to increase the duration of primary calls once a threshold in observing vessel density (e.g., whale watching) was reached, which has been suggested as a response to increased masking noise produced by the vessels (Foote et al. 2004). In contrast, both sperm and pilot whales potentially ceased sound production during the Heard Island feasibility test (Bowles et al. 1994), although it cannot be absolutely determined whether the inability to acoustically detect the animals was due to the cessation of sound production or the displacement of animals from the area.

Avoidance—Avoidance is the displacement of an individual from an area as a result of the presence of a sound. It is qualitatively different from the flight response in its magnitude (i.e., directed movement, rate of travel, etc.). Oftentimes avoidance is temporary, and animals return to the area once the noise has ceased. Longer term displacement is possible, however, which can lead to changes in abundance or distribution patterns of the species in the affected region if they do not become acclimated to the presence of the sound (Blackwell et al. 2004; Bejder et al. 2006; Teilmann et al. 2006). Acute avoidance responses have been observed in captive porpoises and pinnipeds exposed to a number of different sound sources (Kastelein et al. 2001; Finneran et al., 2003; Kastelein et al. 2006a; Kastelein et al. 2006b). Short-term avoidance of seismic surveys, low-frequency emissions, and acoustic deterrants has also been noted in wild populations of odontocetes (Bowles et al. 1994; Goold 1996; 1998; Stone et al., 2000; Morton and Symonds, 2002) and to some extent in mysticetes (Gailey et al. 2007), while longer term or repetitive/chronic displacement for some dolphin groups and for manatees has been suggested to be due to the presence of chronic vessel noise (Haviland-Howell et al. 2007; Miksis-Olds et al. 2007).

Orientation—A shift in an animal's resting state or an intentional change via an orienting response represent behaviors that would be considered mild disruptions if occurring alone, and thus are placed at the bottom of the framework behavior list. As previously mentioned, the responses may co-occur with other behaviors, e.g., an animal may initially orient toward a sound source, and then move away from it. Thus, any orienting response should be considered in context of other reactions that may occur.

3.9.7.1.7 Life Function

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, must be considered in determining how the ultimate life history functions are affected. Consideration of the magnitude of the impact to each of the proximate life history functions depends on 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 of breeding behavior when compared to an actively displaying adult of prime reproductive age.

The ultimate life functions are those which enable an animal to contribute to the population (or stock, or species, etc.) and which relate to the animal's fitness. 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. Assessment of the magnitude of the stress response from a chronic perturbation would require an understanding of how and whether animals acclimate to a specific, repeated stressor and whether a chronic stress response occurs and results in subsequent fitness deficits.

The proximate life functions are loosely ordered in decreasing severity of impact. Mortality (survival) has an immediate impact 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 The Regulatory Framework

To complete the acoustic effects analysis, the conceptual framework (Section 3.9.7.1) must be related to the existing regulatory frameworks of the ESA and MMPA. The following sections describe the relationship between analyses conducted within the conceptual framework and regulations established by the MMPA and ESA.

3.9.7.3 Marine Mammal Protection Act Harassment

For military readiness activities, MMPA 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 this OEIS/EIS and previous rulings (NOAA 2001, 2002a), is the destruction or loss of biological tissue. Consistent with prior actions and rulings (NOAA 2001), this OEIS/EIS assumes that all injuries (slight to severe) are considered Level A harassment under the MMPA.

For military readiness activities, MMPA Level B harassment includes all actions that disturb or are likely to disturb a marine mammal or marine mammal stock in the wild through the disruption of natural behavioral patterns including, but not limited to, migration, surfacing, nursing, breeding, feeding, or sheltering to a point where such behavioral patterns are abandoned or significantly altered.

Some physiological responses to sound exposure can occur that are noninjurious 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 TTS 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. This OEIS/EIS assumes that all TTS (slight to severe) is considered Level B harassment, even if the effect from the temporary impairment is biologically insignificant.

The harassment status of slight behavior disruption (without physiological effects as defined in this OEIS/EIS) has been addressed in workshops, previous actions, and rulings (NOAA 1999, 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." These conclusions and definitions, including the 2004 amendments to the definitions of harassment, were considered in developing conservative thresholds for behavioral disruptions, as presented in Section 3.9.7.3. As a result, the actual incidental harassment of marine mammals associated with this action may be less than calculated.

The volumes of ocean in which Level A and Level B harassment are predicted to occur are described as harassment zones. The Level A harassment 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 harassment 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 harassment zone is given in Section 3.9.7.3. The Level B harassment zone begins just beyond the point of slightest injury and extends outward from that point to include all animals with the potential to experience Level B harassment. The animals predicted to be in the portion of the zone where temporary impairment of sensory function (altered physiological function) is expected are all assumed to experience Level B harassment because of the potential impediment of behaviors that rely on acoustic cues. Beyond that distance, the Level B harassment zone continues to the point at which no behavioral disruption is expected to occur. The criterion and threshold used to define the outer limit of the Level B harassment zone are given in Section 3.9.7.3.

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 in this OEIS/EIS as biological indicators of physiological responses that qualify as harassment.

PTS is nonrecoverable 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 this OEIS/EIS, 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 harassment zone.

TTS is recoverable and, as in recent rulings (NOAA 2001, 2002a), is considered to result from the temporary, noninjurious distortion of hearing-related tissues. In this OEIS/EIS, the smallest measurable amount of TTS (onset-TTS) is taken as the best indicator for slight temporary sensory impairment. Because it is considered noninjurious, the acoustic exposure associated with onset-TTS is used to define the outer limit of the portion of the Level B harassment zone attributable to a physiological impairment, and within which all animals are assumed to incur Level B harassment. This follows from the concept that hearing loss potentially affects an animal's ability to react normally to the sounds around it. Therefore, in this OEIS/EIS the potential for TTS is considered as a Level B harassment that is mediated by a physiological effect upon the auditory system.

At exposure levels below those which can cause TTS, animals may respond to the sound and alter their natural behaviors. Whether or not these alterations result in "a potential for a significant behavioral change or response in a biologically important behavior or activity" depends on the physical characteristics of the sound (e.g., amplitude, frequency characteristics, temporal pattern, duration, etc.) as well as the animal's experience with the sound, the context of the exposure (e.g., what is the animal doing at the time of the exposure), and the animal's life history stage. Responses will be species-specific and must consider the acoustic sensitivity of the species. In this OEIS/EIS a risk function (Section 3.9.7.5) is used to determine the outer limit of the portion of the Level B harassment zone attributable to significant changes in biologically important behaviors, but which is not a function of TTS. The risk function defines a probability of a significant change in biologically important behaviors as a function of the received sound pressure level. This follows from the concept that the probability of a behavioral response will generally decline as a function of decreasing exposure level.

Figure 3.9-7 (Exposure Zones Used in This OEIS/EIS) is a visual depiction of the MMPA acoustic effects framework used in this OEIS/EIS. The volumes of ocean in which Level A and Level B harassment are predicted to occur are described as harassment zones. (This figure is intended to illustrate the general relationships between harassment zones and does not represent the sizes or shapes of the actual harassment zones for this OEIS/EIS.) The Level A harassment zone extends from the source out to the distance and exposure where onset-PTS is predicted to occur. The Level B harassment zone begins just beyond the point of onset-PTS and extends outward to the distance and exposure where no (biologically significant) behavioral disruption is expected to occur. The Level B harassment zone includes both the region in which TTS is predicted to occur and the region in which significant behavioral responses without TS are predicted to occur. Criteria and thresholds used to define the outer limits of the Level A and Level B harassment zones are given in Section 3.9.7.4.

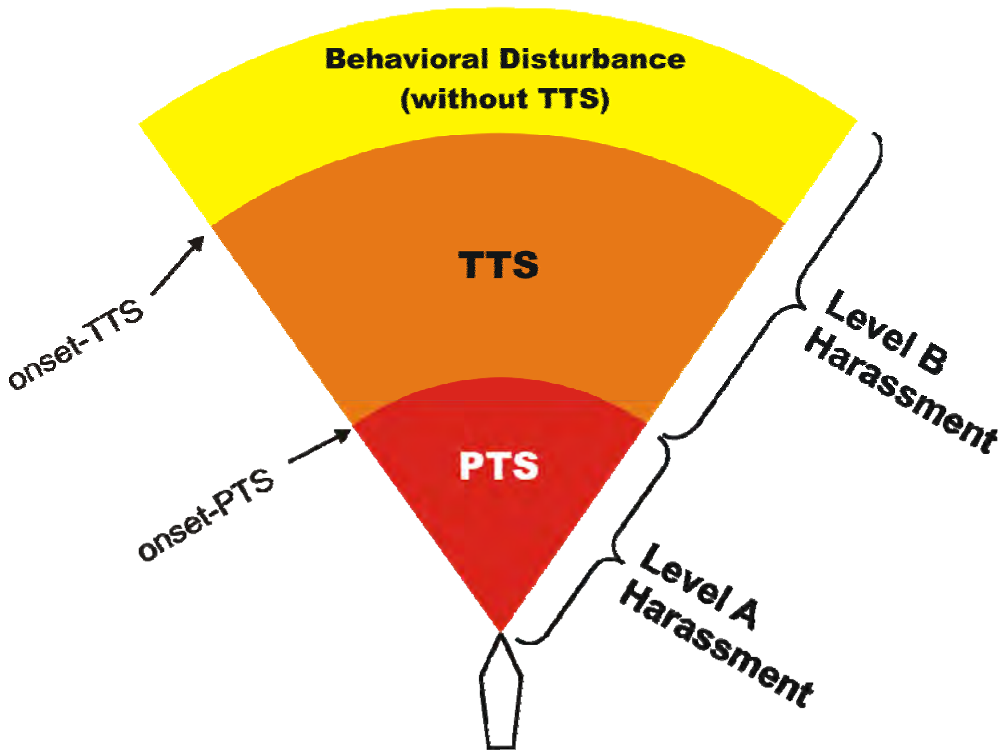

Figure 3.9-7: Exposure Zones Extending From a Hypothetical, Directional Sound Source

(This figure is intended to illustrate the general relationships between harassment zones and does not represent the sizes or shapes of the actual harassment zones for this OEIS/EIS.)

Sound exposure criteria and thresholds relevant to MMPA regulations were developed using the MMPA Level A and Level B definitions. Regulations established by the ESA establish different criteria for determining impacts to animals covered by the ESA.

- ESA regulations define harm as “an act which actually kills or injures” fish or wildlife (50 Code of Federal Regulations [C.F.R.] 222.102). Based on this definition, the criteria and thresholds developed to estimate MMPA Level A harassment zones are also used to provide an initial assessment of the potential for harm under the ESA. The Level A harassment criterion applied here is the slightest measurable degree of tissue injury. If any ESA-listed marine mammals are predicted to be within the Level A harassment zone, these species are considered to potentially experience ESA harm (Section 3.9.7.3).
- ESA regulations define harassment as 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 C.F.R. 17.3). Consistent with NMFS section 7 analyses (e.g., NMFS 2007), the spatial and temporal overlap of activities with the presence of listed species is assessed. The density and distribution of age, gender, and life history stage of the species present are then considered with respect to the predicted number and types of behavioral reactions expected to occur as a result of the action. The potential for behavioral responses to affect the fitness of an individual is then determined; the fitness of the animal is generally related to the animal's relative lifetime reproductive success. Disrupted factors that can impact an animal's fitness include survival, growth, and reproductive effort or success. A reduction in an animal's fitness may have the potential to contribute to an overall reduction in the abundance of a population by affecting the growth rate of the population to which it belongs. In this OEIS/EIS, the risk function for estimating Level B harassment under the MMPA is used to first assess the number of acoustic exposures of marine mammals that could "possibly" affect the fitness of an individual. For each species, the relationship between the exposure values and predicted behavioral responses are then compared against the predicted distribution of age, gender and life history stage of the exposed animals. Next, a determination is made as to whether behavioral responses will have a fitness consequence to the animals. Any behavioral responses that are deemed to have potential fitness consequences are qualified as harassment. Finally, a determination is made as to whether the cumulative cost to the fitness of the individuals is likely to adversely affect the population's viability.

Results of the acoustic effects modeling are evaluated with respect to the species density inputs to the model to determine if the sound exposures predicted in the model are expected to occur on the SOCAL Range Complex. Details of the predicted exposure levels (e.g., number, duration, and sound pressure level of received pings), species density and distribution information, species life history information, and the conceptual biological framework are then consulted to evaluate the potential for harm or harassment as defined in the ESA. Details of this evaluation are provided in Section 3.9.8.

Table 3.9-5: Summary of the TTS and PTS Thresholds for Cetaceans and Pinnipeds

Physiological Effects			
Animal	**Criteria**	**Threshold (re dB 1μPa^2-s)**	**MMPA Effect**
Cetaceans All species	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

A marine mammal predicted to receive a sound exposure with EL of the appropriate threshold (203-215 dB re 1 μPa^2-s) is assumed to experience PTS and is counted as a Level A harassment. A marine mammal predicted to receive a sound exposure with EL of the appropriate threshold (183- 195 dB re 1 μPa^2-s but less than the PTS threshold) is assumed to experience TTS and is counted as Level B harassment. The only exceptions to this approach are for a limited number of species where the predicted sound exposure is not expected to occur, due to significant differences in the expected species presence at a specific SOCAL Range Complex site versus the modeled density inputs for the larger area of the SOCAL Range Complex.

3.9.7.3.1 Derivation of Effect Thresholds

The TTS threshold is primarily based on the cetacean TTS data from Schlundt et al. (2000) and pinniped data from Kastak et al. (1999, 2005). Since these tests used short-duration tones similar to sonar pings, they are the most directly relevant data for this OEIS/EIS. 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 mid-frequency tone data of Finneran et al. (2005) and Schlundt et al. (2006) and the long-duration noise data from Nachtigall et al. (2003, 2004). 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.

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. 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.

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 estimate is conservative because (1) 40 dB of TS is actually an upper limit for TTS used to approximate onset-PTS; (2) the 1.6 dB/dB growth rate is the highest observed in the data from Ward et al. (1958, 1959) and larger than that experimentally observed in dolphins; and (3) a bottlenose dolphin exposed to a 3 kHz tone at 217 dB re 1 μPa^2-s experienced only TTS and no permanent effects.

3.9.7.3.2 Mysticetes and Odontocetes

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 7 Hz to 22 kHz, with good sensitivity from 20 Hz to 2 kHz (Ketten, 1998; Southall et al. 2007). 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. 2001a). The results suggest that humpbacks are sensitive to frequencies between 700 Hz to 10 kHz, with maximum relative sensitivity between 2 and 6 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 in this OEIS/EIS 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 in this OEIS/EIS, 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.

3.9.7.3.3 Use of Exposure Level for Permanent Threshold Shift/Temporary Threshold Shift

Thresholds for PTS/TTS 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 (nonimpulsive sounds) of interest in this OEIS/EIS, 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 (Section 3.12 in Appendix F). Since mammals exhibit lower TSs from intermittent exposures compared to continuous exposures with the same energy (Ward 1997), basing the 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 severity of a particular exposure. Therefore, estimates in this OEIS/EIS are conservative because recovery is not taken into account; intermittent exposures are considered equivalent 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

3.9.7.3.4 Previous Use of Exposure Level for Permanent Threshold Shift/Temporary Threshold Shift

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 for TTS in this OEIS/EIS. The 192 dB re 1 µPa2-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. 2005; Nachtigall et al. 2003, 2004; Schlundt et al. 2006). This OEIS/EIS, 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. The threshold is applied in this OEIS/EIS as an "all-or-nothing" value, where 100 percent of animals receiving EL $\geq$ 195 dB re 1 µPa^2-s are considered to experience TTS. 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 harassment incidents in future actions relies (in part) on using the EL at which onset-TTS will most likely occur. When the 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 harassment incidents by onset-TTS over all of those exercises. Use of the minimum value would overestimate the amount of incidental harassment 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 for the "all-or-nothing" threshold for effect.

3.9.7.4 Summary of Existing Credible Scientific Evidence Relevant to Assessing Behavioral Effects

3.9.7.4.1 Background

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 substantially 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. 1995a; Wartzok et al. 2003; Southall et al. 2007). 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.

It is possible that some marine mammal behavioral reactions to anthropogenic sound may result in strandings. Several "mass stranding" events—strandings that involve two or more individuals of the same species (excluding a single cow–calf pair)—that have occurred over the past two decades have been associated with naval operations, seismic surveys, and other anthropogenic activities that introduced sound into the marine environment. Sonar exposure has been identified as a contributing cause or factor in five specific mass stranding events: Greece in 1996; the Bahamas in March 2000; Madeira, Portugal in 2000; the Canary Islands in 2002, and Spain in 2006 (Advisory Committee Report on Acoustic Impacts on Marine Mammals 2006).

In these circumstances, exposure to acoustic energy has been considered a potential indirect cause of the death of marine mammals (Cox et al. 2006). A popular hypothesis regarding a potential cause of the strandings is that tissue damage results from a "gas and fat embolic syndrome" (Fernandez et al. 2005; Jepson et al. 2003; 2005). Models of nitrogen saturation in diving marine mammals have been used to suggest that altered dive behavior might result in the accumulation of nitrogen gas such that the potential for nitrogen bubble formation is increased (Houser et al. 2001; Zimmer and Tyack 2007). If so, this mechanism might explain the findings of gas and bubble emboli in stranded beaked whales. It is also possible that stranding is a behavioral response to a sound under certain contextual conditions and that the subsequently observed physiological effects of the strandings (e.g., overheating, decomposition, or internal hemorrhaging from being on shore) were the result of the stranding and not the direct result of exposure to sonar (Cox et al. 2006).

3.9.7.4.2 Development of the Risk Function

In Section 4.1.2.4.9 of the Hawaii Range Complex (HRC) EIS/OEIS (DoN 2008), the Navy presented a dose methodology to assess the probability of MMPA Level B behavioral harassment from the effects of MFA and high-frequency active (HFA) sonar on marine mammals. Following publication of the HRC EIS/OEIS the Navy continued working with NMFS to refine the mathematically representative curve previously used, along with applicable input parameters with the purpose of increasing the accuracy of the Navy's assessment. 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 NMFS scientists, one from the NMFS Office of Science and Technology and one from the Office of Protected Resources, then summarized 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 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 2004b); (2) 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; and (3) the mean of the lowest received levels from the 3 kHz data that the Space and Naval Warfare System (SPAWAR) Systems Center (SSC Pacific) classified as altered behavior from Finneran and Schlundt (2004).

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 (SURTASS) low-frequency active (LFA) sonar (DoN 2001c). This function is appropriate for application to instances with limited data (Feller 1968). This methodology is subsequently identified as "the risk function" in this document.

The NMFS Office of Protected Resources 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 (DoN 2002b; National Oceanic and Atmospheric Administration 2007b).

3.9.7.4.3 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 (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.

As noted in the prior section, the Navy and NMFS have previously 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 3.9-5 left panel). These acoustic thresholds have been represented by either sound exposure level (related to sound energy, abbreviated as SEL), sound pressure level (abbreviated as SPL), or other metrics such as peak pressure level and acoustic impulse. 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 RIMPAC Major Exercise (NOAA 2006i) used 173 decibel re 1 micropascal squared-second (dB re 1 μPa^2-s) 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 173 dB re 1 μPa^2-s, then the animal was considered to have been behaviorally harassed. If the received accumulated energy level was below 173 dB re 1 μPa^2-s, then the animal was not treated as having been behaviorally harassed.

The left panel in Figure 3.9-8 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.

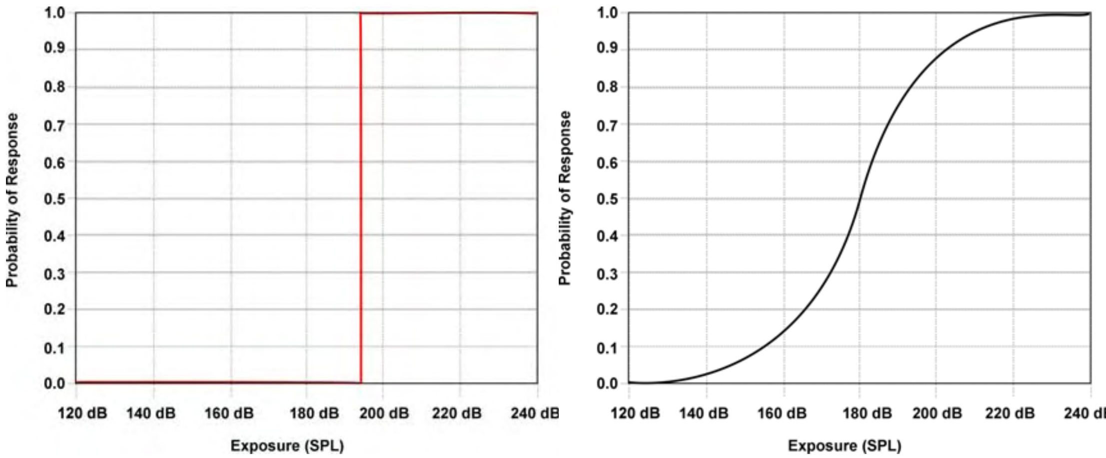

Figure 3.9-8: Typical Step Function (Left) and Typical Risk Continuum-Function (Right)

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 3.9-5 illustrates a typical acoustic risk function that might relate an exposure, as received sound pressure level in decibels referenced to 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 2001c); 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 2007d).

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 sound pressure level (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 sound exposure level (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 prior to the Hawaii Range Complex MFA sonar assessments of the potential effects of MFA sonar on marine mammals (DoN 2008), 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 (EPA 1998); the Nuclear Regulatory Commission uses dose-functions to estimate the consequences of radiation exposures (see Nuclear Regulatory Commission 1997 and 10 C.F.R. 20.1201); the Centers for Disease Control and Prevention and the Food and Drug Administration use dose-functions as part of their assessment methods (for example, see Centers for Disease Control and Prevention 2003, U.S. Food and Drug Administration and others 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 OSHA 1996b; OSHA 2006).

3.9.7.4.4 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) for the probability as defined in the SURTASS LFA Sonar Final OEIS/EIS (DoN 2001c), and relied on in the Supplemental SURTASS LFA Sonar EIS (DoN 2007d) for the probability of MFA/HFA sonar risk for MMPA Level B behavioral harassment with input parameters modified by NMFS for MFA/HFA 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 (2001c), 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 (A=10 odontocetes/pinnipeds; A=8 mysticetes) (explained in 3.9.7.6.7).

In order to use this function, the values of the three parameters (B, K, and A) need to be established. As further explained in Section 3.9.7.6.7, the values used in this analysis are based on three sources of data: TTS experiments conducted at SSC PACIFIC 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 2005a); U.S. Department of the Navy (2004b); 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.

3.9.7.4.5 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 (Cox et al. 2006; Southall et al. 2007). The 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 (NMFS 2008).

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. Until applicable data sets are evaluated to better qualify harassment from HFA sources, the risk function derived for MFA sources will apply to HFA.

3.9.7.4.6 Data from Space and Naval Warfare Systems Command'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 PACIFIC'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. 2002a). Bottlenose dolphins exposed to 1-second (sec) intense tones exhibited short-term changes in behavior above received sound levels of 178 to 193 dB re 1 μPa root mean square (rms), and beluga whales did so at received levels of 180 to 196 dB and above. Test animals sometimes vocalized after an exposure to impulsive sound from a seismic watergun (Finneran et al. 2002a). In some instances, animals exhibited aggressive behavior toward the test apparatus (Ridgway et al. 1997; Schlundt et al. 2000).

- 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-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 Pacific 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^2/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 SPL were randomly presented.

Data from Studies of Baleen (Mysticetes) Whale Responses

The only mysticete data available resulted from a field experiments in which baleen whales (mysticetes) were exposed to frequency sounds ranging in frequency from 50 Hz (ship noise playback) to 4500 Hz (alert stimulus) (Nowacek et al. 2004). Behavioral reactions to an alert stimulus, consisting of a combination of tones and frequency and amplitude modulated signals ranging in frequency from 500 Hz to 4500 Hz, was the only portion of the study used to support the risk function input parameters.

- Nowacek et al. (2004; 2007) 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/√Hz.

Observations of Killer Whales in Haro Strait in the Wild

In May 2003, killer whales (*Orcinus orca*) were observed exhibiting behavioral responses while 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 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.

- U.S. Department of Commerce (NMFS 2005a); Department of the Navy (2004b); Fromm (2004a, 2004b) documented reconstruction of sound fields produced by USS SHOUP associated with the behavioral response of killer whales observed in Haro Strait. Observations from this reconstruction included an estimate of 169.3 dB SPL which represents the mean received level at a point of closest approach within a 500 m wide area which the animals were exposed. Within that area, the estimated received levels varied from approximately 150 to 180 dB SPL.

3.9.7.4.7 Limitations of the Risk Function Data Sources

There are substantial 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.

While NMFS considers all data sets as being weighted equally in the development of the risk function, the Navy believes the SSC Pacific 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 killer whales in the wild data set 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.

SSC Pacific Trained Bottlenose Dolphins and Beluga Data Set:

- 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 μPa2-s).
- The animals were not exposed in the open ocean but in a shallow bay or pool.
- The tones used in the tests were 1-second pure tones similar to MFA sonar.

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 an 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 observed response as opposed to baseline conditions.

3.9.7.4.8 Input Parameters for the Feller Adapted Risk Function

The values of B, K, and A need to be specified in order to utilize the risk function defined in Section 3.9.7.6.4 previously. The risk continuum function approximates the dose-response function in a manner analogous to pharmacological risk assessment (DoN 2001c, 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.

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.

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 five 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 (except harbor porpoises), and pinnipeds, and A=8 for mysticetes, (Figures 3.9-9 and 3.9-10) (NMFS 2008a).

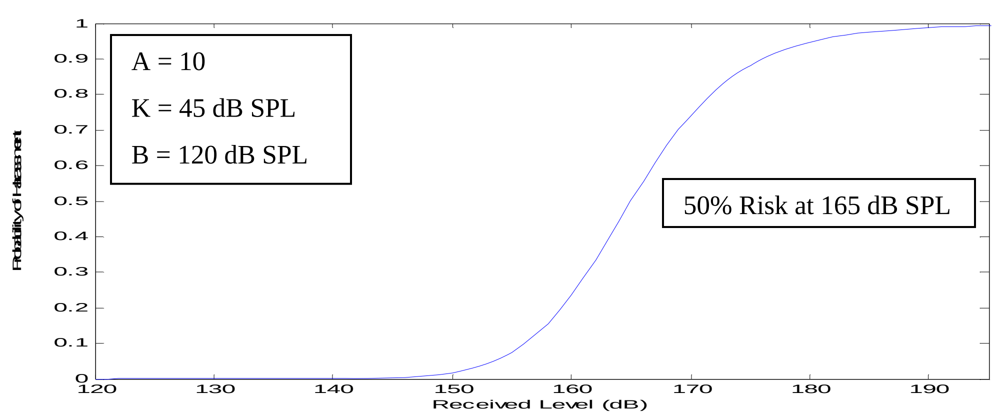

Figure 3.9-9: Risk Function Curve for Odontocetes (Toothed Whales) and Pinnipeds

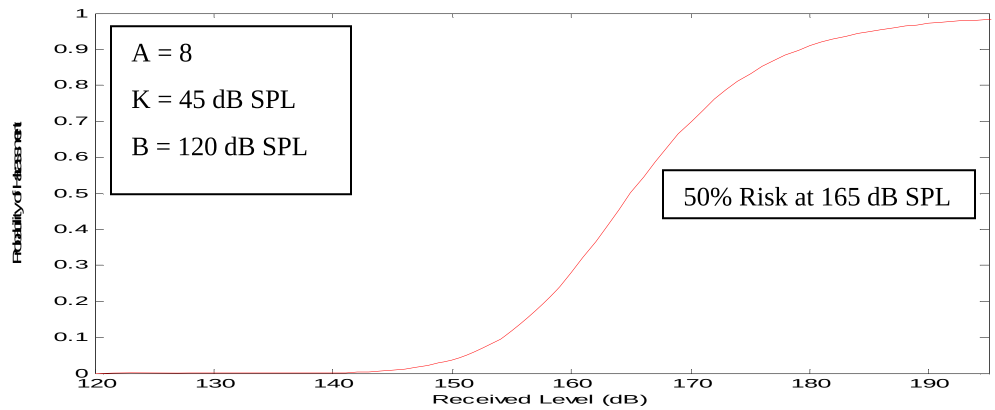

Figure 3.9-10: Risk Function Curve for Mysticetes (Baleen Whales)

Justification for the Steepness Parameter of A=10 for the Odontocete Curve

The NMFS independent review process described in Section 4.1.2.4.9 of HRC FEIS Navy (DoN 2008) provided the impetus for the selection of the parameters for the risk function curves. One scientist recommended staying close to the risk continuum concept as used in the SURTASS LFA sonar EIS. This scientist opined that both the basement and slope values; B=120 dB and A=10 respectively, from the SURTASS LFA sonar risk continuum concept are logical solutions in the absence of compelling data to select alternate values supporting the Feller-adapted risk function for MFA sonar. Another scientist indicated a steepness parameter needed to be selected, but did not recommend a value. Four scientists did not specifically address selection of a slope value. After reviewing the six scientists' recommendations, the two NMFS scientists recommended selection of A=10. Direction was provided by NMFS to use the A=10 curve for odontocetes based on the scientific review of potential risk functions explained in Section 4.1.2.4.9.2 of the HRC FEIS (DoN 2008).

As background, a sensitivity analysis of the A=10 parameter was undertaken and presented in Appendix D of the SURTASS/LFA FEIS (DoN 2001c). The analysis was performed to support the A=10 parameter for mysticete whales responding to a low-frequency sound source, a frequency range to which the mysticete whales are believed to be most sensitive to. The sensitivity analysis results confirmed the increased risk estimate for animals exposed to sound levels below 165 dB. Results from the Low Frequency Sound Scientific Research Program (LFS SRP) phase II research showed that whales (specifically gray whales in their case) did scale their responses with received level as supported by the A=10 parameter (Buck and Tyack 2000). In the second phase of the LFS SRP research, migrating gray whales showed responses similar to those observed in earlier research (Malme et al. 1983, 1984) when the LF source was moored in the migration corridor (2 km [1.1 nm] from shore). The study extended those results with confirmation that a louder SL elicited a larger scale avoidance response. However, when the source was placed offshore (4 km [2.2 nm] from shore) of the migration corridor, the avoidance response was not evident. This implies that the inshore avoidance model – in which 50 percent of the whales avoid exposure to levels of 141 $\pm$ 3 dB – may not be valid for whales in proximity to an offshore source (DoN 2001c). As concluded in the SURTASS LFA Sonar Final OEIS/EIS (DoN 2001c), 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; Buck and Tyack 2000; and SURTASS LFA Sonar EIS, Sections 1.43, 4.2.4.3, and Appendix D, and NMFS 2008).

Justification for the Steepness Parameter of A=8 for the Mysticete Curve

The Nowacek et al. (2004) study provides the only available data source for a mysticete species behaviorally responding to a sound source (i.e., alert stimuli) with frequencies in the range of tactical mid-frequency sonar (1-10 kHz), including empirical measurements of received levels (RLs). While there are fundamental differences in the stimulus used by Nowacek et al. (2004) and tactical mid-frequency sonar (e.g., source level, waveform, duration, directionality, likely range from source to receiver), they are generally similar in frequency band and the presence of modulation patterns. Thus, while they must be considered with caution in interpreting behavioral responses of mysticetes to mid-frequency sonar, they seemingly cannot be excluded from this consideration given the overwhelming lack of other information. The Nowacek et al. (2004) data indicate that five out the six North Atlantic right whales exposed to an alert stimuli "significantly altered their regular behavior and did so in identical fashion" (i.e., ceasing feeding and swimming to just under the surface). For these five whales, maximum RLs associated with this response ranged from root- mean-square sound (rms) pressure levels of 133-148 dB (re: 1 µPa).

When six scientists (one of them being Nowacek) were asked to independently evaluate available data for constructing a dose response curve based on a solution adapted from Feller (1968), the majority of them (4 out of 6; one being Nowacek) indicated that the Nowacek et al. (2004) data were not only appropriate but also necessary to consider in the analysis. While other parameters associated with the solution adapted from Feller (1968) were provided by many of the scientists (i.e., basement parameter [B], increment above basement where there is 50 percent risk [K]), only one scientist provided a suggestion for the risk transition parameter, A.

A single curve may provide the simplest quantitative solution to estimating behavioral harassment. However, the policy decision, by NMFS-OPR, to adjust the risk transition parameter from A=10 to A=8 for mysticetes and create a separate curve was based on the fact the use of this shallower slope better reflected the increased risk of behavioral response at relatively low RLs suggested by the Nowacek et al. (2004) data. In other words, by reducing the risk transition parameter from 10 to 8, the slope of the curve for mysticetes is reduced. This results in an increase the proportion of the population being classified as behaviorally harassed at lower RLs. It also slightly reduces the estimate of behavioral response probability at quite high RLs, though this is expected to have quite little practical result owing to the very limited probability of exposures well above the mid-point of the function. This adjustment allows for a slightly more conservative approach in estimating behavioral harassment at relatively low RLs for mysticetes compared to the odontocete curve and is supported by the only dataset currently available. It should be noted that the current approach (with A=8) still yields an extremely low probability for behavioral responses at RLs between 133-148 dB, where the Nowacek data indicated significant responses in a majority of whales studied. (Note: Creating an entire curve based strictly on the Nowacek et al. [2004] data alone for mysticetes was advocated by several of the reviewers and considered inappropriate, by NMFS-OPR, since the sound source used in this study was not identical to tactical mid-frequency sonar, and there were only five data points available). The policy adjustment made by NMFS-OPR was also intended to capture some of the additional recommendations and considerations provided by the scientific panel (i.e., the curve should be more data driven and that a greater probability of risk at lower RLs be associated with direct application of the Nowacek et al. 2004 data).

3.9.7.4.9 Basic Application of the Risk Function and Relation to the 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 MFA 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.

NMFS and Navy made the decision to apply the MFA risk function curve to HFA sources due to lack of available and complete information regarding HFA sources. As more specific and applicable data become available for MFA/HFA sources, NMFS can use these data to modify the outputs generated by the risk function to make them more realistic. 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). In the SOCAL example, animals exposed to received levels between 140 and 150 dB may be more than 10 nm (20,253 yards) from a sound source; those distances would influence whether those animals might perceive the sound source as a potential threat, and their behavioral responses to that threat. 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, the 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 on 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. Generally speaking, the 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.

3.9.7.5 Critique of the Two Risk Function Curves as Presented in the Final EIS/OEIS for the Hawaii Range Complex

The risk functions used in this Final EIS/OEIS to assess non-injurious temporary behavioral effects to marine mammals were first set forth in the Navy's Final EIS/OEIS for the Hawaii Range Complex (HRC) [DoN 2008]. The Navy received several comments on the HRC Final EIS/OEIS critical of the risk function curves specified by NMFS. In reviewing whether the parameters employed were based upon the best available science, the implications in the uncertainty in the values, and biases and limitations in the risk function criteria, such comments asserted that data were incorrectly interpreted by NMFS when calculating parameter values, resulting in a model that underestimates takes. Of primary importance to these commenters was the point that the risk function curves specified by NMFS do not account for a wide range of frequencies from a variety of sources (e.g., motor boats, seismic survey activities, banging on a pipe). In fact, all of the comments concerning "data sets not considered" by NMFS relate to sound sources that are either higher or lower in frequency than MFA sonar, are contextually different (such as those presented in whale watch vessel disturbances or oil industry activities), or are relatively continuous in nature as compared to intermittent sonar pings. These sounds from data sets not considered have no relation to the frequency or duration of a typical Navy MFA sonar as described in this Final EIS/OEIS.

As discussed above, NMFS selected data sets that were relevant to MFA sonar sources and selected parameters accordingly. In order to satisfy the concern reflected in that a risk function must be inherently precautionary, NMFS could have selected data sets and developed parameters derived from a wide variety of sources across the entire spectrum of sound frequencies in addition to or as substitutes for those that best represent the Navy's MFA sonar. The net result, however, would have been a risk function that captures a host of behavioral responses beyond those that are biologically significant as contemplated by the definition of Level B harassment under the MMPA applicable to military readiness activities.

Given the results of the modeling and the marine mammal densities in the SOCAL Range Complex, having a lower basement value would not result in any significant number of additional takes. This is demonstrated in the Final EIS/OEIS Tables 3.9-6 and 3.9-7, showing that less than 1 percent of the predicted number of takes resulted from exposures below 140 dB. Accordingly, while lowering the basement value from 120 dB to something "far lower than 110 dB" would change the risk function curve, it is not likely to result in any appreciable increase in the number of takes. In addition, lowering the basement value below the present 120 dB would involve modeling for impacts occurring below the naturally occurring ambient background noise present in the SOCAL Range Complex.

Table 3.9-6: Harassments at Each Received Level Band during the Cold Season in the SOCAL Range Complex

Received Level (dB SPL)	Distance at which Levels Occur in SOCAL	Estimated Percent of Harassments Occurring at Given Levels
Below 140 dB SPL	24 nm – 76 nm (44 km - 140 km)	< 1 %
140 - 150 dB SPL	10 nm – 24 nm (19 km - 44 km)	2 %
150 - 160 dB SPL	3.6 nm – 10 nm (6.7 km - 19 km)	19 %
160 - 170 dB SPL	1.2 nm -3.6 nm (2.2 km - 6.7 km)	42 %
170 - 180 dB SPL	0.4 nm – 1.2 nm (0.68 km - 2.2 km)	26 %
180 - 190 dB SPL	690 ft – 2,230 ft (210 m – 0.68 km)	10 %
Above 190 Level	0 – 690 ft (0 - 210 m)	<1%

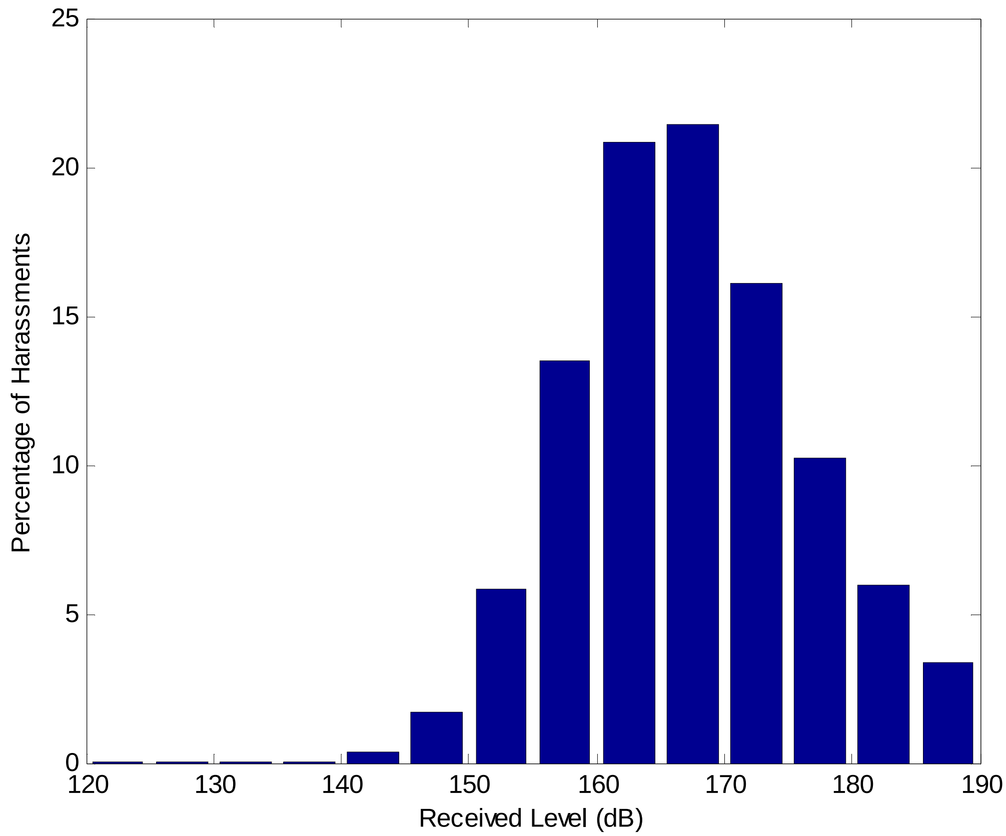

Figure 3.9-11: Percentage of SOCAL Behavioral Harassments Resulting from the Risk Function for Every 5 dB of Received Level During the Cold Season

Table 3.9-7: Harassments at Each Received Level Band During the Warm Season in SOCAL

Received Level (dB SPL)	Distance at which Levels Occur in SOCAL	Estimated Percent of Harassments Occurring at Given Levels
Below 140	4.5 nm – 22 nm (8.3 km - 40 km)	< 1 %
140 - 150	1.8 nm – 4.5 nm (3.4 km - 8.3 km)	2 %
150 - 160	0.7 nm – 1.8 nm (1.3 km - 3.4 km)	17 %
160 - 170	0.3 nm – 0.7 nm (0.5 km - 1.3 km)	39 %
170 - 180	656 ft – 1,640 ft (200 m - 500 m)	28 %
180 - 190	328 ft – 656 ft (100 m - 200 meters)	13 %
Above 190 Level	0 – 328 ft (0-100 meters)	<1%

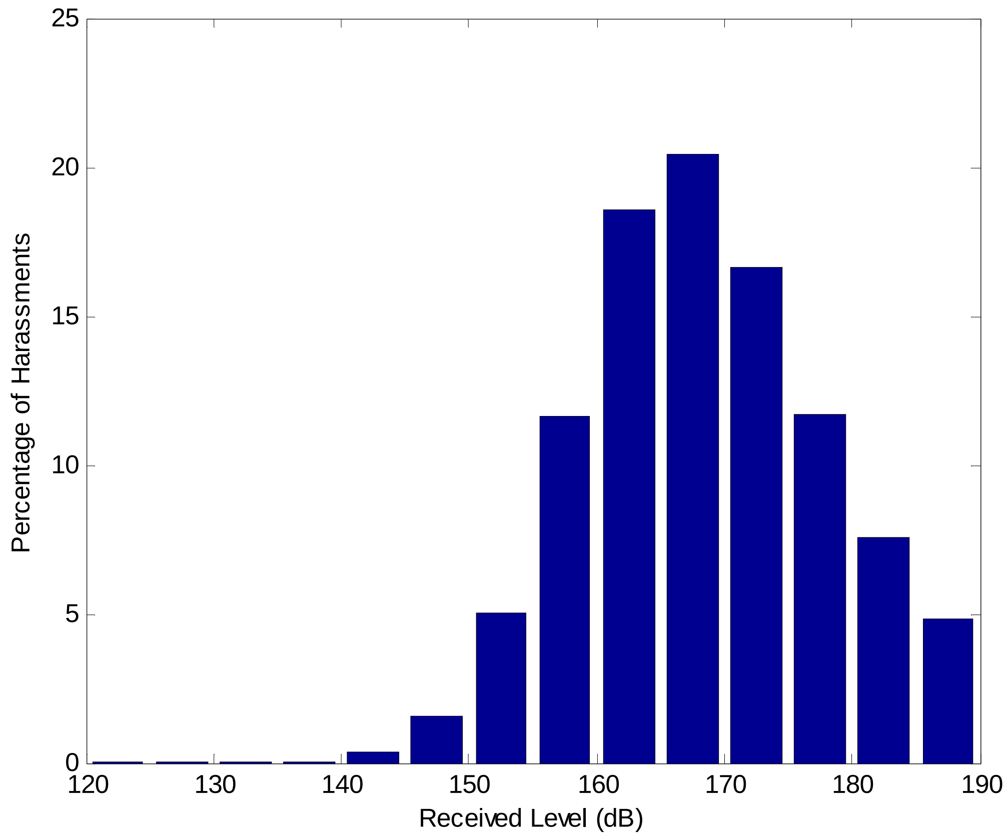

Figure 3.9-12: Percentage of SOCAL Behavioral Harassments Resulting from the Risk Function for Every 5 dB of Received Level during the Warm Season

Such criticism suggests that the criteria used to establish the risk function parameters should reflect the biological basement where any reaction is detectable. The MMPA did not intend to regulate any and all marine mammal behavioral reactions as suggested by the comment. Congress's intent is reflected in the 2003 amendments to the MMPA which re-defined harassment as applied to military readiness activities: "(i) any act that injures or has the significant potential to injure a marine mammal or marine mammal stock in the wild (Level A Harassment); or (ii) any act that disturbs or is likely to disturb a marine mammal or marine mammal stock in the wild by causing disruption of natural behavioral patterns, including, but not limited to, migration, surfacing, nursing, breeding, feeding, or sheltering, to a point where such behavioral patterns are abandoned or significantly altered (Level B Harassment)." Therefore, Congress, by amending the MMPA, specifically did not intend to regulate any and all behavioral reactions as the comment suggests. NMFS, as the regulator, specified the data sets and parameters for use in the risk function analysis. NMFS, as a cooperating agency and in its role as the MMPA regulator, reviewed all available applicable data and determined there were specific data from three data sets that should be used to develop the criteria. NMFS then applied the risk function to predict exposures that resulted in exposures that NMFS may classify as harassment. As discussed above, NMFS developed two risk curves based on the Feller adaptive risk function, one for odontocetes and pinnipeds and one for mysticetes, with input parameters of B=120dB, K=45, 99 percent point = 195 dB, 50 percent point = 165 dB. Only data sets with continuous, low frequency sound sources (drilling, aircraft or machinery) provided a K value that would have approached a 100 percent probability of a response but these are not applicable to MFA sonar.

