Comprehensive

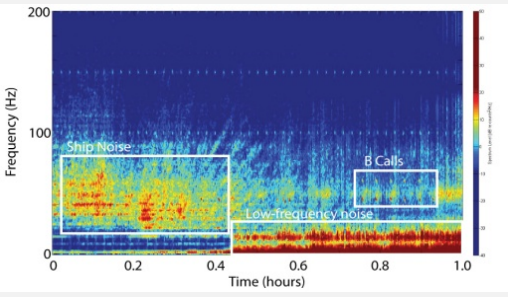
Exercise and Marine Species Monitoring Report

For the U.S. Navy's

Southern California Range Complex

2009-2012

Department of the Navy
United States Pacific Fleet



June 1, 2013
FINAL

In Support Of
Letter of Authorization
Under The Marine Mammal Protection Act
For Incidental Harassment of Marine Mammals Resulting From
U.S. Navy Training and Testing Activities
In The Southern California Range Complex

Comprehensive Exercise and Marine Species Monitoring Report

For the U.S. Navy's Southern California Range Complex

Prepared in Accordance With
50 C.F.R. §216.275(h)

Submitted By
Department of the Navy
Commander, United States Pacific Fleet
250 Makalapa Drive
Pearl Harbor, Hawaii 96860-3131

Submitted To
National Marine Fisheries Service
Office of Protected Resources
1315 East-West Highway
Silver Spring, Maryland 20910-3226

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1 INTRODUCTION

The United States (U.S.) Department of the Navy (Navy) developed Range Complex-specific Monitoring Plans under the Navy Monitoring Program 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.

The U.S. Pacific and Atlantic Fleets' marine species monitoring programs are composed of a collection of "range-specific" monitoring plans, each developed as part of the MMPA/ESA authorization process. The Fleets individual plans establish specific monitoring requirements for each range complex based on a set of effort-based metrics.

This report describes Navy-funded monitoring within the Navy's Southern California (SOCAL) Range Complex conducted between January 2009 and August 2012 and is based on annual monitoring reports submitted previously to the National Marine Fisheries Service (NMFS) (Department of the Navy 2009a, 2010a, 2011a, 2012). This document is a comprehensive report summarizing to the best extent practical monitoring program results, prepared in accordance with 50 Code of Federal Regulations §216.275(h). The Navy, per NMFS instruction, submitted an outline of this report to the NMFS on 30 November 2012, submitted a draft report on 24 January 2013, and submitted the final report on 1 June 2013.

Section 3.3 (Visual Survey [Aerial Monitoring]) was composited and analyzed over the summer to fall of 2012 by the scientists who conducted the work. That aerial data assessment is included in this Comprehensive Report. Passive acoustic reviews are still ongoing in Fiscal Year (FY) 13 (Section 3.4, Passive Acoustic Monitoring), so new analytical information is not available. Therefore, the Passive Acoustic Monitoring (PAM) section of this Comprehensive Report summarizes key observations from previous annual reports. Section 3.5 (Marine Mammal Observers) similarly summarizes previous information. All of Section 4 (Navy Basic and Applied Research Summary) is not funded by U.S. Pacific Fleet and any information is a voluntary contribution to the Navy. The Research information then is also a summary of key updates previously reported in prior annual reports.

1.1 REPORT OVERVIEW

This report is comprised of six main sections summarizing key monitoring results from 2009 to 2012:

- Introduction
- Exercise Reporting Summary
- Compliance Monitoring Summary
- Navy Basic and Applied Research Summary
- Progress on Monitoring Questions, Feasibility, and Cost-benefit Comparison
- Future Direction

The Exercise Report Summary contains a composite listing and review of marine mammal sightings from Navy platforms (surface ships and aircraft) during major training events (MTE) within the SOCAL Range Complex.

The Compliance Monitoring Summary discusses scientific contribution and major results from U.S. Pacific Fleet-funded Compliance Monitoring under the MMPA and ESA authorizations for the SOCAL Range Complex. Fleet-funded Compliance Monitoring is directly tied to the monitoring objectives from the NMFS approved SOCAL Range Complex Monitoring Plan (Department of the Navy 2009b).

The Navy Basic and Applied Research Summary describes other concurrent research projects within Southern California that either increase scientific knowledge on marine mammal and anthropogenic impacts, or provide for testing and validation of new detection technologies. These projects, while supportive of the conclusions discussed in this report, are not directly tied to permit-required compliance monitoring and therefore have variable temporal and spatial scales (i.e., multi-year studies within the Southern California Bight either on or off of the Navy's SOCAL Range Complex).

