PLEASE NOTE

This document is an updated and improved Draft Monitoring Plan submitted to NMFS *after* the publication of the SOCAL Proposed Rule for consideration in the final rule. NMFS has not yet reviewed this plan and is not soliciting comments, but is making the plan available to the public to view.

The earlier version of the draft Monitoring Plan, which is specifically considered part of the proposed rule, is posted in the same cell of the same table of the same website and entitled "Monitoring Plan".

Southern California Range Complex Marine Mammal Monitoring Plan

SUBMITTED TO
Office of Protected Resources, National Marine Fisheries Service
DRAFT 07 OCTOBER 2008

National Marine Fisheries Service
Office of Protected Resources
Prepared by
Department of the Navy

Southern California Range Complex Marine Mammal Monitoring Plan

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This Monitoring Plan is submitted to NMFS in support of the Taking and Importing Marine Mammals; U.S. Navy Training in the Southern California Range Complex; Proposed Rule

AND

Biological Opinion on the U.S. Navy's Training in the Southern California Range Complex

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Front page photo: Blue whale observed in offshore waters of Southern California

Photo By: Office of Protected Resources, Southwest Fisheries Science Center, National Marine Fisheries Service

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INTRODUCTION

The U.S. Navy has developed this Southern California (SOCAL) Range Complex (**Figure 1**) Monitoring Plan to provide marine mammal and sea turtle monitoring as required under the Marine Mammal Protection Act (MMPA) of 1972 and the Endangered Species Act (ESA) of 1973.

In order to issue an Incidental Take Authorization (ITA) for an activity, Section 101(a) (5) (a) of the MMPA states that National Marine Fisheries Service (NOAA/NMFS) must set forth "*requirements pertaining to the monitoring and reporting of such taking*". The MMPA implementing regulations at 50 CFR Section 216.104 (a) (13) note that requests for Letters of Authorization (LOAs) must include the suggested means of accomplishing the necessary monitoring and reporting that will result in increased knowledge of the species and of the level of taking or impacts on populations of marine mammals that are expected to be present (NOAA/NMFS, 2005).

While the Endangered Species Act does not have specific monitoring requirements, recent Biological Opinions issued by National Marine Fisheries Service (NMFS) have included terms and conditions requiring the Navy to develop a monitoring program.

Additional Navy funded research and development (R&D) studies and ancillary research collaborations with academia and other institutions will be integrated as possible to enhance the available data, and will be used in part to address objectives of a larger Navy-wide initiative discussed in this Plan. Lastly, as an adaptive management strategy, the SOCAL Range Complex Monitoring Plan will integrate elements from Navy-wide marine mammal research into the regional monitoring and data analysis proposed in this Plan when new technologies and techniques become available.

NAVY-WIDE INTEGRATED COMPREHENSIVE MONITORING PROGRAM (ICMP)

The Integrated Comprehensive Monitoring Program (ICMP) is Navy-wide and will provide an overarching structure and coordination that compiles data from all Navy range specific monitoring plans (**Figure 2**).

In addition to the SOCAL Range Complex monitoring plan, a number of other Navy range complex monitoring plans are being developed for protected marine species, primarily marine mammals and sea turtles, as part of the environmental planning and regulatory compliance process associated with a variety of training actions in those regions. Goals of these monitoring plans are to assess the impacts of training activities on marine species and effectiveness of the Navy's current mitigation practices.

The SOCAL Range Complex plan is one component of the ICMP and the studies outlined here will also be implemented in other range complexes (**Figure 2**). The overall objective of the ICMP is to assimilate relevant data collected across Navy range complexes in order to answer questions pertaining to the impact of mid-frequency active sonar (MFAS) and underwater explosive detonation on marine mammals and sea turtles.

The primary objectives of the ICMP are to:

- Monitor and assess the effects of Navy activities on protected marine species;
- Ensure that data collected at multiple locations is collected in a manner that allows comparison between and among different geographical locations;
- Assess the efficacy and practicality of monitoring and mitigation techniques;
- Add to the overall knowledgebase of marine species, and the effects or lack of effects of Navy activities on marine species.

SOCAL RANGE COMPLEX MONITORING PLAN

Monitoring Plan Objectives

The SOCAL Range Complex Monitoring Plan has been designed as a collection of focused "*studies*" to gather data that will allow us to attempt to address the following questions which are described fully in the following sections:

1. Are marine mammals and sea turtles exposed to mid-frequency active sonar (MFAS), 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?
2. If marine mammals and sea turtles are exposed to MFAS in SOCAL, do they redistribute geographically as a result of continued exposure? If so, how long does the redistribution last?
3. If marine mammals and sea turtles are exposed to MFAS, what are their behavioral responses to various levels?
4. What are the behavioral responses of marine mammals and sea turtles that are exposed to explosives at specific levels?
5. Is the Navy's suite of mitigation measures for MFAS and explosives (e.g., PMAP, major exercise measures agreed to by the Navy through permitting) effective at avoiding TTS, injury, and mortality of marine mammals and sea turtles?

Marine Species Under Consideration

There are 41 marine mammal species or separate stocks with possible or confirmed occurrence in the marine waters off Southern California and within the SOCAL Range Complex. There are 34 cetacean species (whales, dolphins, and porpoises), six pinnipeds (sea lions, fur seals and true seals) and one sea otter species (**Table 1**). Barlow and Forney (2007) contain the latest cetacean density estimates for multiple species within California. The Navy's SOCAL Marine Resources Assessment summarizes previous scientific literature on SOCAL marine mammals as well as the SOCAL DEIS\DOEIS (DoN, 2005; DoN, 2008). Not all species of these are regularly observed within Southern California and may represent rare, infrequent or extralimital occurrences (Forney and Barlow, 1998). **Table 1** discusses likely occurrence within Southern California. This SOCAL Range Complex Monitoring Plan has been designed to attempt gathering data on all species of marine mammals and sea turtles observed in the SOCAL study area. However, the Navy will prioritize monitoring efforts for species based on regulatory requirement due to ESA-listing, and on beaked whale species where MFAS use and strandings have been linked in certain circumstances. Of note, all of the beaked whale strandings and association with MFAS have been in specific geographic locations of the Atlantic Ocean (Bahamas, Canary Islands) and Mediterranean Sea (Greece). There have been no beaked whale atypical mass strandings associated with MFAS use on U.S. Navy Range Complexes within the Atlantic or Pacific. A detailed discussion on marine mammal stranding is contained in the SOCAL DEIS\DOEIS (DoN, 2008).

Therefore, based on the requirements listed above, species for study that regularly occur within SOCAL will be prioritized for research under this Monitoring Plan as follows:

- **ESA-listed species** (blue whale, fin whale, humpback whale, sei whale, sperm whale, and Guadalupe fur seal)
- **beaked whale species** (Cuvier's beaked whale, Baird's beaked whale, other Mesoplodon species)
- **other deep diving toothed whale species** (as possible surrogate for beaked whaled based on similar foraging patterns)

The Plan recognizes that deep diving and cryptic species of marine mammals such as beaked whales, and sperm whales, may have low probability of visual detection (Barlow and Gisiner, 2006). Therefore, methods will be utilized to attempt to address this issue (e.g., passive acoustic monitoring, animal tagging). Beaked whales will be given particular attention during monitoring in the SOCAL study area in the form of focal follows when observed and passive acoustic monitoring when possible; although monitoring methods could be similar for any species under study.

Monitoring Plan Research Elements

Each monitoring technique has advantages and disadvantages that vary temporally and spatially, as well as support one particular study objective better than another. The Navy intends to use a combination of techniques so that detection and observation of marine animals is maximized, and meaningful information can be derived to answer the research objectives described above.

Monitoring methods proposed for the SOCAL Range Complex include a combination of the following research elements designed to support both Range Complex specific monitoring, and contribute information to the ICMP. These research elements include:

- Visual Surveys- Vessel and aerial
- Passive Acoustic Monitoring (PAM)
- Marine Mammal Observers (MMO) on Navy ships
- Marine mammal tagging

VISUAL SURVEYS- VESSEL, AERIAL, OR SHORE-BASED

Visual surveys of marine animals can provide detailed information about behavior, distribution, and abundance. Baseline measurements and data for comparison can be obtained before, during, and after training exercises. In accordance with all safety considerations, observations will be maximized by working from all available platforms: vessels, aircraft, land and/or in combination. Vessel and aerial surveys will be conducted on commercial vessels and aircraft. Visual surveys will be conducted during a variety of Navy at-sea training events that have been identified as providing the greatest likelihood of successful sightings in relationship to the Plan's overall research objectives.

Vessel surveys are often preferred by researchers because of their slow speed, offshore survey ability, duration, and ability to more closely approach animals under observation. They also result in higher rate of species identification, the opportunity to combine line-transect and mark-recapture methods of estimating abundance, tag deployment and retrieval, and collection of oceanographic and other relevant data. Vessels can be less expensive per unit of time, but because of the length of time to cover a given survey area, may actually be more expensive in the long run compared to aerial surveys (Dawson et al., 2008). Changes in behavior and geographical distribution may be used to infer if and how animals are impacted by sound. However, it should be noted that animal reaction (reactive movement) to the survey vessel itself are possible (Dawson et al., 2008). Vessel surveys may not allow for observation of animals below the ocean surface (e.g., in the water column) as compared to aerial surveys, and are not always logistically feasible due to resource constraints (time, personnel, ship availability).

Visual survey teams will collect: 1) location of sighting; 2) species; 3) number of individuals; 4) number of calves present; 5) duration of sighting; 6) behavior of marine animals sighted; 7) direction of travel; 8) environmental information associated with sighting event including beaufort sea state, wave height, swell direction, wind direction,

wind speed, glare, percentage of glare, percentage of cloud cover; and 9) when in relation to navy exercises did the sighting occur (before, during or after detonations/exercise.

Aerial surveys offer an excellent opportunity for detailed behavioral focal observations using established protocol (Richardson et al., 1985, 1986, 1990; Würsig et al., 1985, 1989; Smultea and Würsig, 1995; Patenaude et al., 2002). Aerial surveys also allow observation of marine mammals that are below the surface (0-30+ feet depending on water clarity) and are able to cover a given search area in a shorter time (Slooten et al., 2004; Dawson et al., 2008). Aircraft are able to routinely cover a larger area in a shorter time as compared to vessels, and are less prone to causing reactions from the animals under observation given the altitude of most surveys (800-1,000 ft; 244-305 m) (Dawson et al., 2008). Due to limited aircraft seating, the number of observers carried by aircraft is less than vessel surveys and the opportunity to rotate observers to avoid observer fatigue is reduced (Dawson et al., 2008).

PASSIVE ACOUSTIC MONITORING (PAM)

There are both benefits and limitations to passive acoustic monitoring (Mellinger and Barlow, 2003; Mellinger et al., 2007). PAM allows detection of marine mammals that may not be seen during a visual survey. When interpreting data collected from PAM, it should be noted that species specific results must be viewed with caution because not all animals within a given population may be vocalizing, or may only vocalize only under certain conditions (Mellinger et al., 2007; ONR, 2007). PAM from the existing Navy fixed underwater range at the Southern California ASW Range (SOAR) west of San Clemente Island (**Figure 3**), and deployable acoustic recording packages (ARP) will be employed. Other acoustic monitoring buoy types might also be considered for deployment as well (Lammers et al., 2005). Mellinger and Barlow (2003) and Mellinger et al. (2007) contain detailed discussions on the benefits and limitations to passive acoustic monitoring.

Marine Mammal Monitoring on Navy Ranges (M3R)

The Navy already has an existing fixed passive acoustic array at SOAR mounted on the bottom of San Nicholas basin west of San Clemente Island, as well as a proposal for extending this array as part of the SOCAL DEIS/DOEIS (DoN, 2008). This system was originally designed to record underwater sounds and provide tracking capability for Navy training events. The hydrophones on this fixed system are not currently capable of recording vocalization from all marine mammal species, especially low frequency specialist such as some baleen whales (in particular, blue and fin whales). The existing hydrophones on SOAR are bandwidth limited to 8 – 40 kHz. Planned updates and refurbishment of this passive array are funded and design work in progress which will allow for greater frequency range once newer hydrophones are installed in summer 2009. After this refurbishment, hydrophone bandwidth will be increased to ~50 Hz – 40 kHz.

The Navy also plans on future integration of the Marine Mammal Monitoring on Navy Ranges (M3R) project within the SOAR underwater range (Tiemann et al., 2006)(**Figure 3**). The main objective of the M3R project is to develop a toolset for passive detection, localization, and tracking of marine mammals using existing Navy undersea range infrastructure. The project by the Naval Undersea Warfare Center (NUWC) was originally funded by the Office of Naval Research (ONR) and now continuous under Chief of Naval Operations (CNO N45) funding. A necessary first step in this effort is the creation of a baseline of acoustic classification and behavior that requires long-term monitoring of marine mammals. As part of an overall comprehensive compliance program, M3R is working to develop new tools for tracking marine mammals. It should

be noted, however, that M3R passive acoustics, especially real-time detection, is an emerging field that does need continued research especially as applied to classification, localization, and density estimation. Data from the M3R system tests on the fixed passive acoustic range at SOAR will be used opportunistically as available. The system is still in development and undergoing periodic field tests of marine mammal species identification based on passive detections. There has been recent success in particular with detection and classification of Cuvier's beaked whales. Prototype real-time classifiers for beaked whales are tentatively scheduled for deployment at SOAR by spring of 2009.

M3R has been funded by CNO N45 in FY08 for a 3-year marine mammal monitoring program within the SOCAL Range Complex. The major program objectives are to:

1. Measure the effect of active sonar on marine mammal populations with an emphasis on Cuvier's beaked whales.

2. Assess population size and structure of beaked whales and other species in relation to potential impacts using passive acoustic methods, tagging, and photo-identification.