Various comments recommending that the B parameter and the data used should be revised given that, "… 120 dB re 1uPa has broadly been found as the value at which 50 percent of individuals respond to noise ..." and that "... 50 percent of migrating whales changed course to remain outside the 120 dB re 1uPa contour (citing to Malme et al. 1983, 1984);" and that "... mysticetes exposed to a variety of sounds associated with the oil industry, typically 50 percent exhibited responses at 120 dB re 1uPa" are factually inaccurate. All of these comments provided a single citation to Malme et al. (1983, 1984) for the repeated assertion that 50 percent of marine mammals will react to 120 db re 1uPa. Malme et al. (1983, 1984) in fact indicated that for migrating whales, a 50-percent probability of response occurred at 170 dB for a continuous, low frequency sound source that is very different from MFA sonar.

Regarding criticism that the model underestimates takes because of uncertainty arising from "inter-specific variation" or from "broad confidence intervals," the risk function methodology assumes variations in responses within the species and was chosen specifically to account for uncertainties and the limitations in available data. NMFS considered all available data sets and, as discussed above, made a determination as to the best data currently available. While the data sets have limitations, they constitute the best available science.

Criticism that the model has limitations in that it does not account for social factors, and is likely to underestimate takes, reflects a concern that if one animal is "taken" and leaves an area then the whole pod would likely follow. As explained in Appendix F to the Final EIS/OEIS, the model does not operate on the basis of an individual animal but quantifies the exposures NMFS may classify as takes based on the summation of fractional marine mammal densities. Because the model does not consider the many mitigation measures that the Navy utilizes when it is using MFA sonar, to include MFA sonar power down and power off requirements should mammals be spotted within certain distances of the ship, if anything, it overestimates the amount of takes.

Lastly, regarding criticism that there are additional datasets, including datasets not considered by NMFS and the Navy, that should have been considered and not having done so resulted in the model underestimating takes, the various data sources suggested by the critics involve contexts that are neither applicable to the proposed actions nor the sound exposures resulting from those actions. For instance, Lusseau et al. (2004) involved disturbance to a small pod of dolphins exposed to 8,500 whale-watching opportunities annually. This is nothing like the type or frequency of action that is proposed by the Navy for the SOCAL Range Complex. In a similar manner, the example from noise used in drive fisheries is not applicable to Navy training. Navy training involving the use of active sonar typically occurs in situations where the ships are located miles apart, the sound is intermittent, and the training does not involve surrounding the marine mammals at close proximity. Furthermore, suggestions that effects from acoustic harassment devices and acoustic deterrent devices, which are relatively continuous, high frequency sound sources (unlike MFA sonar) and are specifically designed to exclude marine mammals from habitat, are also fundamentally different from the use of MFA sonar. Finally, reactions to airguns used in seismic research or other activities associated with the oil industry are also not applicable to MFA sonar, since the sound or noise source, its frequency, source level, and manner of use is fundamentally different.

3.9.7.6 Navy Protocols for Acoustic Modeling Analysis of Marine Mammal Exposures

The quantification of the acoustic modeling results includes additional analysis to increase the accuracy of the number of marine mammals affected. Table 3.9-8 provides a summary of the modeling protocols used in this analysis. Post modeling analysis includes reducing acoustic footprints where they encounter land masses, accounting for acoustic footprints for sonar sources that overlap to accurately sum the total area when multiple ships are operating together, and to better account for the maximum number of individuals of a species that could potentially be exposed to sonar within the course of one day or a discreet continuous sonar event.

Table 3.9-8: Navy Protocols Providing for Modeling Quantification of Marine Mammal Exposures

Historical Data	Sonar Positional Reporting System (SPORTS)	Annual active sonar usage data is 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	The AN/SQS-53 and the AN/SQS-56 active sonar sources are modeled separately to account for the differences in source level, frequency, and exposure effects.
	Submarine Sonar	Submarine active sonar use is included in effects analysis calculations using the SPORTS database.
Post Modeling Analysis	Land Shadow	For sound sources within the acoustic footprint of land, the land area is subtracted from the marine mammal exposure calculation.
	Multiple Ships	Correction factors are used to address the maximum potential of exposures to marine mammals resulting from multiple counting based on the acoustic footprint when there are occasions for more than one ship operating within approximately 130 nm of one another.
	Multiple Exposures	Accurate accounting for SOCAL training events within the course of one day or a discreet continuous sonar event: • 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 3.9-9).

Table 3.9-9: Effects Analysis Criteria for Underwater Detonations

	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
Mortality & Injury	Slight Injury Onset of slight lung hemorrhage	Shock Wave Goertner modified positive impulse	13.0 psi-msec*	All marine mammals (dolphin calf)	Goertner 1982
Mortality & Injury	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[1]	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
Harassment	Temporary Auditory Effects TTS[1]	Noise Exposure Peak Pressure	23 psi	All marine mammals	DoN 2001
Behavioral	Behavioral Modification (MSE Only)	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

[1] The criteria with the greatest number of exposures is presented in the impacts analysis

For explosives < 2000 lb Net Explosive Weight (NEW), based on CHURCHILL FEIS (DON 2001) and Eglin Air Force Base IHA (NMFS 2005e) and LOA (NMFS 2006a).

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. 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

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 3.9-9).

- 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 noninjurious 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 (FEIS) (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 with concurrence from NMFS 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/DOEIS are less than 1,500 lb.

3.9.8.2 Harassment Threshold for Multiple Successive Explosions

There may be rare occasions when multiple successive explosions (MSE) are part of a static location event such as during Mine Laying Exercise (MINEX), Missile Exercise (MISSILEX), Bombing Exercise (BOMBEX), Sinking Exercise (SINKEX), Gunnery Exercise (GUNEX), and Naval Surface Fire Support (NSFS) (when using other than inert weapons). For MSEs, accumulated energy over the entire training time is the natural extension for energy thresholds since energy accumulates with each subsequent shot; this is consistent with the treatment of multiple arrivals in Churchill. For positive impulse, it is consistent with Churchill to use the maximum value over all impulses received.

For MSE, the acoustic criterion for behavioral harassment is used to account for behavioral effects significant enough to be judged as harassment, but occurring at lower sound energy levels than those that may cause TTS. The behavioral harassment threshold is derived following the approach of the Churchill FEIS for the energy-based TTS threshold.

The research on pure tone exposures reported in Schlundt et al. (2000) and Finneran and Schlundt (2004) provided the pure-tone threshold of 192 dB as the lowest TTS value. This value is modified for explosives by (a) interpreting it as an energy metric, (b) reducing it by 10 dB to account for the time constant of the mammal ear, and (c) measuring the energy in 1/3 octave bands, the natural filter band of the ear. The resulting TTS threshold for explosives is 182 dB re 1 mPa^2-s in any 1/3 octave band. As reported by Schlundt et al. (2000) and Finneran and Schlundt (2004), instances of altered behavior in the pure tone research generally began 5 dB lower than those causing TTS. The behavioral harassment threshold is therefore derived by subtracting 5 dB from the 182 dB re 1 mPa^2-s in any 1/3 octave band threshold, resulting in a 177 dB re 1 μPa^2-s behavioral disturbance harassment threshold for multiple successive explosives.

3.9.8.3 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-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, 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 lb 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.

3.9.9.1 Approach to Analysis

3.9.9.1.1 Acoustic Impact Model Process Applicable to All Alternative Discussions

The methodology for analyzing potential impacts from sonar and explosives is presented in Section 3.9.8 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.

3.9.9.1.2 Model Results Explanation

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) or for multiple explosives. Controlled studies in the laboratory have been conducted to determine physical changes (TTS) in hearing of marine mammals associated with sound exposure (Finneran et al. 2001, 2003, 2005). Research on behavioral effects has been difficult because of the difficulty and complexity of implementing controlled conditions.

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 (National Research Council [NRC] 2003, 2005). The 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."

For purposes of predicting the number of marine mammals that will be behaviorally harassed or sustain either temporary or permanent threshold shift, the Navy uses an acoustic impact model process with numeric criteria agreed upon with the NMFS.

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. Exclusive Economic Zone (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.

3.9.9.1.3 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 3.9-10). 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). Many behavioral responses may be short term (seconds to minutes orienting to the sound source or over several hours if they move away from the sound source) and of little immediate consequence for the animal. However, certain responses may lead to a stranding or mother-offspring separation (Baraff and Weinrich 1994; Gabriele et al. 2001). 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 severity scale response spectrum proposed by Southall et al. (2007), responses classified as from 0-3 are brief and minor, those from 4-6 have a higher potential to affect foraging, reproduction, or survival and those from 7-9 are likely to affect foraging, reproduction and survival. Sonar and explosive mitigation measures (sonar power-down or shut-down zones and explosive exclusion zones) would likely prevent animals from being exposed to the loudest sonar sounds or explosive effects that could potentially result in TTS or PTS and more intense behavioral reactions (i.e., 7-9) on the response spectrum.

There are 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 exposed to seismic survey airguns or ship noise (e.g., Malme et al. 1984; McCauley et al. 1998; Nowacek et al. 2004). MFA sonar use in SOCAL is not new and has occurred using the same basic sonar equipment and output for over approximately 30 years. Given this history the Navy believes that risk to marine mammals from sonar training is low.

Even for more cryptic species such as beaked whales, the main determinant of causing a stranding appears to be exposure in a limited egress areas (a long narrow channel) with multiple ships. The result is that animals may be exposed for a prolonged period rather than several sonar pings over a several minutes and the animals having no means to avoid the exposure. Under these specific circumstances and conditions MFA sonar is believed to have contributed to the stranding and mortality of a small number of beaked whales in locations other than SOCAL. There are no limited egress areas (long narrow channels) in the SOCAL Range Complex, therefore, it is unlikely that the proposed sonar use would result in any strandings. Although the Navy has substantially changed operating procedures to avoid the aggregate of circumstances that may have contributed to previous strandings, it is important that future unusual stranding events be reviewed and investigated so that any human cause of the stranding can understood and avoided.

There have been no beaked whales strandings in SOCAL associated with the use of MFA/HFA sonar. This is a critically important contextual difference between SOCAL and areas of the world where strandings have occurred (Southall et al. 2007). While the absence of evidence does not prove there have been no impacts on beaked whales, decades of history with no evidence cannot be lightly dismissed.

3.9.9.1.4 Temporary Threshold Shift

A temporary threshold shift is a temporary recoverable, loss of hearing sensitivity over a small range of frequencies related to the sound source to which it was exposed (larger range of frequencies with exposure to broadband underwater detonations). The animal may not even be aware of the TTS and 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 (including multiple exposures). Some baleen whales and odontocetes may use mid-frequencies calls but with mitigation measures few animals, if any, would be exposed to sound levels that would produce TTS. Animals may increase calling rates, increase the sound level of calls, or the way they process sound to compensate for loud sounds within their environment (Buckstaff 2006; Parks et al. 2007; Tyack 2008) and may do the same to compensate for TTS effects although this has not been studied. Sonar exposures are generally 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 and underwater detonations are 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. TTS range from a MFA sonar's 235 dB source level one second ping is approximately 361 ft (110 m) from the bow of the ship under nominal oceanographic conditions.

3.9.9.1.5 Permanent Threshold Shift

A permanent threshold shift is nonrecoverable and results from the destruction of tissues within the auditory system and occurs 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 MFA or HFA 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. The distance to PTS from a MFA sonar's 235 dB source level one second ping is approximately 33 ft (10 m) from the bow of the ship under nominal oceanographic conditions.

3.9.9.1.6 Population Level Effects

Some SOCAL training activities will be conducted in the same general areas, so marine mammal populations could be exposed to repeated activities over time. This does not mean, however, that there will be a repetition of any effects given the vast number of variables involved. The acoustic analyses assume that short-term noninjurious sound levels predicted to cause TTS or temporary behavioral disruptions qualify as Level B harassment. However, it is unlikely that most behavioral disruptions or instances of TTS will result in long-term significant effects. The majority of the exposures modeled for SOCAL would be below 170 dB SPL and are below the previously used behavioral threshold for Rim of the Pacific Exercise (RIMPAC), Undersea Warfare Exercise (USWEX), and Composite Training Unit Exercise (COMPTUEX)- Joint Task Force Exercise (JTFEX) (173 db re 1 μPa^2-s). Mitigation measures reduce the likelihood of exposures to sound levels that would cause significant behavioral disruption (the higher levels of 7-9 in Figure 3.9-13), TTS or PTS. It is unlikely that the short term behavioral disruption would adversely affect the species or stock through effects on annual rates of recruitment or survival.

0 -No observable response

1 -Brief orientation response (investigation / visual orientation)

2 -Moderate or multiple orientation behaviors
-Brief or minor cessation/ modification of vocal behavior
-Brief or minor change in respiration rates

3 -Prolonged orientation behavior
-Individual alert behavior
-Minor changes in locomotion speed, direction, and/or dive profile but no avoidance of sound source
-Moderate change in respiration rate
-Minor cessation or modification of vocal behavior (duration < duration of source operation), including the Lombard Effect

4 -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)

5 -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)

6 -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

7 -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

8 -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

9 -Outright panic, flight, stampede, attach of conspecifics, or stranding events
-Avoidance behavior related to predator detection

1-3 DEFINED BY NMFS AS NO MMPA BEHAVIORAL HARASSMENT (levels 0–3)

7-9 DEFINED BY NMFS AS MMPA BEHAVIORAL HARASSMENT Plus subset behaviors in 4 to 6 depending on context of behavior

Note: Severity scale for ranking observed behaviors from Southall et al. 2007

Figure 3.9-13: Marine Mammal Response Spectrum to Anthropogenic Sound

3.9.9.2 No Action Alternative

3.9.9.2.1 Nonsonar Acoustic Impacts and Nonacoustic Impacts

<u>Ship Noise</u>

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.

Above-Water Firing and Detonations

Acoustic energy enters the water from weapons firings and detonations that occur above the water. This section presents an analysis of impacts to species as a result of naval gunfire and detonations that occur on a surface target. Based on the analyses below, the Navy has concluded that no effects to listed species or marine mammals would occur, so no MMPA authorization was requested.

Impacts Related to Close-In Weapons System (CIWS) Operations

CIWS would be used during surface-to-air gunnery exercises in the Range Complex during major SOCAL training exercises. The CIWS fires inert rounds, and has a theoretical firing rate of 3,000 rounds per minute with a very low dispersion pattern for the projectiles. The projectiles have a muzzle velocity of 3,650 ft (1,113 m) per second and a maximum range of 4,875 ft (1,486 m). Typically the gun fires a burst of about 200 rounds. Each projectile weighs 0.22 lbs (0.10 kg) and has a tungsten penetrator. CIWS rounds fired directly into the water decelerate to non-lethal velocity within 22 inches (in) (56 centimeters [cm]) of the water's surface after impact (Naval Air Warfare Center Weapons Division Point Mugu 1998).

The Point Mugu Sea Range environmental impact statement/overseas environmental impact statement (EIS/OEIS) (DoN 2002) analyzed the impacts associated with CIWS operations. The analyses estimated the maximum area of water surface that might be struck by the 20-mm CIWS rounds by taking the cross-sectional surface area of a 20-mm round multiplied by the total number of rounds fired during a typical year. Marine mammal densities were then multiplied by the maximum area of water surface that might be struck by a 20-mm round to determine the total number of marine mammals that could be hit by a round. The analyses determined that the probability of a marine mammal being hit it 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.

Since the proposed CIWS operations for major training exercises in SOCAL are far less than that analyzed in the Point Mugu Sea Range EIS/OEIS and marine mammal and sea turtle density estimates are similar to those in the Point Mugu Sea Range, there would be no effect to listed species or marine mammals as a result of CIWS operations during the major SOCAL training exercises.

Effects from Naval Gunfire

Although fired above the deck, energy from 5"/54 caliber Naval gunfire can propagate into the water from the muzzle blast, through the hull, and from the shell traveling supersonically along its trajectory.

Muzzle Blast

Firing of the deck gun produces a shock wave in air that propagates away from the muzzle in all directions, including toward the air/water surface. Effects of greatest concern due to this shock wave are the peak pressure, impulse, and noise transfer from air into water because the species of concern here spend almost all of their time underwater.

The design of naval ships is such that the muzzle does not protrude over the side of the ship; therefore, energy traveling directly down is reflected off of the deck. The blast wave impinging on the water will undergo spherical spreading until it reaches the side of the ship. The blast wave diffracts around the ship structure and the blast wave will be less than the source when it enters the water. Much of the blast energy that does reach the water's surface is reflected back into the air if the incident angle is greater than 13.7° (critical angle) from the perpendicular (Urick 1983).

Direct measurements of shock wave pressures and acoustic energy were made below the 5"/54 caliber gun while firing (Naval Surface Warfare Center 2000; Yagla and Stiegler 2003b). The impulse of the blast wave transferred across the air-sea interface was measured at approximately 4.3 psi-msec, whereas potentially harmful levels are greater than 13 psi-msec at shallow depths . Calculated peak SPL approximately 10 m below the gun muzzle at the air-sea interface was between 195 and 205 dB re:1µPa, and 328 ft. down-range, near the surface, the peak SPL was calculated to be lower than 186 dB re 1mPa (Pater 1981; Yagla 1986; Yagla and Stiegler 2003a). The greatest EFD level in the 1/3 octave above 10 Hz was calculated for a point directly below the muzzle as 190 dB re:1mPa^2-s and drops below 182 dB re 1mPa^2-s at 98 ft. underwater.

Gunnery Noise Transmitted Through the Ship Hull

A gun blast sends energy through the ship structure that can enter the water and propagate away from the ship. This effect was also investigated in conjunction with the measurement of 5" gun blasts described above (Naval Surface Warfare Center, 2000; Yagla and Stiegler, 2003b). The structure-borne component of the energy, when measured in the water, consisted of low-level oscillations that preceded the main pulse from the air blast impinging upon the water. The component of 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 discussed above. Noise transmitted from the gun through the hull into the water was therefore judged to be insignificant during the study and is not analyzed further.

Noise from Sonic Boom of Shell

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. During a study of the bow shock environment from 5" and 16" gun projectiles, the highest in-air SPL was measured at 145.1 dB re: 20 mPa, with the preponderance of noise at SPLs between 90 and 120 dB re: 20 mPa (Pater 1981; Miller 1991). The initial boom of the shell, once it has left the barrel, has a peak pressure in the water nearest the gun barrel of 195 dB re: 1 mPa (roughly 0.8 psi). The calculated 1/3 octave band EFD level containing the most energy above 10 Hz from a single shell is 180 dB re: 1 mPa2-s. If the shell is fired horizontally, the traveling shell transmits those pressures and energy along its trajectory in air with essentially the same noise levels reaching the air-water interface along the path of the shell. A typical line of flight initially increases in altitude until it reaches the midpoint of the trajectory, at which point the altitude decreases as the shell nears the target. The underwater noise levels would decrease logarithmically from the initial levels mentioned above as the shell height increases above the water surface.

The region of underwater noise influence from a single traveling shell is relatively small, diminishes quickly as the shell gains altitude, and is of brief duration. Additionally, watch standers observe waters surrounding the ship to ensure that marine animals are not nearby. Therefore, noise from the sonic boom of the traveling shell is not likely to adversely affect listed species.

Noise produced during gunfire may disturb animals in the vicinity of the ship. Because the noise from shooting at the target dissipates rapidly, no significant disruption of behavior is expected from 5"/54 caliber gunfire. Even though gunfire noise may prove to be a source of annoyance to listed species, the duration is relatively brief and the severity of its effects would be insignificant.

Injury from the shock wave produced during 5"/54 caliber Naval gunfire is not likely because in-water impulses at ranges close to the muzzle are well below those found to be harmful at shallow depths. Additionally, temporary effects, such as those to the auditory system, are not likely because the region of noise influence from a single shot is relatively small and watchstanders observe waters surrounding the ship to ensure that marine animals are not nearby the ship.

Effects of On-target Explosions

Detonation of ordnance within the target can send sound energy into the water via two paths. The first path is internal, through the ship, and the second path is external, via the air. In the spaces where the detonation occurs, the pressure may be large enough to deform and rupture nearby bulkheads, transferring energy directly through the hull into the water. For sufficiently large charges, failure of the weather bulkhead can result in the formation of a large hole through which shock wave energy can exit into the atmosphere and subsequently into the water.

As the products of the explosion expand away from the point of detonation, a strong shock wave moves radially away through the ship. When the shock wave impinges on a surface, such as decks and bulkheads, it causes dishing, buckling, and collapsing (Charles 1990; Anonymous 2004). The plating moves impulsively away from the impact point, displacing air in adjoining spaces. Through sequential plate deformation and air motion, the effects of the explosion are transmitted through the ship, eventually deforming the hull and transmitting a sound wave that moves away from the ship through the water. Each transfer of energy from air to steel and steel to air involves losses of energy due to impedance mismatches of the mediums and the mechanical deformation of steel. For example, the transfer of energy from steel to air is very inefficient; approximately 0.01% of the energy is transmitted through the steel-air interface (Yagla 2003). After several transfers through the ship, the energy will transfer into the water. The coefficient for energy transfer from steel to water is better than that of steel to air, but is still relatively inefficient at about 10%. During one analysis of an explosive charge set within a Navy vessel, there was a factor of less than 10 -17 fraction of the initial energy transferred from detonation within a compartment to the water via the hull. Analysts described the transfer of energy into the water as "miniscule" (Yagla 2003).

When the high-pressure detonation products expand, a breech can be created in the hull or the hole through which the ordnance entered can be expanded. The failure is so sudden that the products of detonation drive a shock wave through the hole and exit into the surrounding atmosphere. Energy transfer via the breech in the weather surface is influenced by proximity of the detonation to it (Yagla 2003). For example, more energy is transferred into the water by explosions nearer the weather surface than those deeper inside of the ship. However, even a detonation directly above the water surface can be 1000 times less hazardous than a similar charge below the surface (Goertner 1978); therefore, effects reduce substantially as the explosion location moves within the ship. A considerable amount of the total energy is absorbed by the ship in the form of heat and deformation of steel plating described above. A fraction of the total energy released by the detonation exits through the hole and impinges upon the water, but is completely reflected with no transfer of energy if the incident angle is greater than critical (13.7 degree), a phenomenon known as acoustic cut off (Urick 1983). Finally, a 3dB loss results from the insertion of the shock wave into the water further reducing energy transfer from initial levels (Yagla 2003).

When the two paths for noise energy from on-target detonations were considered, only insignificant amounts of energy were found to enter the water as noise. Therefore, blast waves and noise energy generated by on-target detonations were found to have no effect on listed species.

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).

After reviewing historical records and computerized stranding databases for evidence of ship strikes involving baleen and sperm whales, Laist et al. (2001) found that accounts of large whale ship strikes involving motorized boats in the area date back to at least the late 1800s. Ship collisions remained infrequent until the 1950s, after which point they increased. Laist et al. (2001) report that both the number and speed of motorized vessels have increased over time for trans-Atlantic passenger services, which transit through the area. They concluded that most strikes occur over or near the continental shelf, that ship strikes likely have a negligible effect on the status of most whale populations, but that for small populations or segments of populations the impact of ship strikes may be significant.

Although ship strike mortalities may represent a small proportion of whale populations, Laist et al. (2001) also concluded that, when considered in combination with other human-related mortalities in the area (e.g., entanglement in fishing gear), these ship strikes may present a concern for whale populations.

Of 11 species known to be hit by ships, fin whales are struck most frequently; right whales, humpback whales, sperm whales, and gray whales are all hit commonly (Laist et al 2001). In some areas, one-third of all fin whale and right whale strandings appear to involve ship strikes.

Sperm whales spend long periods (typically up to 10 minutes; Jacquet et al. 1998) "rafting" at the surface between deep dives. This could make them exceptionally vulnerable to ship strikes. Berzin (1972) noted that there were "many" reports of sperm whales of different age classes being struck by vessels, including passenger ships and tug boats. There were also instances in which sperm whales approached vessels too closely and were cut by the propellers (NMFS 2006b).

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 Targets (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 5 in. (13 centimeters [cm]) in diameter, 3 ft (1 meter [m]) long, and weighs between 14 and 39 lb (6 and 18 kg), depending on the type. In addition, aircraft-launched sonobuoys deploy a nylon parachute of varying sizes, ranging from 1.6 to 3.8 square feet (ft^2) (0.15 to 0.35 square meters [m^2]). The shroud lines range from 12 to 21 in. (0.30 to 0.53 m) in length and are made of either cotton polyester with a 30-lb (13.6-kg) breaking strength or nylon with a 100-lb (45.4-kg) breaking strength. All parachutes are weighted with a 2-ounce (oz.) (0.06-kg) 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 Expendable Mobile ASW Training Targets (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 are typically recovered when used in a nondetonation exercise mode. An assortment of air launch accessories, all of which consist of nonhazardous 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 composed of a protective nose cover, suspension bands, air stabilizer, release wire, and propeller baffle (DoN 1996). Mk-54 air launch accessories may be composed 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 Torpedo Exercise (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 lb (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 lb (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 42 lb (19 kg) and can be broken by hand. Up to 15 miles (mi.) (28 km) of wire is deployed during a run, which will sink to the sea floor at a rate of 0.5 feet per second (ft/sec) (0.15 meters per second [m/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 42 lb (19 kg) 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 0.5 ft [0.2 m] 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 (76 m) 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 SOCAL Range Complex 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 in. (12 by 91 cm) and weigh approximately 21 lb.(9.5 kg) 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.

Acoustic Device Countermeasures. Acoustic Device Countermeasures (ADC) are approximately 40 to 110 in (1 to 2.8 m). by 3 to 6 in (76 to 152 mm). diameter, and they weigh between 7 and 125 lb. (3.2 and 56.7 kg) ADCs are approximately the same size as sonobuoys. ADCs produce a low intensity mid-frequency sound and were not modeled.

Once expended, ADCs and their associated batteries will sink to the ocean floor throughout the SOCAL Study Area and will be covered with sediments over time. 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.

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, expendable bathythermographs 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.

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 (50 m) (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 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 82 ft (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 2635 ft [800 m]) 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 that may be important in navigation, foraging, avoiding predators, or for social behaviors. 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 is 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.

3.9.9.2.2 Summary of Potential Mid- and High Frequency Active Sonar Effects—No Action Alternative

Tables 3.9-10 and 3.9-11 represent the number of No Action Alternative active sonar hours or usage per year for different sonar sources.

SOCAL Additional Exposures

During rule making consultation with NMFS Office of Protected Resources, NMFS requested the Navy to account for potential exposures from certain high-frequency sonar systems. These include the submarine AN/BQQ-15 (submarine navigation sonar), Acoustic Device Countermeasure (ADC), and AN/SLQ-25A NIXIE (surface ship acoustic torpedo countermeasure). Since this request was made after SOCAL specific acoustic impact modeling had been completed, related modeling from the Atlantic Fleet Active Sonar Training (AFAST) EIS\OEIS was incorporated to address potential exposure estimates to select marine mammals.

Using ratios between the SOCAL EIS\OEIS and AFAST EIS\OEIS, a comparison was made of operational tempos, number of submarines and surface ships, geographic extent of use, and likely species exposed. In the AFAST EIS\OEIS, very limited risk function exposures were reported from a larger use of ADC along the East Coast. Given this small exposure within AFAST (< 10 annual risk function exposures) and more limited ADC use within SOCAL, it was determined that there would be no significant ADC exposure within SOCAL and this source was removed from consideration. Based on this qualitative analysis and comparison for the remaining systems (AN/BQQ-15 and AN/SLQ-25A NIXIE), 270 additional risk function exposures and 29 additional TTS exposures were predicted annually for SOCAL. Due to the frequency range of the sonar systems in question (> 20 kHz), NMFS and Navy agreed that there would be limited to no exposure and effects to baleen whale species. The scope of the exposure assessment could be limited to certain dolphin and pinnipeds species likely to be in the area of highest use which include bottlenose dolphin, long beaked common dolphin, northern right whale dolphin, Pacific white-sided dolphin, Risso's dolphin, short beaked common dolphin, Pacific harbor seal, and California sea lion. Therefore, the 270 risk function and 29 TTS exposures were equally divided between the eight species such that each species was assigned an additional 34 risk function exposures, and an additional 3 TTS exposures. These additional exposures were then added to species-specific exposures described above for the No Action Alternative, Alternative 1, and Alternative 2, since the level of operations for the sonar systems in this assessment are not forecast to vary significantly between alternatives.

In addition to the additional exposures describe above, the replacement of the Improved Extended Echo Ranging (IEER) sonobuoy system with the Advanced Extended Echo Ranging (AEER) system may result in very slight increases in behavioral exposures of marine mammals. Based on AFAST ratios as described above, and the level of expected use of the AEER system, as many as three additional exposures for 20 different species of marine mammals is possible. The AEER system is a sonar-based system, similar to the SSQ-62 sonobouy, whereas the IEER used an impulsive (small explosive charge) source. Therefore, the increased exposures are sonar exposures and will be reflected below in Table 3.9-20.

Table 3.9-10: No Action Summary of Active Sonar Hours

Event	**SQS-53 C Sonar Hours**	**SQS-56 C Sonar Hours**	**BQQ-10 Sub Sonar Hours**	**BQQ-15 Sub Sonar Hours**	***Total Sonar Hours***
Major Exercises (8/yr)	927	231	86	32	**1,276**
Integrated Exercises (7/yr)	357	90	122	32	**601**
ULT & Maintenance	469	117	515	32	**1,133**
Total Hours	**1,753**	**438**	**723**	**96**	**3,010**

Note: A sonar hour indicates that the system was operating in its normal mode for one hour. Each system has different operating parameters that determine the number and duration of "pings." The parameters critical to determining marine mammal exposures are explained in Section 2.1.1 of Appendix F.

Table 3.9-11: No Action Summary of Number of Sonar Dips, Number of Sonobuoys, Torpedo Runs, and NIXIE Hours

Event	AQS-22 Number of Dips	SSQ-62 Number of Sonobuoy Deployment	MK-48 Number of Torpedo Events	MK-46 Number of Torpedo Events	AN/SLQ-25A NIXIE Number of Hours
Major Exercises (8/yr)	299	1,999	9	23	62
Integrated Exercises (7/yr)	612	749	14	23	62
ULT, Coordinated Events & Maintenance	1,500	1,024	57	23	62
Total Hours or Number of Events or Deployments	**2,411**	**3,772**	**76**	**69**	**186**

Table 3.9-12 presents estimated marine mammal exposures for potential noninjurious (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 99,809 annual exposures that could potentially result in behavioral harassment (Level B harassment: risk function or behavioral harassment and TTS); 9,658 annual exposures that could potentially result in TTS (Level B harassment); and 19 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 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 19 for six species, one blue whale, one gray whale, one long-beaked common dolphin, one striped dolphin, six short-beaked common dolphins, and nine Pacific harbor seals. 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.

Table 3.9-12: 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	478	61	1
Fin whale	136	12	0
Humpback whale	13	2	0
Sei whale	0	0	0
Sperm whale	123	8	0
Guadalupe fur seal	772	170	0
Sea otter	0	0	0
Mysticetes			
Bryde's whale	0	0	0
Gray whale	4,349	484	1
Minke whale	96	16	0
Odontocetes			
Baird's beaked whale	12	1	0
Bottlenose dolphin (offshore)	1,115	171	0
Cuvier's beaked whale	339	33	0
Dall's porpoise	470	77	0
Killer whale	6	1	0
Long beaked common dolphin	3,591	384	1
Mesoplodon spp.	101	13	0
Northern right whale dolphin	1,158	148	0
Pacific white-sided dolphin	1,020	169	0
Pygmy sperm whale	125	16	0
Risso's dolphin	2,769	300	0
Short beaked common dolphin	30,857	3,303	6
Short-finned pilot whale	35	6	0
Striped dolphin	1,389	221	1
Ziphiid whales	76	8	0
Pinnipeds			
Northern elephant seal	739	5	0
Pacific harbor seal	898	4,043	9
California sea lion	48,192	3	0
Northern fur seal	772	170	0
Total	**99,809**	**9,658**	**19**

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.

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 Anti-Submarine Warfare (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.

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 3-9-13. The modeling indicates 1,220 annual exposures to pressure from underwater detonations that could potentially result in behavioral harassment (Level B harassment); 893 annual exposures that could 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, SSQ-110-A sonobuoy (Extended Echo Ranging and Improved Extended Echo Ranging [EER/IEER] Systems), and NSFS. 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 EIS/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 subsection (Section 3.9.9.2.2). 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 3.9-13: No Action Annual Underwater Detonation Exposures Summary

Species	Level B Exposures		Level A Exposures	
	Behavioral Harassment 177 dB re 1µPa^2-s	TTS 182 dB/23 psi[1]	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	3	2	0	0
Fin whale	2	1	0	0
Humpback whale	0	0	0	0
Sei whale	0	0	0	0
Sperm whale	2	1	0	0
Guadalupe fur seal	2	2	0	0
Sea otter	0	0	0	0
Mysticete				
Bryde's whale	0	0	0	0
Gray whale	4	5	0	0
Minke whale	0	0	0	0
Odontocetes				
Baird's beaked whale	0	0	0	0
Bottlenose dolphin (offshore)	12	8	0	0
Cuvier's beaked whale	3	2	0	0
Dall's porpoise	2	2	0	0
Killer whale	0	0	0	0
Long-beaked common dolphin	51	33	1	0
Mesoplodon spp.	2	1	0	0
Northern right whale dolphin	14	9	0	0
Pacific white-sided dolphin	9	7	0	0
Pygmy sperm whale	2	1	0	0
Risso's dolphin	42	25	1	0
Short-beaked common dolphin	444	288	10	3
Short-finned pilot whale	0	0	0	0
Striped dolphin	5	5	0	0
Ziphiid whale	2	1	0	0
Pinnipeds				
Northern elephant seal	62	33	0	0
Pacific harbor seal	20	20	1	0
California sea lion	466	397	13	4
Northern fur seal	71	50	2	1
Total	**1,220**	**893**	**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.

[1] The criteria with the highest number of exposures is presented for TTS

3.9.9.2.4 Species-Specific Potential Impacts: No Action Alternative

Blue Whale

The risk function and Navy post-modeling analysis estimates 478 blue whales will exhibit behavioral responses NMFS will classify as harassment under the MMPA (Table 3.9-12). Modeling also indicates there would be 61 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.

Without consideration of clearance procedures, there would be three exposures from impulsive sound or pressures from underwater detonations that would exceed the behavioral harassment threshold, two exposures that would exceed the TTS threshold, none that would exceed the onset of slight injury threshold, and no exposures that would exceed the onset of massive lung injury or mortality threshold (Table 3.9-13).

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. The implementation of mitigation measures to reduce exposure to high levels of sonar sound, and the short duration and intermittent exposure to sonar, reduces the likelihood that exposure to MFA/HFA sonar sound would cause a behavioral response that may affect vital functions (reproduction or survival), TTS, or PTS.

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 may affect but are not likely to adversely affect blue whales. It is unlikely that SOCAL Range Complex training would result in any death or injury to blue whales.

Fin Whale

The risk function and Navy post-modeling analysis estimates 136 fin whales will exhibit behavioral responses NMFS will classify as harassment under the MMPA (Table 3.9-12). Modeling also indicates there would be 12 exposures to accumulated acoustic energy above 195 dB re 1 μPa2-s, which is the threshold established indicative of onset TTS. No fin whales would be exposed to sound levels that could cause PTS.

Without consideration of clearance procedures, there would be two exposures from impulsive sound or pressures from underwater detonations that would exceed the behavioral harassment threshold, one exposure that would exceed the TTS threshold, none that would exceed the onset of slight injury threshold, and no exposures that would exceed the onset of massive lung injury or mortality threshold (Table 3.9-13).

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. The implementation of mitigation measures to reduce exposure to high levels of sonar sound, and the short duration and intermittent exposure to sonar, reduces the likelihood that exposure to MFA/HFA sonar sound would cause a behavioral response that may affect vital functions (reproduction or survival), TTS, or PTS.

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 may affect but are not likely to adversely affect fin whales. It is unlikely that SOCAL Range Complex training would result in any death or injury to fin whales.

Humpback Whale

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 3.9-12). 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 behavioral harassment threshold, no exposures that would exceed the TTS threshold, none that would exceed the onset of slight injury threshold, and no exposures that would exceed the onset of massive lung injury or mortality threshold (Table 3.9-13).

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. The implementation of mitigation measures to reduce exposure to high levels of sonar sound, and the short duration and intermittent exposure to sonar, reduces the likelihood that exposure to MFA/HFA sonar sound would cause a behavioral response that may affect vital functions (reproduction or survival), TTS, or PTS.

There are no audiograms of baleen whales, but Houser et al. (2001) estimated the hearing range of humpback whales at 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 responses 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 represents only a small portion of the 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 may affect but are not likely to adversely affect humpback whales. It is unlikely that SOCAL Range Complex training would result in any death or injury to humpback whales.

Sei Whale

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 3.9-12). Modeling also indicates there would be no exposures to accumulated acoustic energy above 195 dB re 1 μPa2-s, which is the threshold established indicative of onset TTS. No sei 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 behavioral harassment threshold, no exposures that would exceed the TTS threshold, none that would exceed the onset of slight injury threshold, and no exposures that would exceed the onset of massive lung injury or mortality threshold (Table 3.9-13).

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. The implementation of mitigation measures to reduce exposure to high levels of sonar sound, and the short duration and intermittent exposure to sonar, reduces the likelihood that exposure to MFA/HFA sonar sound would cause a behavioral response that may affect vital functions (reproduction or survival), TTS, or PTS.

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 may affect but are not likely to adversely affect sei whales. It is unlikely that SOCAL Range Complex training would result in any death or injury to sei whales.

Sperm Whale

The risk function and Navy post-modeling analysis estimates 123 sperm whales will exhibit behavioral responses NMFS will classify as harassment under the MMPA (Table 3.9-12). Modeling also indicates there would be eight exposures to accumulated acoustic energy above 195 dB re 1 μPa^2-s, which is the threshold established indicative of onset TTS. No sperm whales would be exposed to sound levels that could cause PTS.

Without consideration of clearance procedures, there would be two exposures from impulsive sound or pressures from underwater detonations that would exceed the behavioral harassment threshold, one exposure that would exceed the TTS threshold, none that would exceed the onset of slight injury threshold, and no exposures that would exceed the onset of massive lung injury or mortality threshold (Table 3.9-13).

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. The implementation of mitigation measures to reduce exposure to high levels of sonar sound, and the short duration and intermittent exposure to sonar, reduces the likelihood that exposure to MFA/HFA sonar sound would cause a behavioral response that may affect vital functions (reproduction or survival), TTS, or PTS.