The Progress on Monitoring Questions discusses how various technologies and associate results contribute to the SOCAL Range Complex monitoring objectives.

Finally, Future Directions describes the Navy's recommendations for follow-on monitoring within the SOCAL Range Complex starting in 2014.

1.2 INTEGRATED COMPREHENSIVE MONITORING PROGRAM

The Integrated Comprehensive Monitoring Program (ICMP) provides an overarching framework for coordination of the Navy's marine species monitoring across multiple range complexes (Department of the Navy 2010b). It has been developed in direct response to permitting requirements for Navy ranges, which are established in the various MMPA Final Rules, ESA Consultations, Biological Opinions, and applicable regulations. As a framework document, the ICMP applies by regulation to those activities on ranges for which the Navy sought and received incidental take authorization.

The ICMP is intended for use as a planning tool to focus Navy monitoring priorities pursuant to ESA and MMPA requirements. Top priority will always be given to satisfying the mandated legal requirements across all ranges. Once legal requirements are met, any additional monitoring related research will be planned and prioritized using guidelines outlined by the ICMP, consistent with availability of both funding and scientific resources. As a planning tool, the ICMP is a "living document" and will be routinely updated, as needed. The initial area of focus for improving Navy marine species monitoring in 2011 and 2012 was on development of a Strategic Plan to be incorporated as a major component of the ICMP to guide investments and help refine specific monitoring actions to more effectively and efficiently address ICMP goals and objectives.

The ICMP is evaluated through the Adaptive Management Review process to: (1) assess progress, (2) provide a matrix of goals and objectives for the following year, and (3) make recommendations for refinement and analysis of the monitoring and mitigation techniques. This process includes conducting an annual adaptive management meeting at which the Navy and NMFS jointly consider the prior-year goals, monitoring results, and related scientific advances to determine if modifications to monitoring plans are warranted to more effectively address program goals. Modifications to the ICMP that result from adaptive management review discussions are incorporated into a revision to the ICMP and submitted to NMFS.

ICMP Goals – Under the ICMP, monitoring measures prescribed in range-specific monitoring plans and Navy-funded research relating to the effects of Navy activities on protected marine species should be designed to accomplish one or more of the following top-level goals as prescribed in the current revision of the ICMP (Department of the Navy 2010b):

(a) An increase in our understanding of the likely occurrence of marine mammals and/or ESA-listed marine species in the vicinity of the action (i.e., presence, abundance, distribution, and/or density of species).
(b) An increase in our understanding of the nature, scope, or context of the likely exposure of marine mammals and/or ESA-listed species to any of the potential stressors associated with the action (e.g., sound, explosive detonation, or expended materials), through better understanding of one or more of the following: (1) the nature of the action and its surrounding environment (e.g., sound-source characterization, propagation, and ambient noise levels); (2) the affected species (e.g., life history or dive patterns); (3) the likely co occurrence of marine mammals and/or ESA-listed marine species with the action (in whole or part); and/or (4) the likely biological or behavioral context of exposure to the stressor for the marine mammal and/or ESA listed marine species (e.g., age class of exposed animals or known pupping, calving, or feeding areas).
(c) An increase in our understanding of how individual marine mammals or ESA-listed marine animals respond (behaviorally or physiologically) to the specific stressors associated with the action (in specific contexts, where possible, e.g., at what distance or received level).
(d) An increase in our understanding of how anticipated individual responses, to individual stressors or anticipated combinations of stressors, may impact either: (1) the long-term fitness and survival of an individual; or (2) the population, species, or stock (e.g., through effects on annual rates of recruitment or survival).
(e) An increase in our understanding of the effectiveness of mitigation and monitoring measures, including increasing the probability of detecting marine mammals to better achieve the above goals (through improved technology or methodology), both generally and more specifically within the mitigation zone (thus allowing for more effective implementation of the mitigation). Improved detection technology will be rigorously and scientifically validated prior to being proposed for mitigation, and should meet practicality considerations (engineering, logistic, and fiscal).
(f) A better understanding and record of the manner in which the authorized entity complies with the MMPA incidental take authorization and ESA incidental take statement.

The Navy's Office of the Chief of Naval Operations Energy and Environmental Readiness Division (OPNAV N45) in Washington, D.C. is responsible for maintaining and updating the ICMP, as necessary, reflecting the results of regulatory agency rulemaking, Adaptive Management Reviews, best available science, improved assessment methodologies, and more effective protective measures. This is done as part of the Adaptive Management process, in consultation with Navy technical experts, Fleet program managers, and other Navy commands as appropriate. The ICMP is authored by OPNAV N45 with inputs from the Fleets and Naval Facility Engineer Commands. OPNAV N45 is tasked with coordinating integration of the ICMP with ongoing Navy funded monitoring programs.