3. Develop the algorithms and infrastructure required for long-term monitoring

To meet these objectives for the M3R program, the following tasks will be incorporated:

1. Collect SOAR hydrophone and visual/acoustic survey data in the range both in the presence and absence of active sonar exercises

2. Place satellite tags on marine mammals in and near the range to document the effect of sonar usage on their spatial and temporal distribution

3. Determine the abundance, residency patterns, and movements of marine mammals, including beaked whales, in the SOAR range through analysis of passive acoustic and photo-identification data

4. Collect verified species vocalization data for marine mammals found on the SOAR range

5. Develop detection, classification, and localization algorithms for as many marine mammal species as feasible

6. Develop and implement prototype classifiers for Cuvier's and Blainville's beaked whales

7. Upgrade the M3R processor for SOAR refurbishment hydrophone upgrades

8. Monitor environmental changes and effects on marine mammals

Other PAM

In addition to working with the passive acoustic detection capabilities of the Navy's SOCAL fixed range, the Navy also commits to deploying at least two autonomous acoustic recording buoys such as a High-frequency Acoustic Recording Package (HARP) (Appendix A) or similar buoy (see Newcomb et al., 2002; Wiggins and Hildebrand, 2007; Lammers et al., 2008). These buoys will be used for PAM in the SOCAL Range Complex in order to detect, locate, and potentially track vocalizing marine mammals. The exact number of buoys above two needed to adequately characterize an area is under review and will be promulgated as a separate study plan. Buoys will be set on a duty cycle that maximizes battery power, data storage space and provides adequate sampling. If Navy funding is available and additional buoys deemed necessary after consultation with NMFS and regional scientists, then potentially additional buoys may be considered. Another PAM buoy under consideration are pop-up buoys (or similar buoys) to be used

to monitor specific areas for periods of time before, during, and after training events in conjunction with other monitoring efforts when possible. The buoys will be distributed in an array to facilitate data collection on geographical movements; however, the exact placement of the buoys each year will be determined using operational guidance to maximize the likelihood of capturing data during training events. These buoys will be left in place for a long enough duration that data are collected both during and outside of training events. All passive acoustic recording packages will be set on a duty cycle to provide appropriate sampling coverage and maximize battery power and data storage space. Buoys will be retrieved as required for maintenance and downloading of data. Autonomous acoustic recording buoys will provide long term, daily information on the presence and absence of marine mammals in each area and their movements through the area. These systems will also provide information on the species present and their movements when an exercise occurs in that area (Mellinger and Barlow, 2003; Oswald et al., 2003; Melliger et al., 2007). Acoustic data will be collected according to standard and accepted passive acoustic monitoring protocols (NMFS 2008 Passive Acoustic guidelines).

MARINE MAMMAL OBSERVER ON NAVY SHIPS

Marine Mammal Observers (MMOs) aboard Navy vessels will be used to research the effectiveness of Navy lookouts, as well as for data collection during other monitoring surveys.

MMOs will be field-experienced observers that are either Navy biologists or contracted marine biologists. These civilian MMOs will be placed alongside existing Navy lookouts during a sub-set of training events. This can only be done on certain vessels and observers may be required to have security clearance. Use of MMOs will verify Navy lookout sighting efficiency, offer an opportunity for more detailed species identification, and provide an opportunity to bring animal protection awareness to the ships crew, and provide the opportunity for an experienced biologist to collect data on marine mammal behavior. Data collected by the MMOs is anticipated to assist the Navy with potential improvements to lookout training as well as providing the lookouts with a chance to gain additional knowledge on marine mammal sighting. Events selected for MMO participation will be an appropriate fit in terms of security, safety, logistics, and compatibility with Navy training. MMOs will monitor for marine mammals from the same height above water as Navy lookouts (e.g., bridge wings or slightly higher if space limited). As all visual survey teams, MMOs will collect the same data collected by Navy watchstanders, including but not limited to: 1) location of sighting; 2) species; 3) number of individuals; 4) number of calves present; 5) duration of sighting; 6) behavior of marine animals sighted; 7) direction of travel; 8) environmental information associated with sighting event including beaufort sea state, wave height, swell direction, wind direction, wind speed, glare, percentage of glare, percentage of cloud cover; and 9) when in relation to Navy exercises did the sighting occur (before, during or after detonations/exercise).

The MMOs will not be part of the Navy's formal reporting chain of command during their data collection efforts and Navy lookouts will follow their chain of command in reporting marine mammal sightings. Exceptions will be made if an animal is observed by the MMO within the shutdown zone was not seen by the lookout. The MMO will inform the lookout of the sighting so that appropriate action may be taken by the ship. For less biased data, it is recommended that MMOs schedule their daily observation schedule to duplicate the lookout schedule. A more complete description of MMO procedures is described in the individual Study methods.

MARINE MAMMAL TAGGING

Technological advancements in recent years now provide opportunity for data collection by deploying tags on individual marine mammals (Mate et al., 1999; Baird et al., 2006; Tyack, 2007; Baird, et al., 2008; Calambokidis et al., 2008). Individuals can be tracked using VHF radio or satellite tags. These types of tags, as well as acoustic recording tags that provide more discreet information about pitch, roll, vertical and horizontal movement, can provide significant new information about animal movement and habitat use. This tool is especially useful when deployed on medium-sized, difficult-to-observe and deep-diving target species such as beaked whales (Zimmer et al., 2005; Tyack, 2007, Johnson et al., 2008). To date, some tag attachments are lasting in excess of 60 days (Baird, pers. comm. 2008). A variety of long and short term tags will be used to obtain a broad-scale data set. Effort will also be given to coordinate with ongoing marine mammal tagging efforts in the SOCAL study area for baleen whale species (i.e., Tagging of Pacific Predators available at:http://www.topp.org). Tagging of Pacific Predators began in 2000 as one of 17 projects of the Census of Marine Life, a 10-year, 80-nation endeavor to assess and explain the diversity and abundance of life in the oceans. NOAA's Pacific Fisheries Ecosystems Lab, Stanford's Hopkins Marine Lab, and University of California, Santa Cruz's Long Marine Laboratory manage the program. The Navy's ONR already provides funding for marine mammal tag development and improvement. If an opportunity arises, Navy is open to providing further assistance to SOCAL efforts that attempt to tag baleen whale species in and around SOCAL training areas in context of the TOPP program.

In addition to baleen whale tagging, the Navy will directly fund academic researchers in a program to tag beaked whales and certain substitute deep diving surrogate species recommended by these researchers within SOCAL. This program is in an initial planning phase and will be integrated as the SOCAL monitoring plan matures. Depending on results and timing for NMFS permitting require prior to conducting marine mammal tagging research, one of the goals of the SOCAL tagging program will be to place one of two types of tags on beaked whales or surrogate species: a retrievable Digital Acoustic Recording Tag (DTAG) which is a short-term tag (hours-to-days) that can record short term animal movement (diving profiles, swimming speed, depth), exposure to underwater sound, and potential behavioral reactions; or one of a series of satellite position tags that can provide longer term indication of animal movement. Another tag successfully used in SOCAL by academic and Navy researchers has been satellite Argos tags. Argo tags can be attached by a dorsal fin dart and can remain attached for over 30 days (Schorr et al., 2007). These tags provide a direct measure of the animals' movements, and have already been used in 2007 on fin and Cuvier's beaked whales sighted during a Navy PAM field test west of San Clemente Island (SOAR).

Another example of a long term tags, discussed on the TOPP web site, is the Smart Position or Temperature Transmitting Tag (SPOT) which has a potential lifespan of two years. Species will be tagged opportunistically; however the focus will be on cryptic and deep diving species such as beaked, or sperm whales that have the lowest rates of detectability in visual surveys (Barlow and Gisiner, 2006). Results from tagging will be examined annually to assess the effectiveness of this technique.

Monitoring Plan Study Descriptions

The implementation of various SOCAL Range Complex specific studies and proposed hour goal for conducting these monitoring studies are shown in **Table 2**. The hours shown are actual study hours when active sonar is being used (e.g., aerial survey in conjunction with training event if possible), with darkness and non-ASW hours removed.

In order to effectively meet the objectives outlined in this Plan, it was determined that training events recommended for monitoring should contain: 1) one or more surface combatants conducting ASW or explosive use during a regularly scheduled training event; 2) training events that occur close enough to shore that re-fueling does not become an issue with the aerial survey team; 3) for some studies, the ability to conduct aerial surveys in close proximity to Navy assets, and 4) for some studies, the ability to employ multiple research elements before, during, or after a given Navy training event within the same geographic area. An example of this might be aerial survey coupled with MMO while a ship(s) is/are training within SOAR with complimentary passive acoustic detection of marine mammals.

Specific areas within SOCAL have been deemed focus areas based on either past marine mammal surveys within that area, or lack of marine mammal survey information. **Figure 4** shows the preliminary areas of monitoring interest within the SOCAL Range Complex and represent areas accessible enough for the various research elements discussed in this Plan. These nominated research areas, however, do not preclude monitoring in other areas of the SOCAL Range Complex, but are intended to designation sub-regions within SOCAL that will have initial prioritization. The designation of the most appropriate monitoring sub-areas will be reviewed at the end of each monitoring year as part of an adaptive management approach based on results for that year's monitoring. As stated previously, survey locations and protocols will be coordinated with NMFS scientists at Southwest Fisheries Science Center (SWFSC) in La Jolla, California.

Total hours summarized at the bottom of **Table 2** are tied to practical timelines for each survey type. In this case, nominal 12-hr per day for visual vessel survey, 6-hr per day for visual aerial survey, 12-hr per day for MMO. Major Navy exercises within SOCAL can last from one to three weeks, while intermediate exercises last are typically two to four days. Unit level training (ULT) occurs in terms of hours or less than one day.

The monitoring hours shown in **Table 2** represent the minimum number of hours available per year. If additional funding and survey hours become available, they will be used as available, allowing for collection of more statistically significant sample sizes. Additionally, to best utilize resources, opportunities and adaptive management recommendations, hours may vary slightly between years within a survey type, or even between survey types, but overall effort will not fall below the minimum amount indicated in the table.

As described later in this Plan, at the end of each monitoring and reporting year, a review of monitoring results, expectations, and fit in answering the Plan's overall objectives will be conducted, termed an Adaptive Management Review (AMR).

STUDY 1: Are marine mammals and sea turtles exposed to mid-frequency active sonar (MFAS)? If so, at what levels are they exposed?

In order to address this question, there is a need to detect marine mammals and sea turtles not only at the surface, but to the extent possible in the water column.

Methods- Shipboard surveys, either from Navy vessels or contracted research vessels, will not enable the observers to always see animals much below the surface. While shipboard surveys are preferable in many ways (slow speed, offshore survey ability and duration, close approaches), they do not allow for observation of animals that are below the ocean surface as do aerial surveys. Therefore, for this study, a combination of aerial surveys and MMOs aboard Navy vessels will be used. Tagging, if possible given resource and animal availability, will provide complimentary information on the movements of submerged animals. MMOs will assist with species identification aboard the Navy ships and coordination.

Visual Survey- Aerial

An aerial survey team will fly pre-determined zigzag transects relative to a Navy surface combatant which is transmitting MFAS. The Navy will collect detailed ship track, speed and sonar use data for comparison with the survey data. The aerial survey team will collect both visual sightings (to be used to help calculate densities) and behavioral observations. These transects will allow for the gathering of movement relative to ship and behavioral responses of marine mammals at different received levels. The same altitude above water will be used for all aerial surveys. The surveys will be conducted both during and outside of sonar transmissions to allow for comparative data of densities and behaviors. Due to the large amount of air traffic off of Southern California, controlled airspace may prove to be a challenge with this type of survey. However, Navy will make every effort to coordinate and schedule this proposed monitoring.

The survey will be flown at a speed of 100 knots and an altitude of 800-1,000 ft (244-305 m). During an aerial survey, two observers will spot marine mammals and report data to a recorder. Information recorded will include species sighted, numbers of individuals, presence, or absence of a calf, behavior, angle to the sighting and any apparent reaction to the aircraft. It is important to note any unusual behavior or species associations. Additionally, GPS locations and altitude will be automatically recorded at 30-sec intervals, as well as manually whenever a sighting is made. Environmental data (sea-state, glare and visibility) will be manually recorded at the start of each transect leg and whenever conditions change.

The aerial survey team will attempt to collect: 1) species identification and group size; 2) location and relative distance from the Navy ship(s); 3) the behavior of marine mammals and sea turtles including date; 4) time and visual conditions associated; 5) direction of travel relative to Navy vessel; and 6) duration of the observation. Animal sightings and relative distance from the ship will be used post-survey to estimate received levels for active transmission periods. This data will be used, post-survey, to estimate the number of marine mammals and sea turtles exposed to different received levels and their corresponding behavior.

MMOs on Navy vessels:

When available and consistent with scheduled Navy training, field experienced MMOs will be placed alongside existing Navy ship lookouts aboard select platforms and for a certain sub-set of training events. Presence of MMOs allows for verification of Navy lookout sighting efficiency, allows for more detailed species identification of marine mammal sightings, and provides an opportunity for an experienced biologist to make qualified observations on potential marine mammal behavior at the time of sighting.

Navy biologists and contracted biologists will be used; contracted MMOs must have appropriate security clearance to board Navy vessels and cannot have a conflict of interest in working for the Navy. MMOs will not be placed aboard Navy vessels for every Navy training event or major exercise, but during specifically identified opportunities deemed appropriate for data collection efforts. The events selected for MMO participation will take into account safety, logistics, and operational concerns.

MMOs will observe from the same height above water as the lookouts. As discussed previously, MMOs will collect the same information on a given sighting that Navy lookout report. Because of their relative marine mammal experience, MMOs will also attempt species identification to the lowest taxon possible, more detailed information on marine mammal behavior if warranted. All MMO sighting and associated data collection will be conducted according to a standard operating procedure (SOP), and will be integrated into the ICMP data set.

The types of exercises and level of effort proposed for this type of monitoring are outlined in **Table 2**.

Marine mammal tagging (Beaked whale or surrogate species animal tagging)

Attempts to tag suitable animals will be conducted prior to a given Navy event, allowing animals the opportunity to distribute naturally prior to any potential immediate exposure to training activities. Tags shall be applied in a geographical area within SOCAL that is likely to be transited by Navy vessels during the training event. If DTAGs are deployed, then direct measures of potential acoustic exposures by individual animals can be determined along with any behavioral reactions, or lack of reactions. It should be cautioned that finding, approaching, and tagging these rather cryptic species is a very difficult process, and successful tag attachment can not be guaranteed.

To some extent a previously funded effort on SOAR (discussed more fully under Study 2) has already been implemented to tag beaked whale species in Southern California.

STUDY 2: If marine mammals and sea turtles are exposed to MFAS in the SOCAL Range Complex, do they redistribute geographically as a result of continued exposure? If so, how long does the redistribution last?

Line-transect shipboard surveys are regularly conducted by National Oceanographic and Atmospheric Administration (NOAA) NMFS in the SOCAL study area to assess long-term trends in abundance (e.g., Forney, 2007; NMFS, 2008). While funding dependent, it is assumed this NOAA data collection will continue. Numerous NMFS surveys have had augmented Navy funding in the past in part to address questions on occurrence within a given area, or longer term trends in abundance. Unfortunately, these surveys, which are typically conducted approximately every 3 years, are not designed to detect short term shifts in animal distribution based on natural or anthropogenic factors. Therefore, detection of marine mammal redistribution on the order of hours to days will be addressed by Study 2.