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). Additionally, even though the sperm whales may exhibit a reaction when initially exposed to active acoustic energy, the exposures are not expected to be long-term due to the likely low received level of acoustic energy and relatively short duration of potential exposures.

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 may affect but are not likely to adversely affect sperm whales. It is unlikely that SOCAL Range Complex training would result in any death or injury to sperm whales.

Guadalupe fur Seal

The risk function and Navy post-modeling analysis estimates 772 Guadalupe fur seals will exhibit behavioral responses NMFS will classify as harassment under the MMPA (Table 3.9-12). Modeling also indicates there would be 170 exposures to accumulated acoustic energy above 195 dB re 1 μPa2-s, which is the threshold established indicative of onset TTS. No Guadalupe fur seals would be exposed to sound levels that could cause PTS.

Without consideration of clearance procedures, there would be two exposures from impulsive sound or pressures from underwater detonations that would exceed the behavioral harassment threshold, two exposures that would exceed the TTS threshold, none that would exceed the onset of slight injury threshold, and no exposures that would exceed the onset of massive lung injury or mortality threshold (Table 3.9-13).

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. The implementation of mitigation measures to reduce exposure to high levels of sonar sound, and the short duration and intermittent exposure to sonar, reduces the likelihood that exposure to MFA/HFA sonar sound would cause a behavioral response that may affect vital functions (reproduction or survival), TTS, or PTS.

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 may affect but are not likely to adversely affect Guadalupe fur seals. It is unlikely that SOCAL Range Complex training would result in any death or injury to Guadalupe fur seals.

Sea otter

The risk function and Navy post-modeling analysis estimates no sea otters will exhibit behavioral responses NMFS will classify as harassment under the MMPA (Table 3.9-12). Modeling also indicates there would be no exposures to accumulated acoustic energy above 195 dB re 1 µPa2-s, which is the threshold established indicative of onset TTS. No sea otters 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 behavioral harassment threshold, no exposures that would exceed the TTS threshold, none that would exceed the onset of slight injury threshold, and no exposures that would exceed the onset of massive lung injury or mortality threshold (Table 3.9-13).

Sea otters are predominately near shore species that will only be around San Nicolas Island at the northern edge of the SOCAL Range Complex. In addition, the experimental translocated population is very small (approximately 29 animals). The implementation of mitigation measures to reduce exposure to high levels of sonar sound, and the short duration and intermittent exposure to sonar, reduces the likelihood that exposure to MFA/HFA sonar sound would cause a behavioral response that may affect vital functions (reproduction or survival), TTS, or PTS.

Based on the model results, behavioral patterns, acoustic abilities of sea otters, 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 sea otters and are not likely to affect sea otters. It is unlikely that SOCAL Range Complex training would result in any death or injury to sea otters.

Bryde's Whale

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 3.9-12). Modeling also indicates there would be no exposures to accumulated acoustic energy above 195 dB re 1 µPa2-s, which is the threshold established indicative of onset TTS. No Bryde's 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 behavioral harassment threshold, no exposures that would exceed the TTS threshold, none that would exceed the onset of slight injury threshold, and no exposures that would exceed the onset of massive lung injury or mortality threshold (Table 3.9-13).

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, Bryde's whales that migrate into the operating area would be detected by visual observers. The implementation of mitigation measures to reduce exposure to high levels of sonar sound, and the short duration and intermittent exposure to sonar, reduces the likelihood that exposure to MFA/HFA sonar sound would cause a behavioral response that may affect vital functions (reproduction or survival), TTS, or PTS.

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

The risk function and Navy post-modeling analysis estimates 4,349 gray whales will exhibit behavioral responses NMFS will classify as harassment under the MMPA (Table 3.9-12). Modeling also indicates there would be 484 exposures to accumulated acoustic energy above 195 dB re 1 μPa2-s, which is the threshold established indicative of onset TTS. One gray whale would be exposed to sound levels that could cause PTS.

Without consideration of clearance procedures, there would be four exposures from impulsive sound or pressures from underwater detonations that would exceed the behavioral harassment threshold, five exposures that would exceed the TTS threshold, none that would exceed the onset of slight injury threshold, and no exposures that would exceed the onset of massive lung injury or mortality threshold (Table 3.9-13).

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. The implementation of mitigation measures to reduce exposure to high levels of sonar sound, and the short duration and intermittent exposure to sonar, reduces the likelihood that exposure to MFA/HFA sonar sound would cause a behavioral response that may affect vital functions (reproduction or survival), TTS, or PTS.

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

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 3.9-12). Modeling also indicates there would be 16 exposures to accumulated acoustic energy above 195 dB re 1 μPa2-s, which is the threshold established indicative of onset TTS. No minke 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 behavioral harassment threshold, no exposures that would exceed the TTS threshold, none that would exceed the onset of slight injury threshold, and no exposures that would exceed the onset of massive lung injury or mortality threshold (Table 3.9-13).

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

The risk function and Navy post-modeling analysis estimates 12 Baird's beaked whales will exhibit behavioral responses NMFS will classify as harassment under the MMPA (Table 3.9-12). Modeling also indicates there would be one exposure to accumulated acoustic energy above 195 dB re 1 μPa2-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.

Without consideration of clearance procedures, there would be no exposures from impulsive sound or pressures from underwater detonations that would exceed the behavioral harassment threshold, no exposures that would exceed the TTS threshold, none that would exceed the onset of slight injury threshold, and no exposures that would exceed the onset of massive lung injury or mortality threshold (Table 3.9-13).

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 (Offshore Stock)

The risk function and Navy post-modeling analysis estimates 1,115 bottlenose dolphins will exhibit behavioral responses NMFS will classify as harassment under the MMPA (Table 3.9-12). Modeling also indicates there would be 171 exposures to accumulated acoustic energy above 195 dB re 1 μPa2-s, which is the threshold established indicative of onset TTS. No bottlenose dolphins would be exposed to sound levels that could cause PTS.

Without consideration of clearance procedures, there would be 12 exposures from impulsive sound or pressures from underwater detonations that would exceed the behavioral harassment threshold, eight exposures that would exceed the TTS threshold, none that would exceed the onset of slight injury threshold, and no exposures that would exceed the onset of massive lung injury or mortality threshold (Table 3.9-13).

Given the frequent surfacing, aggregation of approximately nine 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. The implementation of mitigation measures to reduce exposure to high levels of sonar sound, and the short duration and intermittent exposure to sonar, reduces the likelihood that exposure to MFA/HFA sonar sound would cause a behavioral response that may affect vital functions (reproduction or survival), TTS, or PTS.

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

The risk function and Navy post-modeling analysis estimates 339 Cuvier's beaked whales will exhibit behavioral responses NMFS will classify as harassment under the MMPA (Table 3.9-12). Modeling also indicates there would be 33 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.

Without consideration of clearance procedures, there would be three exposures from impulsive sound or pressures from underwater detonations that would exceed the behavioral harassment threshold, two exposures that would exceed the TTS threshold, none that would exceed the onset of slight injury threshold, and no exposures that would exceed the onset of massive lung injury or mortality threshold (Table 3.9-13).

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). The implementation of mitigation measures to reduce exposure to high levels of sonar sound, and the short duration and intermittent exposure to sonar, reduces the likelihood that exposure to MFA/HFA sonar sound would cause a behavioral response that may affect vital functions (reproduction or survival), TTS, or PTS.

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

The risk function and Navy post-modeling analysis estimates 470 Dall's porpoise will exhibit behavioral responses NMFS will classify as harassment under the MMPA (Table 3.9-12). Modeling also indicates there would be 77 exposures to accumulated acoustic energy above 195 dB re 1 μPa2-s, which is the threshold established indicative of onset TTS. No Dall's porpoise would be exposed to sound levels that could cause PTS.

Without consideration of clearance procedures, there would be two exposures from impulsive sound or pressures from underwater detonations that would exceed the behavioral harassment threshold, two exposures that would exceed the TTS threshold, none that would exceed the onset of slight injury threshold, and no exposures that would exceed the onset of massive lung injury or mortality threshold (Table 3.9-13).

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. The implementation of mitigation measures to reduce exposure to high levels of sonar sound, and the short duration and intermittent exposure to sonar, reduces the likelihood that exposure to MFA/HFA sonar sound would cause a behavioral response that may affect vital functions (reproduction or survival), TTS, or PTS.

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

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 3.9-12). Modeling also indicates there would be one exposure to accumulated acoustic energy above 195 dB re 1 μPa2-s, which is the threshold established indicative of onset TTS. No killer 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 behavioral harassment threshold, no exposures that would exceed the TTS threshold, none that would exceed the onset of slight injury threshold, and no exposures that would exceed the onset of massive lung injury or mortality threshold (Table 3.9-13).

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. The implementation of mitigation measures to reduce exposure to high levels of sonar sound, and the short duration and intermittent exposure to sonar, reduces the likelihood that exposure to MFA/HFA sonar sound would cause a behavioral response that may affect vital functions (reproduction or survival), TTS, or PTS.

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

The risk function and Navy post-modeling analysis estimates 3,591 long beaked common dolphin will exhibit behavioral responses NMFS will classify as harassment under the MMPA (Table 3.9-12). Modeling also indicates there would be 384 exposures to accumulated acoustic energy above 195 dB re 1 μPa2-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.

Without consideration of clearance procedures, there would be 51 exposures from impulsive sound or pressures from underwater detonations that would exceed the behavioral harassment threshold, 33 exposures that would exceed the TTS threshold, one that would exceed the onset of slight injury threshold, and no exposures that would exceed the onset of massive lung injury or mortality threshold (Table 3.9-13).

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. The implementation of mitigation measures to reduce exposure to high levels of sonar sound, and the short duration and intermittent exposure to sonar, reduces the likelihood that exposure to MFA/HFA sonar sound would cause a behavioral response that may affect vital functions (reproduction or survival), TTS, or PTS.

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

The risk function and Navy post-modeling analysis estimates 101 Mesoplodont whales will exhibit behavioral responses NMFS will classify as harassment under the MMPA (Table 3.9-12). Modeling also indicates there would be 13 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.

Without consideration of clearance procedures, there would be two exposures from impulsive sound or pressures from underwater detonations that would exceed the behavioral harassment threshold, one exposure that would exceed the TTS threshold, none that would exceed the onset of slight injury threshold, and no exposures that would exceed the onset of massive lung injury or mortality threshold (Table 3.9-13).

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). The implementation of mitigation measures to reduce exposure to high levels of sonar sound, and the short duration and intermittent exposure to sonar, reduces the likelihood that exposure to MFA/HFA sonar sound would cause a behavioral response that may affect vital functions (reproduction or survival), TTS, or PTS.

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

The risk function and Navy post-modeling analysis estimates 1,158 northern right whale dolphins will exhibit behavioral responses NMFS will classify as harassment under the MMPA (Table 3.9-12). Modeling also indicates there would be 148 exposures to accumulated acoustic energy above 195 dB re 1 μPa2-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.

Without consideration of clearance procedures, there would be 14 exposures from impulsive sound or pressures from underwater detonations that would exceed the behavioral harassment threshold, nine exposures that would exceed the TTS threshold, none that would exceed the onset of slight injury threshold, and no exposures that would exceed the onset of massive lung injury or mortality threshold (Table 3.9-13).

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. The implementation of mitigation measures to reduce exposure to high levels of sonar sound, and the short duration and intermittent exposure to sonar, reduces the likelihood that exposure to MFA/HFA sonar sound would cause a behavioral response that may affect vital functions (reproduction or survival), TTS, or PTS.

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

The risk function and Navy post-modeling analysis estimates 1,020 Pacific white-sided dolphins will exhibit behavioral responses NMFS will classify as harassment under the MMPA (Table 3.9-12). Modeling also indicates there would be 169 exposures to accumulated acoustic energy above 195 dB re 1 μPa2-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.

Without consideration of clearance procedures, there would be nine exposures from impulsive sound or pressures from underwater detonations that would exceed the behavioral harassment threshold, seven exposures that would exceed the TTS threshold, none that would exceed the onset of slight injury threshold, and no exposures that would exceed the onset of massive lung injury or mortality threshold (Table 3.9-13).

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. The implementation of mitigation measures to reduce exposure to high levels of sonar sound, and the short duration and intermittent exposure to sonar, reduces the likelihood that exposure to MFA/HFA sonar sound would cause a behavioral response that may affect vital functions (reproduction or survival), TTS, or PTS.

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

The risk function and Navy post-modeling analysis estimates 125 pygmy sperm whales will exhibit behavioral responses NMFS will classify as harassment under the MMPA (Table 3.9-12). Modeling also indicates there would be 16 exposures to accumulated acoustic energy above 195 dB re 1 μPa2-s, which is the threshold established indicative of onset TTS. No pygmy sperm whales would be exposed to sound levels that could cause PTS.

Without consideration of clearance procedures, there would be two exposures from impulsive sound or pressures from underwater detonations that would exceed the behavioral harassment threshold, one exposure that would exceed the TTS threshold, none that would exceed the onset

of slight injury threshold, and no exposures that would exceed the onset of massive lung injury or mortality threshold (Table 3.9-13).

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. The implementation of mitigation measures to reduce exposure to high levels of sonar sound, and the short duration and intermittent exposure to sonar, reduces the likelihood that exposure to MFA/HFA sonar sound would cause a behavioral response that may affect vital functions (reproduction or survival), TTS, or PTS.

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

The risk function and Navy post-modeling analysis estimates 2,769 Risso's dolphins will exhibit behavioral responses NMFS will classify as harassment under the MMPA (Table 3.9-12). Modeling also indicates there would be 300 exposures to accumulated acoustic energy above 195 dB re 1 μPa2-s, which is the threshold established indicative of onset TTS. No Risso's dolphins would be exposed to sound levels that could cause PTS.

Without consideration of clearance procedures, there would be 42 exposures from impulsive sound or pressures from underwater detonations that would exceed the behavioral harassment threshold, 25 exposures that would exceed the TTS threshold, one that would exceed the onset of slight injury threshold, and no exposures that would exceed the onset of massive lung injury or mortality threshold (Table 3.9-13).

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. The implementation of mitigation measures to reduce exposure to high levels of sonar sound, and the short duration and intermittent exposure to sonar, reduces the likelihood that exposure to MFA/HFA sonar sound would cause a behavioral response that may affect vital functions (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

The risk function and Navy post-modeling analysis estimates 30,857 short-beaked common dolphins will exhibit behavioral responses NMFS will classify as harassment under the MMPA (Table 3.9-12). Modeling also indicates there would be 3,303 exposures to accumulated acoustic energy above 195 dB re 1 μPa2-s, which is the threshold established indicative of onset TTS. Six short-beaked common dolphins would be exposed to sound levels that could cause PTS.

Without consideration of clearance procedures, there would be 444 exposures from impulsive sound or pressures from underwater detonations that would exceed the behavioral harassment threshold, 288 exposures that would exceed the TTS threshold, 10 that would exceed the onset of slight injury threshold, and three exposures that would exceed the onset of massive lung injury or mortality threshold (Table 3.9-13).

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. The implementation of mitigation measures to reduce exposure to high levels of sonar sound, and the short duration and intermittent exposure to sonar, reduces the likelihood that exposure to MFA/HFA sonar sound would cause a behavioral response that may affect vital functions (reproduction or survival), TTS, or PTS.

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

The risk function and Navy post-modeling analysis estimates 35 short-finned pilot whales will exhibit behavioral responses NMFS will classify as harassment under the MMPA (Table 3.9-12). Modeling also indicates there would be six exposures to accumulated acoustic energy above 195 dB re 1 μPa2-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.

Without consideration of clearance procedures, there would be no exposures from impulsive sound or pressures from underwater detonations that would exceed the behavioral harassment threshold, no exposures that would exceed the TTS threshold, none that would exceed the onset of slight injury threshold, and no exposures that would exceed the onset of massive lung injury or mortality threshold (Table 3.9-13).

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. The implementation of mitigation measures to reduce exposure to high levels of sonar sound, and the short duration and intermittent exposure to sonar, reduces the likelihood that exposure to MFA/HFA sonar sound would cause a behavioral response that may affect vital functions (reproduction or survival), TTS, or PTS.

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

The risk function and Navy post-modeling analysis estimates 1,389 striped dolphins will exhibit behavioral responses NMFS will classify as harassment under the MMPA (Table 3.9-12). Modeling also indicates there would be 221 exposures to accumulated acoustic energy above 195 dB re 1 μPa^2-s, which is the threshold established indicative of onset TTS. One striped dolphin would be exposed to sound levels that could cause PTS.

Without consideration of clearance procedures, there would be five exposures from impulsive sound or pressures from underwater detonations that would exceed the behavioral harassment threshold, five exposures that would exceed the TTS threshold, none that would exceed the onset of slight injury threshold, and no exposures that would exceed the onset of massive lung injury or mortality threshold (Table 3.9-13).

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

The risk function and Navy post-modeling analysis estimates 76 Ziphiid whales will exhibit behavioral responses NMFS will classify as harassment under the MMPA (Table 3.9-12). Modeling also indicates there would be eight exposures to accumulated acoustic energy above 195 dB re 1 μPa2-s, which is the threshold established indicative of onset TTS. No Ziphiid whales would be exposed to sound levels that could cause PTS.

Without consideration of clearance procedures, there would be two exposures from impulsive sound or pressures from underwater detonations that would exceed the behavioral harassment threshold, one exposure that would exceed the TTS threshold, none that would exceed the onset of slight injury threshold, and no exposures that would exceed the onset of massive lung injury or mortality threshold (Table 3.9-13).

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). The implementation of mitigation measures to reduce exposure to high levels of sonar sound, and the short duration and intermittent exposure to sonar, reduces the likelihood that exposure to MFA/HFA sonar sound would cause a behavioral response that may affect vital functions (reproduction or survival), TTS, or PTS.

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

The risk function and Navy post-modeling analysis estimates 739 northern elephant seals will exhibit behavioral responses NMFS will classify as harassment under the MMPA (Table 3.9-12). Modeling also indicates there would be five exposures to accumulated acoustic energy above 204 dB re 1 μPa2-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.

Without consideration of clearance procedures, there would be 62 exposures from impulsive sound or pressures from underwater detonations that would exceed the behavioral harassment threshold, 33 exposures that would exceed the TTS threshold, none that would exceed the onset

of slight injury threshold, and no exposures that would exceed the onset of massive lung injury or mortality threshold (Table 3.9-13).

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). The implementation of mitigation measures to reduce exposure to high levels of sonar sound, and the short duration and intermittent exposure to sonar, reduces the likelihood that exposure to MFA/HFA sonar sound would cause a behavioral response that may affect vital functions (reproduction or survival), TTS, or PTS.

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

The risk function and Navy post-modeling analysis estimates 898 Pacific harbor seals will exhibit behavioral responses NMFS will classify as harassment under the MMPA (Table 3.9-12). Modeling also indicates there would be 4,043 exposures to accumulated acoustic energy above 183 dB re 1 μPa2-s, which is the threshold established indicative of onset TTS for harbor seals. Nine Pacific harbor seals would be exposed to sound levels that could cause PTS.

Without consideration of clearance procedures, there would be 20 exposures from impulsive sound or pressures from underwater detonations that would exceed the behavioral harassment threshold, 20 exposures that would exceed the TTS threshold, one that would exceed the onset of slight injury threshold, and no exposures that would exceed the onset of massive lung injury or mortality threshold (Table 3.9-13).

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. The implementation of mitigation measures to reduce exposure to high levels of sonar sound, and the short duration and intermittent exposure to sonar, reduces the likelihood that exposure to MFA/HFA sonar sound would cause a behavioral response that may affect vital functions (reproduction or survival), TTS, or PTS.

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

The risk function and Navy post-modeling analysis estimates 48,192 California sea lions will exhibit behavioral responses NMFS will classify as harassment under the MMPA (Table 3.9-12). Modeling also indicates there would be three exposures to accumulated acoustic energy above three 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.

Without consideration of clearance procedures, there would be 466 exposures from impulsive sound or pressures from underwater detonations that would exceed the behavioral harassment threshold, 397 exposures that would exceed the TTS threshold, 13 that would exceed the onset of slight injury threshold, and four exposures that would exceed the onset of massive lung injury or mortality threshold (Table 3.9-13).

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. The implementation of mitigation measures to reduce exposure to high levels of sonar sound, and the short duration and intermittent exposure to sonar, reduces the likelihood that exposure to MFA/HFA sonar sound would cause a behavioral response that may affect vital functions (reproduction or survival), TTS, or PTS.

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

The risk function and Navy post-modeling analysis estimates 772 northern fur seals will exhibit behavioral responses NMFS will classify as harassment under the MMPA (Table 3.9-12). Modeling also indicates there would be 170 exposures to accumulated acoustic energy above three dB re 1 μPa2-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.

Without consideration of clearance procedures, there would be 71 exposures from impulsive sound or pressures from underwater detonations that would exceed the behavioral harassment threshold, 50 exposures that would exceed the TTS threshold, two that would exceed the onset of slight injury threshold, and one exposure that would exceed the onset of massive lung injury or mortality threshold (Table 3.9-13).

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. The implementation of mitigation measures to reduce exposure to high levels of sonar sound, and the short duration and intermittent exposure to sonar, reduces the likelihood that exposure to MFA/HFA sonar sound would cause a behavioral response that may affect vital functions (reproduction or survival), TTS, or PTS.

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.

3.9.9.3 Alternative 1

3.9.9.3.1 Nonacoustic Impacts

Nonacoustic 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.

3.9.9.3.2 Summary of Potential Mid- and High-Frequency Active Sonar Effects

Tables 3.9-14 and 3.9-15 represent the number of Alternative 1 active sonar hours or usage per year for different sonar sources.

Table 3.9-14: Alternative 1 Summary of Active Sonar Hours

Event	SQS-53 C Sonar Hours	SQS-56 C Sonar Hours	BQQ-10 Sub Sonar Hours	BQQ-15 Sub Sonar Hours	*Total Sonar Hours*
Major Exercises (8/yr)	986	246	92	36	**1,360**
Integrated Exercises (7/yr)	380	95	157	36	**668**
ULT & Maintenance	499	125	520	36	**1,180**
Total Hours	**1,865**	**466**	**769**	**108**	**3,208**

Table 3.9-15: Alternative 1 Summary of Number of Sonar Dips, Number of Sonobuoys, Torpedo Runs, and NIXIE Hours

Event	AQS-22 Number of Dips	SSQ-62 Number of Sonobuoy Deployment	MK-48 Number of Torpedo Events	MK-46 Number of Torpedo Events	AN/SLQ-25A NIXIE Number of Hours
Major Exercises (8/yr)	318	2,127	10	25	69
Integrated Exercises (7/yr)	651	797	14	25	69
ULT, Coordinated Events & Maintenance	1,596	1,090	57	25	69
Total Hours or Number of Events or Deployments	**2,565**	**4,014**	**81**	**75**	**207**

Table 3.9-16 presents estimated marine mammal exposures for potential non injurious (Level B harassment: risk function or behavioral harassment and TTS), 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 106,179 annual exposures that could potentially result in behavioral harassment (Level B harassment); 10,265 annual exposures that could potentially result in TTS (Level B harassment); and 19 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- and high-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 19 for six species; one blue whale, one gray whale, one long-beaked common dolphin, one striped dolphin, six short-beaked common dolphins, and nine Pacific harbor seals. 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.

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 3.9-16: 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	508	64	1
Fin whale	144	12	0
Humpback whale	13	2	0
Sei whale	0	0	0
Sperm whale	130	8	0
Guadalupe fur seal	821	180	0
Sea otter	0	0	0
Mysticetes			
Bryde’s whale	0	0	0
Gray whale	4,626	514	1
Minke whale	103	16	0
Odontocetes			
Baird’s beaked whale	12	1	0
Bottlenose dolphin (offshore)	1,186	181	0
Cuvier’s beaked whale	361	35	0
Dall’s porpoise	500	82	0
Killer whale	6	1	0
Long beaked common dolphin	3,820	408	1
Mesoplodon spp.	108	13	0
Northern right whale dolphin	1,232	157	0
Pacific white-sided dolphin	1,085	179	0
Pygmy sperm whale	133	16	0
Risso’s dolphin	2,946	320	0
Short beaked common dolphin	32,826	3,515	6
Short-finned pilot whale	37	6	0
Striped dolphin	1,479	235	1
Ziphiid whales	81	8	0
Pinnipeds			
Northern elephant seal	786	5	0
Pacific harbor seal	956	4,301	9
California sea lion	51,269	3	0
Northern fur seal	1,011	3	0
Total	**106,179**	**10,265**	**19**

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 Alternative 1

The modeled exposure harassment numbers for all training operations involving explosives are presented by species in Table 3-9-17. The modeling indicates 1,240 annual exposures to pressure from underwater detonations that could potentially result in behavioral harassment behavioral harassment (Level B harassment); 1,008 annual exposures from underwater detonations that could potentially result in TTS (Level B harassment), 30 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 MISSILEX, Surface to Surface Missile Exercise, Bombing Exercise, SINKEX, Surface to Surface GUNEX, and NSFS. 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 subsection (Section 3.9.9.3.2). In addition, implementation of the mitigation and monitoring procedures will further minimize the potential for marine mammal exposures to underwater detonations.

Table 3.9-17: Alternative 1 Annual Underwater Detonation Exposures Summary

Species	Level B Exposures		Level A Exposures	
	Behavioral Harassment 177 dB re 1μPa^2-s	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	2	0	0
Fin whale	2	1	0	0
Humpback whale	0	0	0	0
Sei whale	0	0	0	0
Sperm whale	2	1	0	0
Guadalupe fur seal	2	2	0	0
Sea otter	0	0	0	0
Mysticete				
Bryde's whale	0	0	0	0
Gray whale	4	6	0	0
Minke whale	0	0	0	0
Odontocetes				
Baird's beaked whale	0	0	0	0
Bottlenose dolphin (offshore)	10	8	0	0
Cuvier's beaked whale	5	3	0	0
Dall's porpoise	2	2	0	0
Killer whale	0	0	0	0
Long-beaked common dolphin	52	37	1	0
Mesoplodon spp.	0	1	0	0
Northern right whale dolphin	14	10	0	0
Pacific white-sided dolphin	9	8	0	0
Pygmy sperm whale	1	1	0	0
Risso's dolphin	44	28	1	0
Short-beaked common dolphin	460	322	11	4
Short-finned pilot whale	0	0	0	0
Striped dolphin	4	5	0	0
Ziphiid whale	2	1	0	0
Pinnipeds				
Northern elephant seal	65	36	0	0
Pacific harbor seal	22	24	1	0
California sea lion	465	454	14	5
Northern fur seal	73	56	2	1
Total	**1,240**	**1,008**	**30**	**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.

3.9.9.3.4 Species-Specific Potential Impacts: Alternative 1

Blue Whale

The risk function and Navy post-modeling analysis estimates 508 blue whales will exhibit behavioral responses NMFS will classify as harassment under the MMPA (Table 3.9-16). Modeling also indicates there would be 64 exposures to accumulated acoustic energy above 195 dB re 1 μPa2-s, which is the threshold established indicative of onset TTS. One blue whale would be exposed to sound levels that could cause PTS.

Without consideration of clearance procedures, there would be two exposures from impulsive sound or pressures from underwater detonations that would exceed the behavioral harassment threshold, two exposures that would exceed the TTS threshold, none that would exceed the onset of slight injury threshold, and no exposures that would exceed the onset of massive lung injury or mortality threshold (Table 3.9-17).

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. The implementation of mitigation measures to reduce exposure to high levels of sonar sound, and the short duration and intermittent exposure to sonar, reduces the likelihood that exposure to MFA/HFA sonar sound would cause a behavioral response that may affect vital functions (reproduction or survival), TTS, or PTS.

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 may affect but are not likely to adversely affect blue whales. It is unlikely that MIRC training would result in any death or injury to blue whales.

Fin Whale

The risk function and Navy post-modeling analysis estimates 144 fin whales will exhibit behavioral responses NMFS will classify as harassment under the MMPA (Table 3.9-16). Modeling also indicates there would be 12 exposures to accumulated acoustic energy above 195 dB re 1 μPa2-s, which is the threshold established indicative of onset TTS. No fin whales would be exposed to sound levels that could cause PTS.

Without consideration of clearance procedures, there would be two exposures from impulsive sound or pressures from underwater detonations that would exceed the behavioral harassment threshold, one exposure that would exceed the TTS threshold, none that would exceed the onset of slight injury threshold, and no exposures that would exceed the onset of massive lung injury or mortality threshold (Table 3.9-17).

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. The implementation of mitigation measures to reduce exposure to high levels of sonar sound, and the short duration and intermittent exposure to sonar, reduces the likelihood that exposure to MFA/HFA sonar sound would cause a behavioral response that may affect vital functions (reproduction or survival), TTS, or PTS.

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 may affect but are not likely to adversely affect fin whales. It is unlikely that MIRC training would result in any death or injury to fin whales.

Humpback Whale

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 3.9-16). Modeling also indicates there would be two exposures to accumulated acoustic energy above 195 dB re 1 µPa2-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 behavioral harassment threshold, no exposures that would exceed the TTS threshold, none that would exceed the onset of slight injury threshold, and no exposures that would exceed the onset of massive lung injury or mortality threshold (Table 3.9-17).

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. The implementation of mitigation measures to reduce exposure to high levels of sonar sound, and the short duration and intermittent exposure to sonar, reduces the likelihood that exposure to MFA/HFA sonar sound would cause a behavioral response that may affect vital functions (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 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 µPa2-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 responses 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). 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 may affect but are not likely to adversely affect humpback whales. It is unlikely that MIRC training would result in any death or injury to humpback whales.

Sei Whale

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 3.9-16). Modeling also indicates there would be no exposures to accumulated acoustic energy above 195 dB re 1 µPa2-s, which is the threshold established indicative of onset TTS. No sei 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 behavioral harassment threshold, no exposures that would exceed the TTS threshold, none that would exceed the onset of slight injury threshold, and no exposures that would exceed the onset of massive lung injury or mortality threshold (Table 3.9-17).

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. The implementation of mitigation measures to reduce exposure to high levels of sonar sound, and the short duration and intermittent exposure to sonar, reduces the likelihood that exposure to MFA/HFA sonar sound would cause a behavioral response that may affect vital functions (reproduction or survival), TTS, or PTS.

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 may affect but are not likely to adversely affect sei whales. It is unlikely that MIRC training would result in any death or injury to sei whales.

Sperm Whale

The risk function and Navy post-modeling analysis estimates 130 sperm whales will exhibit behavioral responses NMFS will classify as harassment under the MMPA (Table 3.9-16). Modeling also indicates there would be eight exposures to accumulated acoustic energy above 195 dB re 1 μPa2-s, which is the threshold established indicative of onset TTS. No sperm whales would be exposed to sound levels that could cause PTS.

Without consideration of clearance procedures, there would be two exposures from impulsive sound or pressures from underwater detonations that would exceed the behavioral harassment threshold, one exposure that would exceed the TTS threshold, none that would exceed the onset of slight injury threshold, and no exposures that would exceed the onset of massive lung injury or mortality threshold (Table 3.9-17).

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). The implementation of mitigation measures to reduce exposure to high levels of sonar sound, and the short duration and intermittent exposure to sonar, reduces the likelihood that exposure to MFA/HFA sonar sound would cause a behavioral response that may affect vital functions (reproduction or survival), TTS, or PTS.

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 may affect but are not likely to adversely affect sperm whales. It is unlikely that MIRC training would result in any death or injury to sperm whales.

Guadalupe fur Seal

The risk function and Navy post-modeling analysis estimates 821 Guadalupe fur seals will exhibit behavioral responses NMFS will classify as harassment under the MMPA (Table 3.9-16). Modeling also indicates there would be 180 exposures to accumulated acoustic energy above 195 dB re 1 μPa2-s, which is the threshold established indicative of onset TTS. No Guadalupe fur seals would be exposed to sound levels that could cause PTS.

Without consideration of clearance procedures, there would be two exposures from impulsive sound or pressures from underwater detonations that would exceed the behavioral harassment threshold, two exposures that would exceed the TTS threshold, none that would exceed the onset of slight injury threshold, and no exposures that would exceed the onset of massive lung injury or mortality threshold (Table 3.9-17).

Guadalupe fur seals dive for short periods and often rest on the surface between foraging bouts (Gallo 1994) making them easier to detect. The implementation of mitigation measures to reduce exposure to high levels of sonar sound, and the short duration and intermittent exposure to sonar, reduces the likelihood that exposure to MFA/HFA sonar sound would cause a behavioral response that may affect vital functions (reproduction or survival), TTS, or PTS.

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 may affect but are not likely to adversely affect Guadalupe fur seals. It is unlikely that MIRC training would result in any death or injury to Guadalupe fur seals.

Sea otter

The risk function and Navy post-modeling analysis estimates no sea otters will exhibit behavioral responses NMFS will classify as harassment under the MMPA (Table 3.9-16). Modeling also indicates there would be no exposures to accumulated acoustic energy above 195 dB re 1 μPa2-s, which is the threshold established indicative of onset TTS. No sea otters 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 behavioral harassment threshold, no exposures that would exceed the TTS threshold, none that would exceed the onset of slight injury threshold, and no exposures that would exceed the onset of massive lung injury or mortality threshold (Table 3.9-17).

Sea otters are predominately near shore species that will only be around San Nicolas Island at the northern edge of the SOCAL Range Complex. In addition, the experimental translocated population is very small (approximately 29 animals). The implementation of mitigation measures to reduce exposure to high levels of sonar sound, and the short duration and intermittent exposure to sonar, reduces the likelihood that exposure to MFA/HFA sonar sound would cause a behavioral response that may affect vital functions (reproduction or survival), TTS, or PTS.

Based on the model results, behavioral patterns, acoustic abilities of sea otters, 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 sea otters and are not likely to adversely affect sea otters. It is unlikely that SOCAL Range Complex training would result in any death or injury to sea otters.

Bryde's Whale

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 3.9-16). 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.

Without consideration of clearance procedures, there would be no exposures from impulsive sound or pressures from underwater detonations that would exceed the behavioral harassment threshold, no exposures that would exceed the TTS threshold, none that would exceed the onset

of slight injury threshold, and no exposures that would exceed the onset of massive lung injury or mortality threshold (Table 3.9-17).

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. The implementation of mitigation measures to reduce exposure to high levels of sonar sound, and the short duration and intermittent exposure to sonar, reduces the likelihood that exposure to MFA/HFA sonar sound would cause a behavioral response that may affect vital functions (reproduction or survival), TTS, or PTS.

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

The risk function and Navy post-modeling analysis estimates 4,626 gray whales will exhibit behavioral responses NMFS will classify as harassment under the MMPA (Table 3.9-16). Modeling also indicates there would be 514 exposures to accumulated acoustic energy above 195 dB re 1 μPa2-s, which is the threshold established indicative of onset TTS. One gray whale would be exposed to sound levels that could cause PTS.

Without consideration of clearance procedures, there would be four exposures from impulsive sound or pressures from underwater detonations that would exceed the behavioral harassment threshold, six exposures that would exceed the TTS threshold, none that would exceed the onset of slight injury threshold, and no exposures that would exceed the onset of massive lung injury or mortality threshold (Table 3.9-17).

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. The implementation of mitigation measures to reduce exposure to high levels of sonar sound, and the short duration and intermittent exposure to sonar, reduces the likelihood that exposure to MFA/HFA sonar sound would cause a behavioral response that may affect vital functions (reproduction or survival), TTS, or PTS.

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

The risk function and Navy post-modeling analysis estimates 103 minke whales will exhibit behavioral responses NMFS will classify as harassment under the MMPA (Table 3.9-16). Modeling also indicates there would be 16 exposures to accumulated acoustic energy above 195 dB re 1 μPa2-s, which is the threshold established indicative of onset TTS. No minke 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 behavioral harassment threshold, no exposures that would exceed the TTS threshold, none that would exceed the onset of slight injury threshold, and no exposures that would exceed the onset of massive lung injury or mortality threshold (Table 3.9-17).

Minke whales are difficult to spot visually but can be detected using passive acoustic monitoring. The implementation of mitigation measures to reduce exposure to high levels of sonar sound, and the short duration and intermittent exposure to sonar, reduces the likelihood that exposure to MFA/HFA sonar sound would cause a behavioral response that may affect vital functions (reproduction or survival), TTS, or PTS.

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

The risk function and Navy post-modeling analysis estimates 12 Baird's beaked whales will exhibit behavioral responses NMFS will classify as harassment under the MMPA (Table 3.9-16). Modeling also indicates there would be one exposure to accumulated acoustic energy above 195 dB re 1 μPa2-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.

Without consideration of clearance procedures, there would be no exposures from impulsive sound or pressures from underwater detonations that would exceed the behavioral harassment threshold, no exposures that would exceed the TTS threshold, none that would exceed the onset of slight injury threshold, and no exposures that would exceed the onset of massive lung injury or mortality threshold (Table 3.9-17).

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). The implementation of mitigation measures to reduce exposure to high levels of sonar sound, and the short duration and intermittent exposure to sonar, reduces the likelihood that exposure to MFA/HFA sonar sound would cause a behavioral response that may affect vital functions (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 (Offshore)

The risk function and Navy post-modeling analysis estimates 1,186 bottlenose dolphins will exhibit behavioral responses NMFS will classify as harassment under the MMPA (Table 3.9-16). Modeling also indicates there would be 181 exposures to accumulated acoustic energy above 195 dB re 1 μPa2-s, which is the threshold established indicative of onset TTS. No bottlenose dolphins would be exposed to sound levels that could cause PTS.

Without consideration of clearance procedures, there would be 10 exposures from impulsive sound or pressures from underwater detonations that would exceed the behavioral harassment threshold, eight exposures that would exceed the TTS threshold, none that would exceed the onset of slight injury threshold, and no exposures that would exceed the onset of massive lung injury or mortality threshold (Table 3.9-17).

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. The implementation of mitigation measures to reduce exposure to high levels of sonar sound, and the short duration and intermittent exposure to sonar, reduces the likelihood that exposure to MFA/HFA sonar sound would cause a behavioral response that may affect vital functions (reproduction or survival), TTS, or PTS.

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

The risk function and Navy post-modeling analysis estimates 361 Cuvier's beaked whales will exhibit behavioral responses NMFS will classify as harassment under the MMPA (Table 3.9-16). Modeling also indicates there would be 35 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.

Without consideration of clearance procedures, there would be five exposures from impulsive sound or pressures from underwater detonations that would exceed the behavioral harassment threshold, three exposures that would exceed the TTS threshold, none that would exceed the onset of slight injury threshold, and no exposures that would exceed the onset of massive lung injury or mortality threshold (Table 3.9-17).

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). The implementation of mitigation measures to reduce exposure to high levels of sonar sound, and the short duration and intermittent exposure to sonar, reduces the likelihood that exposure to MFA/HFA sonar sound would cause a behavioral response that may affect vital functions (reproduction or survival), TTS, or PTS.

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

The risk function and Navy post-modeling analysis estimates 500 Dall's porpoise will exhibit behavioral responses NMFS will classify as harassment under the MMPA (Table 3.9-16). Modeling also indicates there would be 82 exposures to accumulated acoustic energy above 195 dB re 1 μPa2-s, which is the threshold established indicative of onset TTS. No Dall's porpoises would be exposed to sound levels that could cause PTS.

Without consideration of clearance procedures, there would be two exposures from impulsive sound or pressures from underwater detonations that would exceed the behavioral harassment threshold, two exposures that would exceed the TTS threshold, none that would exceed the onset of slight injury threshold, and no exposures that would exceed the onset of massive lung injury or mortality threshold (Table 3.9-17).

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. The implementation of mitigation measures to reduce exposure to high levels of sonar sound, and the short duration and intermittent exposure to sonar, reduces the likelihood that exposure to MFA/HFA sonar sound would cause a behavioral response that may affect vital functions (reproduction or survival), TTS, or PTS.

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

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 3.9-16). Modeling also indicates there would be one exposure to accumulated acoustic energy above 195 dB re 1 μPa2-s, which is the threshold established indicative of onset TTS. No killer 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 behavioral harassment threshold, no exposures that would exceed the TTS threshold, none that would exceed the onset of slight injury threshold, and no exposures that would exceed the onset of massive lung injury or mortality threshold (Table 3.9-17).

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. The implementation of mitigation measures to reduce exposure to high levels of sonar sound, and the short duration and intermittent exposure to sonar, reduces the likelihood that exposure to MFA/HFA sonar sound would cause a behavioral response that may affect vital functions (reproduction or survival), TTS, or PTS.

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

The risk function and Navy post-modeling analysis estimates 3,820 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 408 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.

Without consideration of clearance procedures, there would be 52 exposures from impulsive sound or pressures from underwater detonations that would exceed the behavioral harassment threshold, 37 exposures that would exceed the TTS threshold, one that would exceed the onset of slight injury threshold, and no exposures that would exceed the onset of massive lung injury or mortality threshold (Table 3.9-17).

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. The implementation of mitigation measures to reduce exposure to high levels of sonar sound, and the short duration and intermittent exposure to sonar, reduces the likelihood that exposure to

MFA/HFA sonar sound would cause a behavioral response that may affect vital functions (reproduction or survival), TTS, or PTS.

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

The risk function and Navy post-modeling analysis estimates 108 Mesoplodont whales will exhibit behavioral responses NMFS will classify as harassment under the MMPA (Table 3.9-16). Modeling also indicates there would be 13 exposures to accumulated acoustic energy above 195 dB re 1 μPa2-s, which is the threshold established indicative of onset TTS. No Mesoplodont 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 behavioral harassment threshold, one exposure that would exceed the TTS threshold, none that would exceed the onset of slight injury threshold, and no exposures that would exceed the onset of massive lung injury or mortality threshold (Table 3.9-17).

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). The implementation of mitigation measures to reduce exposure to high levels of sonar sound, and the short duration and intermittent exposure to sonar, reduces the likelihood that exposure to MFA/HFA sonar sound would cause a behavioral response that may affect vital functions (reproduction or survival), TTS, or PTS.

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

The risk function and Navy post-modeling analysis estimates 1,232 northern right whale dolphins will exhibit behavioral responses NMFS will classify as harassment under the MMPA (Table 3.9-16). Modeling also indicates there would be 157 exposures to accumulated acoustic energy above 195 dB re 1 μPa2-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.

Without consideration of clearance procedures, there would be 14 exposures from impulsive sound or pressures from underwater detonations that would exceed the behavioral harassment threshold, 10 exposures that would exceed the TTS threshold, none that would exceed the onset of slight injury threshold, and no exposures that would exceed the onset of massive lung injury or mortality threshold (Table 3.9-17).

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. The implementation of mitigation measures to reduce exposure to high levels of sonar sound, and the short duration and intermittent exposure to sonar, reduces the likelihood that exposure to MFA/HFA sonar sound would cause a behavioral response that may affect vital functions (reproduction or survival), TTS, or PTS.

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

The risk function and Navy post-modeling analysis estimates 1,085 Pacific white-sided dolphin will exhibit behavioral responses NMFS will classify as harassment under the MMPA (Table 3.9-16). Modeling also indicates there would be 179 exposures to accumulated acoustic energy above 195 dB re 1 µPa2-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.

Without consideration of clearance procedures, there would be nine exposures from impulsive sound or pressures from underwater detonations that would exceed the behavioral harassment threshold, eight exposures that would exceed the TTS threshold, none that would exceed the onset of slight injury threshold, and no exposures that would exceed the onset of massive lung injury or mortality threshold (Table 3.9-17).

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. The implementation of mitigation measures to reduce exposure to high levels of sonar sound, and the short duration and intermittent exposure to sonar, reduces the likelihood that exposure to MFA/HFA sonar sound would cause a behavioral response that may affect vital functions (reproduction or survival), TTS, or PTS.

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

The risk function and Navy post-modeling analysis estimates 133 pygmy whales will exhibit behavioral responses NMFS will classify as harassment under the MMPA (Table 3.9-16). Modeling also indicates there would be 16 exposures to accumulated acoustic energy above 195 dB re 1 µPa2-s, which is the threshold established indicative of onset TTS. No pygmy sperm whales 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 behavioral harassment threshold, one exposure that would exceed the TTS threshold, none that would exceed the onset of slight injury threshold, and no exposures that would exceed the onset of massive lung injury or mortality threshold (Table 3.9-17).

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. The implementation of mitigation measures to reduce exposure to high levels of sonar sound, and the short duration and intermittent exposure to sonar, reduces the likelihood that exposure to MFA/HFA sonar sound would cause a behavioral response that may affect vital functions (reproduction or survival), TTS, or PTS.

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

The risk function and Navy post-modeling analysis estimates 2,946 Risso's dolphins will exhibit behavioral responses NMFS will classify as harassment under the MMPA (Table 3.9-16). Modeling also indicates there would be 320 exposures to accumulated acoustic energy above 195 dB re 1 μPa2-s, which is the threshold established indicative of onset TTS. No Risso's dolphins would be exposed to sound levels that could cause PTS.

Without consideration of clearance procedures, there would be 44 exposures from impulsive sound or pressures from underwater detonations that would exceed the behavioral harassment threshold, 28 exposures that would exceed the TTS threshold, one that would exceed the onset of slight injury threshold, and no exposures that would exceed the onset of massive lung injury or mortality threshold (Table 3.9-17).

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 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. The implementation of mitigation measures to reduce exposure to high levels of sonar sound, and the short duration and intermittent exposure to sonar, reduces the likelihood that exposure to MFA/HFA sonar sound would cause a behavioral response that may affect vital functions (reproduction or survival), TTS, or PTS.

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

The risk function and Navy post-modeling analysis estimates 32,826 short-beaked common dolphins will exhibit behavioral responses NMFS will classify as harassment under the MMPA (Table 3.9-16). Modeling also indicates there would be 3,515 exposures to accumulated acoustic energy above 195 dB re 1 μPa^2-s, which is the threshold established indicative of onset TTS. Six short-beaked common dolphins would be exposed to sound levels that could cause PTS.

Without consideration of clearance procedures, there would be 460 exposures from impulsive sound or pressures from underwater detonations that would exceed the behavioral harassment threshold, 322 exposures that would exceed the TTS threshold, 11 that would exceed the onset of slight injury threshold, and four exposures that would exceed the onset of massive lung injury or mortality threshold (Table 3.9-17).

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. The implementation of mitigation measures to reduce exposure to high levels of sonar sound, and the short duration and intermittent exposure to sonar, reduces the likelihood that exposure to MFA/HFA sonar sound would cause a behavioral response that may affect vital functions (reproduction or survival), TTS, or PTS.

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

The risk function and Navy post-modeling analysis estimates 37 short-finned pilot whales will exhibit behavioral responses NMFS will classify as harassment under the MMPA (Table 3.9-16). Modeling also indicates there would be six exposures to accumulated acoustic energy above 195 dB re 1 μPa2-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.

Without consideration of clearance procedures, there would be no exposures from impulsive sound or pressures from underwater detonations that would exceed the behavioral harassment threshold, no exposures that would exceed the TTS threshold, none that would exceed the onset of slight injury threshold, and no exposures that would exceed the onset of massive lung injury or mortality threshold (Table 3.9-17).

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. The implementation of mitigation measures to reduce exposure to high levels of sonar sound, and the short duration and intermittent exposure to sonar, reduces the likelihood that exposure to MFA/HFA sonar sound would cause a behavioral response that may affect vital functions (reproduction or survival), TTS, or PTS.

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

The risk function and Navy post-modeling analysis estimates 1,479 striped dolphins will exhibit behavioral responses NMFS will classify as harassment under the MMPA (Table 3.9-16). Modeling also indicates there would be 235 exposures to accumulated acoustic energy above 195 dB re 1 μPa2-s, which is the threshold established indicative of onset TTS. One striped dolphin would be exposed to sound levels that could cause PTS.

Without consideration of clearance procedures, there would be four exposures from impulsive sound or pressures from underwater detonations that would exceed the behavioral harassment threshold, five exposures that would exceed the TTS threshold, none that would exceed the onset of slight injury threshold, and no exposures that would exceed the onset of massive lung injury or mortality threshold (Table 3.9-17).

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. The implementation of mitigation measures to reduce exposure to high levels of sonar sound, and the short duration and intermittent exposure to sonar, reduces the likelihood that exposure to MFA/HFA sonar sound would cause a behavioral response that may affect vital functions (reproduction or survival), TTS, or PTS.

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

The risk function and Navy post-modeling analysis estimates 81 Ziphiid whales will exhibit behavioral responses NMFS will classify as harassment under the MMPA (Table 3.9-16). Modeling also indicates there would be eight 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.

Without consideration of clearance procedures, there would be two exposures from impulsive sound or pressures from underwater detonations that would exceed the behavioral harassment threshold, one exposure that would exceed the TTS threshold, none that would exceed the onset of slight injury threshold, and no exposures that would exceed the onset of massive lung injury or mortality threshold (Table 3.9-16).

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). The implementation of mitigation measures to reduce exposure to high levels of sonar sound, and the short duration and intermittent exposure to sonar, reduces the likelihood that exposure to MFA/HFA sonar sound would cause a behavioral response that may affect vital functions (reproduction or survival), TTS, or PTS.

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

The risk function and Navy post-modeling analysis estimates 786 northern elephant seals will exhibit behavioral responses NMFS will classify as harassment under the MMPA (Table 3.9-16). Modeling also indicates there would be five exposures to accumulated acoustic energy above 204 dB re 1 μPa2-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.

Without consideration of clearance procedures, there would be 65 exposures from impulsive sound or pressures from underwater detonations that would exceed the behavioral harassment threshold, 36 exposures that would exceed the TTS threshold, none that would exceed the onset of slight injury threshold, and no exposures that would exceed the onset of massive lung injury or mortality threshold (Table 3.9-17).

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). The implementation of mitigation measures to reduce exposure to high levels of sonar sound, and the short duration and intermittent exposure to sonar, reduces the likelihood that exposure to MFA/HFA sonar sound would cause a behavioral response that may affect vital functions (reproduction or survival), TTS, or PTS.

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

The risk function and Navy post-modeling analysis estimates 956 Pacific harbor seals will exhibit behavioral responses NMFS will classify as harassment under the MMPA (Table 3.9-16). Modeling also indicates there would be 4,301 exposures to accumulated acoustic energy above 183 dB re 1 μPa2-s, which is the threshold established indicative of onset TTS for Pacific harbor seals. Nine Pacific harbor seals would be exposed to sound levels that could cause PTS.

Without consideration of clearance procedures, there would be 22 exposures from impulsive sound or pressures from underwater detonations that would exceed the behavioral harassment threshold, 24 exposures that would exceed the TTS threshold, one that would exceed the onset of slight injury threshold, and no exposures that would exceed the onset of massive lung injury or mortality threshold (Table 3.9-17).

Harbor seals forage near their rookeries (usually within 27 nm [50 km]) therefore they tend to remain in the Southern California area most of the time in comparison to northern elephant seals. The implementation of mitigation measures to reduce exposure to high levels of sonar sound, and the short duration and intermittent exposure to sonar, reduces the likelihood that exposure to MFA/HFA sonar sound would cause a behavioral response that may affect vital functions (reproduction or survival), TTS, or PTS.

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

The risk function and Navy post-modeling analysis estimates 51,269 California sea lions will exhibit behavioral responses NMFS will classify as harassment under the MMPA (Table 3.9-16). Modeling also indicates there would be three exposures to accumulated acoustic energy above 206 dB re 1 μPa2-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.

Without consideration of clearance procedures, there would be 465 exposures from impulsive sound or pressures from underwater detonations that would exceed the behavioral harassment threshold, 454 exposures that would exceed the TTS threshold, 14 that would exceed the onset of slight injury threshold, and five exposures that would exceed the onset of massive lung injury or mortality threshold (Table 3.9-17).

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. The implementation of mitigation measures to reduce exposure to high levels of sonar sound, and the short duration and intermittent exposure to sonar, reduces the likelihood that exposure to MFA/HFA sonar sound would cause a behavioral response that may affect vital functions (reproduction or survival), TTS, or PTS.

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

The risk function and Navy post-modeling analysis estimates 1,011 northern fur seals will exhibit behavioral responses NMFS will classify as harassment under the MMPA (Table 3.9-16). Modeling also indicates there would be three exposures to accumulated acoustic energy above 206 dB re 1 µPa2-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.

Without consideration of clearance procedures, there would be 73 exposures from impulsive sound or pressures from underwater detonations that would exceed the behavioral harassment threshold, 56 exposures that would exceed the TTS threshold, two that would exceed the onset of slight injury threshold, and one exposure that would exceed the onset of massive lung injury or mortality threshold (Table 3.9-17).

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.

3.9.9.4 Alternative 2

3.9.9.4.1 Nonacoustic Impacts

Shallow Water Training Range (SWTR) Installation

Once underway during array installations, the 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 of 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 Nonacoustic Impacts

Nonacoustic 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.

3.9.9.4.2 Summary of Potential Mid- and High-Frequency Active Sonar Effects

Tables 3.9-18 and 3.9-19 represents the number of Alternative 2 active sonar hours or usage per year for different sonar sources.

Table 3.9-18: Alternative 2 Summary of Active Sonar Hours

Event	SQS-53 C Sonar Hours	SQS-56 C Sonar Hours	BQQ-10 Sub Sonar Hours	BQQ-15 Sub Sonar Hours	*Total Sonar Hours*
Major Exercises (8/yr)	1,045	261	98	41	**1,445**
Integrated Exercises (7/yr)	403	101	138	41	**683**
ULT & Maintenance	529	132	579	40	**1,280**
Total Hours	**1,977**	**494**	**815**	**122**	**3,408**

Table 3.9-19: Alternative 2 Summary of Number of Sonar Dips, Number of Sonobuoys, Torpedo Runs, and NIXIE Hours

Event	AQS-22 Number of Dips	SSQ-62 Number of Sonobuoy Deployment	MK-48 Number of Torpedo Events	MK-46 Number of Torpedo Events	AN/SLQ-25A NIXIE Number of Hours
Major Exercises (8/yr)	337	2,255	11	28	76
Integrated Exercises (7/yr)	690	845	15	28	76
ULT, Coordinated Events & Maintenance	1,692	1,156	61	28	76
Total Hours or Number of Events or Deployments	**2,719**	**4,256**	**87**	**84**	**228**

Table 3.9-20 presents estimated marine mammal exposures for potential non injurious (Level B: risk function or behavioral harassment and TTS) 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 112,821 annual exposures that could potentially result in behavioral harassment (Level B harassment); 10,897 annual exposures that could potentially result in TTS (Level B harassment); and 19 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.

Table 3.9-20: 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	541	67	1
Fin whale	155	12	0
Humpback whale	16	2	0
Sei whale	0	0	0
Sperm whale	140	8	0
Guadalupe fur seal	870	190	0
Sea otter	0	0	0
Mysticetes			
Bryde's whale	0	0	0
Gray whale	4,906	544	1
Minke whale	113	16	0
Odontocetes			
Baird's beaked whale	15	1	0
Bottlenose dolphin (offshore)	1,294	194	0
Cuvier's beaked whale	386	37	0
Dall's porpoise	533	88	0
Killer whale	9	1	0
Long beaked common dolphin	4,086	435	1
Mesoplodon spp.	118	13	0
Northern right whale dolphin	1,343	169	0
Pacific white-sided dolphin	1,187	192	0
Pygmy sperm whale	144	16	0
Risso's dolphin	3,160	343	0
Short beaked common dolphin	34,832	3,730	6
Short-finned pilot whale	42	6	0
Striped dolphin	1,572	249	1
Ziphiid whales	89	8	0
Pinnipeds			
Northern elephant seal	833	5	0
Pacific harbor seal	1,048	4,562	9
California sea lion	54,380	6	0
Northern fur seal	1,072	3	0
Total	**112,884**	**10,897**	**19**

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.

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 19 for six species, one blue whale, one gray whale, one long-beaked common dolphin, one striped dolphin, six short-beaked common dolphins, and nine Pacific harbor seals. 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.

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.

3.9.9.4.3 Summary of Potential Underwater Detonation Effects Alternative 2

The modeled exposure harassment numbers for all training operations involving explosives are presented by species in Table 3-9-21. The modeling indicates 1,499 annual exposures to pressure from underwater detonations that could potentially result in behavioral response (Level B harassment), 1,128 annual exposures that could potentially result in TTS (Level B harassment); 34 annual exposures from pressure from underwater detonations that could cause slight injury (Level A harassment); and 11 exposures that could cause severe injury or mortality. Exposures are presented without consideration of mitigation measures that would be implemented during underwater detonation activities.

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.

Table 3.9-21: Alternative 2 Annual Underwater Detonation Exposures Summary

Species	Level B Exposures		Level A Exposures	
	Behavioral Harassment 177 dB re 1µPa^2-s	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	2	0	0
Fin whale	2	1	0	0
Humpback whale	0	0	0	0
Sei whale	0	0	0	0
Sperm whale	2	1	0	0
Guadalupe fur seal	2	2	0	0
Sea otter	0	0	0	0
Mysticete				
Bryde's whale	0	0	0	0
Gray whale	6	7	0	0
Minke whale	0	0	0	0
Odontocetes				
Baird's beaked whale	0	0	0	0
Bottlenose dolphin (offshore)	14	10	0	0
Cuvier's beaked whale	5	3	0	0
Dall's porpoise	2	2	0	0
Killer whale	0	0	0	0
Long-beaked common dolphin	61	41	1	0
Mesoplodon spp.	2	1	0	0
Northern right whale dolphin	19	12	0	0
Pacific white-sided dolphin	12	9	0	0
Pygmy sperm whale	1	1	0	0
Risso's dolphin	57	34	1	0
Short-beaked common dolphin	528	354	12	4
Short-finned pilot whale	0	0	0	0
Striped dolphin	6	6	0	0
Ziphiid whale	2	1	0	0
Pinnipeds				
Northern elephant seal	76	41	0	0
Pacific harbor seal	26	26	1	0
California sea lion	584	510	16	6
Northern fur seal	90	64	3	1
Total	**1,499**	**1,128**	**34**	**11**

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.

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 subsection (Section 3.9.9.4.2). In addition, implementation of the mitigation and monitoring procedures will further minimize the potential for marine mammal exposures to underwater detonations.

3.9.9.4.4 Species-Specific Potential Impacts: Alternative 2

Blue Whale

The risk function and Navy post-modeling analysis estimates 541 blue whales will exhibit behavioral responses NMFS will classify as harassment under the MMPA (Table 3.9-20). 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 blue whales would be exposed to sound levels that could cause PTS.

Without consideration of clearance procedures, there would be two exposures from impulsive sound or pressures from underwater detonations that would exceed the behavioral harassment threshold, two exposures that would exceed the TTS threshold, none that would exceed the onset of slight injury threshold, and no exposures that would exceed the onset of massive lung injury or mortality threshold (Table 3.9-21).

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. The implementation of mitigation measures to reduce exposure to high levels of sonar sound, and the short duration and intermittent exposure to sonar, reduces the likelihood that exposure to MFA/HFA sonar sound would cause a behavioral response that may affect vital functions (reproduction or survival), TTS, or PTS.

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 may affect but are not likely to adversely affect blue whales. It is unlikely that SOCAL Range Complex training would result in any death or injury to blue whales.

Fin Whale

The risk function and Navy post-modeling analysis estimates 155 fin whales will exhibit behavioral responses NMFS will classify as harassment under the MMPA (Table 3.9-20). Modeling also indicates there would be 12 exposures to accumulated acoustic energy above 195 dB re 1 μPa2-s, which is the threshold established indicative of onset TTS. No fin whales would be exposed to sound levels that could cause PTS.

Without consideration of clearance procedures, there would be two exposures from impulsive sound or pressures from underwater detonations that would exceed the behavioral harassment threshold, one exposure that would exceed the TTS threshold, none that would exceed the onset of slight injury threshold, and no exposures that would exceed the onset of massive lung injury or mortality threshold (Table 3.9-21).

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. The implementation of mitigation measures to reduce exposure to high levels of sonar sound, and the short duration and intermittent exposure to sonar, reduces the likelihood that exposure to MFA/HFA sonar sound would cause a behavioral response that may affect vital functions (reproduction or survival), TTS, or PTS.

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 may affect but are not likely to adversely affect fin whales. It is unlikely that SOCAL Range Complex training would result in any death or injury to fin whales.

Humpback Whale

The risk function and Navy post-modeling analysis estimates 16 humpback whales will exhibit behavioral responses NMFS will classify as harassment under the MMPA (Table 3.9-20). 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 behavioral harassment threshold, no exposures that would exceed the TTS threshold, none that would exceed the onset of slight injury threshold, and no exposures that would exceed the onset of massive lung injury or mortality threshold (Table 3.9-21).

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. The implementation of mitigation measures to reduce exposure to high levels of sonar sound, and the short duration and intermittent exposure to sonar, reduces the likelihood that exposure to MFA/HFA sonar sound would cause a behavioral response that may affect vital functions (reproduction or survival), TTS, or PTS.

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 µPa2-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 responses 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 may affect but are not likely to adversely affect humpback whales. It is unlikely that SOCAL Range Complex training would result in any death or injury to humpback whales.

Sei Whale

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 3.9-20). Modeling also indicates there would be no exposures to accumulated acoustic energy above 195 dB re 1 µPa2-s, which is the threshold established indicative of onset TTS. No sei 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 behavioral harassment threshold, no exposures that would exceed the TTS threshold, none that would exceed the onset of slight injury threshold, and no exposures that would exceed the onset of massive lung injury or mortality threshold (Table 3.9-21).

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. The implementation of mitigation measures to reduce exposure to high levels of sonar sound, and the short duration and intermittent exposure to sonar, reduces the likelihood that exposure to MFA/HFA sonar sound would cause a behavioral response that may affect vital functions (reproduction or survival), TTS, or PTS.

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 may affect but are not likely to adversely affect sei whales. It is unlikely that SOCAL Range Complex training would result in any death or injury to sei whales.

Sperm Whales

The risk function and Navy post-modeling analysis estimates 140 sperm whales will exhibit behavioral responses NMFS will classify as harassment under the MMPA (Table 3.9-20). Modeling also indicates there would be eight exposures to accumulated acoustic energy above 195 dB re 1 μPa2-s, which is the threshold established indicative of onset TTS. No sperm whales would be exposed to sound levels that could cause PTS.

Without consideration of clearance procedures, there would be two exposures from impulsive sound or pressures from underwater detonations that would exceed the behavioral harassment threshold, one exposure that would exceed the TTS threshold, none that would exceed the onset of slight injury threshold, and no exposures that would exceed the onset of massive lung injury or mortality threshold (Table 3.9-21).

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. The implementation of mitigation measures to reduce exposure to high levels of sonar sound, and the short duration and intermittent exposure to sonar, reduces the likelihood that exposure to MFA/HFA sonar sound would cause a behavioral response that may affect vital functions (reproduction or survival), TTS, or PTS.

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 may affect but are not likely to adversely affect sperm whales. It is unlikely that SOCAL Range Complex training would result in any death or injury to sperm whales.

Guadalupe fur Seal

The risk function and Navy post-modeling analysis estimates 870 Guadalupe fur seals will exhibit behavioral responses NMFS will classify as harassment under the MMPA (Table 3.9-20). Modeling also indicates there would be 190 exposures to accumulated acoustic energy above 195 dB re 1 μPa2-s, which is the threshold established indicative of onset TTS. No Guadalupe fur seals would be exposed to sound levels that could cause PTS.

Without consideration of clearance procedures, there would be two exposures from impulsive sound or pressures from underwater detonations that would exceed the behavioral harassment threshold, two exposures that would exceed the TTS threshold, none that would exceed the onset of slight injury threshold, and no exposures that would exceed the onset of massive lung injury or mortality threshold (Table 3.9-21).

Guadalupe fur seals dive for short periods and often rest on the surface between foraging bouts (Gallo 1994) making them easier to detect. The implementation of mitigation measures to reduce exposure to high levels of sonar sound, and the short duration and intermittent exposure to sonar, reduces the likelihood that exposure to MFA/HFA sonar sound would cause a behavioral response that may affect vital functions (reproduction or survival), TTS, or PTS.

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 may affect but are not likely to adversely affect Guadalupe fur seals. It is unlikely that SOCAL Range Complex training would result in any death or injury to Guadalupe fur seals.

Sea otter

The risk function and Navy post-modeling analysis estimates no sea otters will exhibit behavioral responses NMFS will classify as harassment under the MMPA (Table 3.9-20). Modeling also indicates there would be no exposures to accumulated acoustic energy above 195 dB re 1 μPa2-s, which is the threshold established indicative of onset TTS. No sea otters 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 behavioral harassment threshold, no exposures that would exceed the TTS threshold, none that would exceed the onset of slight injury threshold, and no exposures that would exceed the onset of massive lung injury or mortality threshold (Table 3.9-21).

Sea otters are predominately near shore species that will only be around San Nicolas Island at the northern edge of the SOCAL Range Complex. In addition, the experimental translocated population is very small (approximately 29 animals). The implementation of mitigation measures to reduce exposure to high levels of sonar sound, and the short duration and intermittent exposure to sonar, reduces the likelihood that exposure to MFA/HFA sonar sound would cause a behavioral response that may affect vital functions (reproduction or survival), TTS, or PTS.

Based on the model results, behavioral patterns, acoustic abilities of sea otters, 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 sea otters and are not likely to adversely affect sea otters. It is unlikely that SOCAL Range Complex training would result in any death or injury to sea otters.

Bryde's Whale

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 3.9-20). 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.

Without consideration of clearance procedures, there would be no exposures from impulsive sound or pressures from underwater detonations that would exceed the behavioral harassment threshold, no exposures that would exceed the TTS threshold, none that would exceed the onset of slight injury threshold, and no exposures that would exceed the onset of massive lung injury or mortality threshold (Table 3.9-21).

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. The implementation of mitigation measures to reduce exposure to high levels of sonar sound, and the short duration and intermittent exposure to sonar, reduces the likelihood that exposure to MFA/HFA sonar sound would cause a behavioral response that may affect vital functions (reproduction or survival), TTS, or PTS.

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

The risk function and Navy post-modeling analysis estimates 4,906 gray whales will exhibit behavioral responses NMFS will classify as harassment under the MMPA (Table 4-28). Modeling also indicates there would be 544 exposures to accumulated acoustic energy above 195 dB re 1 μPa2-s, which is the threshold established indicative of onset TTS. One gray whale would be exposed to sound levels that could cause PTS.

Without consideration of clearance procedures, there would be six exposures from impulsive sound or pressures from underwater detonations that would exceed the behavioral harassment threshold, seven exposures that would exceed the TTS threshold, none that would exceed the onset of slight injury threshold, and no exposures that would exceed the onset of massive lung injury or mortality threshold (Table 3.9-21).

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. The implementation of mitigation measures to reduce exposure to high levels of sonar sound, and the short duration and intermittent exposure to sonar, reduces the likelihood that exposure to MFA/HFA sonar sound would cause a behavioral response that may affect vital functions (reproduction or survival), TTS, or PTS.

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

The risk function and Navy post-modeling analysis estimates 113 minke whales will exhibit behavioral responses NMFS will classify as harassment under the MMPA (Table 3.9-20). Modeling also indicates there would be 16 exposures to accumulated acoustic energy above 195 dB re 1 μPa2-s, which is the threshold established indicative of onset TTS. No minke 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 behavioral harassment threshold, no exposures that would exceed the TTS threshold, none that would exceed the onset

of slight injury threshold, and no exposures that would exceed the onset of massive lung injury or mortality threshold (Table 3.9-21).

Minke whales are difficult to spot visually but can be detected using passive acoustic monitoring. The implementation of mitigation measures to reduce exposure to high levels of sonar sound, and the short duration and intermittent exposure to sonar, reduces the likelihood that exposure to MFA/HFA sonar sound would cause a behavioral response that may affect vital functions (reproduction or survival), TTS, or PTS.

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

The risk function and Navy post-modeling analysis estimates 15 Baird's beaked whales will exhibit behavioral responses NMFS will classify as harassment under the MMPA (Table 3.9-20). Modeling also indicates there would be one exposure to accumulated acoustic energy above 195 dB re 1 μPa2-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.

Without consideration of clearance procedures, there would be no exposures from impulsive sound or pressures from underwater detonations that would exceed the behavioral harassment threshold, no exposures that would exceed the TTS threshold, none that would exceed the onset of slight injury threshold, and no exposures that would exceed the onset of massive lung injury or mortality threshold (Table 3.9-21).

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). The implementation of mitigation measures to reduce exposure to high levels of sonar sound, and the short duration and intermittent exposure to sonar, reduces the likelihood that exposure to MFA/HFA sonar sound would cause a behavioral response that may affect vital functions (reproduction or survival), TTS, or PTS.

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 (Offshore)

The risk function and Navy post-modeling analysis estimates 1,294 bottlenose dolphins will exhibit behavioral responses NMFS will classify as harassment under the MMPA (Table 3.9-20). Modeling also indicates there would be 194 exposures to accumulated acoustic energy above 195 dB re 1 μPa2-s, which is the threshold established indicative of onset TTS. No bottlenose dolphins would be exposed to sound levels that could cause PTS.

Without consideration of clearance procedures, there would be 14 exposures from impulsive sound or pressures from underwater detonations that would exceed the behavioral harassment threshold, 10 exposures that would exceed the TTS threshold, none that would exceed the onset of slight injury threshold, and no exposures that would exceed the onset of massive lung injury or mortality threshold (Table 3.9-21).

Given the frequent surfacing, aggregation of approximately nine 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. The implementation of mitigation measures to reduce exposure to high levels of sonar sound, and the short duration and intermittent exposure to sonar, reduces the likelihood that exposure to MFA/HFA sonar sound would cause a behavioral response that may affect vital functions (reproduction or survival), TTS, or PTS.

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

The risk function and Navy post-modeling analysis estimates 386 Cuvier's beaked whales will exhibit behavioral responses NMFS will classify as harassment under the MMPA (Table 3.9-20). Modeling also indicates there would be 37 exposures to accumulated acoustic energy above 195 dB re 1 μPa2-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.

Without consideration of clearance procedures, there would be five exposures from impulsive sound or pressures from underwater detonations that would exceed the behavioral harassment threshold, three exposures that would exceed the TTS threshold, none that would exceed the onset of slight injury threshold, and no exposures that would exceed the onset of massive lung injury or mortality threshold (Table 3.9-21).

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). The implementation of mitigation measures to reduce exposure to high levels of sonar sound, and the short duration and intermittent exposure to sonar, reduces the likelihood that exposure to MFA/HFA sonar sound would cause a behavioral response that may affect vital functions (reproduction or survival), TTS, or PTS.

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

The risk function and Navy post-modeling analysis estimates 533 Dall's porpoises will exhibit behavioral responses NMFS will classify as harassment under the MMPA (Table 3.9-20). Modeling also indicates there would be 88 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.

Without consideration of clearance procedures, there would be two exposures from impulsive sound or pressures from underwater detonations that would exceed the behavioral harassment threshold, two exposures that would exceed the TTS threshold, none that would exceed the onset of slight injury threshold, and no exposures that would exceed the onset of massive lung injury or mortality threshold (Table 3.9-21).

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. The implementation of mitigation measures to reduce exposure to high levels of sonar sound, and the short duration and intermittent exposure to sonar, reduces the likelihood that exposure to MFA/HFA sonar sound would cause a behavioral response that may affect vital functions (reproduction or survival), TTS, or PTS.

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

The risk function and Navy post-modeling analysis estimates nine killer whales will exhibit behavioral responses NMFS will classify as harassment under the MMPA (Table 3.9-20). Modeling also indicates there would be one exposure to accumulated acoustic energy above 195 dB re 1 μPa2-s, which is the threshold established indicative of onset TTS. No killer 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 behavioral harassment threshold, no exposures that would exceed the TTS threshold, none that would exceed the onset of slight injury threshold, and no exposures that would exceed the onset of massive lung injury or mortality threshold (Table 3.9-21).

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. The implementation of mitigation measures to reduce exposure to high levels of sonar sound, and the short duration and intermittent exposure to sonar, reduces the likelihood that exposure to MFA/HFA sonar sound would cause a behavioral response that may affect vital functions (reproduction or survival), TTS, or PTS.

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

The risk function and Navy post-modeling analysis estimates 4,086 long beaked common dolphin will exhibit behavioral responses NMFS will classify as harassment under the MMPA (Table 3.9-20). Modeling also indicates there would be 435 exposures to accumulated acoustic energy above 195 dB re 1 μPa2-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.

Without consideration of clearance procedures, there would be 61 exposures from impulsive sound or pressures from underwater detonations that would exceed the behavioral harassment threshold, 41 exposures that would exceed the TTS threshold, one that would exceed the onset of slight injury threshold, and no exposures that would exceed the onset of massive lung injury or mortality threshold (Table 3.9-21).

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. The implementation of mitigation measures to reduce exposure to high levels of sonar sound, and the short duration and intermittent exposure to sonar, reduces the likelihood that exposure to MFA/HFA sonar sound would cause a behavioral response that may affect vital functions (reproduction or survival), TTS, or PTS.

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

The risk function and Navy post-modeling analysis estimates 118 Mesoplodont whales will exhibit behavioral responses NMFS will classify as harassment under the MMPA (Table 3.9-20). Modeling also indicates there would be 13 exposures to accumulated acoustic energy above 195 dB re 1 μPa2-s, which is the threshold established indicative of onset TTS. No Mesoplodont whales would be exposed to sound levels that could cause PTS.

Without consideration of clearance procedures, there would be two exposures from impulsive sound or pressures from underwater detonations that would exceed the behavioral harassment threshold, one exposure that would exceed the TTS threshold, none that would exceed the onset of slight injury threshold, and no exposures that would exceed the onset of massive lung injury or mortality threshold (Table 3.9-21).

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). The implementation of mitigation measures to reduce exposure to high levels of sonar sound, and the short duration and intermittent exposure to sonar, reduces the likelihood that exposure to MFA/HFA sonar sound would cause a behavioral response that may affect vital functions (reproduction or survival), TTS, or PTS.

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

The risk function and Navy post-modeling analysis estimates 1,343 northern right whale dolphins will exhibit behavioral responses NMFS will classify as harassment under the MMPA (Table 3.9-20). Modeling also indicates there would be 169 exposures to accumulated acoustic energy above 195 dB re 1 μPa2-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.

Without consideration of clearance procedures, there would be 19 exposures from impulsive sound or pressures from underwater detonations that would exceed the behavioral harassment threshold, 12 exposures that would exceed the TTS threshold, none that would exceed the onset of slight injury threshold, and no exposures that would exceed the onset of massive lung injury or mortality threshold (Table 3.9-21).

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. The implementation of mitigation measures to reduce exposure to high levels of sonar sound, and the short duration and intermittent exposure to sonar, reduces the likelihood that exposure to MFA/HFA sonar sound would cause a behavioral response that may affect vital functions (reproduction or survival), TTS, or PTS.

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

The risk function and Navy post-modeling analysis estimates 1,187 Pacific white-sided dolphin will exhibit behavioral responses NMFS will classify as harassment under the MMPA (Table 3.9-20). Modeling also indicates there would be 192 exposures to accumulated acoustic energy above 195 dB re 1 μPa2-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.

Without consideration of clearance procedures, there would be 12 exposures from impulsive sound or pressures from underwater detonations that would exceed the behavioral harassment threshold, nine exposures that would exceed the TTS threshold, none that would exceed the onset of slight injury threshold, and no exposures that would exceed the onset of massive lung injury or mortality threshold (Table 3.9-21).

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. The implementation of mitigation measures to reduce exposure to high levels of sonar sound, and the short duration and intermittent exposure to sonar, reduces the likelihood that exposure to MFA/HFA sonar sound would cause a behavioral response that may affect vital functions (reproduction or survival), TTS, or PTS.

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

The risk function and Navy post-modeling analysis estimates 144 pygmy sperm whales will exhibit behavioral responses NMFS will classify as harassment under the MMPA (Table 3.9-20). Modeling also indicates there would be 16 exposures to accumulated acoustic energy above 195 dB re 1 μPa2-s, which is the threshold established indicative of onset TTS. No pygmy sperm whales 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 behavioral harassment threshold, one exposure that would exceed the TTS threshold, none that would exceed the onset of slight injury threshold, and no exposures that would exceed the onset of massive lung injury or mortality threshold (Table 3.9-21).

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. The implementation of mitigation measures to reduce exposure to high levels of sonar sound, and the short duration and intermittent exposure to sonar, reduces the likelihood that exposure to MFA/HFA sonar sound would cause a behavioral response that may affect vital functions (reproduction or survival), TTS, or PTS.

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

The risk function and Navy post-modeling analysis estimates 3,160 Risso's dolphins will exhibit behavioral responses NMFS will classify as harassment under the MMPA (Table 3.9-20). Modeling also indicates there would be 343 exposures to accumulated acoustic energy above 195 dB re 1 μPa2-s, which is the threshold established indicative of onset TTS. No Risso's dolphins would be exposed to sound levels that could cause PTS.

Without consideration of clearance procedures, there would be 57 exposures from impulsive sound or pressures from underwater detonations that would exceed the behavioral harassment threshold, 34 exposures that would exceed the TTS threshold, one that would exceed the onset of slight injury threshold, and no exposures that would exceed the onset of massive lung injury or mortality threshold (Table 3.9-21).

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. The implementation of mitigation measures to reduce exposure to high levels of sonar sound, and the short duration and intermittent exposure to sonar, reduces the likelihood that exposure to MFA/HFA sonar sound would cause a behavioral response that may affect vital functions (reproduction or survival), TTS, or PTS.

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

The risk function and Navy post-modeling analysis estimates 34,832 short-beaked common dolphins will exhibit behavioral responses NMFS will classify as harassment under the MMPA (Table 3.9-20). Modeling also indicates there would be 3,730 exposures to accumulated acoustic energy above 195 dB re 1 μPa2-s, which is the threshold established indicative of onset TTS. Six short-beaked common dolphins would be exposed to sound levels that could cause PTS.

Without consideration of clearance procedures, there would be 528 exposures from impulsive sound or pressures from underwater detonations that would exceed the behavioral harassment threshold, 354 exposures that would exceed the TTS threshold, 12 that would exceed the onset of slight injury threshold, and four exposures that would exceed the onset of massive lung injury or mortality threshold (Table 3.9-21).

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. The implementation of mitigation measures to reduce exposure to high levels of sonar sound, and the short duration and intermittent exposure to sonar, reduces the likelihood that exposure to MFA/HFA sonar sound would cause a behavioral response that may affect vital functions (reproduction or survival), TTS, or PTS.

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

The risk function and Navy post-modeling analysis estimates 42 short-finned pilot whales will exhibit behavioral responses NMFS will classify as harassment under the MMPA (Table 3.9-20). Modeling also indicates there would be six exposures to accumulated acoustic energy above 195 dB re 1 μPa2-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.

Without consideration of clearance procedures, there would be no exposures from impulsive sound or pressures from underwater detonations that would exceed the behavioral harassment threshold, no exposures that would exceed the TTS threshold, none that would exceed the onset of slight injury threshold, and no exposures that would exceed the onset of massive lung injury or mortality threshold (Table 3.9-21).

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. The implementation of mitigation measures to reduce exposure to high levels of sonar sound, and the short duration and intermittent exposure to sonar, reduces the likelihood that exposure to MFA/HFA sonar sound would cause a behavioral response that may affect vital functions (reproduction or survival), TTS, or PTS.

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

The risk function and Navy post-modeling analysis estimates 1,572 striped dolphins will exhibit behavioral responses NMFS will classify as harassment under the MMPA (Table 3.9-20). Modeling also indicates there would be 249 exposures to accumulated acoustic energy above 195 dB re 1 μPa2-s, which is the threshold established indicative of onset TTS. One striped dolphin would be exposed to sound levels that could cause PTS.

Without consideration of clearance procedures, there would be six exposures from impulsive sound or pressures from underwater detonations that would exceed the behavioral harassment threshold, six exposures that would exceed the TTS threshold, none that would exceed the onset of slight injury threshold, and no exposures that would exceed the onset of massive lung injury or mortality threshold (Table 3.9-21).

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. The implementation of mitigation measures to reduce exposure to high levels of sonar sound, and the short duration and intermittent exposure to sonar, reduces the likelihood that exposure to MFA/HFA sonar sound would cause a behavioral response that may affect vital functions (reproduction or survival), TTS, or PTS.

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

The risk function and Navy post-modeling analysis estimates 89 Ziphiid whales will exhibit behavioral responses NMFS will classify as harassment under the MMPA (Table 3.9-20). Modeling also indicates there would be eight exposures to accumulated acoustic energy above 195 dB re 1 μPa2-s, which is the threshold established indicative of onset TTS. No Ziphiid whales would be exposed to sound levels that could cause PTS.

Without consideration of clearance procedures, there would be two exposures from impulsive sound or pressures from underwater detonations that would exceed the behavioral harassment threshold, one exposure that would exceed the TTS threshold, none that would exceed the onset of slight injury threshold, and no exposures that would exceed the onset of massive lung injury or mortality threshold (Table 3.9-21).

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). The implementation of mitigation measures to reduce exposure to high levels of sonar sound, and the short duration and intermittent exposure to sonar, reduces the likelihood that exposure to MFA/HFA sonar sound would cause a behavioral response that may affect vital functions (reproduction or survival), TTS, or PTS.

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

The risk function and Navy post-modeling analysis estimates 833 northern elephant seals will exhibit behavioral responses NMFS will classify as harassment under the MMPA (Table 3.9-20). Modeling also indicates there would be five exposures to accumulated acoustic energy above 204 dB re 1 μPa2-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.

Without consideration of clearance procedures, there would be 76 exposures from impulsive sound or pressures from underwater detonations that would exceed the behavioral harassment threshold, 41 exposures that would exceed the TTS threshold, none that would exceed the onset of slight injury threshold, and no exposures that would exceed the onset of massive lung injury or mortality threshold (Table 3.9-21).

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). The implementation of mitigation measures to reduce exposure to high levels of sonar sound, and the short duration and intermittent exposure to sonar, reduces the likelihood that exposure to MFA/HFA sonar sound would cause a behavioral response that may affect vital functions (reproduction or survival), TTS, or PTS.

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

The risk function and Navy post-modeling analysis estimates 1,048 Pacific harbor seals will exhibit behavioral responses NMFS will classify as harassment under the MMPA (Table 3.9-20). Modeling also indicates there would be 4,562 exposures to accumulated acoustic energy above 183 dB re 1 μPa2-s, which is the threshold established indicative of onset TTS for Pacific harbor seals. Nine Pacific harbor seals would be exposed to sound levels that could cause PTS.

Without consideration of clearance procedures, there would be 26 exposures from impulsive sound or pressures from underwater detonations that would exceed the behavioral harassment threshold, 26 exposures that would exceed the TTS threshold, one that would exceed the onset of slight injury threshold, and no exposures that would exceed the onset of massive lung injury or mortality threshold (Table 3.9-21).

Harbor seals forage near their rookeries (usually within 27 nm [50 km]) therefore they tend to remain in the Southern California area most of the time in comparison to northern elephant seals. The implementation of mitigation measures to reduce exposure to high levels of sonar sound, and the short duration and intermittent exposure to sonar, reduces the likelihood that exposure to MFA/HFA sonar sound would cause a behavioral response that may affect vital functions (reproduction or survival), TTS, or PTS.

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

The risk function and Navy post-modeling analysis estimates 54,380 California sea lions will exhibit behavioral responses NMFS will classify as harassment under the MMPA (Table 3.9-20). Modeling also indicates there would be six exposures to accumulated acoustic energy above 206 dB re 1 μPa2-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.

Without consideration of clearance procedures, there would be 584 exposures from impulsive sound or pressures from underwater detonations that would exceed the behavioral harassment threshold, 510 exposures that would exceed the TTS threshold, 16 that would exceed the onset of slight injury threshold, and six exposures that would exceed the onset of massive lung injury or mortality threshold (Table 3.9-21).

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. The implementation of mitigation measures to reduce exposure to high levels of sonar sound, and the short duration and intermittent exposure to sonar, reduces the likelihood that exposure to MFA/HFA sonar sound would cause a behavioral response that may affect vital functions (reproduction or survival), TTS, or PTS.