When feasible, marine mammal densities will be calculated from aerial survey data conducted immediately before and after training events. Additionally, autonomous recording packages (ARP) will be used to gather additional data on movements of animals through the SOCAL study area, providing a baseline and data on animals not detected by the aerial survey. Surveys will be conducted before and after training events, hence it is feasible for this type of survey to be conducted during major and intermediate-level exercises. The SOCAL DEIS\DOEIS provides a complete description of SOCAL Range Complex exercise types (DoN, 2008). Major and intermediate-level exercises typically involve more than three ships using MFAS as well as submarines and aircraft, which will provide data on behavioral responses or lack of responses to larger scale training events.

Methods- A combination of visual survey and PAM will be used for Study 2.

Visual Survey-Aerial

Systematic line-transect aerial surveys will be conducted approximately two days before and a variation of 1-5 days after a Navy training exercise to collect relative marine mammal density data in the exercise area. Attempts will be made to survey during an exercise, but safety of navigation for the survey vessel may preclude conducting this kind of survey during certain Fleet events. The variation in the number of days after allows for the detection of animals that gradually return to an area, if they indeed do change their distribution in response to active sonar. When monitoring is associated with training that takes place near the San Clemente Island, one survey day after the training event will be devoted to flying the coastline of the island to look for potential strandings. If any distressed, injured or stranded animals are observed, an assessment of the animal's disposition (alive, injured, dead, and decayed) will be immediately reported for appropriate action (e.g., notification of the NMFS Regional Stranding Coordinator).

Standard distance sampling and marine mammals survey methodology will be used (Buckland et al., 2001, 2004; Kinsey et al., 2002; Strindberg et al., 2004; Thomas et al., 2007; Dawson et al., 2008). Surveys will be conducted from a twin-engine aircraft, with a minimum of two experienced NOAA trained or certified observers. Dawson et al. (2008) contains a thorough review of numerous considerations in marine mammal survey design, and information from this reference combined with direct consultation with SWFSC will be integrated into this Plan's aerial survey design.

The survey will be flown at a speed of 100 knots and an altitude of 800-1,000 ft (244-305 m). Two observers will spot marine mammals during the surveys and report data to a recorder. Information recorded will include species sighted, numbers of individuals, presence, or absence of a calf, behavior, angle to the sighting and any apparent reaction to the aircraft. It is important

to note any unusual behavior or species associations. Additionally, GPS locations and altitude will be automatically recorded at 30-sec intervals, as well as manually whenever a sighting is made. Environmental data (sea-state, glare and visibility) will be manually recorded at the start of each transect leg and whenever conditions change. When needed, the aircraft will go off effort (off the trackline) for behavioral observations or to confirm species identification. Digital photographs or possible video may be taken as conditions permit. In the event that a given flight date is canceled, due to weather conditions, safety concerns, or mechanical problems, the survey will be flown when the safety or mechanical issue is resolve, next available good weather date, or if prolonged next available training event. The types of exercises and level of effort that are proposed for this type of monitoring are outlined in **Table 2**. In the event of monitoring delay and conflicting exercise schedules, NMFS has agreed that efforts missed in one given year can be made up in the subsequent year.

Passive Acoustic Monitoring (PAM)

In addition to working with the passive acoustic detection capabilities of the Navy's SOCAL fixed range (as discussed in the "Monitoring Plan Research Elements" section previously), the Navy also commits to deploying at least two autonomous acoustic recording buoys such as a High-frequency Acoustic Recording Package (HARP) (**Appendix A**) or similar buoy (see Newcomb et al., 2002; Wiggins and Hildebrand, 2007; Lammers et al., 2008). These buoys will be used for PAM in the SOCAL Range Complex in order to detect, locate, and potentially track vocalizing marine mammals. The exact number of buoys above two needed to adequately characterize an area is under review and will be promulgated as a separate study plan.

One goal for deployment of these temporary buoys is to select potential sub-area or areas used for Navy training events not previously covered by either fixed arrays (i.e., SOAR in San Nicolas Basin, **Figures 1 and 3**) or at areas near Tanner Bank which has had numerous deployments of HARP buys by Scripps Institute of Oceanography (SIO) (**Appendix A**). For instance, select sub-areas south of San Clemente Island are promising sites given lack of previous PAM in those regions (Area 1 in **Figure 4**).

Alternatively, larger buoys such as HARP may be used to adjacent to the existing underwater fixed range at SOAR to complement PAM in that area until range hydrophone refurbishments are complete.

Beaked whale or surrogate species animal tagging

Attempts to tag suitable animals will be conducted prior to a given Navy event, allowing animals the opportunity to distribute naturally prior to any potential immediate exposure to training activities. Tags shall be applied in a geographical area within SOCAL that is likely to be transited by Navy vessels during the training event. The goal of the tagging effort is to examine spatial distribution of animals before, during and after a training event; as well as potential long-term habitat associations and distributions independent of Navy training events. It should be cautioned that finding, approaching, and tagging these rather cryptic species is a very difficult process, and successful tag attachment can not be guaranteed.

STUDY 3: If marine mammals and sea turtles are exposed to MFAS, what are their behavioral responses to various levels?

Note: the methods used in Study 3 are the same as those used for Study 1, with the addition of vessel surveys. Vessel surveys are used here specifically for their ability to collect behavioral data and focal follows.

Documenting known at-sea behavioral reactions of marine mammal to military sonar is complicated by lack of information and direct observations of cause-and-effects. Any particular reaction is likely to be conditional on the species in question, and a host of other factors such as feeding status, breeding status, time of day, overall health, and other issues. In order to address this question, there is a need to assess whether marine mammals and sea turtles are not only at the surface, but in the water column where they could be potentially exposed to sonar. If animals are not present, then there would be no exposure and no possibility of behavioral reaction, or lack of reaction. Observers aboard either Navy vessels or contracted research vessels will have difficulty observing animals below the surface. While shipboard surveys are preferable in many ways (slow speed, offshore survey ability and duration, close approaches), they do not allow for observation of animals that are below the surface as do aerial surveys. Therefore, a combination of aerial surveys, vessel surveys, MMOs aboard Navy vessels, and opportunistic passive acoustic monitoring within SOAR (M3R) will be used for this study.

Methods- A combination of aerial surveys, vessel surveys, and MMOs will be used in conjunction with training events. Aerial surveys are preferred for this type of monitoring as they provide the ability to observe animals that are below the surface. Since this study uses many of the same methods as Study 1, data will likely be collected simultaneously for both studies

Visual Survey- Aerial

During specified training events, an aerial survey team will fly pre-determined zigzag transects relative to a Navy warship which is transmitting sonar. The aerial survey team will collect both visual sightings (to be used for densities) and behavioral observations from observed animals. These transects will allow for gathering information regarding movement of a species relative to the ship and behavioral responses of marine mammals at different received levels. The same altitude above water will be used for all surveys. The surveys will be conducted both during and outside of sonar transmissions to allow for comparative densities and behaviors.

The aerial survey team will collect: 1) species identification and group size; 2) location and relative distance from the Navy ship(s); 3) the behavior of marine mammals and sea turtles including date; 4) time and associated sighting conditions; 5) direction of travel relative to Navy vessel (s); and, 6) duration of the observation. Behavioral observation methods will involve 3 professionally trained marine mammal observers and a pilot. Two observers will observe behaviors, one with hand-held binoculars and one with the naked eye per Würsig et al. (1985) and Richardson et al. (1986). If there is >1 whale, each observer will record respirations of different animals, ideally from the same animal. In the case of large groups, e.g., of delphinids, group behavior, speed, orientation, etc., will be recorded as described in Smultea and Würsig (1995). An observer will use a video camera to record behaviors in real time. Two external microphones will be input and attached to the video camera to record vocal behavioral descriptions on two different channels of the video camera. The videotape will be time-stamped and observers will also call out times. The third observer will record notes, environmental data, and operate a laptop connected to a GPS and the plane's altimeter,

Detailed behavioral focal observations of cetaceans will be recorded the following variables as possible: species, group size and composition (number of calves, etc.), latitude/longitude, surface and dive durations and times, number and spacing/times of respirations, conspicuous behaviors (e.g., breach, tail slap, etc.), behavioral states, orientation and changes in orientation, estimated group travel speed, inter-individual distances, defecations, social interactions, aircraft speed, aircraft altitude, distance to focal group (using the plane's radar) and any unusual behaviors or apparent reactions following previously established protocol (Richardson et al. 1985, 1986, 1990; Würsig et al. 1985, 1989; Smultea and Würsig 1995; Patenaude et al. 2002).

Animal sightings and relative distance from the ship will be used post-survey to determine receive levels for active transmission periods. This data will be used, post-survey, to estimate the number of marine mammals and sea turtles exposed to different received levels and their corresponding behavior. The types of exercises and level of effort that are proposed for this type of monitoring are outlined in **Table 2**.

Visual Survey- Vessel surveys

The primary purpose of the survey will be to document and monitor potential behavioral effects of the planned exercise on marine mammals and sea turtles. As such, parameters to be monitored for potential effects are changes in the occurrence, distribution, numbers, surface behavior, and/or disposition (injured or dead) of marine mammal and sea turtle species before, during and after the training event. While challenging, the vessel surveys will attempt to conduct focal follows on animals with Navy vessels in view. Particular attention will be given to obtaining focal follows on beaked whales.

Specifically, the survey should deviate from a transect protocol to collect behavioral data if a Navy vessel is visible on the horizon or closer. At this point, they will approach within three nautical miles of the vessel(s), if weather and conditions allow, and will work in "Focal Follow Mode" (e.g., collect behavioral data using the big eyes, and observe the behavior of any animals that are seen). The team will go off effort for photo-id, video and close approach "Focal Animal Follows" as feasible, and when marine animal encounters occur in proximity to the vessel. While in Focal Follow Mode, observers will gather detailed behavioral data from the animals, for as long as the animal allows. Analysis of behavioral observations will be made after the exercise or training activity (Altmann, 1974; Martin and Bateson, 1993). While the Navy vessels are within view, attempts will be made to position the dedicated survey vessel in the best possible way to obtain focal follow data in the presence of the Navy exercise. If Navy vessels are not in view, then the vessel will begin a systematic line transect surveys within the area to assess marine mammal occurrence and observe behavior. The goal of this part of the survey is to observe marine mammals that may not have been exposed to MFAS or explosions. Data will be logged using software specifically designed to facilitate collection of behavioral data. This program will be specifically tailored to the needs of the SOCAL Range Complex Monitoring Plan and the ICMP.

The types of exercises and level of effort that are proposed for this type of monitoring are outlined in **Table 2**.

Visual Survey- Shore

Marine mammal observers on Navy vessels:

When available and consistent with scheduled Navy training field experienced MMOs will be placed alongside existing Navy ship lookouts aboard select platforms and for a certain sub-set of training events. MMO qualifications must include expertise in species identification of regional

marine mammal and sea turtle species and conducting behavioral observations. Presence of MMOs allows for verification of Navy lookout sighting efficiency, allows for more detailed species identification of marine mammal sightings, and provides an opportunity for an experienced biologist to make qualified observations on potential marine mammal behavior at the time of sighting.

Navy biologists and contracted biologists will be used; contracted MMOs must have appropriate security clearance to board Navy vessels and cannot have a conflict of interest in working for the Navy. MMOs will not be placed aboard Navy vessels for every Navy training event or major exercise, but during specifically identified opportunities deemed appropriate for data collection efforts. The events selected for MMO participation will take into account safety, logistics, and operational concerns.

MMOs will observe from the same height above water as the lookouts. Of note, these MMOs will not be part of the Navy's formal reporting chain of command during their data collection efforts; Navy lookouts will continue to serve as the primary reporting means within the Navy chain of command for marine mammal sightings. The only exception is that if an animal is observed within the shutdown zone that has not been observed by the lookout, the MMO will inform the lookout of the sighting for the lookout to take the appropriate action through the chain of command.

MMOs will observe from the same height above water as the lookouts. MMOs will collect the same information on a given sighting that Navy lookout report. Because of their relative marine mammal experience, MMOs will also attempt species identification to the lowest taxon possible, more detailed information on marine mammal behavior if warranted. All MMO sighting and associated data collection will be conducted according to a standard operating procedure (SOP), and will be integrated into the ICMP data set.

The types of exercises and level of effort that are proposed for this type of monitoring are outlined in **Table 2**.

Passive Acoustic Monitoring

Opportunistic data collected as part of the M3R effort at SOAR (described in Study 2) may offer insights to animal vocalization rates, potential dive pattern, and possible movement in relation to exercise events. This field is relatively new and the M3R technology still being developed. When available, information derived from M3R monitoring in relation to animal behavior response, or lack of response may be incorporated.

Marine Mammal Tagging- Beaked whale or surrogate species animal tagging

Attempts to tag suitable animals will be conducted prior to a given Navy event, allowing animals the opportunity to distribute naturally prior to any potential immediate exposure to training activities. Tags shall be applied in a geographical area within SOCAL that is likely to be transited by Navy vessels during the training event. As part of the Monitoring Plan implementation, specific tagging SOPs and protocols will be developed. Various categories of tags will be reviewed for ease of use, data quality, longevity, and availability. A benefit to a mix of tag types is the maximization of data collections. Some tags have longer durations over days-week-months (e.g., satellite), while others provide more discreet data on vertical and horizontal movements as well as pitch, roll and acoustics (hours-days). Tagging will be conducted during the week prior to a specified Navy training event. However, depending on the species, not all tagged animals may remain in a given area as part of their normal foraging and movement patterns. For instance, blue whales tagged in Southern California can travel up to 25-40 nm (46-74 km) per day (Mate et al., 1999; B. Mate, unpublished data). If DTAGs are deployed and an animal remains in an exercise area, then direct measures of potential acoustic exposures by individual animals can be

determined along with any behavioral reactions, or lack of reactions. It should be cautioned that finding, approaching, and tagging these rather cryptic species such as beaked whales is a very difficult process, and successful tag attachment can not be guaranteed.

STUDY 4: What are the behavioral responses of marine mammals and sea turtles that are exposed to explosives?

Documenting known at-sea behavioral reactions of marine mammal to underwater explosion that occur on relatively short time scales is complicated by lack of information and direct observations of cause-and-effects. Any particular reaction is likely to be conditional on the species in question, and a host of other factors such as feeding status, breeding status, time of day, overall health, and other issues. In order to address this question, there is a need to assess whether marine mammals and sea turtles are not only at the surface, but in the water column where they could be potentially exposed to underwater explosions. If animals are not present, then there would be no exposure and no possibility of behavioral reaction, or lack of reaction. In order to address this question, there is a need to observe marine mammals and sea turtles not only at the surface, but to the extent possible in the water column. While shipboard surveys are preferable in many ways (slow speed, offshore survey ability and duration, close approaches), they do not allow for observation of animals that are below the ocean surface as do aerial surveys. Therefore, for this study, a combination of aerial and vessel surveys may be used. Current mitigation measures by Navy exercise participants include monitoring the exclusion zone (size depends on the type and size of the explosives being used) beginning 30 minutes prior to detonation and for 30 minutes post detonation.