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

The risk function and Navy post-modeling analysis estimates 1,072 northern fur seals will exhibit behavioral responses NMFS will classify as harassment under the MMPA (Table 3.9-20). 9Modeling also indicates there would be three exposures to accumulated acoustic energy above

195 dB re 1 μPa2-s, which is the threshold established indicative of onset TTS. 9No northern fur seals would be exposed to sound levels that could cause PTS.

Without consideration of clearance procedures, there would be 90 exposures from impulsive sound or pressures from underwater detonations that would exceed the behavioral harassment threshold, 64 exposures that would exceed the TTS threshold, three that would exceed the onset of slight injury threshold, and one exposure that would exceed the onset of massive lung injury or mortality threshold (Table 3.9-21).

Northern fur seals make short duration dives and often rest at the surface (Antonelis et al. 1990) making them easier to detect. The implementation of mitigation measures to reduce exposure to high levels of sonar sound, and the short duration and intermittent exposure to sonar, reduces the likelihood that exposure to MFA/HFA sonar sound would cause a behavioral response that may affect vital functions (reproduction or survival), TTS, or PTS.

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.

3.9.10 Mitigation Measures

The Navy has implemented a comprehensive suite of mitigation measures to 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 MMPA, it may be necessary for NMFS to require additional mitigation or monitoring measures beyond those addressed in this EIS/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's 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 suite of measures developed to date as a result of those MMPA processes are included and analyzed as part of this section.

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. U.S. participants are required to comply with these measures. Non-U.S. participants involved in events within the territorial seas of the U.S. (12 nm) are requested to comply with these measures to the extent these measures do not conflict with Status Of Forces agreements. Non-U.S. participants involved in events beyond the territorial seas (12 nm) are encouraged to comply with these mitigation measures to the extent the measures do not impair training, operations, or operational capabilities.

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 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 online at https://portal.navfac.navy.mil/go/msat. All bridge lookouts will complete both parts one and two of the MSAT; part two is optional for other personnel. Part I of 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. Part II focuses on identification of specific 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-D).
- 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 and 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 mid-frequency active sonar, 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-D).
- After sunset and prior to sunrise, lookouts will employ Night Lookouts Techniques in accordance with the Lookout Training Handbook. (NAVEDTRA 12968-D)
- 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 marine mammals 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 a safe distance from any observed marine mammal and avoid approaching them 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.
- 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.

3.9.10.2 Measures for Specific Training Events

3.9.10.2.1 Mid-Frequency Active Sonar

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 ([NAVEDTRA], 12968-D).
- 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-D).
- After sunset and prior to sunrise, lookouts will employ Night Lookouts Techniques in accordance with the Lookout Training Handbook. Application of these techniques, which include the use of night vision goggles, allow lookouts to effectively monitor a 1,100-yd (1,000-m) safety zone at night.
- 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 yd (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 yd (914 m) of the sonar dome (the bow), the ship or submarine will limit active transmission levels to at least 6 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 that is 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 1,000 yd (914 m) beyond the location of the last detection.
- Should a marine mammal be detected within or closing to inside 500 yd (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 1,000 yd (914 m) beyond the location of the last detection.
- Should the marine mammal be detected within or closing to inside 200 yd (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 1,000 yd (914 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 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.
- Active 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 yd (183 m) of a marine mammal and shall cease pinging if a marine mammal closes within 200 yd (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 will be practiced 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 1,093.6 ft (1,000 m) depth near a shoreline where there is a rapid change in bathymetry on the order of 1,000-6,000 yd (914-5486 m) occurring across a relatively short horizontal distance (e.g., 5 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 (64.8 km) and at least 10 nm (18.5 km) 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 ft [30.5 m]).

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 marine 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 postexercise 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 (up to 5-in. 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 yd (585 m) of known or observed floating weeds and kelp, and algal mats.
- A 600-yd radius buffer zone will be established around the intended target.
- From the intended firing position, 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.
- When manned, 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.

3.9.10.2.3 Surface-to-Surface Gunnery (nonexplosive 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 yd (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, 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.
- When manned, 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 nonexplosive 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.
- When manned, 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 nonexplosive 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 yd (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 ft to 1,500 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 nonexplosive 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, or 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, lookouts will survey for floating kelp, which may be inhabited by immature sea turtles. Ordnance shall not be targeted to impact within 1,000 yd (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 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 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 (nonexplosive bombs and cluster munitions, rockets)

- If surface vessels are involved, 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 yd (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 nonexplosive)

- Ordnance shall not be targeted to impact within 1,800 yd (1646 m) of known or observed floating kelp, which may be inhabited by immature sea turtles.
- 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 ft (457 m) 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 yd (1646 m) of sighted marine mammals and sea turtles.

3.9.10.2.10Underwater 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 TTS, 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-yd arc radius around the detonation site.

Preexercise 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 marine mammal and sea turtle observations during the exercise as well as measures taken if species are detected within the exclusion zone.

Postexercise 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.

3.9.10.2.11 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.

3.9.10.2.12 Sinking Exercise

The selection of sites suitable for SINKEXs involves a balance of operational suitability, requirements established under the Marine Protection, Research, and Sanctuaries Act (MPRSA) permit granted to the Navy (40 C.F.R. § 229.2), and the identification of areas with a low likelihood of encountering marine mammals. 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 yd/2742 m) deep and at least 50 nm from land.

In general, most marine mammals 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.

Sinking Exercise Range Clearance Plan

The Navy has developed range clearance procedures to maximize the probability of sighting any ships or marine mammals 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.
- An exclusion zone with a radius of 1.0 nm (1.85 km) would be established around each target. This exclusion zone is based on calculations using a 990-lb H6 net explosive weight high explosive source detonated 5 ft (1.5 m) below the surface of the water, which yields a distance of 0.85 nm (1.57 km) (cold season) and 0.89 nm (1.64 km) (warm season) beyond which the received level is below the 182-dB re: 1 micropascal squared-seconds (μPa^2-s) threshold established for the WINSTON S. CHURCHILL (DDG 81) shock trials (U.S. Navy, 2001). An additional buffer of 0.5 nm (0.93 km) 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 (1.85 km) out an additional 0.5 nm (0.93 km), would be surveyed. Together, the zones extend out 2 nm (3.7 km) 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.
  - If a marine mammal is 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.
  - During breaks in the exercise of 30 minutes or more, the exclusion zone would again be surveyed for any marine mammal. If marine mammals 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 marine mammals 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 event that any marine mammals 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 National Oceanographic and Atmospheric

Administration (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.

San Clemente Island Very Shallow Water Underwater Detonations Mitigation Measures

- For each exercise, the safety-boat with an observer is launched 30 or more minutes prior to detonation and moves through the area around the detonation site. The task of the safety observer is to augment a shore observer's visual search of the mitigation zone for marine mammals and turtles. The safety-boat observer is in constant radio communication with the exercise coordinator and shore observer.
- At least 10 minutes prior to the planned initiation of the detonation event-sequence, the shore observer, on an elevated on-shore position, begins a continuous visual search with binoculars of the mitigation zone. At this time, the safety-boat observer informs the shore observer if any marine mammal or turtle has been seen in the zone and, together, both search the surface within and beyond the mitigation zone for marine mammals and turtles.
- The shore observer will indicate that the area is clear of animals after 10 or more minutes of continuous observation with no marine mammals or turtles having been seen in the mitigation zone or moving toward it.
- The observer will indicate that the area is not clear of animals any time a marine mammal or turtle is sighted in the mitigation zone or moving toward it and, subsequently, indicate that the area is clear of animals when the animal is out and moving away and no others have been sited.
- Initiation of the detonation sequence will only begin on receipt of an indication from the shore observer that the area is clear of animals and will be postponed on receipt of an indication from that observer that the area is not clear of animals.
- Following the detonation, visual monitoring of the mitigation zone continues for 30 minutes for the appearance of any marine mammal or turtle in the zone. Any marine mammal or sea turtle appearing in the area will be observed for signs of possible injury. Possibly injured marine mammals or turtles are reported to the Commander, Naval Region Southwest Environmental Director and the San Diego Detachment office of Commander, Pacific Fleet.

3.9.10.2.13 Mitigation Measures Related to Explosive Source Sonobuoys (AN/SSQ-110A)

AN/SSQ-110A Pattern Deployment

- Crews will conduct visual reconnaissance of the drop area prior to laying their intended sonobuoy pattern. This search should be conducted below 1,500 ft (152 m) at a slow speed when operationally feasible and weather conditions permit. In dual aircraft operations, crews may 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 (source/receiver sonobuoy pair) detonation. This 30-minute observation period may include pattern deployment time.

- For any part of the briefed pattern where a post will be deployed within 1,000 yd (914 m) of observed marine mammal activity, crews will deploy the receiver ONLY and monitor while conducting a visual search. When marine mammals are no longer detected within 1000 yd (914 m) of the intended post position, crews will collocate the AN/SSQ-110A sonobuoy (source) with the receiver.
- When operationally feasible, crews will conduct continuous visual and aural monitoring of marine mammal activity, including monitoring of their aircraft sensors from first sensor placement to checking off-station and out of radio frequency (RF) range of the sensors.

AN/SSQ-110A Pattern Employment

- Aural Detection:
  - Aural detection of marine mammals cues the aircrew to increase the diligence of their visual surveillance.
  - If, following aural detection, no marine mammals are visually detected, then the crew may continue multistatic active search.
- Visual Detection:
  - If marine mammals are visually detected within 1,000 yd (914 m) of the AN/SSQ-110A sonobuoy 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 30 minutes or are observed to have moved outside the 1,000-yd (914-m) safety zone.
  - Aircrews may shift their multi-static active search to another post, where marine mammals are outside the 1000 yd safety zone.

AN/SSQ-110A Scuttling Sonobuoys

- 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 a 1,000-yd (914-m) safety zone, 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 method or tertiary method.
- Aircrews ensure all payloads are accounted for. Sonobuoys that cannot be scuttled shall be reported as unexploded ordnance via voice communications while airborne and, upon landing, via Naval message.
- Mammal monitoring shall continue until out of their aircraft sensor range.

3.9.10.3 Conservation Measures

3.9.10.3.1 Proposed Monitoring Plan for the SOCAL Range Complex

The Navy has submitted a draft Monitoring Plan for the SOCAL Range Complex, which may be viewed at NMFS' Web site: *http:// www.nmfs.noaa.gov/pr/permits/incidental.htm*. NMFS and the Navy have worked together on the development of this plan in the months preceding the publication of this Final EIS/OEIS; however, Navy and NMFS are still refining the plan and anticipate that it will contain more details by the time it is finalized in advance of the issuance of the Record of Decision. Additionally, the plan may be modified or supplemented based on comments or new information received from the public. A summary of the primary components of the plan follows.

The draft Monitoring Plan for SOCAL has been designed as a collection of focused ‘‘studies’’ (described fully in the SOCAL draft Monitoring Plan) to gather data that will allow the Navy to address the following questions:

- Are marine mammals exposed to MFA sonar, especially at levels associated with adverse effects (i.e., based on NMFS' criteria for behavioral harassment, TTS, or PTS)? If so, at what levels are they exposed?
- If marine mammals are exposed to MFA sonar in the SOCAL Range Complex, do they redistribute geographically as a result of continued exposure? If so, how long does the redistribution last?
- If marine mammals are exposed to MFA sonar, what are their behavioral responses to various levels?
- Is the Navy's suite of mitigation measures for MFA sonar (e.g., measures agreed to by the Navy through permitting) effective at avoiding TTS, injury, and mortality of marine mammals?

Data gathered in these studies will be collected by qualified, professional marine mammal biologists that are experts in their field. They will use a combination of the following methods to collect data:

- Contracted vessel and aerial surveys.
- Passive acoustics.
- Marine mammal observers on Navy ships.

In the five proposed study designs (all of which cover multiple years), the above methods will be used separately or in combination to monitor marine mammals in different combinations before, during, and after training activities utilizing MFA sonar/HFA sonar.

This monitoring plan has been designed to gather data on all species of marine mammals that are observed in SOCAL. The Plan recognizes that deep-diving and cryptic species of marine mammals such as beaked whales have a low probability of detection (Barlow and Gisiner, 2006). Therefore, methods will be utilized to attempt to address this issue (e.g., passive acoustic monitoring).

In addition to the Monitoring Plan for SOCAL, by the end of 2009, the Navy will have completed an Integrated Comprehensive Monitoring Program (ICMP). The ICMP will provide the overarching structure and coordination that will, over time, compile data from both range specific monitoring plans (such as AFAST, the Hawaii Range Complex, and the SOCAL Range Complex) as well as Navy funded research and development (R&D) studies. The primary objectives of the ICMP are to:

- Monitor Navy training events, particularly those involving MFA sonar and underwater detonations, for compliance with the terms and conditions of ESA Section 7 consultations or MMPA authorizations;
- Collect data to support estimating the number of individuals exposed to sound levels above current regulatory thresholds;
- Assess the efficacy of the Navy's current marine species mitigation;
- Add to the knowledge base on potential behavioral and physiological effects to marine species from mid-frequency active sonar and underwater detonations; and,
- Assess the practicality and effectiveness of a number of mitigation tools and techniques (some not yet in use).

More information about the ICMP may be found in the draft Monitoring Plan for SOCAL.

3.9.10.3.2 Adaptive Management

Adaptive management principles consider appropriate adjustments to mitigation, monitoring, and reporting as the outcomes of the proposed actions and required mitigation are better understood. NMFS includes adaptive management principles in the regulations for the implementation of the proposed action, and any adaptive adjustments of mitigation and monitoring would be led by NMFS via the MMPA process and developed in coordination with the Navy. Continued opportunity for public input would be included via the MMPA process, as appropriate (i.e. via the "Letter of Authorization" process). The intent of adaptive management here is to ensure the continued proper implementation of the required mitigation measures, to conduct appropriate monitoring and evaluation efforts, and to recommend possible adjustments to the mitigation/monitoring/reporting to accomplish the established goals of the mitigation and monitoring which include:

Mitigation

- Avoidance or minimization of injury or death of marine mammals wherever possible (goals b, c, and d may contribute to this goal).
- A reduction in the numbers of marine mammals (total number or number at biologically important time or location) exposed to received levels of sound associated with the proposed active sonar activities,
- A reduction in the number of times (total number or number at biologically important time or location) individuals would be exposed to received levels,
- A reduction in the intensity of exposures (either total number or number at biologically important time or location) to received levels
- A reduction in effects to marine mammal habitat, paying special attention to the food base, activities that block or limit passage to or from biologically important areas, permanent destruction of habitat, or temporary destruction/disturbance of habitat during a biologically important time.
- For monitoring directly related to mitigation - an increase in the probability of detecting marine mammals, thus allowing for more effective implementation of the mitigation measures (shut-down zone, etc.).

Monitoring

- An increase in the probability of detecting marine mammals, both within the safety zone (thus allowing for more effective implementation of the mitigation) and in general to generate more data to contribute to the effects analyses.
- An increase in our understanding of how many marine mammals are likely to be exposed to levels of MFA sonar/HFA sonar (or explosives or other stimuli) that we associate with specific adverse effects, such as behavioral harassment, TTS, or PTS.
- An increase in our understanding of how marine mammals respond to MFA sonar/HFA sonar (at specific received levels), explosives, or other stimuli expected to result in take and how anticipated adverse effects on individuals (in different ways and to varying degrees) may impact the population, species, or stock (specifically through effects on annual rates of recruitment or survival)
- An increased knowledge of the affected species
- An increase in our understanding of the effectiveness of certain mitigation and monitoring measures

Generally speaking, adaptive management supports the integration of NEPA's principles into the ongoing implementation and management of the Proposed Action, including a process for improving, where needed, the effectiveness of the identified mitigations. Note that any adjustment of mitigation and monitoring would be within the scope of the environmental analyses and considerations presented in this EIS/OEIS.

3.9.10.3.3 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 70 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,
- Nonauditory 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.

3.9.10.3.4 Stranding Response Plan for Major Navy Training Exercises in the SOCAL Range Complex

NMFS and the Navy have developed a draft Stranding Response Plan for Major Exercises in the SOCAL Range Complex (available at: *http:// www.nmfs.noaa.gov/pr/permits/incidental.htm*). Pursuant to 50 CFR Section 216.105, the plan will be included as part of (attached to) the Navy's MMPA Letter of Authorization (LOA), which contains the conditions under which the Navy is authorized to take marine mammals pursuant to training activities involving MFA sonar/HFA sonar or explosives in the SOCAL Range Complex. The Stranding Response plan is specifically intended to outline the applicable requirements the authorization is conditioned upon in the event that a marine mammal stranding is reported in the SOCAL Range Complex during a major training exercise. As mentioned above, NMFS considers all plausible causes within the course of a stranding investigation and this plan in no way presumes that any strandings that could occur in the SOCAL Range Complex are related to, or caused by, Navy training activities, absent a determination made in a Phase 2 Investigation as outlined in the plan, indicating that MFA sonar or explosive detonation in the SOCAL Range Complex were a cause of the stranding. This plan is designed to address the following three issues:

- Mitigation—When marine mammals are in a situation that can be defined as a stranding, they are experiencing physiological stress. When animals are stranded, and alive, NMFS believes that exposing these compromised animals to additional known stressors would likely exacerbate the animal's distress and could potentially cause its death. Regardless of the factor(s) that may have initially contributed to the stranding, it is NMFS' goal to avoid exposing these animals to further stressors. Therefore, when live stranded cetaceans are in the water and engaged in what is classified as an Uncommon Stranding Event (USE), the shutdown component of this plan is intended to minimize the exposure of those animals to MFA sonar and explosive detonations, regardless of whether or not these activities may have initially played a role in the event.

- Monitoring—This plan will enhance the understanding of how MFA sonar/HFA sonar or underwater detonations (as well as other environmental conditions) may, or may not, be associated with marine mammal injury or strandings. Additionally, information gained from the investigations associated with this plan may be used in the adaptive management of mitigation or monitoring measures in subsequent LOAs, if appropriate.
- Compliance—The information gathered pursuant to this protocol will inform NMFS' decisions regarding compliance with Sections 101(a)(5)(B and C) of the MMPA.

The Stranding Response Plan has several components:

Shutdown Procedures—When an uncommon stranding event occurs during a major exercise in the SOCAL Range Complex, and a live cetacean(s) is in the water exhibiting indicators of distress, NMFS will advise the Navy that they should cease MFA sonar/HFA sonar operation and explosive detonations within 14 nm (26 km) of the live animal involved in the USE (NMFS and Navy will maintain a dialogue, as needed, regarding the identification of the USE and the potential need to implement shutdown procedures). This distance is the approximate distance at which sound from the active sonar sources is anticipated to attenuate to 145 dB (SPL). The risk function predicts that less than 1 percent of the animals exposed to active sonar at this level (mysticete or odontocete) would respond in a manner that NMFS considers Level B Harassment.

Memorandum of Agreement (MOA)—The Navy and NMFS will develop a MOA, or other mechanism consistent with federal fiscal law requirements (and all other applicable laws), that allows the Navy to assist NMFS with the Phase 1 and 2 Investigations of USEs through the provision of in-kind services, such as (but not limited to) the use of plane/boat/truck for transport of stranding responders or animals, use of Navy property for necropsies or burial, or assistance with aerial surveys to discern the extent of a USE. The Navy may assist NMFS with the Investigations by providing one or more of the in-kind services outlined in the MOA, when available and logistically feasible and when the provision does not negatively affect Fleet operational commitments.

Communication Protocol—Effective communication is critical to the successful implementation of this Stranding Response Plan. Very specific protocols for communication, including identification of the Navy personnel authorized to implement a shutdown and the NMFS personnel authorized to advise the Navy of the need to implement shutdown procedures (NMFS Protected Resources HQ—senior administrators) and the associated phone trees, etc. are currently in development and will be refined and finalized for the Stranding Response Plan prior to the issuance of a final rule (and updated yearly).

Stranding Investigation—The Stranding Response Plan also outlines the way that NMFS plans to investigate any strandings (providing staff and resources are available) that occur during major training exercises in the SOCAL Range Complex.

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 Section 3.9, 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 Department of Defense (DoD). Therefore, 16 additional mitigation measures were analyzed and eliminated from further consideration. These measures and the reasons they were eliminated can be found in Section 5.8.4:

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 Nonacoustic Impacts

Impacts to marine mammals from Navy activities in the SOCAL Range Complex may result from nonacoustic 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 99,809 annual exposures to mid- and high-frequency active sonar that could result in a behavioral change (Level B harassment), 9,658 exposures that could result in TTS (Level B harassment), and 19 annual exposures that could result in injury as PTS. The modeled sonar exposure numbers by species are presented in Table 3.9-12. 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 106,179 annual exposures to mid- and high-frequency active sonar that could result in a behavioral change, 10,265 exposures that could result in TTS (Level B harassment), and 19 annual exposures that could result in injury as PTS. The modeled sonar exposure numbers by species are presented in Table 3.9-16.

Alternative 2—The risk function methodology estimates 112,884 annual exposures to mid- and high-frequency active sonar that could result in a behavioral change, 10,897 exposures that could result in TTS (Level B harassment), and 19 exposures that could result in injury as PTS. The modeled sonar exposure numbers by species are presented in Table 3.9-20.

3.9.11.3 Potential Underwater Detonation Effects

No Action Alternative—Modeling estimates 1,220 annual exposures to pressure from underwater detonations that could result in behavioral harassment (Level B harassment) and 893 annual exposures that 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 3.9-13

Alternative 1—Modeling estimates 1,240 annual exposures to pressure from underwater detonations that could result in behavioral harassment (Level B harassment) and 1,008 annual exposures that could result in TTS (Level B harassment). Thirty 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 3.9-17.

Alternative 2—Modeling estimates 1,499 annual exposures to pressure from underwater detonations could result in behavioral harassment (Level B harassment) and 1,128 annual exposures could result in TTS (Level B harassment). Thirty-four annual exposures could result in slight injury. Eleven annual exposures could result in severe injury or mortality. The modeled explosive exposure numbers by species are presented in Table 3.9-21.

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 short-beaked common dolphins, northern fur seals, and California sea lions (11 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 region 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 of 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 3.9-22 presents a summary of effects and mitigation measures for the No Action, Alternative 1, and Alternative 2.

Table 3.9-22: 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. • Nonacoustic 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. • Nonacoustic 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. • Nonacoustic 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. • Nonacoustic 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. • Nonacoustic 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. • Nonacoustic 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.

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3.10 Sea Birds

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3.10 SEABIRDS

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 nonbreeders 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 (USFWS, 2005a).

Many of the SCB seabird populations roost on islands and offshore rocks around the Channel Islands (Dailey et al. 1993). 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 make 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 (U.S.) 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.

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	*Gavia 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*
black storm-petrel	*Oceanodroma melania*	
least storm-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*	

Table 3.10-1: Seabirds Known to Occur in the SOCAL Range Complex (continued)

Common Name	Genus species	Status
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)

3.10.1.1 Migratory Bird Treaty Act

The MBTA of 1918 (16 U.S. Code [U.S.C.] 703 et seq.) and the Migratory Bird Conservation Act (16 U.S.C. 715–715d, 715e, 715f–715r) of 18 Feb 1929 (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 appear in Title 50, Section 10.13 of the Code of Federal Regulations (C.F.R.) (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; 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, 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 (DoD) 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, sufficiently 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 nonmilitary readiness activities is addressed separately in a Memorandum of Understanding (MOU) developed in accordance with Executive Order (EO) 13186, signed January 10, 2001, “Responsibilities of Federal Agencies to Protect Migratory Birds.” The MOU between DoD and the USFWS was signed on July 31, 2006. DoD responsibilities discussed in the MOU 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 DoD 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 USFWS 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 (Sibley, D.A., 2001). 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 (Unitt, 2004). 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 (Sibley, D.A., 2001). They are strictly pelagic, coming to land only when breeding. In the case of most species of storm-petrels, 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). Storm-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 including the Ashy and Black storm petrel are threatened by human activities like coastal development and the introduction of none native species to island breeding areas (IUCN 2006, Ainley, 1995, Carter, et al. 1992).

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 (SCI) 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 sighted on SCI (Carter et al. 1992). The largest breeding colony of black storm-petrels nest 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 SCI. 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 to 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 Island and SCI in 1999 (Nur et al. 1999), though hundreds are suspected (Carter pers. Comm.). Nearly 1,500 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(Sibley, D.A., 2001). These species winter at sea, mostly in tropical waters. Large numbers migrate south along the California coast (probably most of the arctic breeding population) and winter (October to March) off the west coast of South America, as far south as coastal Chile; largest numbers have been reported from the 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 three 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 islands) 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, which 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 (CDFG), 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 Island for the second time since 1928 (UC Santa Cruz 2006). 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 (DoN) 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 (Section 3.10.2.5).

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 (Section 3.10.2.5).

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 decreased dramatically worldwide as well as in coastal California (Dailey et al. 1993). Black-footed albatross usually remain at least 10.8 to 16.2 nautical miles (nm) (20 to 30 kilometers [km]) offshore during the nonbreeding months (July to 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.

<u>Cormorants (Phalacrocoracidae)</u>

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 historical levels (Weseloh et al. 1999). The breeding population of double-crested cormorants was estimated to be 1,191 individuals on Santa Barbara Island, in 1991 (Carter et al. 1992). Historical 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 5,000 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 historical 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 (*Larus 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 seabird 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.

Thousands of Caspian terns, Forster's terns, least terns, 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. Postbreeding 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 nonnative 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, with the population growing to 32 to 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 given 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 1.62 nm [3 km] 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 (Section 3.10.2.5).

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 primarily utilizes 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 32 to 54 nm (60 to 100 km) 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 5.4 nm (10 km) 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, with 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). Postnesting dispersal is variable, with the Southern California population mostly resident (USFWS 2005a). Cassin's auklet populations in California have declined and several historical colonies have disappeared altogether, mainly from predation (Manuwal and Thorensen 1993). Individuals usually breed at the same nest site in successive years (87 percent 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 the relative importance is of nest-site availability and summer and winter food supply 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 had not nested since the early 1900s (Carter et al. 1992). The largest tufted puffin populations occur along the west coast of the Olympic Peninsula, Washington (Speich and Wahl 1989), but their status there is not well known. Several million of these 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). The total world colony population estimate is 2,970,000 birds, of which 82 percent (2,440,000) breed in North America, only a small proportion of the North American population in California (0.01 percent; 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 sighted 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's 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 postbreeding dispersal. Craveri's murrelet breeding colonies are threatened by oil spills, tanker traffic, and predators introduced to its breeding colonies. Increasing tourism development and commercial fishing fleets also further threaten the species. With an estimated population of 6,000 to 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 to 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 (Section 3.10.2.5).

Xantus's murrelet (*Synthliboramphus hypoleucus*) populations persist in very low numbers throughout their range, with 2,000 to 5,000 of the breeding birds documented in Southern California. A significant portion of the 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 to 30,000 by Springer et al. 1993). Numbers breeding in the largest colony at Santa Barbara Island probably 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 SCI 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 (Section 3.10.2.5).

Rhinoceros auklets (*Cerorhinca monocerata*), medium-sized auks, closely related to the puffins (*Fratercula*), breed 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). The current status of the 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 to 2 million, including prebreeders (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 nonbreeding 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)

Loons are typically referred to as "divers" outside of North America, are large, bulky waterbirds with wingspans that range from 3 to 4 feet. Superficially they resemble certain grebes, or even small geese, but the combination of a dagger-like bill, short neck, long wings, and legs set far back on the body give them a distinctive shape. Loons mainly feed on a wide variety of medium-size fish up to about 10 inches long. Loons hunt primarily from the water's surface, peering down with bill and eyes submerged. Loons prefer to nest on undisturbed lakes from boreal to Arctic zones and typically winter in coastal waters as far south as central Mexico (Sibley, D.A., 2001)

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 54,000 nm^2 (10,000,000 km^2). A large global population is estimated to be 490,000 to 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 to 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 nonbreeding 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.

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 seven 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).

The ashy storm-petrel, Xantus's murrelet, and Cassin's auklet have well-documented, important, isolated breeding populations on Santa Barbara Island. Breeding populations on SCI 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.

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 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 four major breeding colonies. Santa Barbara Island and Los Coronados Islands 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 San Benito Island (*S. h. scrippsi*) and Guadalupe Island (*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 (Section 3.10.1.2.3).

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 historical 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., nonbreeding season) individuals appear to disperse widely throughout the historical range of the temperate and subarctic 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. Historical 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 78.2 nm (144.8 km) 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 0.53 to 1.08 nm (1 to 2 km) 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 200 nm (370 km) 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 1.08 nm (2 km) 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 for Xantus's murrelets 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 9.72 nm (18 km) 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 SCI.

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 of Xantus's murrelets was estimated at 2,000 to 4,000 birds in 1980 and 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 1.08 to 7.6 nm (2 to 14 km) from the island. The number of individuals is also noticeably higher over shelf waters ranging from 131 to 328 feet (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 takeoff point for foraging.

Two confirmed nesting sites for this species are known on SCI: Seal Cove and China Cove. In 1992, 20 individuals were documented during the breeding season on SCI (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 nonbreeding season (June through December), most Xantus's murrelets occur offshore in the warm pelagic waters of the California current. Nonbreeding 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 10.8 and 54 nm (20 and 100 km) 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., Guadalupe Island) 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 16.2 nm (30 km) of the shore (Briggs et al. 1981). The California brown pelican usually breeds on small coastal islands within 16.2 to 27 nm (30 to 50 km) 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 10.8 nm (20 km) of nesting islands during breeding season and up to 40.5 nm (75 km) from the closest land during the nonbreeding season.

Four breeding populations of California brown pelican have been identified: (1) the 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 (UC Santa Cruz 2006). 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. Nonbreeding 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 SCI, Santa Catalina Island, and San Nicolas Island; however, there are no breeding records. Brown pelicans use sea stacks at SCI 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 Operating Area (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 Mexican 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 1.08 nm (2 km) 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 2.7 nm (5 km) of the shore, with most activity in water less than 59 feet (18 m) deep. Researchers report that the California least tern in coastal colonies foraged up to 3.2 nm (6 km) from shore; however, up to 75 percent of foraging occurred within 0.65 nm (1.2 km) 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 33 ft [10 meters] from the pier) and open water (>246 ft [75 m] 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 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 1.08 to 16.2 nm (2 to 30 km) offshore of western Mexico, with the majority sighted less than 9.7 nm (18 km) offshore. Specific spring/fall distribution data offshore of Southern California or fall distribution data off western Baja California, Mexico, were 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, oceangoing vessels, and land-based operations. Currently, the majority of aircraft operations are concentrated at the Naval Auxiliary Landing Field (NALF) SCI. In accordance with Chief of Naval Operations' (OPNAV) Instruction 5090.1C CH-22, the Environmental Division or Natural Resource Section of a Naval Air Station (NAS) 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 (See Terrestrial Biology Section 3.11.4) states that the operators should ensure that the California brown pelican is not in proximity to the overblast 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 (1,111 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 nonnative 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 SCI 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 in this section 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 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 oceangoing 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-foot (ft) (160-meter [m]) distance from nesting or roosting seabirds and also advise a 2,000 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 0.13 nm (0.25 km) 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 Threatened and Endangered 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 likely not 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 BASH 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 SCI NALF in 2002.

3.10.2.2 No Action Alternative

Under the No Action Alternative military training activities and Research, Development, Test, and Evaluation (RDT&E) are performed throughout the SOCAL Range Complex.

3.10.2.2.1 SOCAL Operating Areas

<u>Aviation Operations</u>

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 SCI, San Nicolas Island, and NAS 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 occurs 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 SCI. 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 the seabirds below 1,000 ft (305 m) elevation so they can 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 takeoff 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 0.54 nm (1 km) of 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 SCI. The western gull (*Larus occidentalis*) is documented to breed in relatively low numbers (< 300) on SCI, medium numbers (>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 SCI NALF and in offshore ranges would not have adverse impacts on 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 to effect 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 SCI 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 affected. Breeding colonies of Brandt's cormorants on SCI are comparatively small in relation to the other islands, with only 56 breeding individuals in 1991 (Carter et al. 1992). Potential effects from low flight aircraft training on the west shore of SCI within 0.13 nm (0.25 km) of the island or offshore rocks may have isolated and temporary disturbance effects to individual colonies.

OPAREA 3803 and Shore Bombardment Area (SHOBA) have boundaries that are either adjacent to, or overlap, SCI. Air strikes with birds are recorded and reported as mandated by the Federal Aviation Administration (FAA). A Wildlife Hazard Assessment conducted at NALF SCI 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 Anti-Submarine Warfare (ASW) Tracking Exercise (TRACKEX) flies 544 operations averaging 1.8 hours in duration in the waters near SCI (20 percent) and Helicopter Offshore Training Area (HCOTA) (60 percent), 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 (EC) Exercises (748 exercises), Air Defense Exercises (ADEX) (502 exercises), and Surface-to-Air Gunnery Exercises (GUNEX S-A) (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. Breeding and roosting seabird species, particularly those species that nest or roost on cliffs or offshore rocks, are highly susceptible to human disturbances. The potential to harm or disturb breeding seabirds can come from various sources including: popular coastal area recreational activities such as kayaking, boating and hiking; planes and helicopters; water-based tourism/recreation such as wildlife watching or diving; and fisheries operations that fish or anchor near breeding colonies (NOAA 2006). Artificial nightlighting can also be a problem for several seabird species that are nocturnal in colony or foraging habits. The concern over the potential impacts of artificial lights on seabirds in the Channel Islands arose in 1999 when large increases in artificial light intensity levels associated with night-time squid fishery boat activity extended throughout the seabird breeding season. Breeding seabirds in California susceptible to inflight strikes include Xantus's murrelet, Cassin's auklet, rhinoceros auklet, all of the storm-petrel species (ashy, black, fork-tailed, and Leach's), and the fledgling chicks of tufted puffins. Additionally, California brown pelicans, cormorants, and other seabirds are affected by the ancillary fishing activities. (e.g., vessel proximity, motor noise, generators, lights, human voices, seal bombs, gunshots, radios) of the market squid fishery near roosting and breeding sites (CDFG 2005b). Seabirds attracted to oceangoing vessels for various reasons; thus provide increased potential for additional interactions between vessels operating in seabird foraging areas and seabirds roosting, 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. NOAA National Marine Sanctuary (NMS) program, in conjunction with Point Reyes Bird Observatory (PRBO), and associated researchers recommend that motorized vessels remain 1000 ft from seabird colonies to reduce disturbance (PRBO 2008) & (Carter et al. 1998). Current Channel Islands National Marine Sanctuary regulation 15CFR922a requires that aircraft, maintain a minimum altitude of 2000' AGL when flying within one-quarter mile of the coast, over offshore rocks and islands, or within California National Marine Sanctuary.

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 SCI 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 on SCI 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 (NSFS) and Expeditionary Firing Exercise (EFEX) 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 the Northern Air Operating Area (NAOPA), Kingfisher Training Range (KTR), Mine Training Range (MTR), Naval Special Warfare Training Areas (SWATs), 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 SCI and Camp Pendleton where suitable locations exist for nearshore activities. Using buffer distances developed for roosting or foraging seabirds within adjacent marine sanctuary habitat, seabird disturbance or injury from small vessel operation could occur during vessel movement and explosions occurring within close proximity (500 m) of seabird populations. Ingress and egress of amphibious vehicles and live-fire and explosive detonations around SCI 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. SCI amphibious landings and raids at SCI 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 SCI. 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 0.54 nm (1 km) 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 where Ingress/Egress, live fire, and detonations occur is SCI. The majority of nearshore habitat, within 0.54 nm (1 km), adjacent to SCI is rocky bottom less than 100 ft (30 m) deep containing persistent kelp forests.

Excluding the east shore of SCI, where few nearshore training activities take place, some species of 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 roosting on steep cliff faces on the west shore, not adjacent to live fire ranges, and utilizing waters greater than 1 km offshore.

Xantus's murrelet, ashy storm-petrel, and black storm-petrel are not likely to be affected during roosting or foraging, but California brown pelicans and all three cormorant species are likely to suffer some adverse disturbance effects from littoral activities due to their preferred roosting and foraging locations.

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 pounds per square inch (psi)/millisecond (ms 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, rifle, 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 nearcoastal 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 impact overall seabird population 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, sonobuoys).

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, and 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 the mainland or on offshore islands. Of the 48 species identified within the SOCAL Range Complex, only 12 are known to breed on offshore islands within the complex; of those species only 5 are known, or thought to breed on, SCI, 2 are known to breed on San Nicolas Island, 2 are known to breed on Santa Catalina Island, and 12 are known to breed, or thought to breed on Santa Barbara Island. SCI 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 SCI has persisted for nearly 40 years; flights occur daily numbering over 25,000 per year. Species most likely to be affected by NALF SCI aviation operations are California brown pelicans and the three cormorant species. Only the Brandt's cormorant is documented to breed on SCI, but not in the immediate proximity of the landing field. There appear to be two different types of birds around airports: resident birds and non-resident birds. There is evidence that mature resident birds have habituated to the presence of human activity and, like domestic animals, try to avoid hazardous situations. They engage in a variety of identifiable actions which seem designed to help them fit into the 'traffic pattern' at the airport (Kelly et al. 1999). Non-resident birds and young resident birds, however, seem to have little or no awareness as to the hazard of aircraft. These birds react to aircraft as if they are immovable obstacles to be avoided, such as trees, buildings, etc. As a result they often are late attempting to maneuver away from aircraft, resulting in a collision. In colonies where aircraft overflights are frequent, guillemots do not usually react to them, which the authors attribute to habituation (Fjeld, et al. 1988). Considering the resident nature of the most common sea bird species gulls, cormorants and pelicans. 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 SCI 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 Xantus's murrelet have high site fidelity and forage almost exclusively at night in nearcoastal 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 0.13 nm (0.25 km) 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 the seabirds return 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 SCI are primarily within the 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 to December) from high explosives detonating within 0.13 nm (0.25 km) 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, adverse disturbance effects would only arise from ingress and egress of low elevation aircraft and exploding ordnance within 0.13 nm (0.25 km) 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, 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/ms 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 SCI; 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 SCI 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, and 47 are NSFS operations. The remainder consist of various joint force training exercises that encompass land, air, and ocean activities, including EFEX and U.S. Marine

Corps (USMC) Battalion Landing. The area delineated by SHOBA consists of the southern third of SCI 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 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, Assault 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 SCI, or directly adjacent to the island on offshore rocks.

Foraging activities are related to the availability of prey species and are therefore dynamic in both time and space. The western side of SCI, 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 SCI 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 SCI, 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 SCI 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 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 SCI include 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 Operating Areas

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 exercises 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 NAS 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 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 there is a 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 due to the relatively small change in operational frequency, low concentration of seabird species in offshore ranges, and high elevation flight patterns of aircraft operating within offshore ranges. Roosting seabirds inhabiting SCI and the mainland coastal areas near Camp Pendleton and NAS North Island utilize nearshore waters of the SOCAL Range Complex for foraging on a daily basis. Increases in low elevation helicopter and fixed-wing 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 to a reduction in 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 SCI, the 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 SCI and nearshore rocks.

Increased training activities utilizing amphibious vehicles within the 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 seabird 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 SCI seabird breeding colonies and specific training activity detonation sites is lacking, the chance that seabird populations near China Cove incur some lethal and sublethal 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 SCI, 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 SCI or Camp Pendleton.

The increase in ocean operations distributed across the offshore ranges Fleet Training Area HOT (FLETA HOT), Warning Area 291 (W-291), and Area 3803 includes Surface-to-Surface Gunnery Exercises (GUNEX S-S) (315 to 350, 11 percent), GUNEX S-A (262 to 350, 34 percent), and ASW TRACKEX (544 to 1690, 210 percent). 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 potentially be 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 affected seabird populations. Direct mortality to seabirds from ocean operations is unlikely due 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 SCI activities would increase 5 percent from 25,120 to 26,400. Increases to aviation training activities in Alternative 1 are primarily associated with NALF SCI. Increases in potential seabird effect from the No Action Alternative include up-tempo activity of low altitude (less than 3,000 ft AGL) rotary aircraft performing searches or ingress/egress support during training operations. Aircraft-related effects 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 seabird colonies is unknown due to the lack of current data on SCI 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 foraging seabirds are present in nearshore waters 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 sublethal 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 nearshore waters due to targeting error.

Land Operations

Land operations within the SOCAL Range Complex are confined to SCI 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 (340 to 512), as would SCI Amphibious Landing and Raids (7 to 34), Land Demolitions (354 to 674), and NSW Direct Action (156 to 163) would increase. 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 effects described for the No Action Alternative.

3.10.2.4 Alternative 2

3.10.2.4.1 SOCAL Operating Areas

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 SCI 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 takeoff 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 SCI 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 do 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, SCI, 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.

SCI includes suitable habitat adjacent to aviation operational areas providing potentially impacted seabirds alternate habitat 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 NAS North Island, and CPAAA, has 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.

The proposed Shallow Water Training Range (SWTR) encompasses a large area known to support various breeding and foraging seabird colonies including 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 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 there is a 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 due to the relatively small change in operational frequency, low concentration of seabird species in offshore ranges, and high elevation flight patterns of aircraft operating within offshore ranges. Roosting seabirds inhabiting SCI and the mainland coastal areas near Camp Pendleton and NAS North Island utilize nearshore waters of the SOCAL Range Complex for foraging on a daily basis. Increases in low elevation helicopter and fixed-wing 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 to a reduction of individual seabird population success.

Seabird population impacts from related aviation training within the SOCAL Range Complex under Alternative 2 would be similar to the effects 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 with 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 SOCAL 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 SCI 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 (SWM) involves the installation of moorings, cables, and hydrophones in waters more than 250 ft (80 m) in 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 takeoff 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 SCI 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 SCI and would increase about 35 percent under Alternative 2 with 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 to 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 alone would not provide sufficient disturbance to seabird populations at a level to affect breeding or foraging success. 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 20 to 30 nm (37 to 55.6 km) 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 include 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 SOCAL 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 SOCAL 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 nonbreeding 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 SOCAL 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 SCI (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 SCI 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 nighttime 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 SCI 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 SOCAL Range Complex would likely have no effect on the California brown pelican breeding colonies. Brown pelicans roosting or foraging within SOCAL Range Complex boundaries utilize rocky headlands and nearshore waters at SCI, 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 that is 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 affect 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 SOCAL 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 5.56 km (3 nm) 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) Mean Sea Level (MSL) with the exception of landing and takeoff 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 SOCAL Range Complex are concentrated in waters greater than 3 nm (5.5 km) off of the United States mainland. Californian least terns are agile, low-flying seabirds capable of avoiding interactions with SOCAL 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 Section 3.10.1.1, 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 effect 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 they are in the locale of the target area at the point of physical impact during inert/practice ordnance delivery. The temporary degradation of habitat or mortality of young (if the species breed at SCI 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 BASH exists, no adverse impact to bird populations is expected. The Navy has concluded that there would be no significant adverse effects on migratory birds.

3.10.3 Mitigation Measures

Current mitigation measures are described in Section 3.10.1.3. 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 SCI, 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 nearcoastal flight paths near currently documented roosting and breeding seabird colonies, increased training activities should not be expected to increase direct or indirect effects to seabird populations, as compared with 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 SOCAL 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 they successfully fulfill 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 effects 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 effects 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 overblast pressure prior to underwater demolition activities. See Section 3.10.1.3.	• Operators should ensure that the California brown pelican is not in proximity to the overblast pressure prior to underwater demolition activities. See Section 3.10.1.3

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3.11 Terrestrial Biological Resources

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3.11 TERRESTRIAL BIOLOGICAL RESOURCES

This section addresses the plant and animal life of 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 Southern California (SOCAL) Operating Areas (OPAREAs) are addressed in Section 3.10, Seabirds. The discussion in Section 3.10.1.1 of the responsibilities of the Navy under the Migratory Bird Treaty Act (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

3.11.1.1 Vegetation and Wildlife

Information on SCI vegetation communities is drawn primarily from the SCI Integrated Natural Resources Management Plan (INRMP) (Department of Navy [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 nonavian 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 nonavian 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 kinkiensis	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

Table 3.11-1: Scientific and Common Names, Growth Form, and Native versus Introduced Status of Selected San Clemente Island Plants (continued)

Scientific Name	Common Name	Native/ Introduced[1]	Growth Form[2]
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
Lotus argophyllus spp. *adsurgens*	San Clemente Island broom	N	PH
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

Table 3.11-1: Scientific and Common Names, Growth Form, and Native versus Introduced Status of Selected San Clemente Island Plants (continued)

Scientific Name	Common Name	Native/ Introduced[1]	Growth Form[2]
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 SCI includes at least 140 nonnative 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 nonnative species along with those of introduced sheep and cattle, which have also been removed from SCI, have significantly impacted the native vegetation and topsoil. These impacts on vegetation and habitat have also affected the wildlife species present on the island.

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 taken in 1977 from 15,000 feet (4,572 m). 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 3.11-2: Scientific and Common Names of Nonavian Wildlife Species on San Clemente Island

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

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 San Clemente Island 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 San Clemente Island

Grasslands

About one-third of SCI, nearly 12,000 acres (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 feet (ft) (240 meters [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 kinkiensis*). 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-square foot (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 nonnative 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 [2,969 hectacres]) 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* var. *argenteus*), 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 [2,369 hectares]) 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 [2,000 hectares]) of the island vegetation. An additional 4 percent of the island (1,514 ac [613 hectares]) 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* var. *argenteus*), 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 (282 hectares) (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, and 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 3.11.3.6.11).

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 because of the difficulty in 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 the Shore Bombardment Area (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 ac 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 1970s (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 U.S. Fish and Wildlife Service (USFWS) protocol (see Section 3.11.1.2, 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 nonwetland waters of the United States under Sections 401 and 404 of the Clean Water Act (CWA), as discussed below. The wetland survey, conducted during 2001, which was 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 nonwetlands because they did not meet either the hydrophytic (wetland) vegetation or wetland hydrology criteria. Of the 121 three-parameter wetlands identified, 4 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 square meters [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 ac. These are found in the VC-3 Assault Vehicle Maneuver Area (AVMA) and overlapping Training Area and Range (TAR) 15 (0.3 ac), in Artillery Firing Range (AFP)-6 in SHOBA (0.4 ac), and in the Infantry Operations Area (IOA) (2.1 ac). The total area of salt marsh delineated as wetlands on SCI is 0.64 ac. The salt marsh areas are found in 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 premilitary 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.

3.11.1.2 Threatened and Endangered Species

SCI has 11 Federally listed endangered or threatened plant and wildlife species, most of which are also state-listed. Islandwide 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 islandwide 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 islandwide 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 islandwide data depict the distribution and abundance of all species of rare plants across the geographic range of the island within these parameters.

Figure 3.11-3: Delineated Wetland Areas on San Clemente Island

Figure 3.11-4: Network of Drainages on San Clemente Island

To supplement islandwide surveys, rare plant surveys of Special Warfare Training Areas (SWATs) 1 & 2 (including 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 geographical information system (GIS) analysis for this project. Focused rare plant surveys of the Assault Vehicle Maneuver Corridor (AVMC), including the AVMAs, Artillery Maneuver Points (AMPs), AFPs, and IOA were initiated in 2006 and completed in 2007 by Tierra Data, Inc. under contract with the Navy. In 2006, 1992 ac were surveyed within the AVMC. Additional surveys performed in 2007 brought the total survey area to 3547 ac. 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 global positioning system (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 islandwide basis, the numbers of occurrences have a tendency to be overrepresented within the AVMC and IOA, compared to islandwide 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 islandwide surveys by the Santa Barbara Botanic Garden (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 historical 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.*

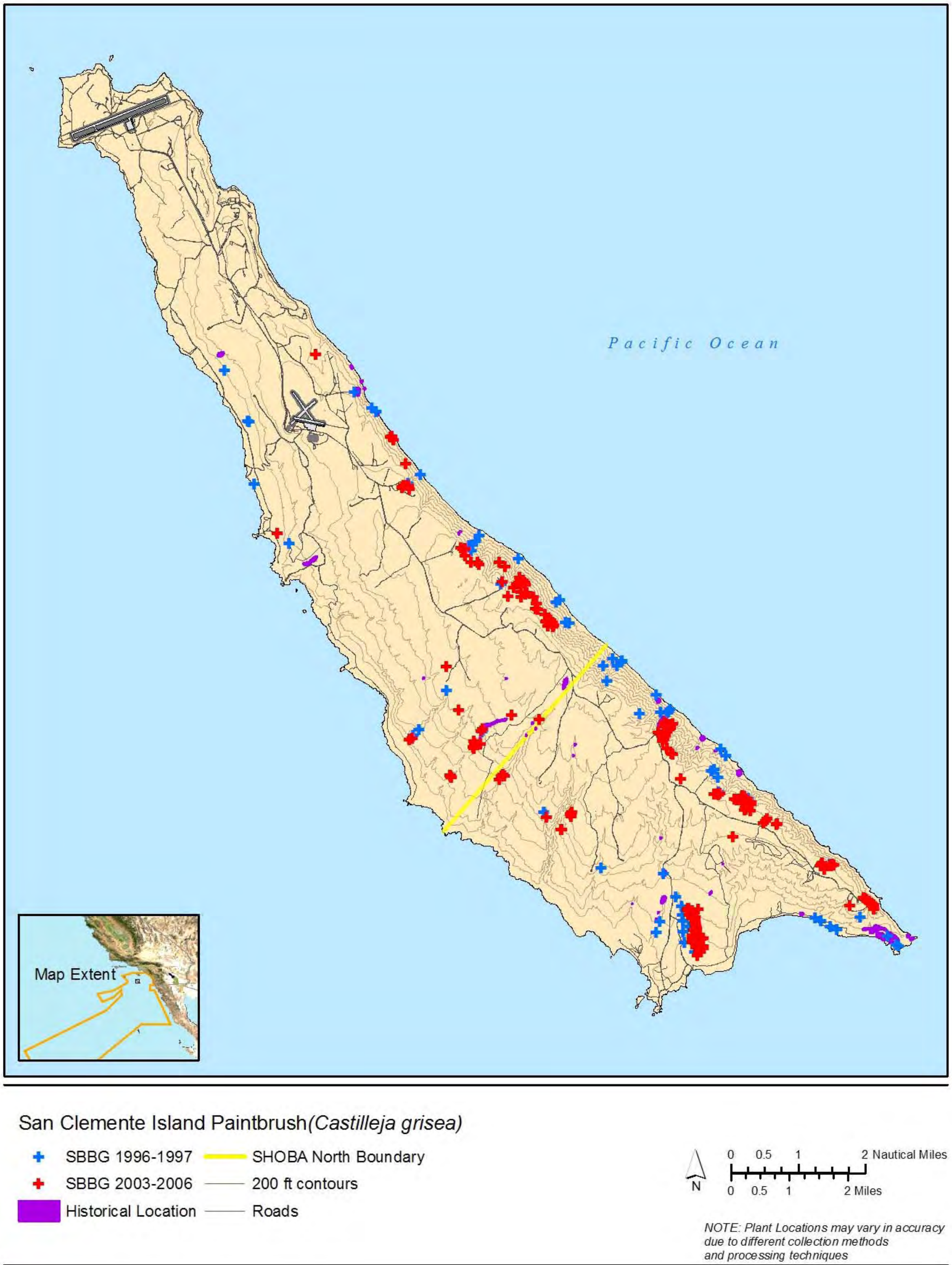


Figure 3.11-5: Existing Locations of San Clemente Island Indian Paintbrush (*Castilleja grisea)*

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 noncatastrophic 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 to 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.

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 to 10 inches (in.) (13 to 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 and 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.

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 10 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 and 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.

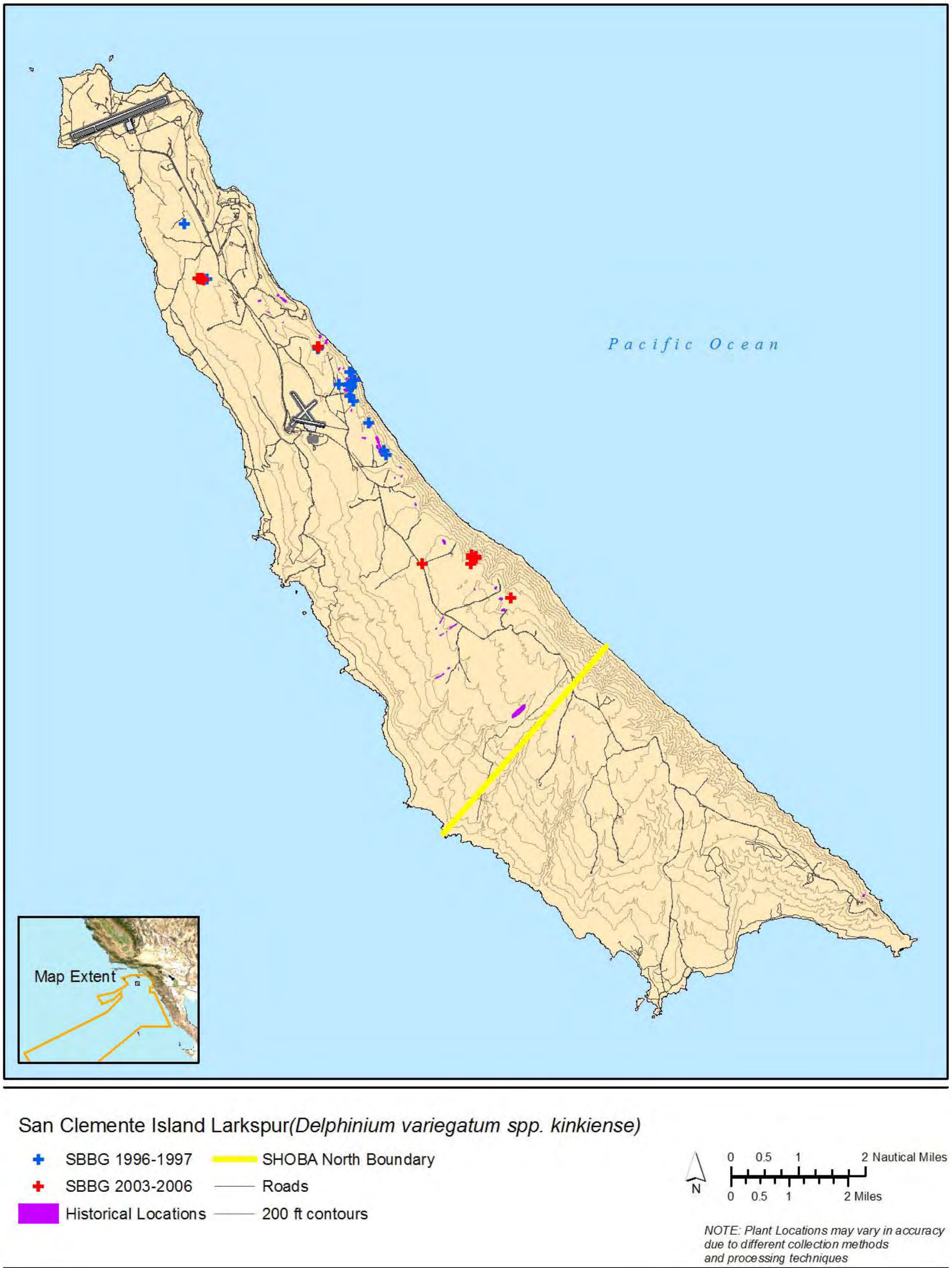


Figure 3.11-6: Existing Locations of San Clemente Island Larkspur (*Delphinium variegatum* spp. *kinkiense*)

Figure 3.11-7: Existing Locations of San Clemente Island Woodland Star (*Lithophragma maximum*)

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 SBBG 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 subshrub 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 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.

Figure 3.11-8: Existing Locations of San Clemente Island Broom (*Lotus dendroideus* var. *traskiae*)

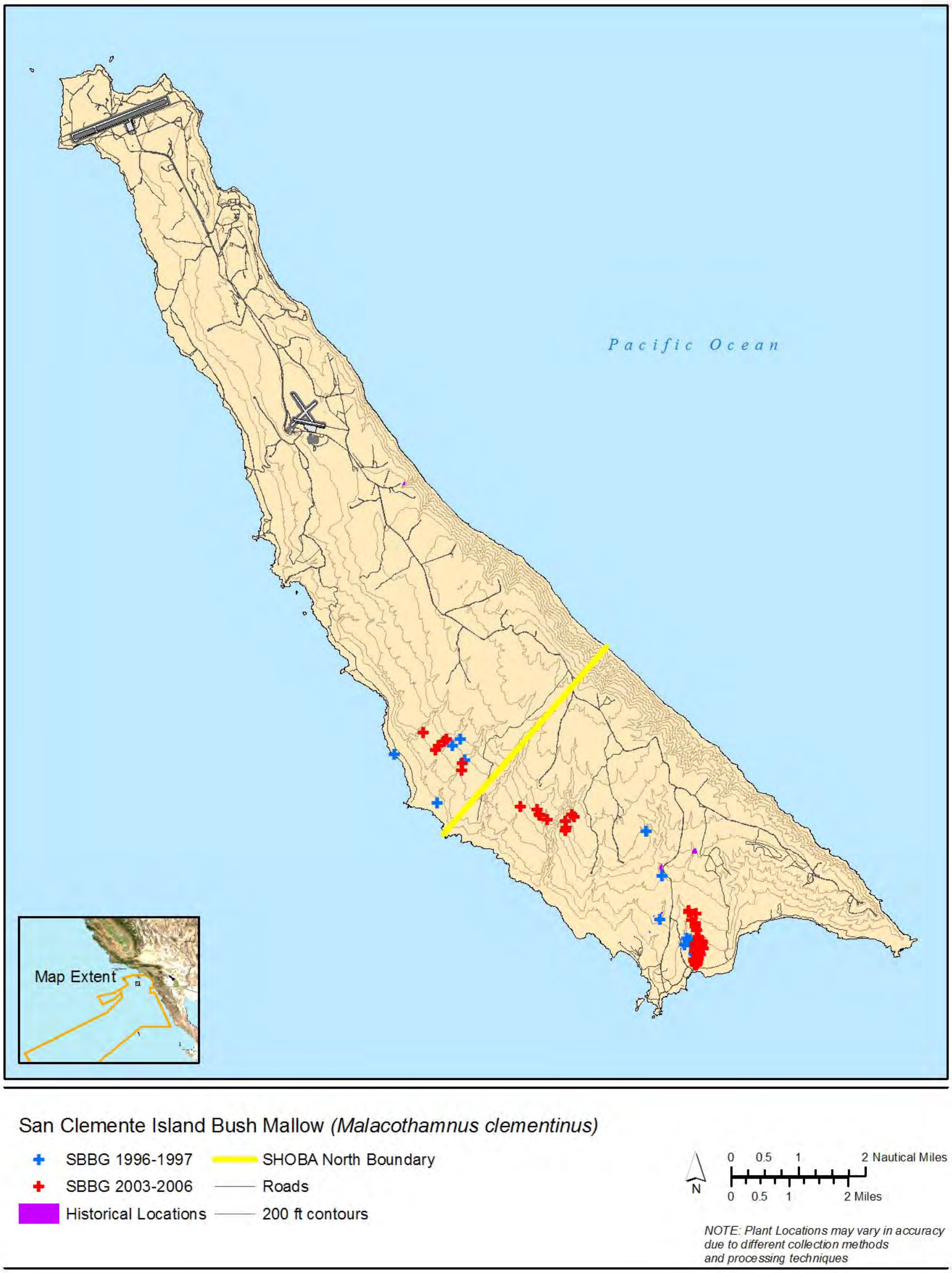


Figure 3.11-9: Existing Locations of San Clemente Island Bush Mallow (*Malacothamnus clementinus*)

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 rediscovered 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 SCI near Pyramid Head (Figure 3.11-10), at elevations between 300 and 540 ft (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).

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 San Nicolas Island 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 104 degrees Fahrenheit (°F) (40 degrees Centrigrade [°C]) (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 californicum*).

Figure 3.11-10: Existing Locations of Santa Cruz Island Rock Cress (*Sibara filifolia*)

Figure 3.11-11: Island Night Lizard Habitat

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 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).

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.

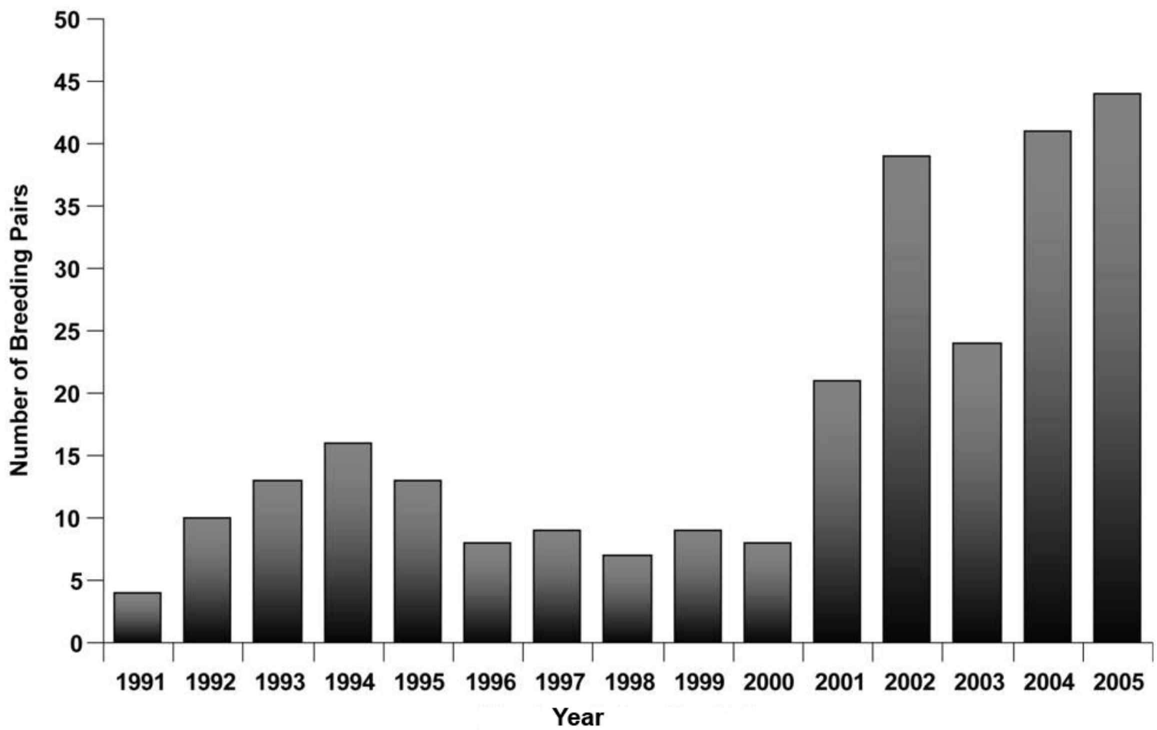
The highest densities of island night lizard are associated with MDS habitats on the west side of SCI, as noted in INRMP Management Units (MUs) 7, 10, 12, and 13 (Terrace Canyon, Seal Cove, Lost Point, and Cave Canyon, respectively [Figure 3.11-11]). These four MUs account for an estimated 56 percent 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 The U.S. Navy submitted a petition on March 22, 2004, to designate SCI and San Nicolas Island populations of the species as distinct population segments and to remove them from the Federal list of threatened species pursuant to the Endangered Species Act (ESA) (DoN 2004b). The U.S. Navy, using the best available scientific data, states that the island night lizard populations on SCI and San Nicolas Island 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 nonmigratory, 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 pairs (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 4 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 SHOBA gate (Table 3.11-4). Locations of nest sites occupied during 2005 are shown in Figure 3.11-13.



Source: Lynn et al. 2006

Figure 3.11-12: Number of San Clemente Loggerhead Shrike Breeding Pairs on San Clemente Island: 1991-2005

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 postfledging. 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).

Table 3.11-4: Number of Loggerhead Shrikes Monitored during the Breeding Season and Their Distribution in Relation to Shore Bombardment Area

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).

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 percent of failed nests. Predation by rats was directly observed by video in one case and suspected in several others.

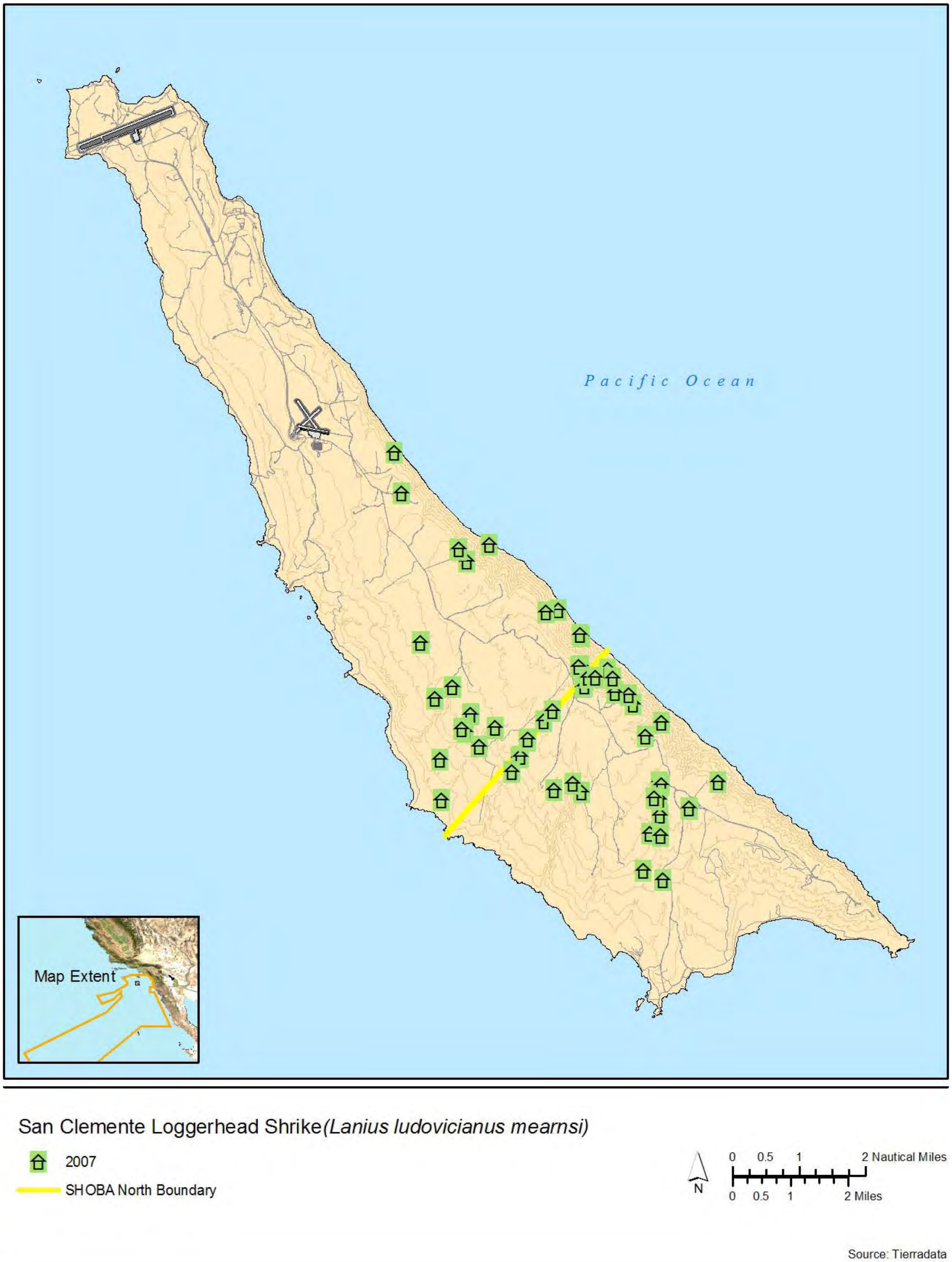


Figure 3.11-13: Location of Loggerhead Shrike Nests in 2005

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 percent were built in island cherry, 27 percent were built in lemonadeberry, 20 percent in sagebrush, 7 percent in toyon, 3 percent each in coyote brush and Catalina ironwood, and 2 percent 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 ac (1998 nesting territories) to 670 ac (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 Commander, Navy Region Southwest [CNRSW] Natural Resources Office [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.

Historical 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 Point Reyes Bird Observatory (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 (6 adults and 11 juveniles in three family groups), single male releases (2 adult males), and independent juvenile releases (26 juveniles). One of the released adults initiated a nest within 7 days of its release, in which 5 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 nonnative 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.

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.

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 San Clemente loggerhead shrike that bred in 2005 were released in previous years. In 2005, 40 San Clemente loggerhead shrike pairs built at least 68 nests (1 to 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 percent 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, August 15, 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.

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 nonmigratory and are limited to the western and northern terraces of the island. Grinnell (1897) described them as “quite common” in *Lycium californicum* (Maritime Desert Scrub [MDS]-*Lycium* phase) 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 MDS-*Lycium* phase 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 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 MDS-*Lycium* phase habitat is occupied during both breeding and nonbreeding 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 MDS-*Lycium* phase 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.

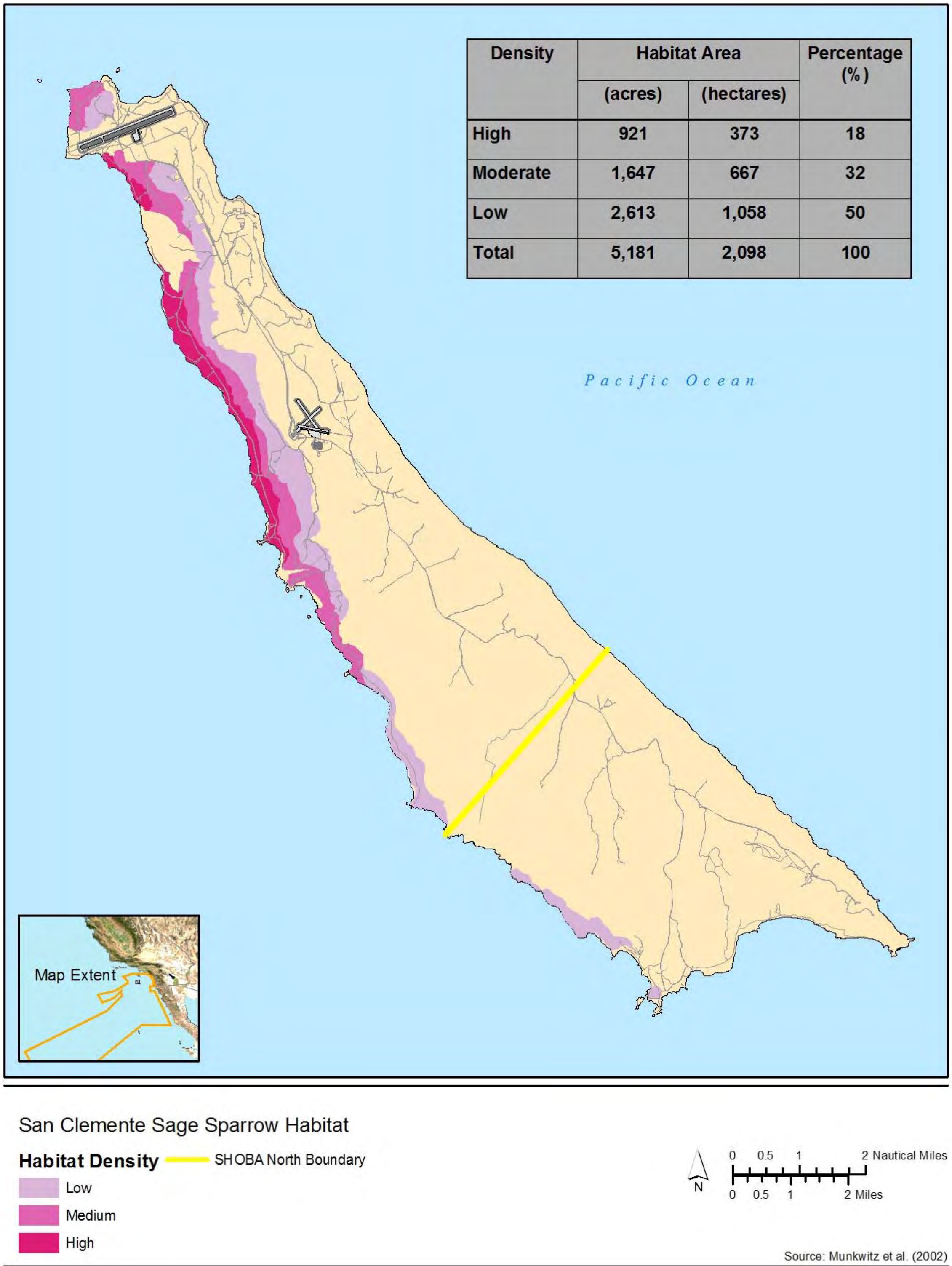
Breeding behavior begins in late January or early February, and nesting begins in mid-March, extending through June. Two to three eggs are laid in a clutch, and some birds may lay two or three clutches in a year. Incubation takes 12 to 13 days, and nest success is high (90 to 97 percent). After the breeding season, adults and juveniles form flocks (3 to 25 birds), which may be stable subpopulations. 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 San Clemente Island

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. In these locations management emphasis is on 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		Percentage (%)
	(acres)	(hectares)	
High	921	373	18
Moderate	1,647	667	32
Low	2,613	1,058	50
Total	5,181	2,098	100

Source: Munkwitz et al 2002

Figure 3.11-14: San Clemente Sage Sparrow Habitat

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 San Nicolas Island. 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.

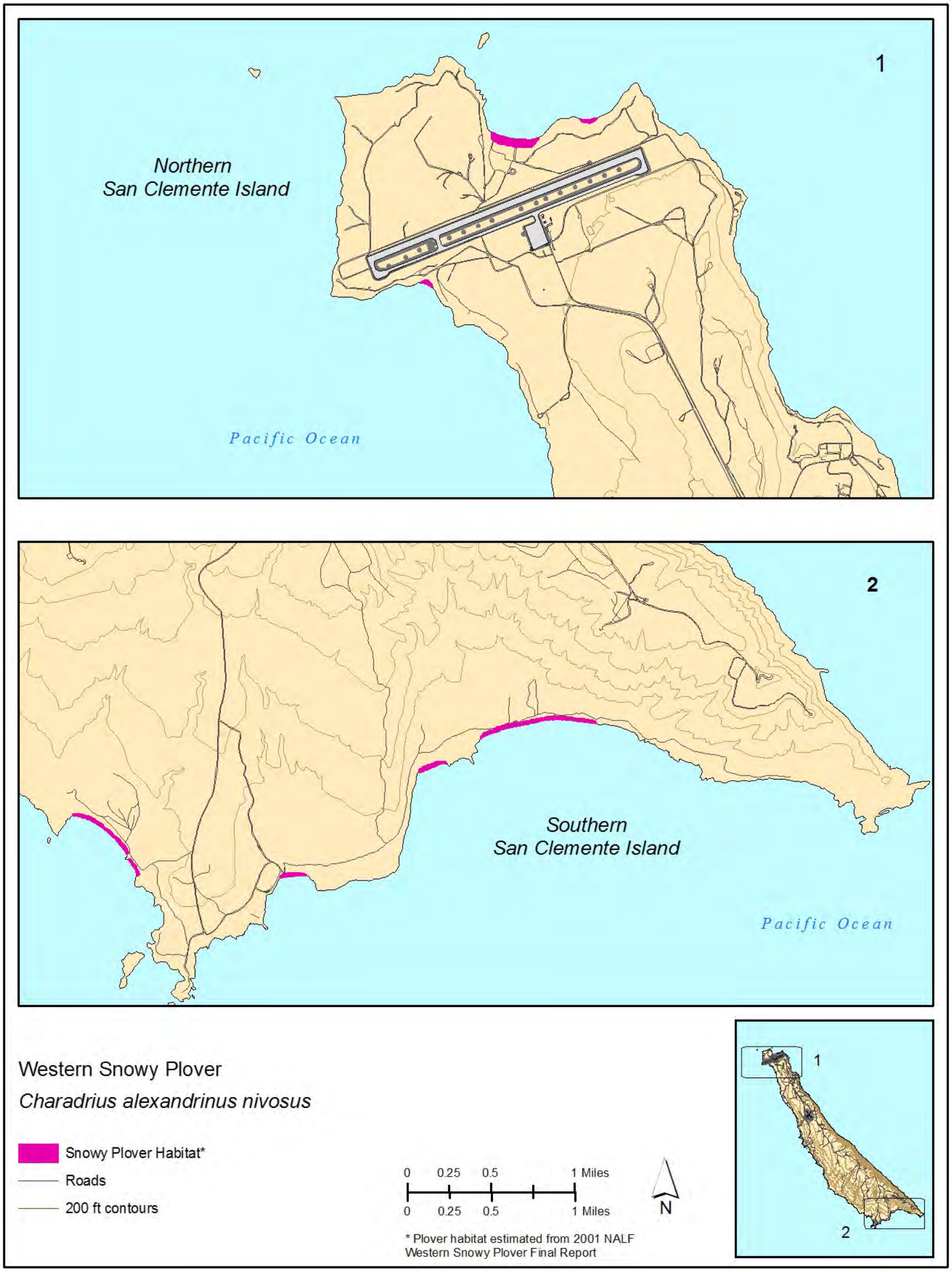


Figure 3.11-15: Western Snowy Plover (*Charadrius alexandrinus nivosus*) Habitat

Although increased recreational use of beaches and development has 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 nonnative predators, which include island foxes, common ravens, and feral cats. Native island foxes and nonnative 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.

3.11.1.3 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 Biological Assessment (BA) and Biological Opinion (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 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, beginning in 2003, all manipulation of these foxes previously conducted to protect nesting loggerhead shrikes. 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 SCI. 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 two to three events of roadside mowing of 14 mi. of road (28 mi. of road shoulders) per year, with the mowing schedule determined after recent rainfalls and with vegetation growth at a minimum 6 in. 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 nonnative 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 islandwide 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 to 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 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 to 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.

3.11.1.4 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 CNPS as being sensitive. 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 lists species occurring within the action area on SCI that have been recognized by the CNPS as rare or endangered in California and elsewhere (CNPS List 1B species).

Figure 3.11-16: Locations of Occurrences of State-listed and California Native Plant Society List 1B Species

Table 3.11-7: Sensitive Plant Species Known from or Potentially Occurring on San Clemente Island

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.
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.

Table 3.11-7: Sensitive Plant Species Known from or Potentially Occurring on San Clemente Island (continued)

Species Name	Sensitivity Status	Plant Communities	Distribution and SCI Localities/Abundance[1]
Non-Listed Sensitive Species (CNPS 1B)			
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, nonnative plants.
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).

Table 3.11-7: Sensitive Plant Species Known from or Potentially Occurring on San Clemente Island (continued)

Species Name	Sensitivity Status	Plant Communities	Distribution and SCI Localities/Abundance[1]
Non-Listed Sensitive Species (CNPS 1B)			
California dissanthelium *(Dissanthelium californicum)*	CNPS List 1A	Maritime desert scrub.	Known only from SCI, Santa Catalina Island, and Guadalupe Island. 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.
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.*

Table 3.11-7: Sensitive Plant Species Known from or Potentially Occurring on San Clemente Island (continued)

Species Name	Sensitivity Status	Plant Communities	Distribution and SCI Localities/Abundance[1]
Non-Listed Sensitive Species (CNPS 1B)			
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.
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.*

Table 3.11-7: Sensitive Plant Species Known from or Potentially Occurring on San Clemente Island (continued)

Species Name	Sensitivity Status	Plant Communities	Distribution and SCI Localities/Abundance[1]
Non-Listed Sensitive Species (CNPS 1B)			
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.
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.

Table 3.11-7: Sensitive Plant Species Known from or Potentially Occurring on San Clemente Island (continued)

Species Name	Sensitivity Status	Plant Communities	Distribution and SCI Localities/Abundance[1]
Non-Listed Sensitive Species (CNPS 1B)			
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).
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). 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.

3.11.1.5 Summary of Resources within Operations Areas

Operations Areas on SCI include the AVMC, including AVMAs, the Assault Vehicle Maneuver Road (AVMR) and AVMR-SHOBA, as well as AMPs A through D, and AFPs 1 and 6 (Table 3.11-8). Additionally TARs, (Table 3.11-9) and the 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 AVMAs (3 percent of the island area) not including nonadjacent 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 ac 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 San Clemente Island

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	

Note: 1) Estimated area, requires engineering design

3.11.1.5.1 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 (NSWG-1) at SCI, California, and the accompanying January 17, 2001 USFWS BO. 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 threatened and endangered and sensitive plant and wildlife species. Information on surveys and threatened, endangered, and sensitive plant and wildlife species is presented above under Threatened and Endangered Species (Section 3.11.1.2)

Table 3.11-9: Habitat Types and Sensitive Species at TAR Sites on San Clemente Island

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.
TAR 16	Existing TAR has severely disturbed grassland without federally listed plant or animal species.	SCI brodiaea at southern TAR boundary. Proposed expansion area contains grassland with many occurrences of SCI brodiaea and a small number of Guadalupe Island lupine.
TAR 17	Disturbed vegetation communities, MDS-*Lycium* phase.	High density San Clemente sage sparrow habitat, California brown pelican; aphanisma, SCI milkvetch, south coast allscale, island poppy, and Guadalupe Island lupine.

Table 3.11-9: Habitat Type and Sensitive Plant Species at TAR Sites on San Clemente Island (continued)

Site	Site Characteristics	Comment[1]
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 SCI but many individuals winter in the same general locations as their nesting territories. California brown pelicans 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 nonnative 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 nonnative grasses outside the fencing and a mixture of nonnative 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 nonnative 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*). A single occurrence of SCI broom (*Lotus dendroideus* subsp. *traskiae)*, an endangered species, is present on this site and additional occurrences are outside the TAR boundaries.

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*), are 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 coinciding with the southern boundary of the Missile Impact Range. There are, however, historical populations of SCI broom and SCI larkspur within approximately 1,312 to 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 NSW 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 nonnative 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.

3.11.1.5.2 Vegetation Communities Contained within the Different Operations Areas on San Clemente Island

The AVMAs and AMPs consist predominantly of disturbed habitat, which was a key environmental consideration in their selection. AFP-1 is mapped principally as MDS 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 MDS 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.

3.11.1.5.3 Listed Wildlife Species Habitat Present within the Different Operations Areas on San Clemente Island

Figures 3.11-17 through 3.11-21 show locations of operations areas and known distribution of endangered and threatened species on SCI.

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.

3.11.1.5.4 Listed Plant Species Habitat Present within the Different Operations Areas on San Clemente Island

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:

- One of 147 (0.7 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 (9.5 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.

3.11.2 Current Mitigation Measures

The Navy implements multiple general, area-specific, and species-specific measures intended 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 INRMP.

General mitigation measures include:

- Control invasive exotic plant species on an islandwide 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 nonbreeding 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.

3.11.2.1 San Clemente Island 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 burned habitat reevaluation thresholds. These thresholds are proposed to manage the risks of extreme fire scenarios, which may be catastrophic to individual species.