Methods- For specified training events, aerial or vessel surveys will be used 1-2 days prior to, during if safely possible, and 1-5 days post detonation. The variation in the number of days after allows for the detection of animals that gradually return to an area, if they indeed do change their distribution in response to underwater detonation events.

Surveys will include any specified exclusion zone around a particular detonation point plus 2,000 yards (1,829 m) beyond the exclusion zone but in no circumstances will aerial and vessels enter the safety designated for participants, which may exceed the exclusion zone and additional 2,000 yard (1,829 m) buffer. Safety of personnel is paramount at all times. For vessel based surveys a passive acoustic system, hydrophone or towed array if available, could be used to determine if marine mammals are in the area before and after a detonation event. Depending on animals sighted, it may be possible to conduct focal surveys of animals outside of the exclusion zone (detonations could be delayed if marine mammals or sea turtles are observed within the exclusion zone) to record behavioral responses to the detonations

The primary goal will be to survey detonation events with multiple detonations and larger live ordnance (5/54 guns shells, SM-2 missiles, MK80 series aerial bombs). This includes SINKEX, Surface-to-Surface Gunnery Exercise (GUNEX specifically with platforms using 5/54 shells), Surface-to-Surface Missile Exercise (MISSILEX), or Bombing Exercise (BOMBEX). Given there may significant annual variability in which events occur more frequently within SOCAL, the Navy will not agree to survey a minimum number of events per year.

Brief aerial or vessel based surveys of the detonation area taking into account local oceanographic currents will be conducted for stranded animals over a two day period post detonation event. If any distressed, injured or stranded animals are observed, an assessment of the animal's disposition (alive, injured, dead, or degree of decomposition) will be reported immediately for appropriate action (notification to NMFS Regional Stranding Coordinator). When conducting a particular survey, the survey team will collect: 1) species identification and group size; 2) location and relative distance from the detonation site; 3) the behavior of marine mammals and sea turtles including standard environmental and oceanographic parameters; 4) date, time and visual conditions associated with each observation; 5) direction of travel relative to the detonation site; and 6) duration of the observation. For safety considerations aerial surveys will only be conducted before and after detonation events. Animal sightings and relative distance from a

particular detonation site will be used post-survey to determine potential received energy and pressure. This data will be used, post-survey, to estimate the number of marine mammals and sea turtles exposed to different received levels (energy and pressure based on distance to the source, bathymetry, oceanographic conditions and the type and size of detonation) and their corresponding behavior.

Visual Surveys - Shore-based (for nearshore events)

Following near shore underwater detonation events, primarily around certain portions of San Clemente Island as described in the SOCAL DEIS\DOEIS (DoN, 2008), aerial, vessel, or land-based surveys of beaches will be conducted for stranded marine animals following nearshore underwater detonation events. If any distressed, injured or stranded animals are observed, an assessment of the animal's condition (alive, injured, dead, or degree of decomposition) will be reported immediately to the Navy and NMFS Regional Stranding Coordinator for appropriate action.

STUDY 5: Is the Navy's suite of mitigation measures effective at avoiding injury and mortality of marine mammals and sea turtles?

It is the Navy's position that the suites of mitigation measures for sonar and explosives are effective at avoiding exposures of marine mammals to levels of energy or pressure from sonar or explosives that would result in harm or mortality of marine mammals. Through several methods, this study will provide the scientific data needed to support that position. The Navy will: 1) conduct aerial surveys before and after two major exercises per year (at least one of which includes multiple explosive detonations) to determine whether animals have been injured in the exercise area; and 2) conduct a comparison of professional marine mammal observers and Navy lookouts.

Methods- For this study a combination of MMO/lookout comparison and aerial visual surveys is proposed.

MMO/Lookout comparison

Navy lookouts are provided with extensive training to detect anything in the water 360 degrees around Navy vessels. This includes marine mammals. The Navy feels strongly that despite the fact that lookouts are not biologists trained to identify marine animals to species, that Navy lookouts have the skills to reasonably detect all marine mammals and sea turtles that are visible at the surface. In order to provide the scientific data to support this position, the Navy will initiate a side-by-side comparison of Navy lookouts ability to detect marine mammals at sea with sightings made by professional marine mammal observers. It is assumed that the abilities of Navy lookouts and professional marine mammal observers will vary; therefore, it is important that data be collected from many locations, in many environmental conditions, with many different lookouts and MMOs. Therefore, as part of the overall Navy ICMP, some of the data will be collected within the SOCAL Range Complex.

MMOs will be placed on Navy vessels during regularly scheduled training events in the SOCAL Range Complex. MMOs qualifications must include expertise in species identification of regional marine mammal and sea turtle species and experience collecting behavioral data. Experience as a NMFS marine mammal observer is preferred, but not required. Navy biologists and contracted biologists will be used; contracted MMOs must have appropriate security clearance to board Navy vessels. As noted above, MMOs will not be placed aboard Navy vessels for every Navy training event or major exercise, but during specifically identified opportunities deemed appropriate for data collection efforts. Additionally, the events selected for MMO participation will take into account safety, logistics, and operational concerns associated with such an endeavor. Navy lookouts will not be specially chosen.

Marine mammal observers will observe from the same height above water as the lookouts. Navy lookouts will officially be on duty and have the same responsibilities that they always do on duty (no more, no less). MMOs will not be part of the Navy's formal reporting chain of command during their data collection efforts; Navy lookouts will continue to serve as the primary reporting means within the Navy chain of command for marine mammal sightings. The only exception is that if an animal is observed within the shutdown zone that has not been observed by the lookout, the MMO will inform the lookout of the sighting for the lookout to take the appropriate action through the chain of command.

To the extent practicable, the MMO and lookouts will try to avoid cueing each other when they observe a marine mammal. Depending on ship configuration, the MMOs and lookout may be on the same bridge wing, or the MMO may be at a position above the bridge (about 15 ft or 4.5 m on most MFAS equipped ships). Because of their relative marine mammal experience, MMOs will also attempt species identification to the lowest taxon possible, more detailed information on

marine mammal behavior if warranted. All MMO sighting and associated data collection will be conducted according to a standard operating procedure (SOP), and will be integrated into the ICMP data set.

Comparisons of the following will be made between experienced observers and the lookouts 1) Rate of detection: Comparison of the number of animals sighted per hour (or other appropriate sighting period), 2) Distance of sighting: Comparison of the distance where the sighting was first made, 3) Distance estimation: Consistency of sighting distance estimates, 4) Animal size estimation: Comparison of animal size estimation (either by actual length, estimated length, or by grouping -small or dolphin size, medium, and large (definition of appropriate size categories will be determined prior to these studies), 5) Direction of travel relative to the ship or by compass bearing, 6) Behavior categorization: Comparison of the categorized behaviors.

The types of exercises and level of effort that are proposed for this type of monitoring are outlined in **Table 2**.

Visual survey- Aerial

A contracted team will conduct pre and post aerial surveys, taking local oceanographic currents into account, of the exercise area as well as a shoreline survey of San Clemente Island and possibly San Nicolas Island. Species composition of at sea and on land marine animals will be reported. If any distressed, injured or stranded animals are observed, an assessment of the animal's disposition (alive, injured, dead, or degree of decomposition) will be reported immediately as per the SOCAL Marine Mammal Stranding Plan to CPF and Commander, Third Fleet for appropriate action (notification to NMFS Regional Stranding Coordinator).

These aerial surveys will be the same as those conducted for other SOCAL monitoring studies. However, for this study in particular, survey data will include identification of any distressed, injured or stranded animals both in the training event area and adjacent island coastlines. The types of exercises and level of effort that are proposed for this type of monitoring are outlined in **Table 2**.

IMPLEMENTATION – ANALYSIS – REPORTING

Worldwide, a suite of visual and acoustic monitoring techniques has been used to assess the effects of anthropogenic sound on marine mammals (Barlow and Gisiner, 2006). The SOCAL Range Complex Monitoring Plan proposes monitoring goals that are unique with regard to their breadth as well as their focus on potential impacts of MFAS and underwater explosions on marine mammals and sea turtles. To accomplish these goals, the Navy will use similar methods of implementation and data analysis which have demonstrated success in comparable monitoring programs studying the effects of anthropogenic sound on marine animals.

SOCAL Range Complex Monitoring Plan Implementation and Analysis

Based upon the Sonar Positional Reporting System (SPORTS) and knowledge of training events in the SOCAL Range Complex, Navy operators determined that several categories of training events are appropriate for marine mammal monitoring within the SOCAL Range Complex. These include major exercise, intermediate-level exercises and when appropriate, unit level training (ULT). ULT offers the best opportunity for multiple study collaboration without significant impacts to larger scale events, as well as easier schedule adjustments. The goal of this monitoring plan is to select from the best representative exercise in which to schedule the most appropriate monitoring, with the understanding that major exercise undergo significant schedule changes base on real-world commitments which may or may not therefore limit the availability of monitoring within these major exercises.

Contracted third party data collection will be collected by qualified, professional marine mammal and sea turtle biologists that are experts in their field. Researchers will provide annual reports to the Navy, however, this is expected to be an ongoing process with data collected, analyzed and interpreted over many years. It is not likely that firm conclusions can be drawn on most questions within a single year of monitoring effort due to the difficulty in achieving sufficient sample sizes for statistical analysis. The Navy will provide annual reports to NMFS headquarters (HQ) in fulfillment of the MMPA Letter of Authorization (LOA) requirements. The report will provide information on the amount and spatial/temporal distribution of monitoring effort as well as summaries of data collected and any preliminary results that may be available from analysis.

While the monitoring described in this plan represent the best estimate of availability, there may be instances within any given year where exercise schedules shift, survey crew availability becomes limited, or extreme weather precludes effective sampling. In case of monitoring delay based on these conditions, monitoring effort will be re-scheduled at the next available opportunity. In the event that a particular target exercise is not available within the remainder of a particular year, monitoring may have to be made up in a following year.

Table 2 provides detail about how the SOCAL Range Complex Monitoring Plan will be implemented from 2009 to 2013. After the issuance of the Letter of Authorization (LOA), implementation of this monitoring plan will commence in 2009 at which time monitoring will begin gradually and then ramp up in 2010. Many of the study hours may overlap when implemented, allowing for data to be collected for more than one study simultaneously.

The Navy will be investing significant funding and personnel towards this monitoring program and intends to conduct the research in a scientifically sound and robust manner. The Navy is committed to conducting research until the original program objectives have been answered to the satisfaction of both NMFS and Navy. Therefore, it is in the best interest of the Navy to choose studies wisely in each range complex that are the most likely to collect large data sets, and will enable the Navy and NMFS to answer required questions. Some field methods may be applied throughout Navy ranges, while other methodologies may be specially selected for one or two ranges that are most likely to produce the best quality data.

The four research projects summarized in **Appendix A** suggest that the sample size required for statistically significant results varies between species, season and project. For the HRC monitoring plan, therefore, it is premature to dictate before data collection begins what sample size will be required from each species in each study. This is particularly true given that research will be conducted on a diversity of species. The HRC plan, as written, covers research on the effects from MFAS and explosives on a diversity of mysticete and odonotocete species found in the HRC. This range of species will make each study unique in the sense of knowing when enough data have been collected. As a result, it may be prudent to initially focus some of the studies on prioritized species that are likely to provide more data collection opportunities and use those as representative species.

Using the Acoustic Thermometry of Ocean Climate (ATOC) and SURTASS Low-Frequency Active Sonar monitoring programs as a guideline for success (**Appendix A**), one thing becomes clear - the key to the success of the plan's execution and analysis is using scientific professionals that are the top of their field (Aburto et al., 1997; Au et al., 1997; Frankel and Clark, 1998 and 2000; NRC, 2000, 2003, 2005; Croll et al., 2001; ONR, 2001; Costa et al., 2003; Fristrup et al., 2003; Clark and Altman, 2006; Mobley, 2001, 2006). It's the Navy's intention that the SOCAL Monitoring Plan be implemented by a team of qualified, professional marine mammal and sea turtle biologists that are experts in their field. This team of experts will include statistical analysts to analyze data and make recommendations as to when they are beginning to see a pattern in the data and/or when the study designs need to be slightly altered for more robust data collection. This adaptive management process will provide a critical feedback loop to allow for adapting to new methods and evolving methodology. The process will be transparent to the public in the sense of yearly reporting to NMFS under the MMPA permit as well as encouraging the scientific team to publish results as they become available.

Although it is not typically considered valid to combine data sets from various platforms, (e.g., shipboard and aerial surveys) this will need to occur in order to provide the best possible data coverage. Issues related to data compatibility will be confronted, given that the use of scientifically acceptable combinations of methods will be critical to accomplishing goals and objectives. Data collection methods will also be standardized to allow for comparison from ranges in different geographic locations. For example, as with the research programs described in **Appendix A**, it is suggested that data collected for the range complex plans will be assessed using a software program that can be custom designed (e.g., Noldus products, Cornell's Aardvark) to provide the framework for standardization of data collection and analysis between the different geographical regions. A data management system will be developed to assure standardized, quality data are collected towards meeting of the goals.

New technology and techniques will be incorporated as part of the Navy's adaptive management strategy. Adaptive measures and feedback from the experts will allow flexibility within a given year and/or within years so as to best achieve monitoring plan goals and take into consideration shifting demands, inclement weather and other unforeseen events. For example, flexibility is built in to monitor an alternate but equal training exercise within the year and/or in a following year in the instance an operational schedule changes, is delayed or cancelled. This flexibility ensures monitoring will occur under the best of circumstances and conditions.

In addition to the studies conducted under the SOCAL Range Complex Monitoring Plan, the Navy intends to collaborate with other researchers in California that are conducting complimentary research on this topic. Those studies will not replace the Navy's obligation under the NMFS Letter of Authorization (LOA) requirements, but will augment the resources provided to the Plan's specific questions.

ICMP and Relationship To SOCAL Range Complex Monitoring Program

The ICMP is currently in development by the Navy. The program does not duplicate the SOCAL Range Complex Monitoring Plan, instead it's intended to provide the overarching coordination that will support compilation of data from range-specific monitoring plans (e.g., SOCAL Range Complex plan) as well as Navy funded research and development (R&D) studies. The ICMP will coordinate the monitoring programs progress towards meeting its goals and develop a data management plan. A program review board is also being considered to provide additional guidance. The ICMP will be evaluated annually to provide a matrix for progress and goals for the following year, and will make recommendations on adaptive management for refinement and analysis of the monitoring methods.

Due to the complexity of the ICMP and large number of U.S. Navy Range Complexes and training events, the Navy is considering the dedication of a Program Manager to oversee the ICMP. Specific qualifications, roles and responsibilities are yet to be determined but may include the oversight and coordination of all range-complex monitoring plans.