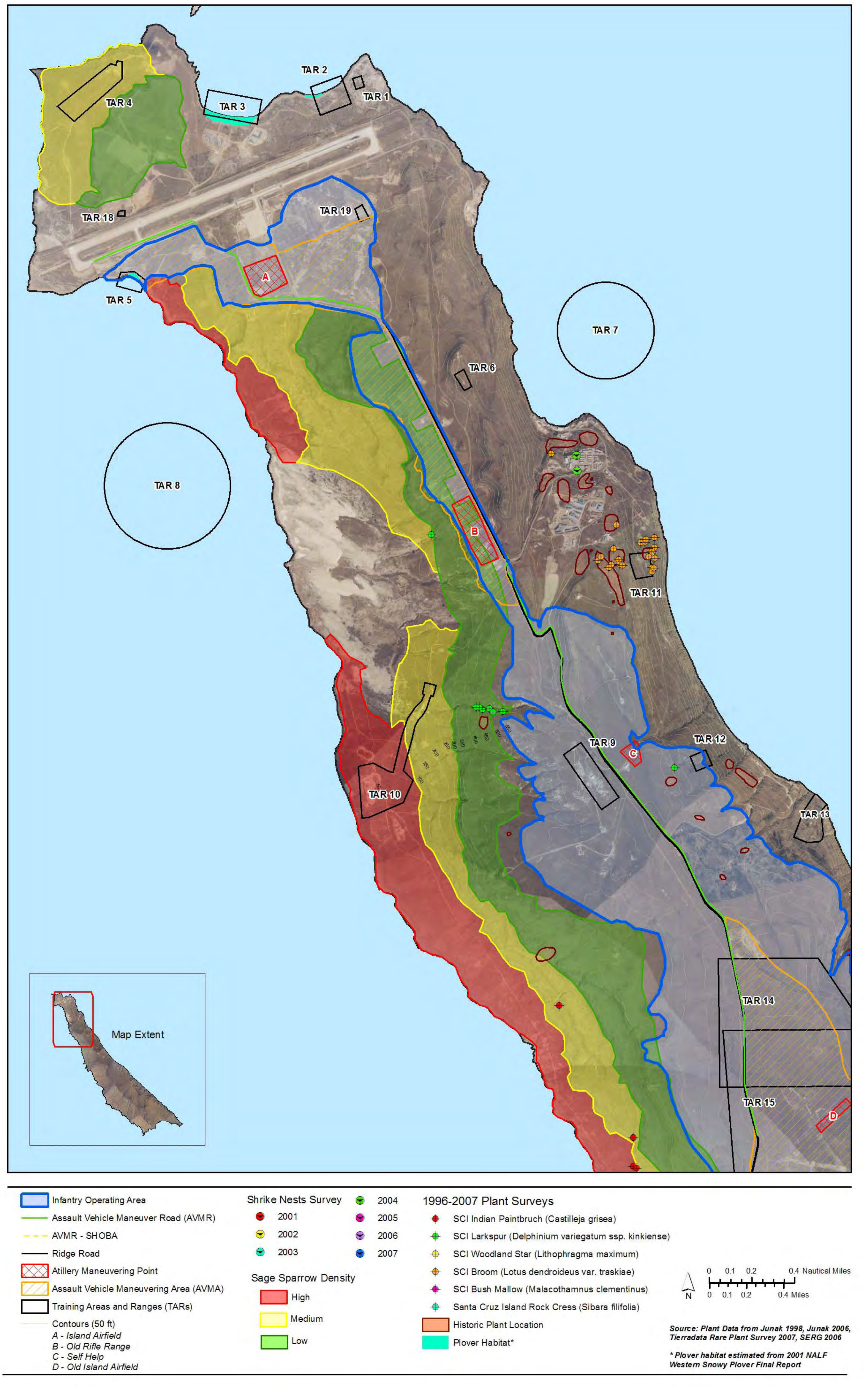


Figure 3.11-17: Listed Endangered and Threatened Wildlife and Plant Species Located in Northern San Clemente Island

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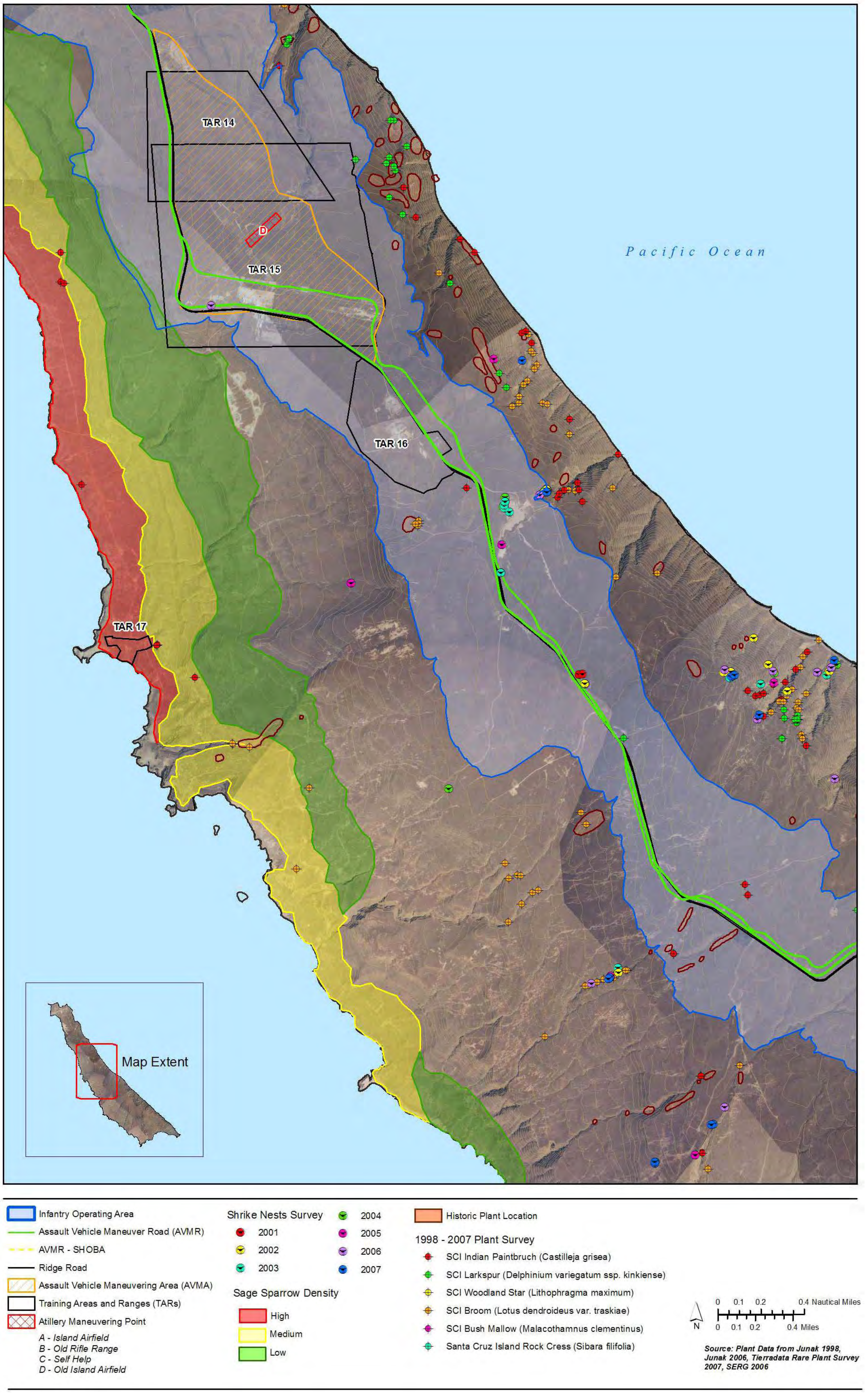

Figure 3.11-18: Listed Endangered and Threatened Wildlife and Plant Species Located in Middle San Clemente Island

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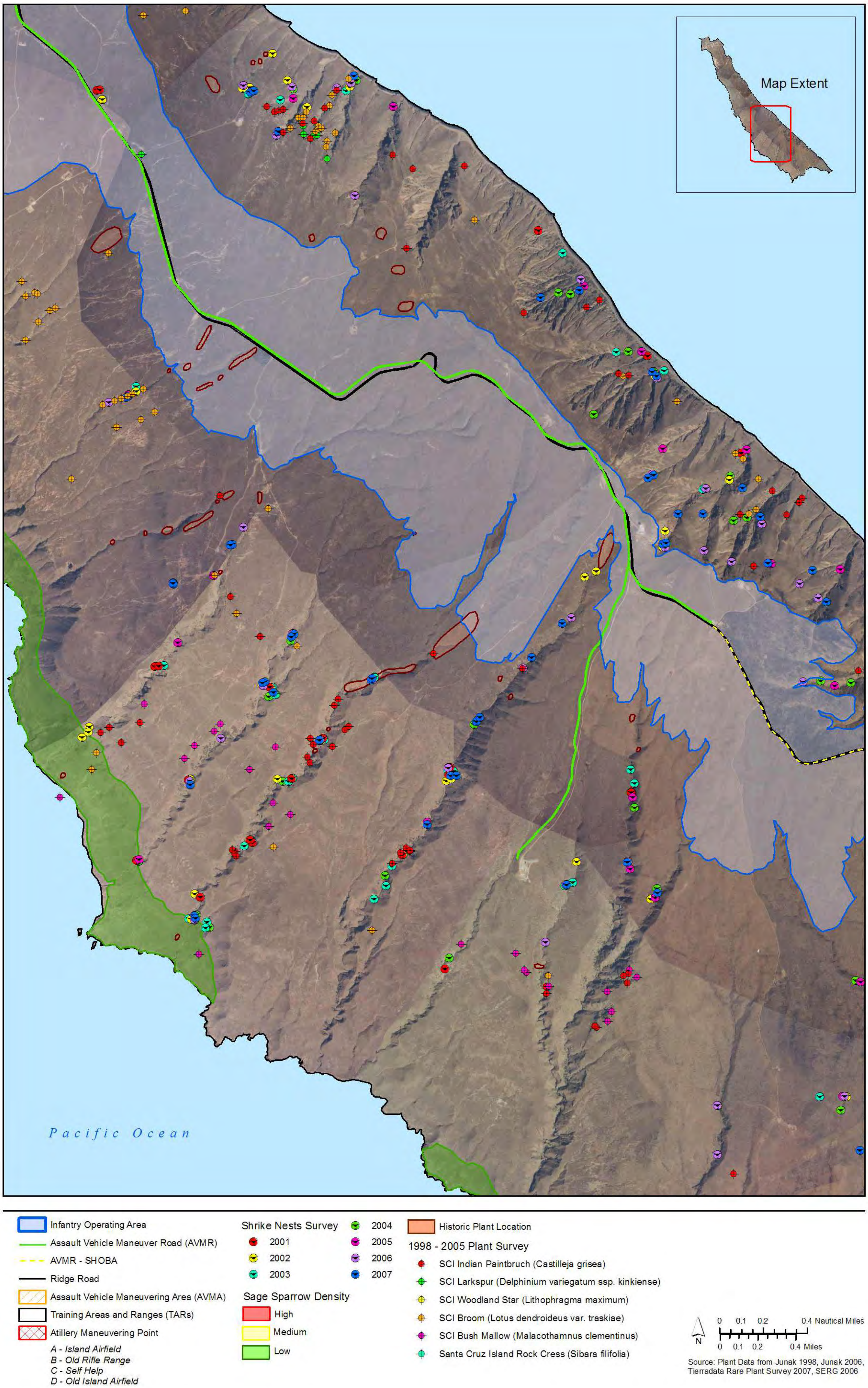

Figure 3.11-19: Listed Endangered and Threatened Wildlife and Plant Species Located in Southwest San Clemente Island

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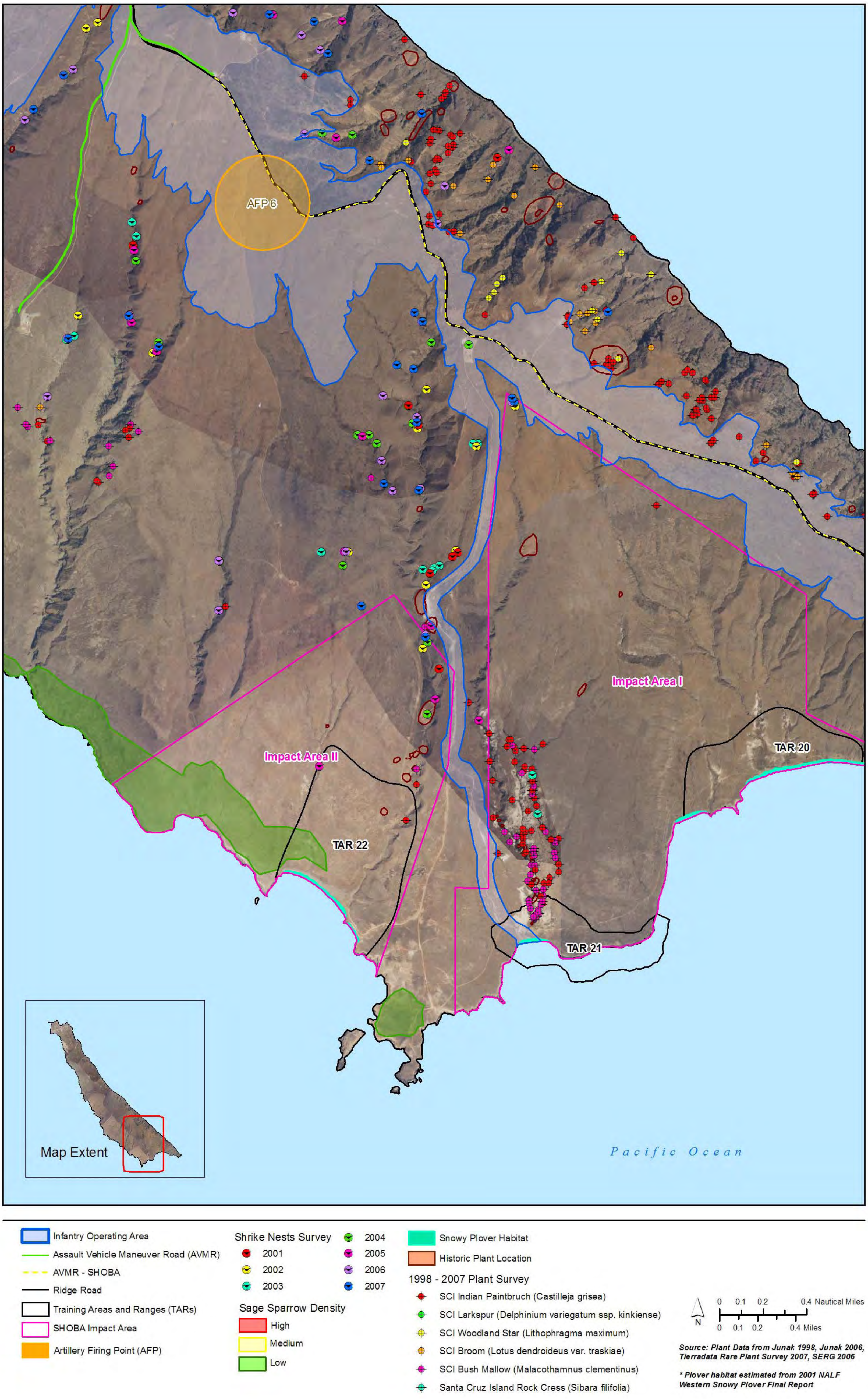

Figure 3.11-20: Listed Endangered and Threatened Wildlife and Plant Species Located in Southern San Clemente Island

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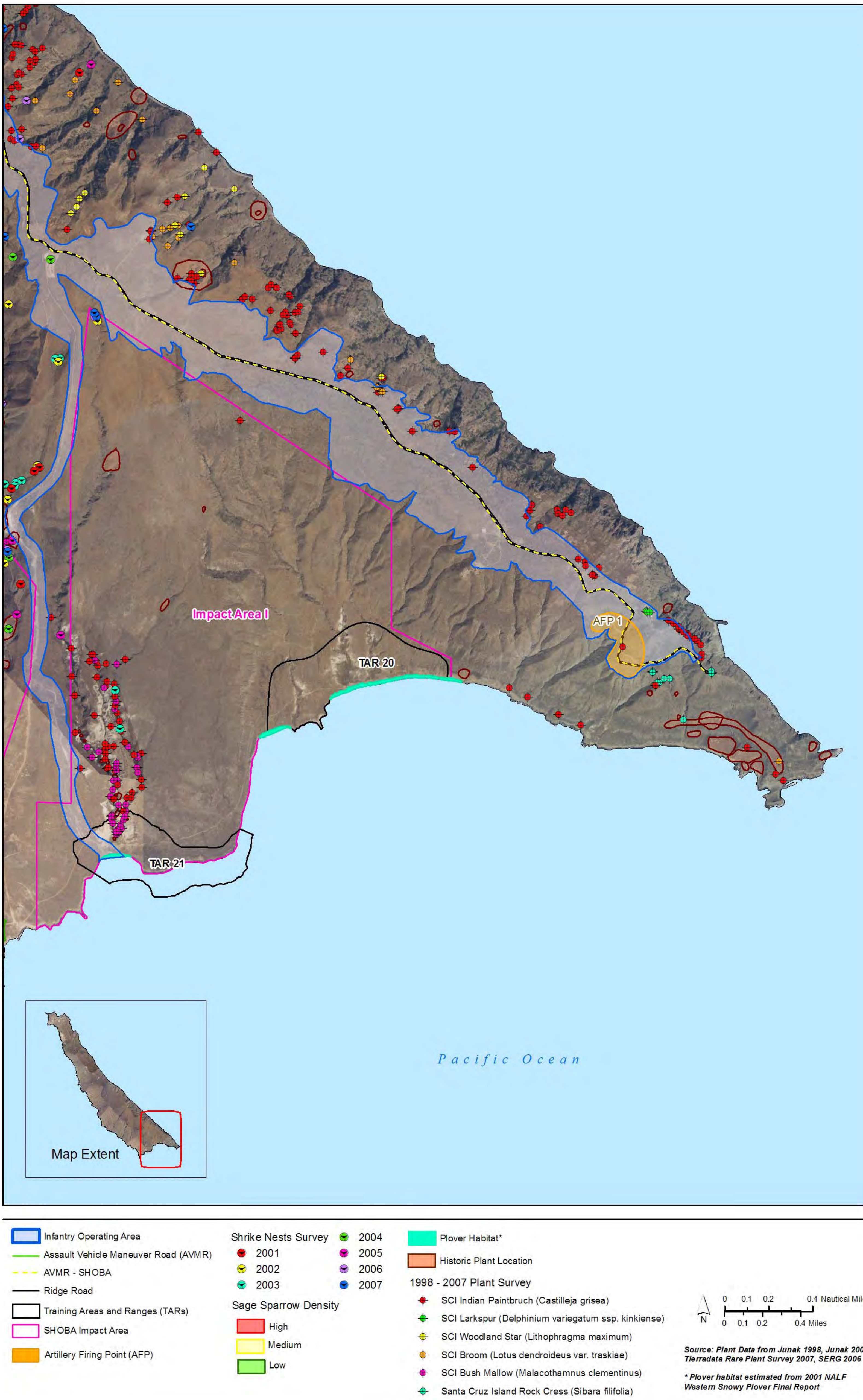

Figure 3.11-21: Listed Endangered and Threatened Wildlife and Plant Species Located in Southeastern San Clemente Island

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3.11.2.2 Management Changes with the Wildland Fire Management Plan

Implementation of the SCI Wildland Fire Management Plan and its BA (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 nonoperational 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.

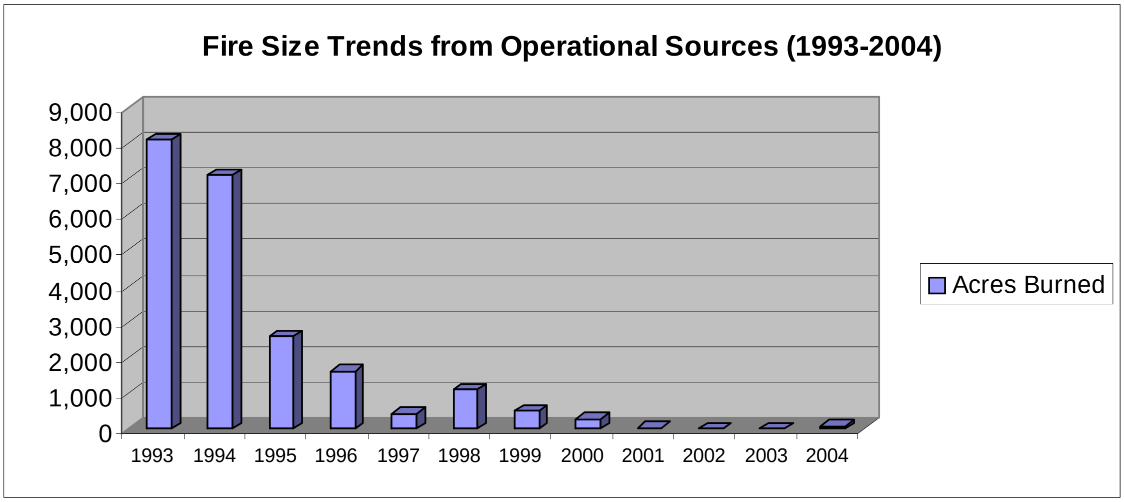


Figure 3.11-22: Wildfire Size Trends from Operations Sources (1993-2004)

3.11.3 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.

3.11.3.1 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.

3.11.3.2 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.

3.11.3.2.1 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 ac. 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 nonnative 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 ac, and the average FY96-04 was 11.4 ac. 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 ac, 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 Corps 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 Training Areas and Ranges

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 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 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 is 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 average 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 wildfires.
- The size of wildfires from identified operational sources has decreased steadily.

3.11.3.2.2 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 to 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 percent 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 nonnative 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.

3.11.3.2.3 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.

3.11.3.2.4 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 to 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).

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

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 to 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.

3.11.3.2.5 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 nonnative 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 nonnative 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	
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

Table 3.11-16: Operations evaluated in the Terrestrial Biology Analysis by Project Alternative (continued)

Navy Warfare Area	No.	Operation Type	No Action	Alternative 1	Alternative 2
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 Section 3.11 (Terrestrial Biological Resources).

3.11.3.3 No Action Alternative

3.11.3.3.1 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.

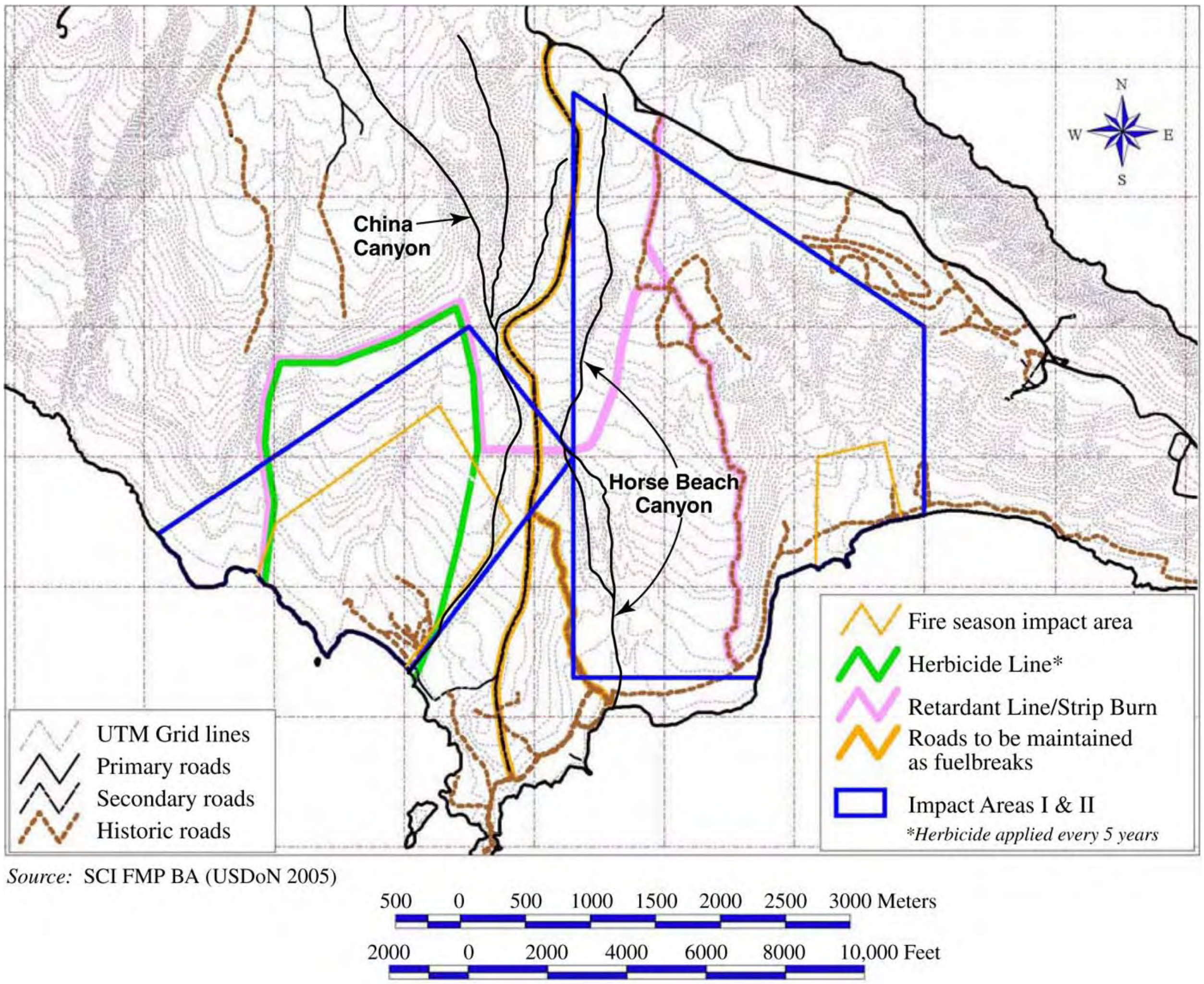
Vegetation and Wildlife. Ordnance hits associated with FIREX would affect vegetation and wildlife in Impact Areas I and II directly through ordnance impact and explosions, and indirectly through fires. Both impact areas have had a long history of ship-to-shore bombardment and vegetation is sparse and 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-in./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-in./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 two to three 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 BA (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 5 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.

3.11.3.3.2 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.

3.11.3.3.3 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).

3.11.3.3.4 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).

3.11.3.3.5 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).

3.11.3.3.6 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).

3.11.3.3.7 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).

3.11.3.3.8 Artillery Operations

Artillery operations would take place five 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 mi. 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.

3.11.3.3.9 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).

3.11.3.3.10 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).

3.11.3.3.11 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).

There is no action equivalent in the No Action Alternative.

3.11.3.3.12 Naval Special Warfare 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.

3.11.3.3.13 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.

3.11.3.3.14 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.

3.11.3.3.15 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.

3.11.3.3.16 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.

3.11.3.3.17 Naval Special Warfare Group One 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.

3.11.3.3.18 Naval Special Warfare Group One 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 federally listed plant or animal species within the TAR boundary and most of the area has been disturbed. Two small occurrences of SCI brodiaea, a CNPS List 1B species, occur within the boundary of the MIR and could be affected by activities there. These represent a very small proportion of the population of this species, which is known to occur only on SCI. Therefore, impacts from operations on TAR 16 would be less than significant.

3.11.3.3.19 Naval Special Warfare 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. Direct Action operations also take place in Basic Training Sites (BTSs) concentrated at the northern end of the island near Northwest Harbor. 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. 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.

3.11.3.3.20 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.

3.11.3.3.21 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.

3.11.3.3.22 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.

3.11.3.3.23 Naval Auxiliary Landing Field 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.

3.11.3.3.24Missile 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.

3.11.3.4 Alternative 1

3.11.3.4.1 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.

3.11.3.4.2 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.

3.11.3.4.3 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 nonnative 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 islandwide 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 mi. outside the site boundary.

3.11.3.4.4 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.

3.11.3.4.5 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.

3.11.3.4.6 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.

3.11.3.4.7 Armored Operations

In these events, four M-1 tanks (for purposes of impacts to the terrestrial environment, M1 category of tanks includes M1A1 tanks and other tracked vehicles), 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 of 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).

3.11.3.4.8 Artillery Operations

Under Alternative 1, artillery operations would increase from five to six 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 mi. 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.

3.11.3.4.9 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 to 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.

3.11.3.4.10 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.

3.11.3.4.11 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 islandwide 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

3.11.3.4.12 Naval Special Warfare 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.

3.11.3.4.13 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.

3.11.3.4.14 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.

3.11.3.4.15 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.

3.11.3.4.16 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.

3.11.3.4.17 Naval Special Warfare Group One 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.

3.11.3.4.18 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 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.

TAR 2—Graduation Beach Underwater Demolition Range

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, nonnative 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 NSW Center Underwater Demolitions. Therefore, impacts to endangered, threatened, and sensitive species would be less than significant.

TAR 3—BUD/S Beach Underwater Demolition Range

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 ESA, unless a §10(a)(1)(A) permit is obtained, or a consultation with USFWS is conducted regarding the western snowy plover and a BO 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 nonnative 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 nonnative 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 16—South VC-3 (Missile Impact Range)

Strategic reconnaissance, live-fire, land demolition activities, direct action, convoy/mounted operations, parachute drops, and UAV training would be conducted in TAR 16, which would be expanded by about 80 acres on the northern, western and southern sides from the original boundaries of the 54-acre Missile Impact Range under Alternatives 1 and 2. Training activities in this expanded area would be the same as those currently proposed for TAR 16, except for the following activities, which will not occur in the expanded area south of the existing MIR: parachute landings zones; convoy operations; land demolition; and target placement. There is a moderate potential for wildland fire ignition associated with use of flares, pyrotechnics, and tracers. There is a low potential for introduction and spread of invasive species due to small groups and relatively infrequent use of the TAR. No federally listed species are known from this site. A concentration of occurrences of SCI brodiaea, a CNPS List 1B species, is present. These are concentrated in the southern portion of the expansion area where about 33 percent of the total documented population on SCI is present. Small numbers of Guadalupe Island lupine, an annual species, are also present, closely associated with the brodiaea occurrences. Parachute landings zones; convoy operations; land demolition; and target placement would not be conducted in this area to minimize impact on these species. The brodiaea, which grows from an underground bulb (corm) during seasons when soil moisture permits (winter through spring) and dries up in summer after producing seed, is capable of resprouting if damaged by foot traffic and also resprouts from underground parts after being burned. It would not be affected by foot traffic during the summer and fall months when soils are dry and the plants are dormant. The lupine is an annual species that grows during the late winter and spring, existing the rest of the year as dormant seed. Because of the resilience of these species and their grassland habitat and the low impact of activities that would take place in the portion of the TAR where they are most concentrated, impacts on this species and the Guadalupe Island lupine are expected to be less than significant.

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 Prisoner of War Camp and Surface-to-Air Missile 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.

3.11.3.4.19 Naval Special Warfare 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 Basic Training Sites (BTSs) as well as at TARs 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

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

NSW Direct Action 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 mi. 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

NSW Direct Action 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.

3.11.3.4.20 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.

3.11.3.4.21 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.

3.11.3.4.22 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.

3.11.3.4.23 Naval Auxiliary Landing Field 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.

3.11.3.4.24Missile 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.

3.11.3.5 Alternative 2

3.11.3.5.1 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.

3.11.3.5.2 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.

3.11.3.5.3 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.

3.11.3.5.4 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.

3.11.3.5.5 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.

3.11.3.5.6 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.

3.11.3.5.7 Armored Operations

Under Alternative 2, the operation would increase to 4 times per year. Impacts would be similar to those described under Alternative 1.

3.11.3.5.8 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.

3.11.3.5.9 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.

3.11.3.5.10Combat 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.

3.11.3.5.11 Amphibious Assault Vehicle and Expeditionary Fighting Vehicle

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.

3.11.3.5.12 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.

3.11.3.5.13 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.

3.11.3.5.14 Naval Special Warfare 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.

3.11.3.5.15 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.

3.11.3.5.16 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.

3.11.3.5.17 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.

3.11.3.5.18 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.

3.11.3.5.19 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.

3.11.3.5.20 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.

3.11.3.5.21 Naval Special Warfare 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, taking place in TARs 20, 21, and 22 as well as the Basic Training Sites (BTSs). However, as for Alternative 1 the impacts would be less than significant with mitigation.

3.11.3.5.22 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.

3.11.3.5.23 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.

3.11.3.5.24 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.

3.11.3.5.25 Naval Auxiliary Landing Field 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.

3.11.3.5.26Missile 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.

3.11.3.6 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 CNPS 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 BA 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.

3.11.3.6.1 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 nonnative 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 ac (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.

3.11.3.6.2 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 percent of the SCI total are in Impact Area I; 0.9 percent are in Impact Area 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 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 mi. (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 An occurrence of 26 individuals of San Clemente Island Indian paintbrush was discovered recently near the center of AFP-1. Foot traffic and vehicle traffic could affect these plants. Occasional foot traffic would have minor and temporary direct effects on individual plants and would be unlikely to result in the loss of any plants. If concentrated in the vicinity of the plants, direct and indirect effects associated with repeated foot traffic could result in the loss of plants over time. Direct impacts associated with vehicle traffic could result in the loss of the AFP-1 occurrence of San Clemente Island Indian paintbrush.

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.

3.11.3.6.3 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).

3.11.3.6.4 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. Their 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).

3.11.3.6.5 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 is one occurrence within TAR 11 and additional occurrences 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.

TAR 11 supports one occurrence of the species with many additional occurrences in nearby areas, as indicated in Appendix Table D-4. The site would experience approximately 22 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.

3.11.3.6.6 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 percent of the SCI total are in Impact Area I; 2.5 percent 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.

3.11.3.6.7 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 nonnative 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.

3.11.3.6.8 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.

3.11.3.6.9 San Clemente Loggerhead Shrike

A number of activities in SHOBA, and islandwide, 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 *Reinitiation 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-in./54 or 5-in./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 two 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 percent and 25 percent 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).

3.11.3.6.10 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 to 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.

3.11.3.6.11 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 to 41 sightings have been made during typical islandwide 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 mi. [4.6 km]) of the 55 mi. (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 to conduct western snowy plover surveys seasonally (breeding and wintering) within the northern beaches where suitable nesting or wintering habitat exists. These beaches include Northwest Harbor and West 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. Surveys of the suitable habitat within the southern end of SCI (Pyramid Cove, Horse Beach, and China Cove) remain infeasible due to safety concerns. The suitable southern western snowy plover habitat is not safe for surveying due to the presence of unexploded ordnance; therefore, updated survey results cannot be safely acquired.

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.

3.11.3.6.12California 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.

3.11.3.6.13Island 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 islandwide 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 nonnative 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 SCI Integrated Natural Resources Management Plan (DoN 2002), and with the adoption and implementation of the SCI 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.

3.11.3.6.14 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 percent 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 SCI 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.

3.11.3.6.15San 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 percent) 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 percent 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 percent of the SCI total) and 400 individuals (7.3 percent 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 to 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.

3.11.3.6.16 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 percent) 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 percent 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 percent of the island total) are clustered in the NALF AVMA near the egress from TAR 5, one occurrence at TAR 10 (3 percent of the SCI total), with several nearby occurrences, and nineteen occurrences (59.4 percent 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 percent of the SCI total) and 40,145 individuals (61 percent of the SCI total) and SCI milkvetch (98 occurrences (48 percent of the SCI total) and 7,651 individuals (35.5 percent 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.

3.11.4 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:

3.11.4.1 General Measures

G-M-1. Continue to control invasive exotic plant species on an islandwide 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) as long as they are demonstrated to support listed species recovery and population maintenance. 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, with review and revision per Navy directives addressing management of natural resources. Identification of conservation measures that provide additional benefits to the protected resources affected by the proposed action will be given priority consideration for incorporation into the SCI INRMP during reviews, updates and revisions.

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 natural resource management 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 nonnative 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 China Point Road and the portion of Horse Beach Canyon 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).

3.11.4.2 AVMC, AVMR, AVMA, AFPs, AMPs, IOA, and Amphibious Landing Site Measures

AVMC-M-1. Survey for Federally listed and sensitive plant species within the AVMC (including AVMAs, AFP-1, AFP-6, AMPs) and IOA.

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 and 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. The goals of the plan would be as follows:

- to minimize soil erosion within each of these operational areas and minimize offside impacts;
- to prevent soil erosion from adversely affecting federally listed or proposed species or their habitats
- to prevent soil erosion from significantly impacting other sensitive resources, including sensitive plant and wildlife species and their habitats, jurisdictional wetlands and non-wetland waters, the area of Special biological Significance (ASBS) surrounding the island, and cultural resources

The plan would lay out the Navy's approach in assessing and reducing soil erosion in the AVMAs, AMPs, AFPs, and the IOAs, as well as 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 the area. The plan would include an adaptive management approach and contain the following essential elements:

- Site-specific BMPs to minimize soil erosion on site and minimize offsite impacts, which could include:
  - Establishing setbacks or buffers from steep slopes, drainages, and sensitive resources
  - Construction of site specific engineered or bio-engineered structures that would reduce soil erosion and transport of sediment off site
  - Revegetation
  - Maps defining boundaries of operational areas that provide appropriate setbacks
  - 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.

AVMC-M-4. Military units will be briefed on maneuver area boundaries prior to conducting operations in these areas.

AVMC-M-5. Assault 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. Tactical ground vehicles will be washed of visible plant material, dirt and mud 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 all traffic. The Navy will 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.

3.11.4.3 Training Areas and Ranges (TARs) Measures

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.

3.11.4.4 Basic Training Sites (BTSs) Measures

BTS-M-1. Construction of structures will not involve grading and will be conducted outside the sage sparrow breeding season. The footprint of the construction areas will be marked to avoid habitat areas in coordination with the SCI natural resources program. Anti-perch devices will be installed on the structures.

3.11.4.5 Additional Species-Specific Measures

3.11.4.5.1 San Clemente Sage Sparrow

SCSS-M-1. Continue surveys and population analysis for the San Clemente sage sparrow. Develop additional surveys to assess sage sparrow juvenile survivorship and habitat use. Surveys will be developed and scheduled such that access to training areas is not restricted when training is needed/requested.

SCSS-M-2. Manage the San Clemente sage sparrow population for long-term persistence in accordance with recommendations in the SCSS Management Plan, and in a manner that is compatible with military training requirements. Identification of conservation measures that provide additional benefits to sage sparrows will be given priority consideration for incorporation into the SCI INRMP and the SCSS Management Plan during reviews, updates and revisions. Conservation benefits provided to San Clemente Sage Sparrows will also benefit the Island Night Lizard, as they co-occur in highest densities in the same prime habitat.

SCSS-M-3: Develop and implement a monitoring plan to assess the incidental take of SCSS within and adjacent to TARs 10 and 17. Incorporate findings into recommendations for minimizing or avoiding incidental take, to the extent practicable, into the SCSS Management Plan.

3.11.4.5.2 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**.**

SCLS-M-3. The shrike monitoring team will provide schedulers the location of shrike nests within operational boundaries and prior to the installation of fuel/fire beak lines.

SCLS-M-4. Range schedulers would provide the GPS coordinates of up to four (4) shrike nests at any one time to operators and advise that sensitive resources occur within a 10 m radius of these points. GPS coordinates would only be provided for nests that appear in the IOA in areas wider than 1000 feet, and not in any AVMA, AVMR, AFP, AMP, or TAR.

3.11.4.5.3 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.

3.11.4.5.4 California brown pelican

CBP-M-1. Ensure that California brown pelicans are not in proximity to over-blast pressure prior to underwater demolition activities. Sequential underwater detonations would be conducted either less than 10 seconds apart or greater than 30 minutes apart to avoid impacts to birds attracted by fish kill..

3.11.4.5.5 Western Snowy Plover

WSP-M-1. Continue annual breeding and nonbreeding season surveys for the western snowy plover at West Cove and Northwest Harbor.

3.11.4.5.6 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.

3.11.4.5.7 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.

RC-M-2. To the extent practicable and as appropriate based on potential impacts, areas surrounding Santa Cruz Island rockcress occurrences will be prioritized as primary targets for weed eradication.

3.11.5 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.

3.11.6 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 – No Action Alternative

<table>
<tr><th colspan="2">Terrestrial Biology</th></tr>
<tr><th>Alternative</th><th>NEPA
(On-Land and U.S. Territorial Waters)</th></tr>
<tr><td rowspan="3">No Action Alternative</td><td>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 nonnative 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.</td></tr>
<tr><th>EO 12114
(Non-U.S. Territorial Waters)</th></tr>
<tr><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 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.</td></tr>
</table>

Table 3.11-19: Summary of Effects – Alternative 1

Terrestrial Biology	
Alternative	**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 ac in the plateau area of SCI. Nineteen new Training Areas and Ranges (TARs) totaling about 1,800 ac 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 ac, 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.

Table 3.11-20: Summary of Effects – Alternative 2 and Mitigation

Terrestrial Biology	
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 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.
	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.
Mitigation Measures, Including Current Measures and Additional Measures Associated with Alternatives 1 and 2	
Mitigation Measures	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 nonnative 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.

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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 regulatory concern are those properties listed in, or eligible for listing in, the National Register of Historic Places (NRHP). To be NRHP-listed or -eligible, cultural resources must meet one or more of the eligibility criteria established by the National Park Service (NPS) and promulgated as Department of the Interior regulations (36 Code of Federal Regulations [CFR] Part 60.4). Whether prehistoric, historic, or traditional, such listed or eligible properties are referred to as "historic properties." Eligible properties are afforded the same regulatory consideration as listed properties. Sites not yet evaluated are considered to be potentially eligible until formally evaluated. Section 106 of the NHPA requires federal agencies to consider the effects of their actions on such historic properties. The regulations implementing

Section 106 (36 CFR Part 800) specify a consultation process to assist in satisfying this requirement.

3.12.1 Affected Environment

3.12.1.1 SOCAL Operating Areas

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 subject to low-energy inundation by rising sea levels over the last 12,000 years and perhaps also to 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.

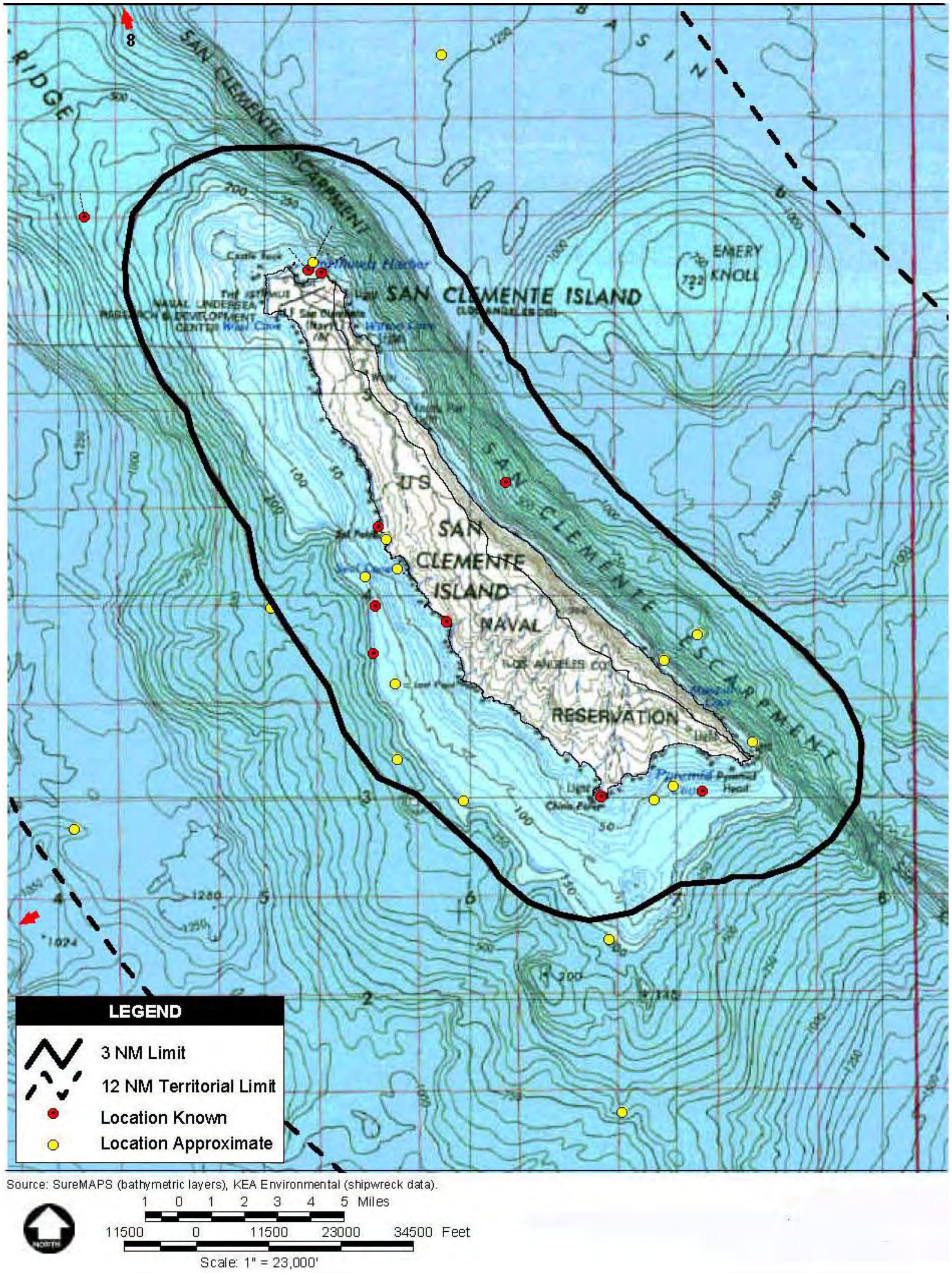

Figure 3.12-1: San Clemente Island Submerged Cultural Resources

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).

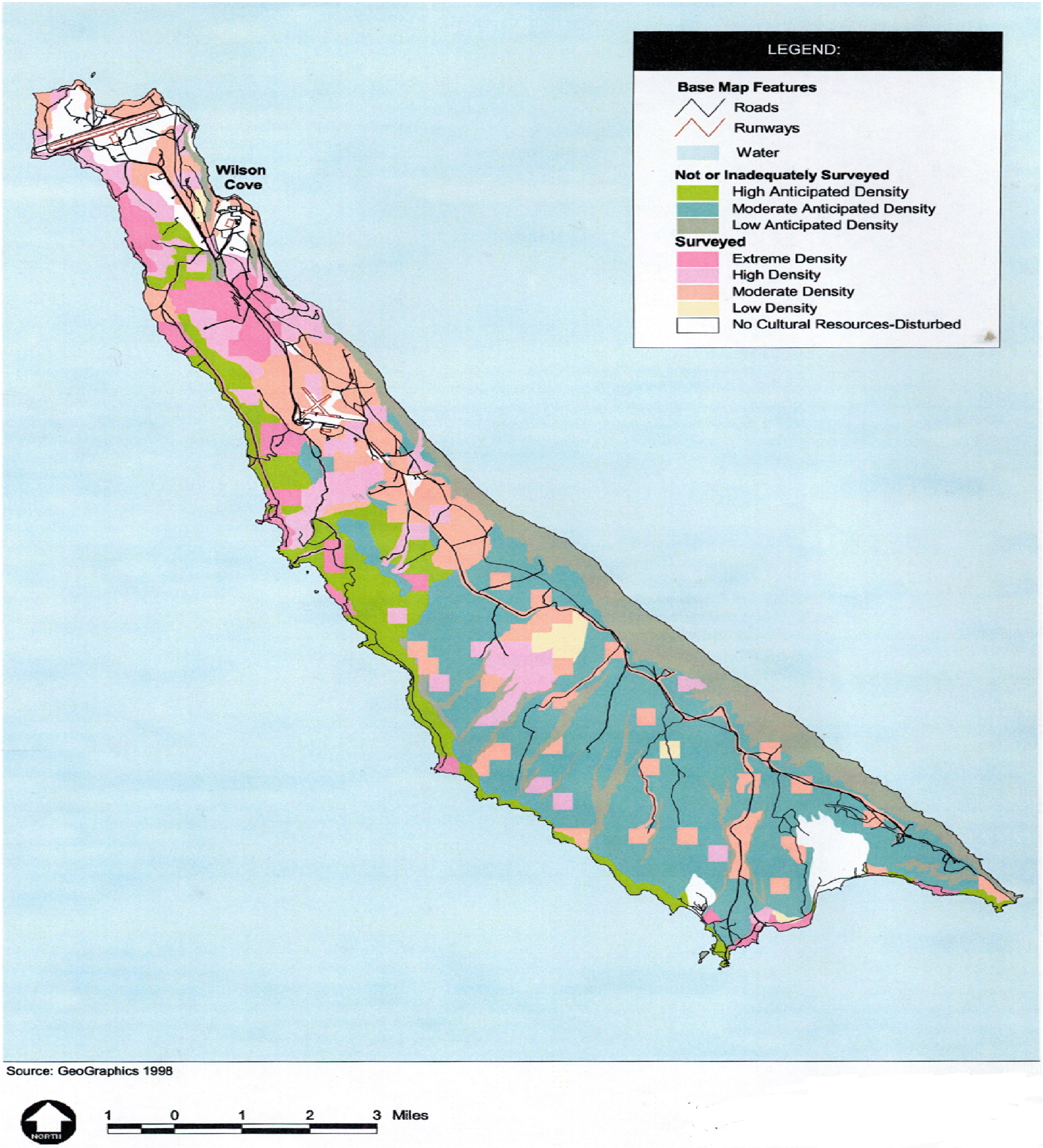

Figure 3.12-2: Cultural Resources Site Density on SCI

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-period 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 by the demolition and replacement of its principal contributing element, NOTS Pier. This consultation resulted in resolving 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. Mitigation actions will be focused on treating adverse effects;
3. All vehicles are required to stay on established roads or within the Assault Vehicle Maneuver Corridor (AVMC) (which encompasses the Assault Vehicle Maneuver Areas [AVMAs] and Assault Vehicle Maneuver Road [AVMR]);
4. Unauthorized collection of archaeological materials is prohibited;
5. Unauthorized digging is prohibited;
6. Archaeological sites in areas of high use are posted with archaeological site protection signage; and
7. U.S. Marine Corps large-scale amphibious landing exercises are restricted to designated shore landing areas and the AVMC, with associated foot traffic 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 ”program alternatives” to implement Section 106 of the NHPA, including Programmatic Agreements (PAs) (36 CFR 800.14(b)). NHPA Section 106 compliance on SCI will be governed by the SCI PA executed in Fall 2008 following consultation among the Navy (by Commanding Officer, NB Coronado), the California SHPO, the ACHP, and 16 other consulting parties (DON, et al. 2008)). The 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 further establishes that seventy years of naval gunfire and aerial bombing use in Impact Areas 1 and 2 within SHOBA has left high concentrations of Material Potentially Possessing Explosive Hazards (MPPEH) and Unexploded Ordnance (UXO) that create adverse health and safety risks to personnel. In response, Navy policy has been codified (CNRSW Instruction 4000.2, Ground Entry/Access to Operational Range Complexes) that prohibits access into these Impact Areas for most uses, including historic preservation management activities. Under the PA, this prohibition on direct historic preservation management activities within the SHOBA Impact Areas has been determined to require an alternative approach for addressing its Section 106 compliance responsibilities in these areas, which will be developed in preparation of the SCI ICRMP.

Stipulation III.D.4 of the PA also defines dispersed pedestrian troop movements as having no adverse effect on archaeological resources. Attachments E and F to the PA contain detailed instructions for the respective reviews of construction, repair, maintenance, and modifications of facilities, and on operational training requests on SCI, to ensure that impacts on historic properties are minimized. Attachment I to the PA contains detailed procedures for marking archaeological sites on SCI with signs to help prevent inadvertent disturbance.

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 under 36 C.F.R. § 800.14, the Navy has executed a PA with the California SHPO and the Advisory Council on Historic Preservation. The PA provides alternatives to the standard procedures for complying with Section 106 of the NHPA. Under the 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 Operating Areas

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

<u>Live-Fire Activities in Shore Bombardment Areas</u>

As noted above, the PA establishes that the long term naval gunfire and aerial bombing use in SHOBA Impact Areas 1 and 2 has left high concentrations of MPPEH and UXO that create risks to personnel, including access historic preservation management activities. Navy policy now prohibits such access. Under the PA, the SHOBA Impact Areas have been determined to require an alternative approach for addressing its Section 106 compliance responsibilities in these areas, which will be developed in preparation of the SCI ICRMP.

As such, 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 to be alternatively addressed later and are excluded from cultural resources impact assessment under NHPA.

EFEXs outside of Impact Areas I and II at Artillery Firing Point (AFP) 1, and at Observation Posts (OPs) 1 and 3, are located in areas with no cultural resources. EFEX events at AFP-6 may affect archaeological resources by disturbing surface soils, but the application of avoidance measures, including protective site signage, limit this potential to No Adverse Effect.

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. Section 106 consultation outside coverage under the PA is required to address any future adverse effects of the Proposed Action may have 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 III.D.4 (Pedestrian Use as No Adverse Effect) of the 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 Adverse 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 III.D.4 of the PA. Thus, no cultural resources are adversely affected by these training activities.

Naval Special Warfare

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 III.D.4 of the 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., Based on the Navy's commitment to avoid sites, SHPO earlier concurred that 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 Prisoner of War Camp and Surface-to-Air Missile 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 entirely located within Impact Area I, and the potential for effects there will be considered under this alternative approach for Impact Areas I and II to be developed in preparation of the SCI ICRMP. Pedestrian activities in the TAR are deemed to have no adverse effect on cultural resources under NHPA, based on Stipulation III.D.4 of the PA.

TAR 21—Horse Beach Cove Training Area

TAR 21 falls entirely within Impact Area I, and the potential for effects there will be considered under this alternative approach for Impact Areas I and II to be developed in preparation of the SCI ICRMP. Pedestrian activities are not considered to have an adverse effect to cultural resources under NEPA or Stipulation III.D.4 of the PA.

TAR 22—China Cove Training Area

TAR-22 lies entirely within Impact Area II, and the potential for effects there will be considered under this alternative approach for Impact Areas I and II to be developed in preparation of the SCI ICRMP. Pedestrian activities are not considered to have an adverse effect to cultural resources under NEPA or Stipulation III.D.4 of the PA.

In summary, NSW training under the No Action Alternative does not adversely 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 III.D.4 of the PA. Air operations and vehicle travel on established roads have no adverse effect on historic properties because they do not disturb 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

Ground support activities for missile flight tests (placing targets and range instrumentation, and EOD range clearance) 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 Operating Areas

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 Shore Bombardment Areas

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 III.D.4 of the PA. Vehicles are restricted to developed routes within the AVMR and the AVMAs. The potential for effect from live fire directed into the Impact Areas would be precluded under the current NEPA analysis, as discussed above, and considered later under the alternative approach for Impact Areas I and II to be developed in preparation of the SCI ICRMP.

Troops conducting Amphibious Landings at Wilson Cove, Northwest Harbor, West Cove, and SHOBA use existing roads to access VC-3. Air operations, air-to-ground weapons delivery, and artillery firings are conducted in SHOBA. All vehicles are restricted to existing roads and approved travel corridors. Tracked and amphibious vehicles would use the AVMC. Amphibious landings are consistent with a No Adverse Effect under Stipulation III.D.4 of the PA. No cultural resources are affected by this training operation.

Cultural resources at the Old Airfield (OAF) could be impacted by off-road activities in the AVMA. There are no cultural resources in the two AVMAs located in the northern portion of the island. 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, however, could be affected. Until consultation for effect is later conducted outside an executed PA, site protection signs would be used to facilitate avoidance of the resources in this area.

Naval Special Warfare

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 III.D.4 of the PA.

If a potentially eligible resource were identified during training, the CNRSW would be notified, and the resource would be assessed under stipulated protocols in the 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. As discussed under the No Action Alternative, potential effects to archaeological properties from CSAR training activities in Impact Areas I and II are to be alternatively addressed later and are excluded from cultural resources impact assessment under NHPA.

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

Ground support activities for missile flight tests (placing targets and range instrumentation, and EOD range 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 adverse 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 further SHPO consultation under NHPA prior to their implementation. 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 Operating Areas

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 Shore Bombardment Areas

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 potential 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 III.D.4 of the PA. Vehicles are restricted to developed routes within the AVMR and the AVMAs. The potential for effect from live fire directed into the Impact Areas would be precluded under the current NEPA analysis, as discussed above, and considered later under the alternative approach for Impact Areas I and II to be developed in preparation of the SCI ICRMP.

Troops conducting Amphibious Landings at Wilson Cove, Northwest Harbor, West Cove, and SHOBA use existing roads to access VC-3. Air operations, air-to-ground weapons delivery, and artillery firings are conducted in SHOBA. All vehicles are restricted to existing roads and approved travel corridors. Tracked and amphibious vehicles would use the AVMC. Amphibious landings are consistent with a No Adverse Effect under Stipulation III.D.4 of the PA. No cultural resources are affected by this training operation.

Cultural resources at the Old Airfield (OAF) could be impacted by off-road activities in the AVMA. There are no cultural resources in the two AVMAs located in the northern portion of the island. 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, however, could be affected. Until consultation for effect is later conducted outside an executed PA, site protection signs would be used to facilitate avoidance of the resources in this area.

Naval Special Warfare

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 III.D.4 of the PA. Site protection signage 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. As discussed under the No Action Alternative, potential effects to archaeological properties from CSAR training activities in Impact Areas I and II are to be alternatively addressed later and are excluded from cultural resources impact assessment under NHPA.

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

Ground support activities for missile flight tests (placing targets and range instrumentation, and EOD range 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 adverse 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 further SHPO consultation under NHPA prior to their implementation. 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 Operating Areas

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 United States Marine Corps Amphibious Training

To reduce adverse effects on archaeological sites, detonations will be restricted to designated areas. Until SHPO consultation for effect is conducted under provisions of the 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

To avoid affecting archaeological sites, detonations will be restricted to designated areas that do not contain cultural resources. Site protection signage will be used to facilitate avoidance of sites in all TARs except TARs 20, 21, and 22. Signage as an avoidance measure resulting in a no adverse effect determination for historic properties had been earlier deemed appropriate through consultation with SHPO on other TARS on SCI (Daniel Abeyta to Jan Larson, letter, December 21, 1999).

NRHP-eligible sites and unevaluated sites in TARs at risk for adverse effects will be use site protection signage to facilitate avoidance. Ground-disturbing activities such as target placement will be directed away from the sites through site protection signs. Under the PA, once a site is determined to be eligible for the NRHP, SHPO will be consulted to resolve any identified unavoidable adverse effects through appropriate stipulated treatments (e.g., data recovery).

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 will be unavoidably degrading, damaging, or destroying any prehistoric archaeological resources affected in these areas. However, as described earlier, the PA consultation determined that the SHOBA Impact Areas require an alternative approach for addressing the Navy's Section 106 compliance responsibilities there, which is stipulated to be developed during preparation of the SCI ICRMP. 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 3.12-2 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 has executed a PA to comply with Section 106 of the NHPA and is preparing an ICRMP to implement the PA's stipulated actions and protocols. • Terrestrial archaeological sites are not substantially affected by current training activities. • Any historic buildings and structures are not substantially affected by current training activities. • Compliance with existing SCI cultural resources avoidance measures substantially reduces the potential for adverse effects. • Ground-disturbing activities in areas with cultural resources require additional review, consultation and 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.

Table 3.12-2: Summary of Cultural Resources Effects (continued)

Alternative	NEPA (On-Land and U.S. Territorial Waters)	EO 12114 (Non-U.S. Territorial Waters)
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 further consultation and 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.
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 measures and stipulations are followed and sites that cannot be avoided are addressed through further consultation and 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 in TARs. 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 PA, once a site is determined to be eligible for the NRHP, SHPO will be consulted to resolve adverse effects and identify appropriate stipulated treatments 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 by military vehicles for military activities, 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 United States (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 takeoff 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) (5,486 meters) Mean Sea Level (MSL).
- Class A extends from 18,000 ft (5,486 meters) 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 (3,048 meters) 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).

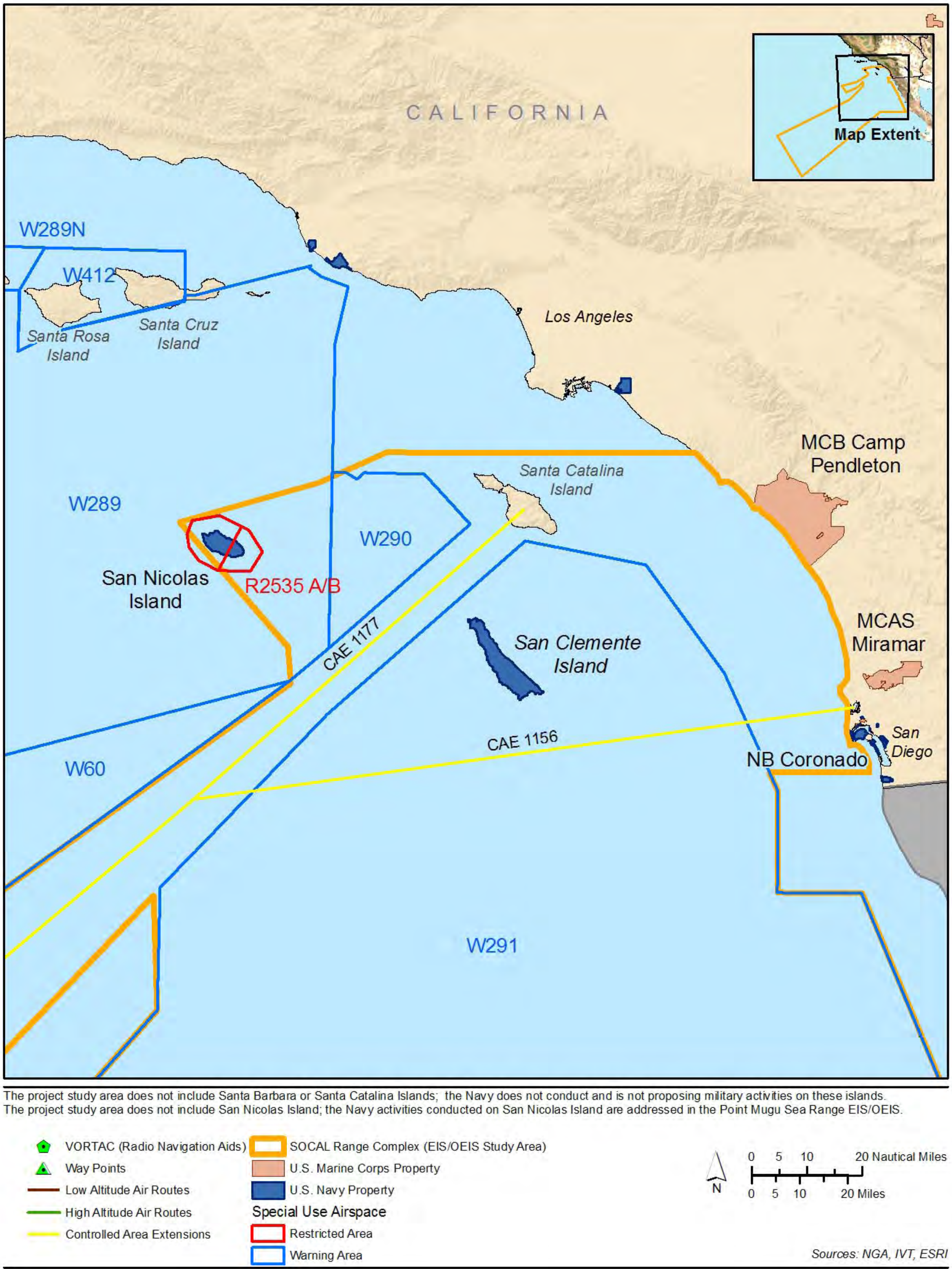

Figure 3.13-1: Air Routes in Vicinity of SOCAL Range Complex

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 Code of Federal Regulations (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 nonaircraft 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 nonparticipating aircraft.

A Restricted Area is a type of SUA within which nonmilitary 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 Operating Areas (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 Operating Areas

3.13.2.1.1 Existing Conditions

<u>Air Traffic</u>

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 (24,384 meters) 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 nonparticipating aircraft are being conducted. Other SUAs within W-291 there are 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 OPAREA. 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 FY2006, 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-nautical mile (nm) (9-kilometer [km]) radius circle centered on NALF SCI and includes the airspace from the surface to 2,700 ft (823 meters) 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 takeoff, landing, low approach to the airfield, or 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, 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 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 transoceanic 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, the National Oceanographic and Atmospheric Administration (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 ft (3 meters) (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 FY2006, 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 (USCG) 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 Naval Air Station (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 nautical miles (93,240 km^2) 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 percent decrease over the 2001 totals of 5,662. The year 2003, however, produced 5,696 arrivals for Los Angeles/Long Beach Harbor, which represents a 6 percent 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 vessel 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 USCG 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 Section 3.14, Socioeconomics). Other activities such as fishing, yachting, and sailing can be found sporadically around the SOCAL OPAREAs.

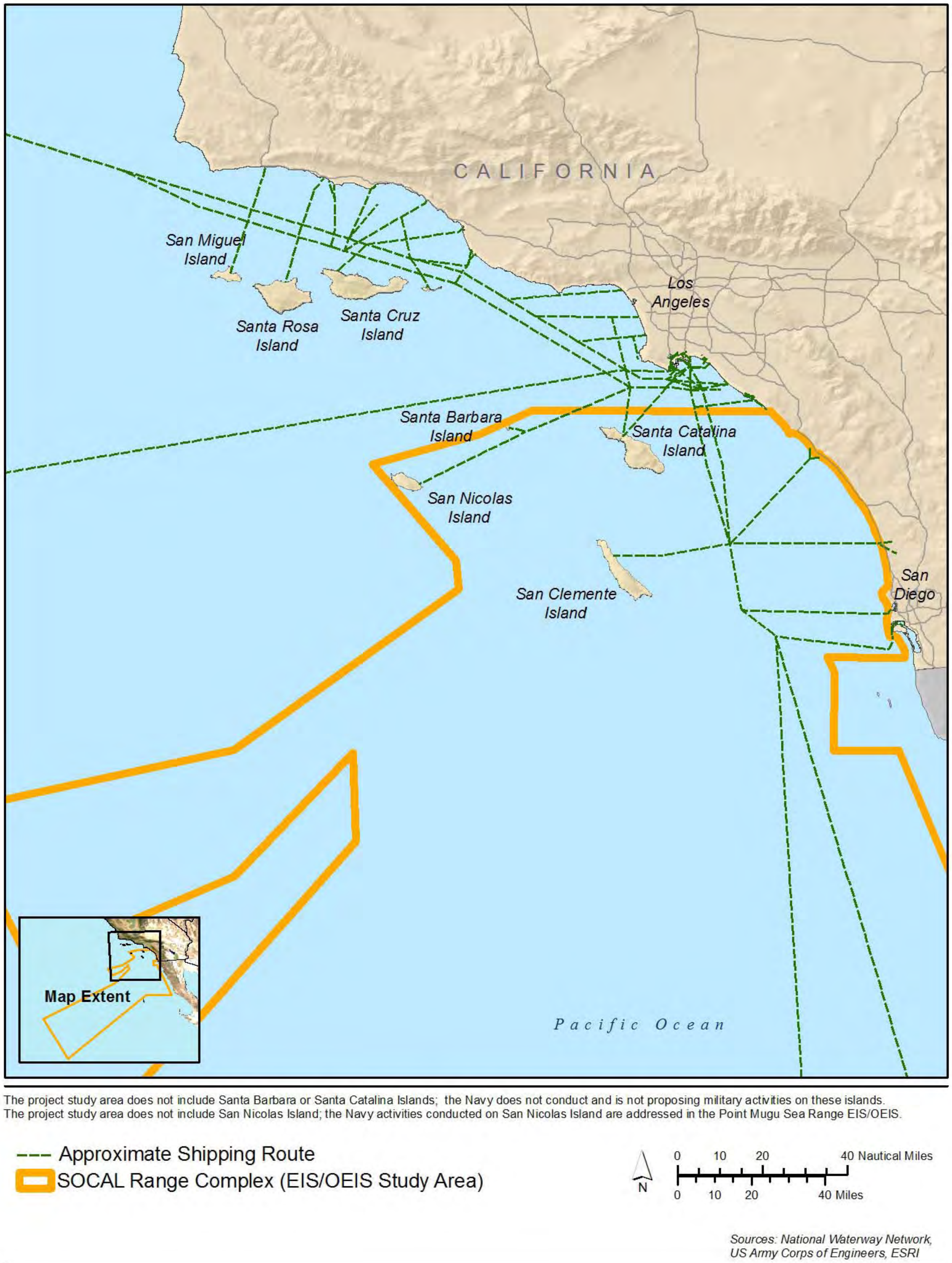

Figure 3.13-2: SOCAL Range Complex Shipping Routes

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 (NOTAM) 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 (Department of Defense [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 warning areas.
- Publication of Notices to Mariners (NOTMARs) and other outreach. The Navy provides information about potentially hazardous activities planned for the SOCAL OPAREAs, for publication by the USCG in NOTMARs. 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 nonparticipating 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 Operating Areas

Both military and nonmilitary 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 OPAREAs 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 USCG.

3.13.3.3 Alternative 1

3.13.3.3.1 SOCAL Operating Areas

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 LOAs 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 USCG. Despite an increase in training tempo, commercial and recreational interests will not be affected by military 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 Operating Areas

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 LOAs 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 USCG. Despite an increase in training tempo, commercial and recreational interests will not be affected by military operational increases.

The 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 3.13.2.1.2. 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 USCG.	• 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 USCG.
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 away from shipping lanes and other recreational areas. • Hazardous marine operations are communicated to all vessels and operators by NOTMARs, published by the USCG.

Table 3.13-1: Summary of Traffic Effects (continued)

Alternative	NEPA (On-Land and U.S. Territorial Waters)	EO 12114 (Non-U.S. Territorial Waters)
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 USCG.
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 Operating Areas

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 (DoN) (including United States [U.S.] Marine Corps [USMC] 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 (Department of Transportation [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 Section 3.13, Traffic). 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 nearshore 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 Section 3.7, Fish), 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 the commercial portion of the average annual pounds (lb) of catch. The average annual catch of pelagic, flatfish, demersal, and all other fish amounts to 50,901,141 average annual catch (in lb) and $6,870,514 (in dollar value).

The average annual catch of crustaceans is about half lobster (average 431,805 lb 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 $210,634 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)	Average Value (Dollars)
Fish	Tuna (yellowfin, skipjack, bluefin, and albacore)	1,034,430	$488,040
	Pacific Sardine	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

The SOCAL Range Complex marine environments are popular locations for recreational activities including sightseeing, whale watching, sport fishing, boating, diving, and surfing. Most recreation- and tourism-related activities occur close to the mainland coast of Southern California or between the mainland and the Channel Islands. The shallower waters near the Channel Islands and some offshore banks, such as Tanner and Cortes Banks, are especially popular areas for Self-

Contained Underwater Breathing Apparatus (SCUBA) diving, fishing, and occasionally surfing. There is very little recreational activity in the southwestern portion of the SOCAL Range Complex due to its distance from land and its water depth.

Santa Catalina and Santa Barbara Islands are within the study area; however, no operations occur on land at either island and naval operations are conducted offshore of the islands to avoid potential contact with nonparticipants.

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 and Cortes Banks. Due to distance from shore, Tanner and Cortes Banks are inherently more hazardous due to their open-ocean diving conditions. Therefore, the nearshore 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 nearshore 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.

Population and Housing

With the exception of SCI, Santa Catalina Island, Santa Barbara Island, and San Nicolas Island, 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.

Figure 3.14-1: Sport Fishing, Surfing, and Diving Areas

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 at 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) to allow the public to plan accordingly. The local 11^{th} District U.S. Coast Guard (USCG) NOTMAR may be found at: http://www.navcen.uscg.gov/lnm/d11/default.htm. The FAA NOTAM 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 (DoN 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 SCI and its personnel is to operate facilities and provide services, arms, and material support to Fleet tactical training and Research, Development, Test and Evaluation (RDT&E) activities. All employment on SCI 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 of these personnel 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 and recreational activities 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. 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. Also, the Proposed Action primarily involves training activities; it does not involve major construction projects.

When considering affects to recreational activities, both the economic impact associated with revenue from recreational tourism and the societal benefit of the public being able to enjoy recreational activities in Southern California are considered.

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 must also be considered. Potential effects on socioeconomic and recreational activities within the SOCAL Range Complex area are addressed for each alternative.

3.14.2.2 No Action Alternative

3.14.2.2.1 SOCAL Operating Areas

Civilian activities currently conducted in the SOCAL OPAREAs include commercial shipping, commercial fishing, sport fishing/diving, and tourism-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 SCI website (www.scisland.org), and the public is notified via a NOTMAR. These measures provide mariners with Navy use areas in advance, which allows nonparticipants 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 Section 3.16, 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. Damage to fishing gear from Navy mine warfare operations in the Kingfisher Range or hydrophones in Southern California Anti-Submarine Warfare (ASW) Range (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.

Concerns about Navy activities affecting the viewshed of coastal Southern California can be analyzed in terms of which Navy activities can be seen from shore. In general, Navy training and RDT&E activities fall into two categories: aircraft activities and ship activities. It should also be noted that although some training activities can be seen from shore, many people do not consider it a negative impact on the viewshed. Many people enjoy seeing ships on the horizon and aircraft flying off into the distance.

Aircraft Activities. Aircraft can frequently be seen transiting from shore to the OPAREA, but are soon out of sight. Most fixed-wing aircraft operations take place well out of sight of coastal Southern California and except for transit from shore, have no impact to the viewshed. Helicopter activities in SOCAL OPAREAs originate and terminate from a ship and are never seen from shore, or they arrive or depart from shore and are visible during transit. Among those helicopter activities in SOCAL OPAREAs are some that take place in the Helicopter Offshore Training Area (HCOTA) (Figure 3.14-2). Operating at an altitude of 50 to 200 feet (ft) (15 to 60 meters [m]), activities in areas Alpha and Bravo could be viewable from shore.

Ship Activities. Ships, like aircraft, can be seen transiting out of San Diego Bay into the SOCAL OPAREAs. As a ship proceeds away from shore, it eventually disappears below the horizon due to the curvature of the earth. Assuming a nominal ship height above water of 55 ft (17 m), ships 8 nautical miles (nm) (14 km) or further from shore will not be visible. Even with an eye-point 150 ft (46 m) above sea level at the shoreline, Navy ships will descend below the horizon at approximately 28 nm (51 km). Except for limited activities off the coast of Coronado, nearly all ship activities take place far from shore and well beyond the visible horizon.

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 Operating Areas

The increase in operations from the No Action Alternative 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. For example, commercial fishermen will know in advance about potential closures in a specific area. This notification will prevent them from wasting their time and fuel transiting to a closed location and they can plan for an alternate location instead. Upon completion of training, the range would be reopened and fishermen would be able to return to fish in the previously closed area. 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 increase in offshore training will not limit access to surf breaks or beaches on the mainland, Catalina Island, or Santa Barbara Island. Other than training at the Camp Pendleton Amphibious Assault Area (CPAAA), Navy training does not occur close enough to shore to limit access to beaches or surf breaks. Public access has not historically been available at CPAAA; therefore, this does not constitute a change in access. Access to surf breaks surrounding SCI and at Cortes Bank may be temporarily limited during training; however, users will be forewarned, the duration of closure is limited, and the number of users is limited.

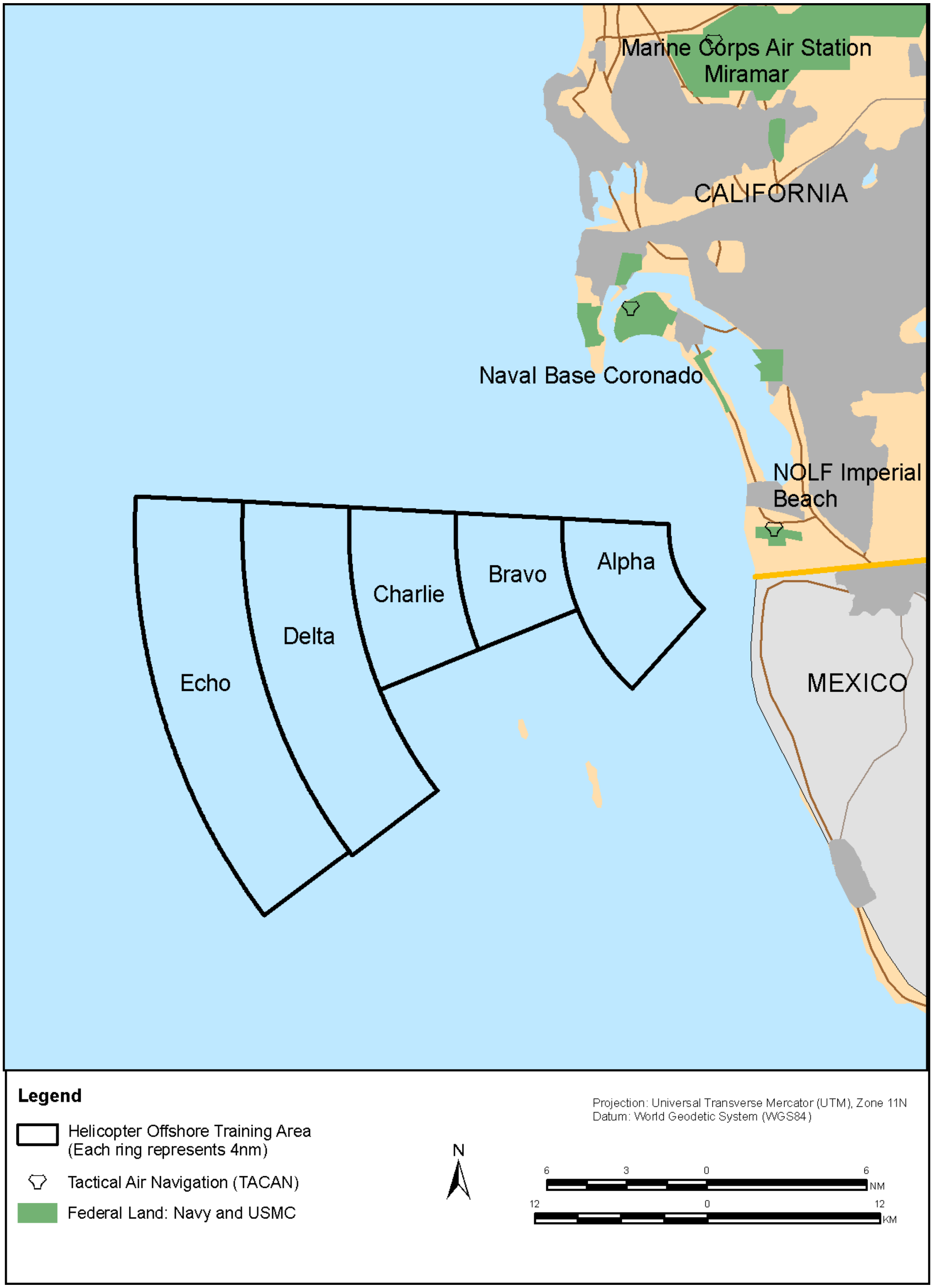

Figure 3.14-2. Helicopter Operating Areas

Impacts to the viewshed from coastal Southern California may change slightly in relation to the baseline No Action Alternative; however, most would take place well beyond shore, and out of sight. Therefore the change is not considered substantial.

3.14.2.3.2 San Clemente Island

Operations on SCI will increase by 45 percent relative to the No Action Alternative. 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 Operating Areas

The increase in operations from Alternative 2 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. As described above under the Alternative 1 discussion, commercial fishermen and other users can more efficiently plan their trips into the SOCAL Range Complex. 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 increase in offshore training will not limit access to surf breaks or beaches on the mainland, Catalina Island, or Santa Barbara Island. Other than training at the CPAAA, Navy training does not occur close enough to shore to limit access to beaches or surf breaks. Public access has not historically been available at CPAAA; therefore, this does not constitute a change in access. Access to surf breaks surrounding SCI and at Cortes Bank may be temporarily limited during training; however, users will be forewarned, the duration of closure is limited, and the number of users is limited.

Impacts to the viewshed from coastal Southern California may change slightly in relation to the baseline No Action Alternative; however, most would take place well beyond shore, and out of sight. Therefore the change is not considered substantial.

The Navy's proposed mine training range is proposed for Tanner Bank. The minefield would be a maximum of 3 by 3 nm. 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 to 4 ft (0.9 to 1.2 m) in diameter 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 both to 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 adverse effects.

3.14.5 Summary of Effects by Alternative

Table 3.14-2 summarizes the effects and mitigation measures related to socioeconomics for the No Action Alternative, Alternative 1, and Alternative 2.

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 long-term effects. • No adverse socioeconomic impacts would occur as a result of implementation of the proposed action.	• Effects are generally the same as described for the No Action Alternative.
Alternative 2 (Preferred Alternative)	• Effects are generally the same as described for Alternative 1.	• Effects are generally 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.

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 (U.S.) 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)/Overseas Environmental Impact Statement (OEIS) include development of Federal agency implementation strategies and 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 that 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 Operating Areas

The Southern California (SOCAL) EIS/OEIS Operating Areas (OPAREAs) consist of open water; therefore, no human populations exist.

3.15.3.2 San Clemente Island

Military support facilities on San Clemente Island (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 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 Operating Areas

As noted in Section 3.15.3.1, no 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, scheduled, and sited to avoid military training activities, ongoing military 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 Operating Areas

As noted previously, no 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 Operating Areas

As noted previously, no 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 from 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 3.15-1 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 of EO 12898 and EO 13045 Effects

Alternative	NEPA (On-Land and U.S. Territorial Waters)	EO 12114 (Non-U.S. Territorial Waters)
No Action Alternative	**Environmental Justice** • No 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 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 Operating Areas

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 (SUA) 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 nonparticipating 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 occasionally enter the nearshore areas of SCI 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.

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.

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, vessels authorized by the Navy, and emergencies.
Southeast Restricted Area (33 C.F.R. 334.920)	Covers the ocean areas near Naval Ordnance Test Station (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 Southern California Anti-submarine Warfare (ASW) Range (SOAR).	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 SCI 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.

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 miles [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 nonparticipants 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 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 nonparticipating 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 nonparticipating aircraft while operating under visual flight rules (VFRs) 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 VFRs 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 nonparticipating vessels, people, or aircraft. The Officer Conducting the Exercise (OCE) 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 FAA 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 preapproved, nonmilitary uses such as scientific research. A scheduled contract aircraft shuttle transports personnel between Naval Air Station North Island (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/SEAL (BUD/S) Camp and Marine 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 explosive weight [n.e.w.]) 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 Auxiliary Landing Facility (NALF) runway, at the Missile Assembly Building at NOTS Pier, and at OP-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) 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 (ROC) 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 ft 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 nonmilitary 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 Operating Areas

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 nonexplosive 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 nonparticipants. 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-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 nonmilitary 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 approximately 1 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 of a temporary nature.

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 nonmilitary 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, Hazardous Materials and Waste. 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

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 (UXO). 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 nonparticipants. 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 nonexplosive 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 ensures the area is clear.

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 (LCAC), Landing Craft Utility (LCU), 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 nonmilitary vessels, and low frequency of activities tend to prevent interaction between civilian vessels and the amphibious vehicles.

Naval Special Warfare

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 nonparticipants. 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 (BOMBEXs) 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 nonmilitary 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

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 (JSOWs), 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 nonparticipants, the test is either delayed or canceled.

Sonobuoys are tested exclusively in the SCI 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 nonparticipants. 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 Operating Areas

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 nonparticipants. 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, Hazardous Materials and Waste. 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 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 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 nonparticipants, 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 provided, 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

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) providing advance notification to island personnel, (3) implementing range surveillance 30 to 60 minutes prior to initiation, (4) ensuring visual confirmation by the RSO that the area is clear of all nonparticipants, (5) ensuring weather conditions allow clear visibility of all targets and impact areas, (6) ensuring all unit members have been prebriefed and trained for their roles, (7) designating a safe area for nonparticipants, (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

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 Operating Areas

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 nonparticipants. 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 Shallow Water Training Range (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, Hazardous Materials and Waste. 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 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

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 nonparticipants 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 and mitigation measures related to public safety for the No Action Alternative, 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 nonparticipants. 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 nonparticipants. 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 that are directive for range users. • Aircraft in W-291 fly under VFR 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 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 EMR 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 VFR 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 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 EMR to Personnel, Ordnance and Fuel have been determined for EMR sources.

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