Analysis And Reporting

The Navy is currently working on the overarching structure and coordination (ICMP) that will, over time, compile data from both range-specific monitoring plans (e.g., SOCAL monitoring plan) as well as Navy funded research and development (R&D) studies. The analysis protocols are still in development phase at this time. However, data collection methods will be standardized to allow for comparison from ranges in different geographic locations. The sampling scheme for the program will be developed so that the results are scientifically defensible. For example, since all data will be collected using a behavioral program like Noldus, data collection will be standardized between the different geographical regions. A data management system will be developed to assure standardized, quality data are collected towards meeting of the goals. The data management plan shall provide standard marine species sighting forms for Navy lookouts and biologists to use to standardize data collection. Annual reports summarizing effort, analysis and results will be compiled and submitted to NMFS. These reports will allow the Navy and NMFS to assess and adaptively manage the Navy's monitoring effort to more effectively answer the questions outlined above.

Data collection will begin after January 2009, after the SOCAL LOA is issued and the monitoring plan is finalized (See **Table 2** for year by year implementation schedule). Data collected from the SOCAL monitoring plan will be added to a Navy wide analysis of monitoring from other permitted Navy range complexes via the ICMP. All available data will be included in Navy's annual report and individual exercise reports for the SOCAL Range Complex as detailed in the requirements specified in the NMFS MMPA LOA. The Navy's reports will provide information on the amount and spatial/temporal distribution of monitoring effort as well as summaries of data collected and any preliminary results that may be available from analysis. This also includes an evaluation of the effectiveness of any given element within the SOCAL Range Complex monitoring program. All subsequent analysis shall be completed in time for Navy's five year report to NMFS.

All data will be considered Navy and NMFS proprietary at least throughout the five year period of the LOA. Annual Reports, associated data, and any conclusions based on data from this Monitoring Plan cannot be published or used by non-Navy or non-NMFS individuals or organizations without the written consent of both the Director of NOAA and the Secretary of the Navy or their designee.

ADAPTIVE MANAGEMENT

Background

NMFS acknowledges that the SOCAL Range Complex Monitoring Plan plan will enhance the understanding of how MFAS/HFAS or underwater detonations (as well as other environmental conditions) may, or may not, be associated with marine mammal injury or strandings. Additionally, NMFS also points out that 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.

Adaptive management is an iterative process of optimal decision making in the face of uncertainty, with an aim to reducing uncertainty over time via system monitoring. Within the natural resource management community, adaptive management involves ongoing, real-time learning and knowledge creation, both in a substantive sense and in terms of the adaptive process itself. Adaptive management focuses on learning and adapting, through partnerships of managers, scientists, and other stakeholders who learn together how to create and maintain sustainable ecosystems (Williams el at., 2007). Adaptive management helps science managers maintain FLEXIBILTY in their decisions, knowing that uncertainties exist and provides managers the latitude to change direction; will improve UNDERSTANDING of ecological systems to achieve management objectives; and is about taking ACTION to improve progress towards desired outcomes (Williams et al., 2008). Further discussion of adaptive management in the natural resource community is available from the U.S. Department of Interior's Adaptive Management Guidelines: http://www.doi.gov/initiatives/AdaptiveManagement/index.html

The Navy's adative management of the SOCAL Range Complex Monitoring Plan involve close coordination with NMFS to align marine mammal monitoring with the Plan's overall objectives as stated within earlier sections of the Plan. To recap, the objectives of the Navy's SOCAL Range Complex Monitoring Plan are to determine:

1. Are marine mammals and sea turtles exposed to mid-frequency active sonar (MFAS), 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?
2. If marine mammals and sea turtles are exposed to MFAS in SOCAL, do they redistribute geographically as a result of continued exposure? If so, how long does the redistribution last?
3. If marine mammals and sea turtles are exposed to MFAS, what are their behavioral responses to various levels?
4. What are the behavioral responses of marine mammals and sea turtles that are exposed to explosives at specific levels?
5. Is the Navy's suite of mitigation measures for MFAS and explosives (e.g., PMAP, major exercise measures agreed to by the Navy through permitting) effective at avoiding TTS, injury, and mortality of marine mammals and sea turtles?

Adaptive Management Implementation

There are periodic exercise and annual reporting requirements contained in NMFS MMPA authorization associated with the SOCAL Range Complex EIS\OEIS. Following the Navy's Annual Report to NMFS, the Navy will request specific written discussion from NMFS of NMFS's assessment of the Plan's past year results. The goal of this consultation and collaberation would be to determine if these research elements and associated results continue to meet the overall objectives of the Plan specific to the SOCAL Range Complex. For instance, if one particilar research element does not provide direct or indirect support to one of the objectives listed above, then resources for future instances of that element could be re-directed to other research elements that do provide more support. Until at least one or two years worth of monitoring data are collected and analyzed both within the SOCAL Range Complex and in context of the ICMP, it is premature to guess which, if any of the proposed elements contained in this Plan will provide the most scientifically valid information to address the objectives. Most likely it will be a combination of elements that will provide the best data in addressing MFAS and explosive effects or lack of effects on the marine mammals within the SOCAL Range Complex. The original intent of this Monitoring Plan is to integrated into both the text discussions on research elements, and Table 2 allocation of effort, what is anticipated as being the best allocation of resources to address the Plan's objectives.

Proper application of the adaptive management concept will allow future adjustments to be made to the SOCAL Range Complex Monitoring Plan that will enhance overall scientific conclusions, lead to better statistical approaches, integrate new technologices in marine mammal monitoring and detection, and provide a stronger foundation upon which to base mitigation and policy decisions.

FIGURES AND TABLES

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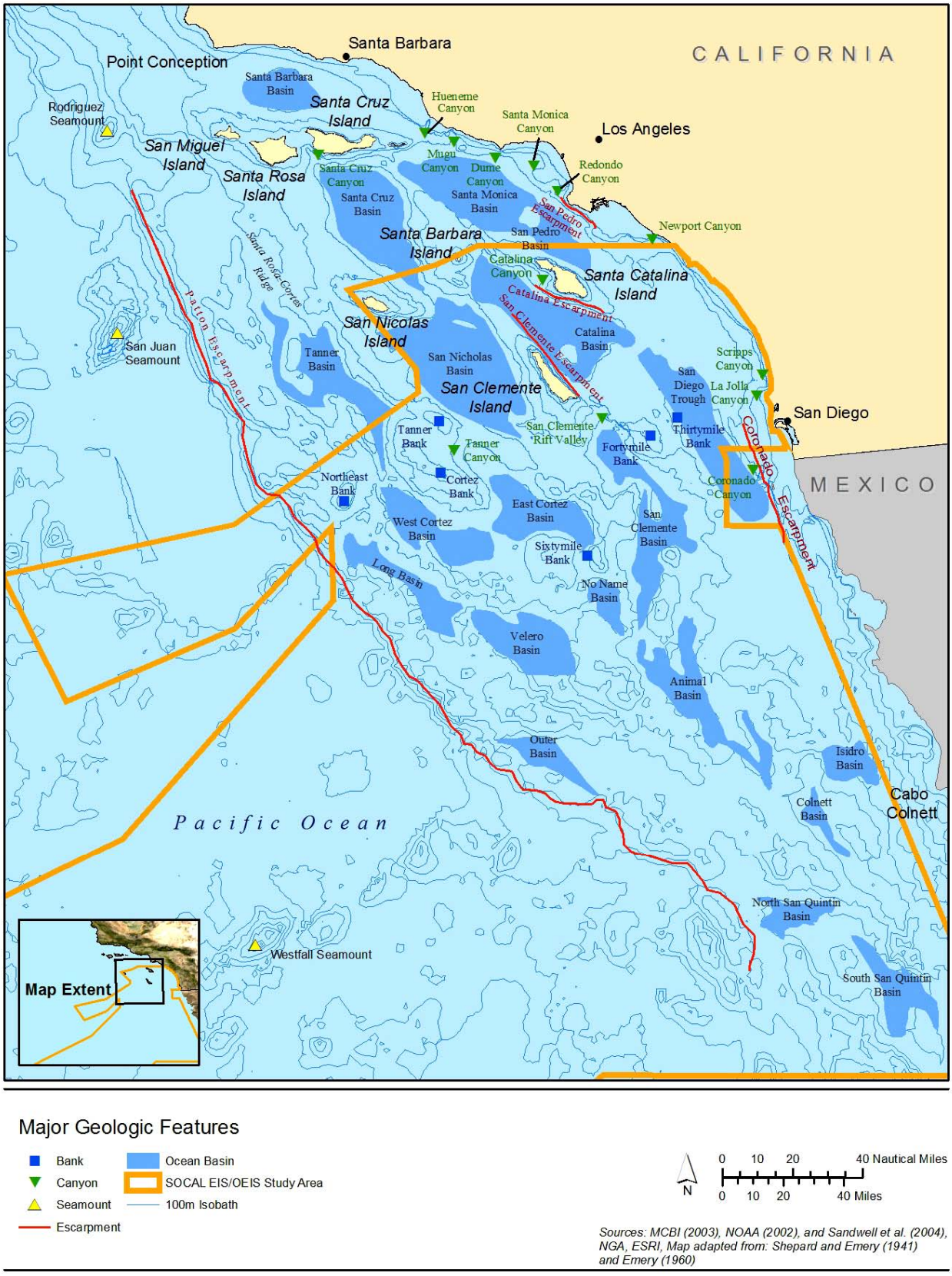


Figure 1. Southern California (SOCAL) Range Complex and major underwater geographical features (From DoN, 2008).

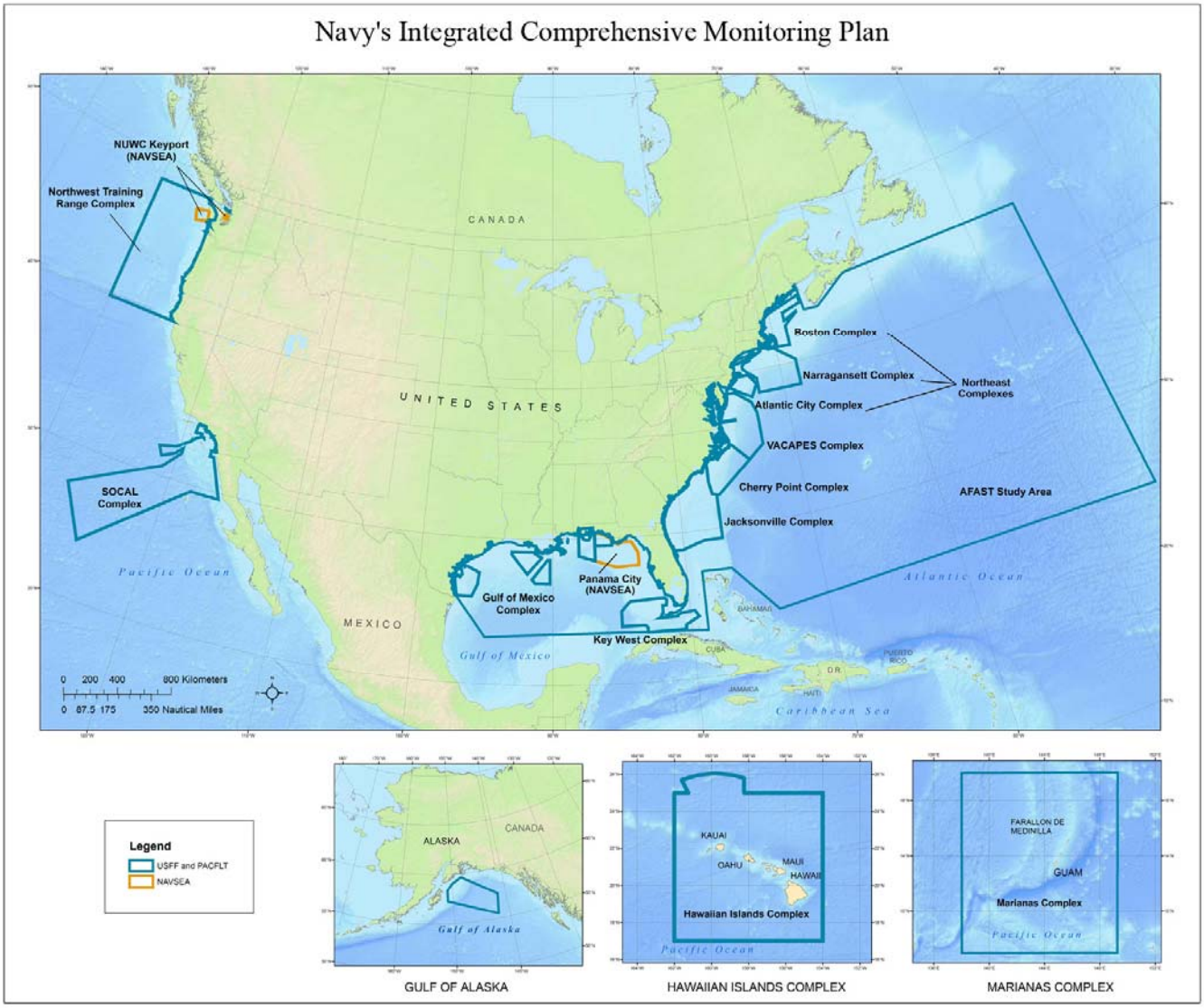


Figure 2. Integrated Comprehensive Monitoring Plan – Navy-wide Map of Ranges where data collection is expected to occur.

Details to be determined as compliance documents are finalized.

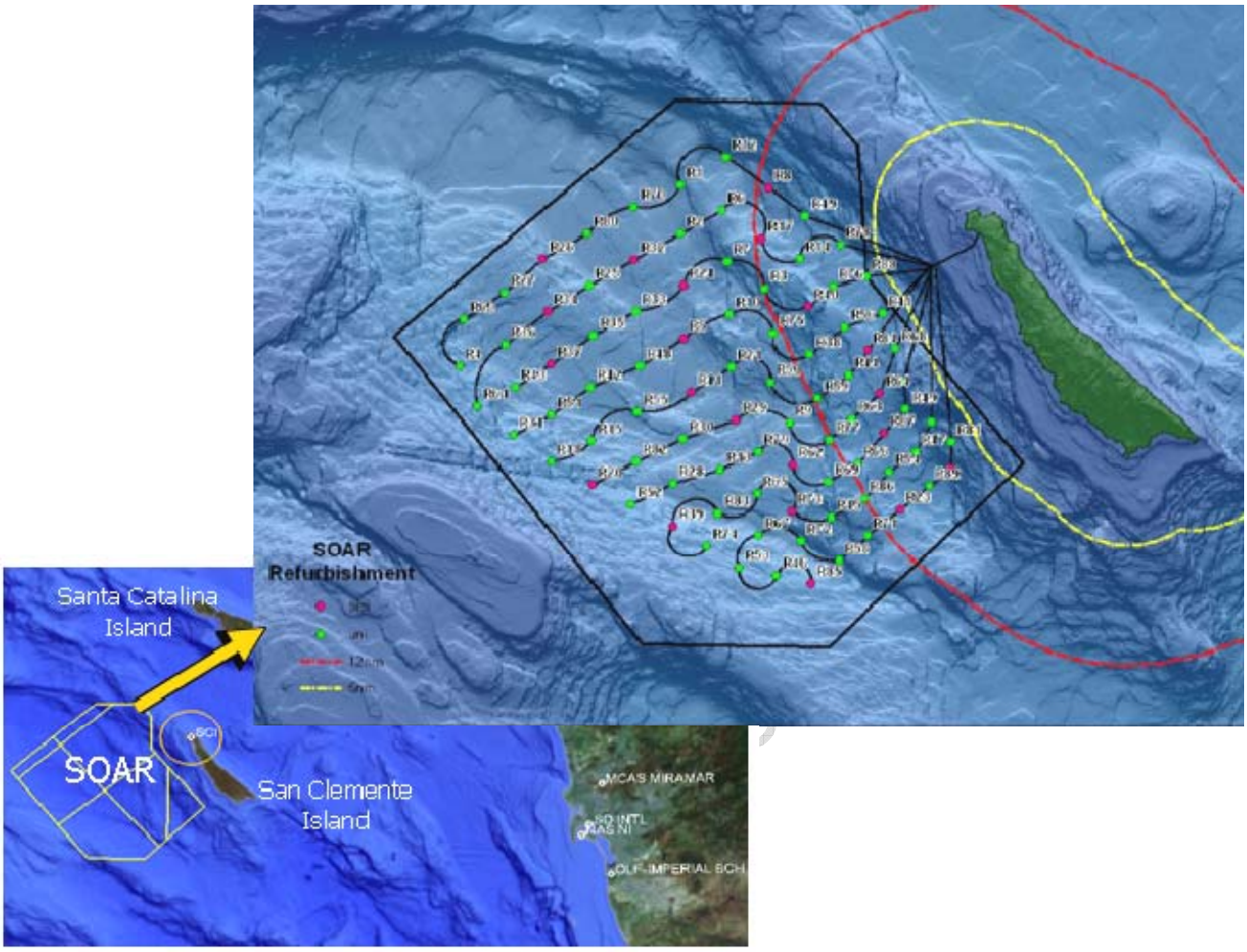


Figure 3. Southern California Anti-submarine Warfare Range (SOAR) and associated underwater tracking hydrophones.

These and future hydrophones are undergoing testing using the M3R system for marine mammal detection.

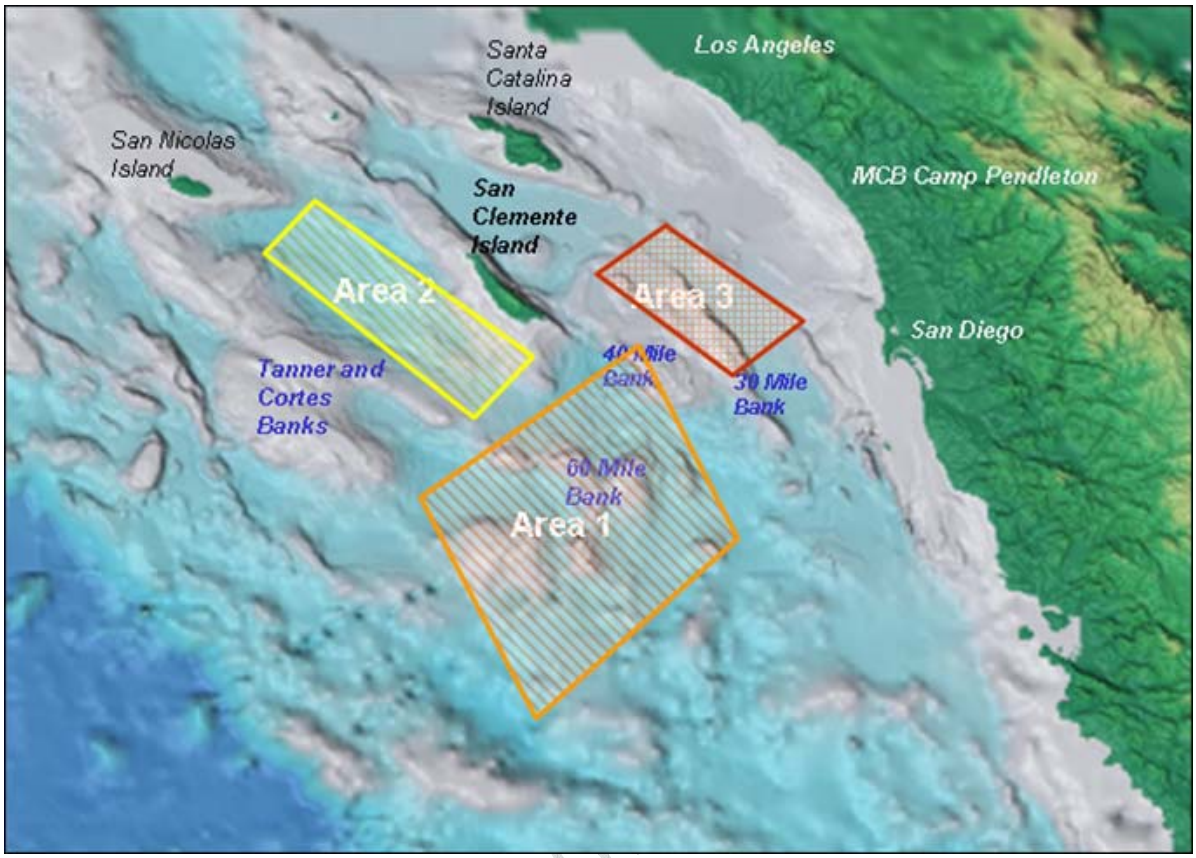


Figure 4. Proposed offshore regions within Southern California proposed as initial focus area for the SOCAL Range Complex Monitoring Plan.

Area(s) actually monitored depends on individual survey design, and safety of flight determinations for visual aerial surveys. Monitoring could occur in any particular combination of areas.

Table 1. Summary of Marine Mammal Species in Southern California.

Common Name	NMFS Stock Designation	Annual Population Trend; And Occurrence	Warm Season May-Oct	Cold Season Nov-Apr
ESA-listed Species				
Blue whale	Eastern North Pacific	May be increasing ; Seasonal; Arrive Apr-May; more common late summer to fall	YES	NO
Fin whale	California, Oregon, & Washington	May be increasing ; Year round species; small population	YES MORE	YES LESS
Humpback whale	California, Oregon, & Washington	Increasing 6-7%: Seasonal; More sightings around the northern Channel Islands	YES	NO
North Pacific right whale	Eastern North Pacific	Unknown; Very rare: Rare throughout the Pacific; only 12 sightings in California since 1900	RARE	RARE
Sei whale	Eastern North Pacific	May be increasing ; Rare; Less than three sightings within the last 30 years	UNK	UNK
Sperm whale	California, Oregon, & Washington	Unknown; Common year round; More likely in waters > 1000 m, most often > 2000 m	YES MORE	YES LESS
Guadalupe fur seal	Mexico	Increasing 13.7%; Rare; Occasional visitor to northern Channel Islands; mainly breeds on	UNK	UNK
Steller sea lion	California, Oregon, & Washington	Decreasing; Very rare; Summer distribution north of 36°N; last seen in northern Channel Islands in 1998	NO	NO
Southern Sea Otter	California	Increasing ; Main distribution just north of the SOCAL OPAREAs; translocated population of approximately 29 animals at San Nicolas Island is an experimental population and is not considered endangered	YES	YES
Mysticetes (non-ESA listed Baleen whales)				
Bryde's whale	Eastern Tropical Pacific	Unknown ; Rare; Only one confirmed sighting in California	UNK	UNK
Gray whale	Eastern North Pacific	Increasing ~ 2.5%; Transient during seasonal migrations	NO	TRANSIENT
Minke whale	California, Oregon, & Washington	No Trends ; Less common in summer; small numbers around northern Channel Islands	NO	YES
Odontocetes (non-ESA listed toothed whales and dolphins				
Baird's beaked whale	California, Oregon, & Washington	Unknown ; Rare	UNK	UNK
Bottlenose dolphin coastal stock	California Coastal	Stable ; Limited, small population within one km of shore	YES	YES
Bottlenose dolphin offshore stock	California Offshore	No Trend ; Common	YES	YES
Cuvier's beaked whale	California, Oregon, & Washington	Unknown ; Uncommon; seaward of 1000 m; only limited sightings in winter	YES	UNK
Dall's porpoise	California, Oregon, & Washington	Unknown; Common; year round cool water species; more abundant Nov-Apr	NO	YES
Dwarf sperm whale	California, Oregon, & Washington	Unknown; Possible visitor; seaward of 500-1000 m; limited sightings over entire SCB	UNK	YES LESS

Common Name	NMFS Stock Designation	Annual Population Trend; And Occurrence	Warm Season May-Oct	Cold Season Nov-Apr
False killer whale	Eastern Tropical Pacific	Unknown; Uncommon; warm water species; although stranding records from the Channel Islands	UNK	UNK
Killer whale offshore stock	Eastern North Pacific	Unknown; Uncommon; occurs infrequently; more likely in winter	NO	YES
Killer whale transient stock	Eastern North Pacific	Unknown; Uncommon; occurs infrequently; more likely in winter	NO	YES
Long-beaked common dolphin	California	Varies by oceanographic conditions ; Common; more inshore distribution	YES	YES
Mesoplodont beaked whales	California, Oregon, & Washington	Unknown ; Rare; seaward of 500-1000 m; limited sightings	UNK	UNK
Northern right whale dolphin	California, Oregon, & Washington	No Trend ; Common; cool water species; more abundant Nov-Apr	NO	YES
Pacific white-sided dolphin	California, Oregon, & Washington	No Trend ; Common; year round cool water species; more abundant Nov-Apr	YES LESS	YES MORE
Pantropical spotted dolphin	Eastern Tropical Pacific	Unknown ; Rare	UNK	UNK
Pygmy sperm whale	California, Oregon, & Washington	Unknown ; Rare; seaward of 500-1000 m; limited sightings over entire SCB	UNK	UNK
Risso's Dolphin	California, Oregon, & Washington	No Trend ; Common; present in summer, but higher densities Nov-Apr	YES LESS	YES MORE
Rough-toothed dolphin	Tropical and warm temperate	Unknown ; Rare; more tropical offshore species	RARE	RARE
Short-beaked common dolphin	California, Oregon, & Washington	Varies by oceanographic conditions; Common; one of the most abundant SOCAL dolphins; higher summer densities	YES MORE	YES LESS
Short-finned pilot whale	California, Oregon, & Washington	Unknown ; Uncommon; more common before 1982	UNK	UNK
Spinner dolphin	Tropical and warm temperate	Unknown ; Rare	RARE	RARE
Striped dolphin	California, Oregon, & Washington	No Trend ; Occasional visitor; cool water oceanic species	NO	RARE
Pinniped				
Harbor seal	California	Stabilizing ; Common; Channel Islands haul-outs including San Clemente Island	YES	YES
Northern elephant seal	California Breeding	Increasing < 8%; 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	U.S. Stock	Increasing 6%; Common; most common pinniped, Channel Islands breeding sites in summer	YES	YES
Northern fur seal	San Miguel Island	Increasing >8%; Common; small population that breeds on San Miguel Is. May-Oct	YES MORE	YES LESS

Chip Johnson (CPF): This table 2 alternative shows total Navy commitment at the bottom. These hours would be divided among the various study elements. ALSO note use of AMR each year, another proposed change

Table 2. Summary of proposed SOCAL marine mammal monitoring studies by year.

	FY09		FY10		FY11		FY12		FY13
STUDY 1,3, 4 (exposures and behavioral responses)									
Aerial Surveys	Award monitoring contract, develop standard operating procedures (SOP), obtain permits; Portions of major, intermediate level, or Unit Level Training (ULT) mid-frequency active sonar (MFAS) exercises, and offshore detonation events	ADAPTIVE MANAGEMENT REASSESSMENT (AMR)	Portions of major, intermediate level, or ULT MFAS exercises, and offshore detonation events	AMR	Portions of major, intermediate level, or ULT MFAS exercises, and offshore detonation events	AMR	Portions of major, intermediate level, or ULT MFAS exercises, and offshore detonation events	AMR	Portions of major, intermediate level, or ULT MFAS exercises, and offshore detonation events
Marine Mammal Observers (MMO)	Opportunistic as staff and SOP developed; minimum intermediate level or ULT MFAS exercises		Intermediate level or ULT MFAS exercises		Intermediate level or ULT MFAS exercises		Intermediate level or ULT MFAS exercises		Intermediate level or ULT MFAS exercises
Vessel surveys (study 3, 4 only)	Award monitoring contract, develop SOP, obtain permits; Portions of major or intermediate level MFAS exercises including offshore detonation events		Portions of major or intermediate level MFAS exercises including offshore detonation events		Portions of major or intermediate level MFAS exercises including offshore detonation events		Portions of major or intermediate level MFAS exercises including offshore detonation events		Portions of major or intermediate level MFAS exercises including offshore detonation events
Marine Mammal Tagging (1, 3)	Award monitoring contract, develop SOP (Studies 1,2,3)		Conduct opportunistic marine mammal tagging		Conduct opportunistic marine mammal tagging		Conduct opportunistic marine mammal tagging		Complete tag analysis and reporting
STUDY 2 (geographic redistribution)									
Aerial Surveys Before And After Training	Award monitoring contract, develop SOP, obtain permits; Portions of major, intermediate level, or ULT MFAS exercises	AMR	Portions of major, intermediate level, or ULT MFAS exercises	AMR	Portions of major, intermediate level, or ULT MFAS exercises	AMR	Portions of major, intermediate level, or ULT MFAS exercises	AMR	Portions of major, intermediate level, or ULT MFAS exercises
Passive Acoustics	Award monitoring contract, develop SOP, obtain permits; Order devices and determine best location; integrate SOAR M3R classification data for beaked whales (BW)		Install minimum 2 autonomous devices in the SOCAL study area and begin recording; integrate SOAR M3R classification data (BW)		Continue recording from devices; Begin data analysis; integrate SOAR M3R classification data (BW and other species if available)		Continue recording from devices and data analysis; integrate SOAR M3R classification data (BW and other species if available)		Data Analysis and continue recording from devices and data analysis; integrate SOAR M3R classification data (BW and other species if available)
Marine Mammal Tagging	Award monitoring contract, develop SOP, obtain permits		Conduct opportunistic marine mammal tagging		Conduct opportunistic marine mammal tagging		Conduct opportunistic marine mammal tagging		Complete tag analysis and reporting
STUDY 5 (mitigation effectiveness)									
MMO/ Lookout Comparison	Opportunistic as staff and SOP developed; minimum intermediate or ULT	AMR	Intermediate or ULT MFAS exercises	AMR	Intermediate level or ULT MFAS exercises	AMR	Intermediate level or ULT MFAS exercises	AMR	Intermediate level or ULT MFAS exercises
Aerial Surveys Before And After Training	Portions of major or intermediate MFAS exercises		Portions of major or intermediate MFAS exercises		Portions of major or intermediate MFAS exercises		Portions of major or intermediate MFAS exercises		Portions of major or intermediate MFAS exercises
FY Commitment:	**FY09** **-120 hrs aerial survey (approx. 20 aerial survey days at 6 hrs/day)** **-60 hours vessel survey (approx. 5 days at 12 hrs/day)** **-36 hrs MMO (approx. 4 days at 12 hrs/day)** **- integrate existing PAM**		**FY10** **-120 hrs aerial survey (20 days)** **-72 hrs vessel survey (6 days)** **-72 hours MMO (6 days)** **-use existing PAM; deploy min. 2 PAM bottom buoys** **-tagging**		**FY11** **-120 hrs aerial survey** **-72 hrs vessel survey** **-72 hours MMO** **-use existing PAM; deploy min. 2 PAM bottom buoys** **-tagging**		**FY12** **-120 hrs aerial survey** **-72 hrs vessel survey** **-72 hours MMO** **-use existing PAM; deploy min. 2 PAM bottom buoys** **-tagging**		**FY13** **-120 hrs aerial survey** **-72 hrs vessel survey** **-72 hours MMO** **-use existing PAM; deploy min. 2 PAM bottom buoys**

APPENDIX A- ADDITIONAL NAVY RESEARCH AND OTHER STUDIES

Related Navy Funded Research In SOCAL

The Chief of Naval Operations (CNO) Environmental Readiness Division and the Office of Naval Research have developed a coordinated Science & Technology and Research & Development program focused on marine mammals and sound. Total investment in this program for FY07-FY09 is $26 million, and continued funding at levels greater than $14 million is foreseen in subsequent years.

The program does the following:

• Comprises four interrelated areas: determining marine mammal demographics; establishing accepted criteria and thresholds to measure the effects of naval activities; developing effective protective methods to lessen those effects; and further understanding the effects of man-made sound fields on marine life.

• Provides better biological data and tools to enable the Fleet to train prior to deployments at a minimal risk to marine mammals.

• Seeks to make monitoring and mitigation as compatible as possible with Fleet sensors, data displays and personnel training.

The SOCAL monitoring plan will integrate elements of this broader Navy marine mammal research into the exercise and regional monitoring and data analysis proposed in this plan as these new technologies and techniques become available.

Ongoing Navy funded Regional SOCAL Monitoring

Where possible, collaboration will be sought with SOCAL academic researchers, scientists at Southwest Fisheries Science Center (SWFSC NMFS), and Navy funded regional science efforts to contribute additional broad area information on marine mammal distributions within SOCAL. While not being proposed for funding under the SOCAL Range Complex Monitoring Plan, basic biological information from these other sources can contribute to the understanding of regional marine mammal populations.

For FY09, several comprehensive marine mammal monitoring projects are funded for Southern California. These include:

- Marine Mammal Vocalization Characterization
- SCORE Marine Mammal Monitoring
- California Cooperative Oceanic Fisheries Investigation (CalCOFI)
- Cetacean Trends In The California Current
- SCORE Marine Mammal Response to Naval Operations

Details of these particular Navy funded programs are provided below and some preliminary date contained in Hildebrand (2005, 2007).

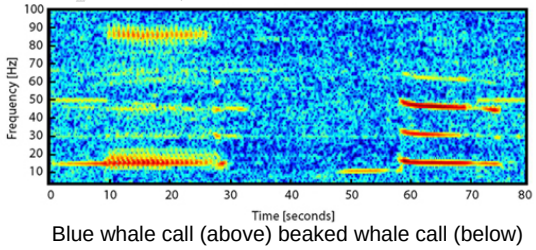
Marine Mammal Vocalization Characterization

Complete an assessment of the probability of detection of several species of marine mammals from various passive acoustic sensors in the SCORE range. Provide information on the initial scope of using broadband energy as a suggestion of behavior of a large group of marine mammals, similar species, or guild of marine mammals with similar behavior. Continue the physical characterization of the ocean environment in SCORE region of interest to provide base information related to marine mammal behavioral ecology. Continue to take HARP measurement data in the Pt. Sur region to provide data and insight as to flow of marine mammals into and out of the Southern California region. Complete the study of long-term ambient noise trends in the Southern California region.

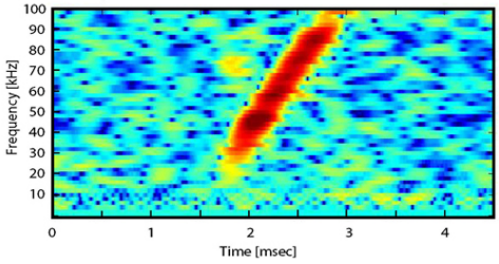
SCORE Passive Acoustic and Visual Marine Mammal Monitoring

Complete evaluation of range hydrophones to detect various species of marine mammals under various environmental conditions; specifically, conduct visual verification via aircraft surveys; deploy HARP buoys for long-term data collection; conduct long-term visual/acoustic detection comparisons with FLIP; place emphasis on beaked whale detection and tracking; and develop acoustic classification algorithms.

Recent FLIP (above) and Acoustic Recording Packages (below) for PAM deployments in SOCAL west of San Clemente Island



Blue whale call (above) beaked whale call (below) recorded in Southern California



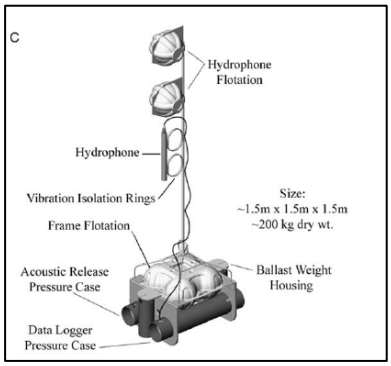
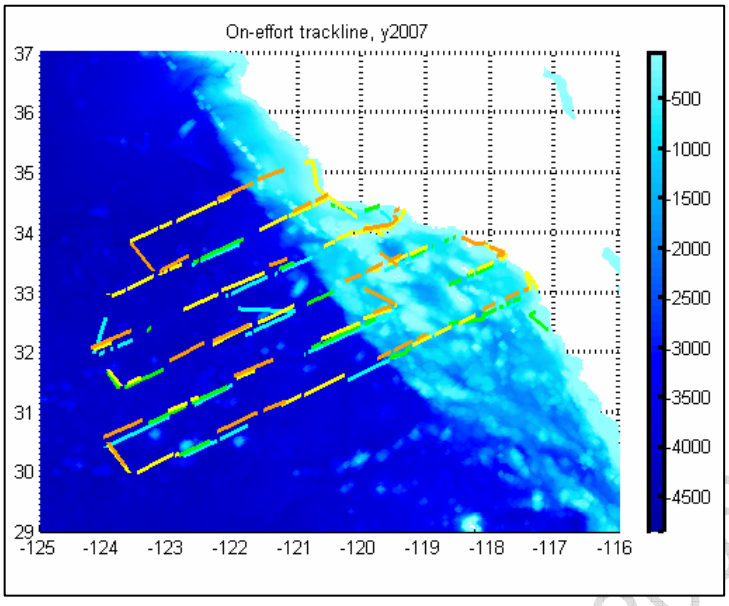


Diagram of SIO High-frequency Recording Package

California Cooperative Oceanic Fisheries Investigation (CalCOFI)

Develop predictive modeling of marine mammal presence/abundance in the Southern California Region, specifically, collaborate with California Cooperative Oceanic Fisheries Investigation (CalCOFI) for environmental data analysis; conduct visual survey support for verification; conduct HARP (a passive acoustic monitoring buoy) and other ancillary sensor deployment, retrieval, and data analysis; continue development of marine mammal density model for use in specialized, defined areas of interest; and continue development of predictive model for estimates of beaked whale abundance. Cetacean survey data from CalCOFI cruises conducted in southern California has been funded by the Navy R&D program. These cruises have been conducted consistently on the same transect lines over the past 60 years and provide one of the longest and most extensive time series of physical and biological oceanographic data in the world. Approximately four years ago, Scripps Institution of Oceanography was awarded a contract to add visual and acoustic surveys of cetaceans to the CalCOFI cruises. Four seasonal cruises were conducted annually. A towed hydrophone is used to detect vocalizing cetaceans. Sonobuoys were deployed and acoustic signals recorded when the ship was stopped for oceanographic observations. The goals of the cetacean surveys are to determine the temporal and spatial patterns of cetacean distribution, to compare visual and acoustic survey methods and results, to quantify differences in vocalizations between cetacean species, and to make seasonal estimates of cetacean density and abundance within the study area. The surveys have been successful in achieving broad coverage (**Figure A-1**). The greatest strength of this survey is its broad seasonal and geographic coverage within southern California. Sample sizes (numbers of sightings) are comparable or greater than the total number of SWFSC sightings from the same area. The weakness of the CalCOFI surveys are that, due to time constraints, the vessel cannot alter course during the survey to estimate group sizes or determine species identifications. A comparison of visual and acoustic detections has shown that most groups are detected by both methods. CalCOFI cetacean surveys are planned to continue for at least the next two years. To date, no estimates of cetacean density or abundance have been made from the CalCOFI surveys, but both are planned in the future. Plans also exist to model cetacean density as a function of habitat models using these survey data.



CalCOFI cetacean survey transects completed in 2007. Different colors represent cruises in 4 different seasons. Shading indicates water depth (graphic from Scripps Institute of Oceanography, Dr. John Hildebrand).

Cetacean Trends In The California Current

Cetacean trends in the California current Determine trends in cetacean abundance in the California Current from 1991 to 2008 taking into consideration ecosystem variability.

SCORE Marine Mammal Response to Naval Operations

Plan, coordinate, and participate in efforts to acquire information of marine mammal locations, movements, and behavior within the undersea SCORE range off southern California, during all seasons and with known variations in the physical ocean environment. Determine the normal animal behavior and the changes that can be correlated with naval training operations.

Marine Mammal Monitoring on Navy Ranges (M3R)

The Navy already has an existing fixed passive acoustic array at SOAR mounted on the bottom of San Nicholas basin west of San Clemente Island, as well as a proposal for extending this array as part of the SOCAL DEIS/DOEIS (DoN, 2008). This system was originally designed to record underwater sounds and provide tracking capability for Navy training events. The hydrophones on this fixed system are not currently capable of recording vocalization from all marine mammal species, especially low frequency specialist such as some baleen whales (in particular, blue and fin whales). The existing hydrophones on SOAR are bandwidth limited to 8 – 40 kHz. Planned updates and refurbishment of this passive array are funded and design work in progress which will allow for greater frequency range once newer hydrophones are installed in summer 2009. After this refurbishment, hydrophone bandwidth will be increased to ~50 Hz – 40 kHz.

The Navy also plans on future integration of the Marine Mammal Monitoring on Navy Ranges (M3R) project within the SOAR underwater range (Tiemann et al., 2006). The main objective of the M3R project is to develop a toolset for passive detection, localization, and tracking of marine mammals using existing Navy undersea range

infrastructure. The project by the Naval Undersea Warfare Center (NUWC) was originally funded by the Office of Naval Research (ONR) and now continuous under Chief of Naval Operations (CNO N45) funding. A necessary first step in this effort is the creation of a baseline of acoustic classification and behavior that requires long-term monitoring of marine mammals. As part of an overall comprehensive compliance program, M3R is working to develop new tools for tracking marine mammals. It should be noted, however, that M3R passive acoustics, especially real-time detection, is an emerging field that does need continued research especially as applied to classification, localization, and density estimation. Data from the M3R system tests on the fixed passive acoustic range at SOAR will be used opportunistically as available. The system is still in development and undergoing periodic field tests of marine mammal species identification based on passive detections. There has been recent success in particular with detection and classification of Cuvier's beaked whales. Prototype real-time classifiers for beaked whales are tentatively scheduled for deployment at SOAR by spring of 2009.

M3R has been funded by CNO N45 in FY08 for a 3-year marine mammal monitoring program within the SOCAL Range Complex. The major program objectives are to:

1. Measure the effect of active sonar on marine mammal populations with an emphasis on Cuvier's beaked whales.

2. Assess population size and structure of beaked whales and other species in relation to potential impacts using passive acoustic methods, tagging, and photo-identification.

3. Develop the algorithms and infrastructure required for long-term monitoring

To meet these objectives for the M3R program, the following tasks will be incorporated:

1. Collect SOAR hydrophone and visual/acoustic survey data in the range both in the presence and absence of active sonar exercises

2. Place satellite tags on marine mammals in and near the range to document the effect of sonar usage on their spatial and temporal distribution

3. Determine the abundance, residency patterns, and movements of marine mammals, including beaked whales, in the SOAR range through analysis of passive acoustic and photo-identification data

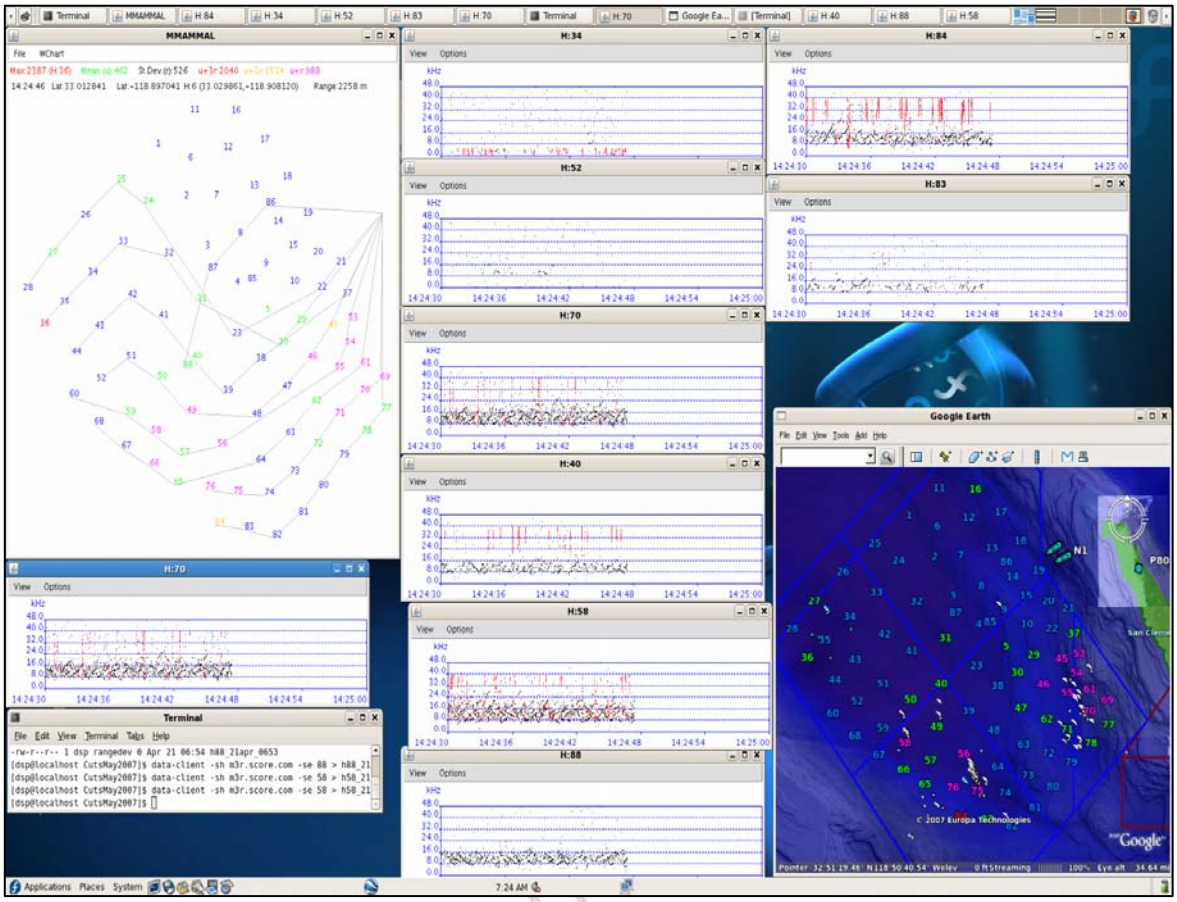
4. Collect verified species vocalization data for marine mammals found on the SOAR range

5. Develop detection, classification, and localization algorithms for as many marine mammal species as feasible

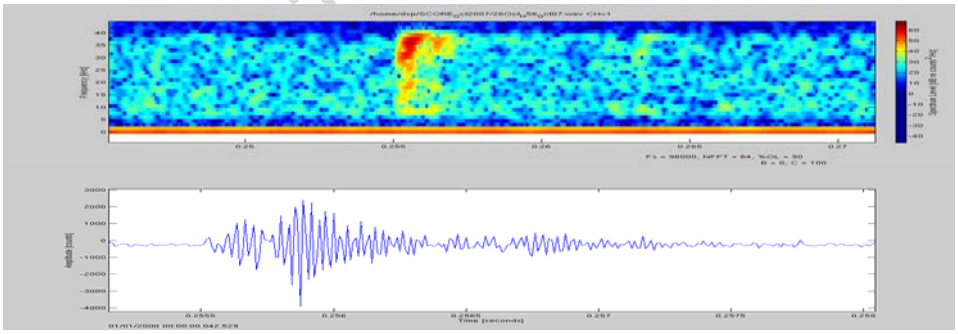
6. Develop and implement prototype classifiers for Cuvier's and Blainville's beaked whales

7. Upgrade the M3R processor for SOAR refurbishment hydrophone upgrades

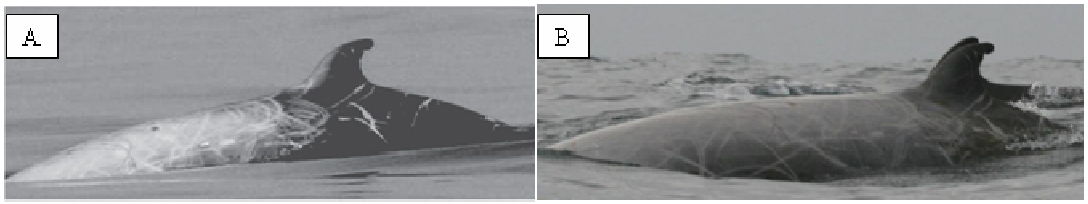
8. Monitor environmental changes and effects on marine mammals



Real-time M3R monitoring displays: Range display with activity shown by colored hydrophone numbers (upper left). Detection displays with common dolphin clicks and whistles (middle). Localization display (lower right).



Frequency (upper) and time (lower) plot of a Cuvier's beaked whale call on a SOAR hydrophone.



Identification photographs of Cuvier's beaked whale in SCORE. The same animal is shown in these two photographs taken on (a) October 24, 2007 and (b) October 26, 2007 (photos from Cascadia Research)

DoD Funded Marine Mammal Research

There is a U.S. Department of Defense environmental research program that also funds marine mammal research of interest to the Navy. These projects while often complementary, are separate for the Navy's internally funded R&D program managed by CNO N45.

The Strategic Environmental Research and Development Program (SERDP) (http://www.serdp.org) is the Department of Defense's (DoD) environmental science and technology program, planned and executed in full partnership with the Department of Energy and the U.S. Environmental Protection Agency, with participation by numerous other federal and non-federal organizations**.**

Specific ongoing projects with future potential relevancy to the SOCAL Range Complex Monitoring Plan include:

Predictive Spatial Analysis of Marine Mammal Habitats (SI-1390)/ Predictive Modeling of Marine Mammal Density from Existing Survey Data and Model Validation Using Upcoming Surveys (SI-1391)

The objectives of this project are to: (1) develop and test the robustness of existing and novel spatio-temporal models of marine mammal distribution, as predicted by physical conditions of the marine environment; (2) design a novel, hierarchical framework for analyzing marine mammal distributions across annual, seasonal and synoptic timeframes; and (3) assemble a spatial decision support system that allows Navy users to analyze model outputs and ancillary oceanographic data across multiple forecasting timescales. (performed by Duke University and Southwest Fisheries Science Center, NMFS)

One goal of this model based project is to allow estimation of dolphin and whale abundance in smaller geographical areas than the large sampling strata in current NMFS visual surveys. Survey and environmental data from 1986 to 2002 will be used to build spatially explicit models that predict cetacean density in the eastern North Pacific based on geographically fixed factors and environmental variables. Fundamentally, habitat modeling allows cetacean density to be interpolated between transect lines and between the relatively rare sightings of each species. Generalized Additive Models (GAM) will be used to define habitat relationships for cetaceans seen on past surveys in the eastern Pacific. The spatially explicit models will be validated using new survey and environmental data to be collected along the west coast of the U.S. and in the eastern tropical Pacific. The predictive power of these models will be evaluated across seasons using aerial survey data collected in the California Current region. It is anticipated that this research will develop and validate density models for approximately 20 species of toothed whales and 4 species of baleen whales. Further environmental variables will be added that trophically are closer to cetaceans by analysis of existing net-tow samples and acoustic backscatter data. Finally, a software interface will be written for the spatially explicit models and made accessible to the Navy.

Acoustic Response and Detection of Marine Mammals on Navy Ranges Using a Digital Acoustic Recording Tag (SI-1539)

The objectives of this project are to: (1) ground truth acoustic monitoring on Navy ranges using boat-based observations and digital acoustic recording tags (DTAG); (2) develop tagging techniques and field efforts that use the DTAG to observe and monitor reactions of marine mammals to exposures of anthropogenic noise; (3) explore potential controlled exposure and opportunistic observation methods to evaluate safety zones based on beaked whale responses to sound; and (4) use results from (3) to prepare a detailed plan for a research program to study the effects of multiple stimuli including experimental controls.

Related Research On Impacts Of Anthropogenic Sound

The SOCAL DEIS/DOEIS summarized some of the science on past studies of anthropogenic (i.e., human generated) noise on marine mammals (DoN, 2008). Other related references also include Cox et al., 2006; Deeck, 2006; Nowacek et al., 2007; and Southall et al., 2008).

1. ATOC Playback

Summary of background and methods:
The overall goal of the Acoustic Thermometry of Ocean Climate project was to measure temperature changes of the ocean using a sound source. It was proposed that projectors near Hawaii and California would transmit a 195 dB re 1 µPa at 1m, 75 Hz signal, which when received at various listening stations throughout the Pacific Ocean, would provide data to estimate temperature along long distance paths. As part of the environmental compliance necessary for the proposed project, a Marine Mammal Research Program was established to study the effects of the proposed signal on the behavior and distribution of selected marine mammals in both Hawaii and California.

Overall, the program consisted of 1) aerial surveys designed to determine any changes in the abundance and distribution of marine mammals in the vicinity of the Pioneer Seamount source; 2) elephant seal tagging studies designed to determine any changes in elephant seal migratory or diving behavior in response to the Pioneer Seamount source transmissions; 3) playback studies to humpback whales off the Kona-Kohala coast of Hawaii designed to look for behavioral changes in response to ATOC-like sounds prior to the actual ATOC source transmissions north of Kauai, 4) aerial surveys designed to determine any changes in the abundance and distribution of humpback whales north of Kauai when the ATOC source was transmitting compared to measurements made in previous years when the source was not transmitting; 5) visual observations of humpback whale abundance, distribution, and behavior north of Kauai to determine if there were any changes in response to the ATOC transmissions; 6) undersea acoustic recordings made with seafloor data recorders north of Kauai to determine any changes in humpback vocalizations in response to the ATOC transmissions; 7) auditory measurements on small odontocetes to determine their sensitivity to the frequencies transmitted by the ATOC sources; and 8) playback studies to fish at the Bodega Bay Marine Laboratory designed to look for behavioral changes in response to ATOC-like sounds.(http://atoc.ucsd.edu).

Baseline research in the form of playback experiments off Kauai and California were conducted for two years. Off Kauai, their work had three components: observations of humpback whale behavior from the air and from shore; underwater recording to measure background ocean noise and normal humpback singing; and aerial surveys to document the abundance and behavior of marine mammals around the Hawaiian Islands. They used three platforms: a shore station for shore based behavioral observations throughout the research area, a playback vessel for the source, and a recording vessel for taking oceanographic measurements, recording the acoustic environment and measuring the acoustic velocity profile (Frankel and Clark 1998). Data were collected on: 1) ambient noise, 2) marine mammal behaviors including respiration, surface and dive times (which once classified, were entered into a data-logging software) 3) marine mammal movements were tracked using a theodolite, 4) vessel movements, 5) marine mammal vocalizations.

Analysis (of Kauai data only): Data were processed by a customized software program (Aardvark) that generated descriptive statistics for movement variable, and output was imported into another software program for analysis. A variety of statistical tests were conducted on the data sets, including Watson U2 test was used as well as an analysis of variance (ANOVA) run for effects of the playbacks (Frankel and Clark 1998). Since the ANOVA does not include the effects of natural variables such as vessel effects, a more detailed analysis was also undertaken using a

multifactor general linear model. And, finally, power analysis was conducted to compare phases. Eight-five trials were conducted in 1996, resulting in a sample size of 50 playback trials of varying lengths. Resulting analysis showed that humpback whales showed no overt responses to the playbacks. However, statistical analysis showed that both the dive duration and the distance traveled between successive surfacings increased with increasing received level of the ATOC playback signal.

2. Full scale ATOC signals

Summary of background and methods:

In 1998, the same researchers collected behavioral observations using the same method as during the playback, but with the actual ATOC source replacing the playback speaker (Frankel and Clark, 2000). Field observations were collected blind to whether or not the ATOC source was transmitting. Focal follows were conducted using the same methods as used during the playback (Frankel and Clark, 1998).

Analysis: To control for any distinctive behavior patterns in a pod, the analysis focused on potential changes in a pod's behavior between the control, and before and during ATOC transmissions (Frankel and Clark, 2000). An analysis of covariance (ANCOVA) test was used so that each pod served as its own control. Each whale behavior was tested separately with the ANCOVA. Vessels, pod composition, etc were included in the analysis. The research was conducted during one field season, and based upon a sample size of 265 acoustic samples, 92 focal pod behavioral follows (100 hours), observations containing control and ATOC portions were obtained for 65 pods. The ANCOVA revealed that both the time and the distance between successive surfacings increased with increasing estimated received sound level (Frankel and Clark, 2000) which is consistent with the playback experiments (Frankel and Clark, 1998). The results indicate that ATOC transmissions produce subtle short-term behavioral changes in humpback whales (Frankel and Clark, 2000). The authors conclude that the operation of ATOC off Kauai is not sufficient to cause biologically significant changes in behavior for the Kauai humpback population. However, they do not generalize to include the combined effects of ATOC, with vessel traffic and other anthropogenic noise (Frankel and Clark, 2000).

3. SURTASS LFA for impacts to blue and fin whales:

Summary of background and methods:

Biological acoustic data were collected during an operational SURTASS LFA exercise in 1996 off the coast of southern California. The primary objectives were to determine if there was any indication of whales changing their vocal behavior when the SURTASS LFA system was functioning (Clark and Altman, 2006). Using a Cornell developed acoustic analysis workstation installed on the Navy R/V Cory Chouest, Navy personnel monitored for blue and fin whale vocalizations. Once calls were heard, they estimated a whale's position relative to the transmitting vessel using customized localization software.

Analysis: In the lab, spectrograms were made for each vocalizing animal and examined by bioacousticians, estimating whale numbers and calls for each. 386 hours of acoustic data were analyzed and linear regression was performed on the samples. The researchers found that the data were too sparse (e.g. too few call sequences) and the vocal behavior too variable to make any statistical assessment of a relationship between the transmission and the change in vocal behavior. They suggest additional research with longer on/off periods of transmission. Similar studies conducted for behavioral responses of gray whales to SURTASS LFA showed strong responses to signal in their migratory path, but not when the source was moved 2 km. In this case, received levels alone cannot explain the observed behavior (Clark et al., 1999).

4. Indo-Pacific dolphins to vessels in Sharks Bay, Australia:

Summary of background and methods:

The researchers studied the effects of experimental vessel approaches on vocal and non-vocal behavior of Indo-Pacific dolphins in two sites. Shore-based observers used a theodolite to conduct focal follows, similar to the ATOC study. Also similar to the ATOC study, they used computer software custom designed for data acquisition. Data were collected from 2001-2002 for a total of 389 hours at the impact site (e.g., vessel interaction) and 120 hours at a control site (Bejder, L et al 2006). This sample represented 18 individuals.

Analysis: The researchers conducted a battery of statistical tests, including a two-way, repeated measures, multivariate analysis of variance (R-MANOVA) and canonical-variate (CV). Results concluded that experimental vessels approaches elicited changes in behavioral responses at both impact and control sites, with a stronger reaction at the control site where dolphins were less habituated to vessel activity (Bejder et al., 2006).

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