1.3 SOUTHERN CALIFORNIA RANGE COMPLEX MONITORING GOALS

The SOCAL Range Complex is situated off the coast of Southern California, generally between Dana Point and San Diego, California. Extending more than 600 nautical miles (nm) southwest into the Pacific Ocean, the SOCAL Range Complex encompasses over 120,000 square nautical miles of sea space. For range management and scheduling purposes, the SOCAL Range Complex is divided into numerous subcomponent training areas (**Figure 1-1** and **1-2**). At the beginning of the SOCAL Range Complex monitoring program in 2009, it quickly became apparent that from a logistics perspective (distances from land, funding, amount of Navy training occurring, etc.) and scientific perspective (availability of previous data for comparison), not all parts of the SOCAL Range Complex could be effectively and safely studied within the time frame of this program (2009–2014). Therefore, the monitoring program focused on highly used key Navy training areas west, east, and south of San Clemente Island (**Figure 1-2** and **1-3**).

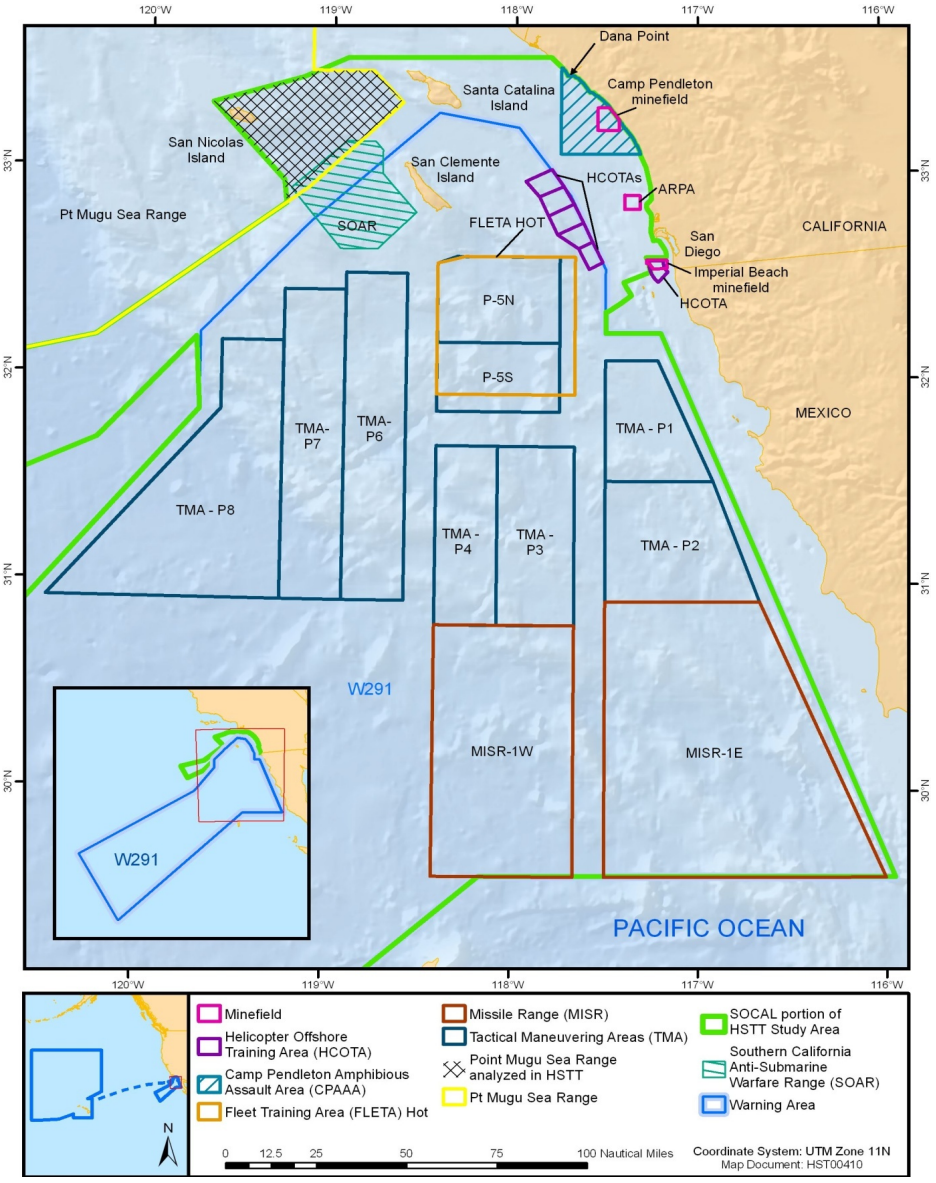

Figure 1-1: SOCAL Range Complex Ocean Training Areas

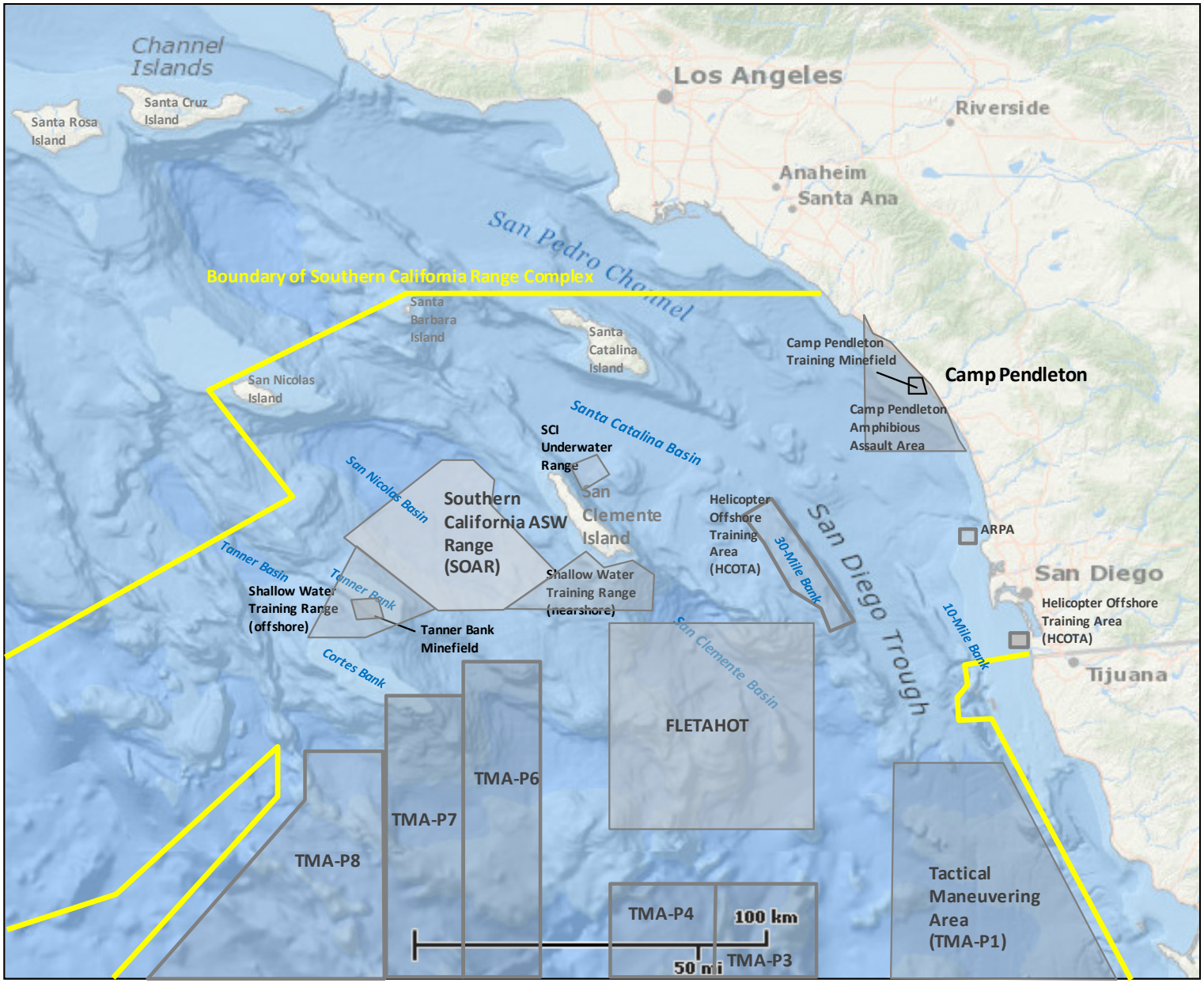

Figure 1-2: Close-Up View of Key SOCAL Range Complex Training Sub-Areas

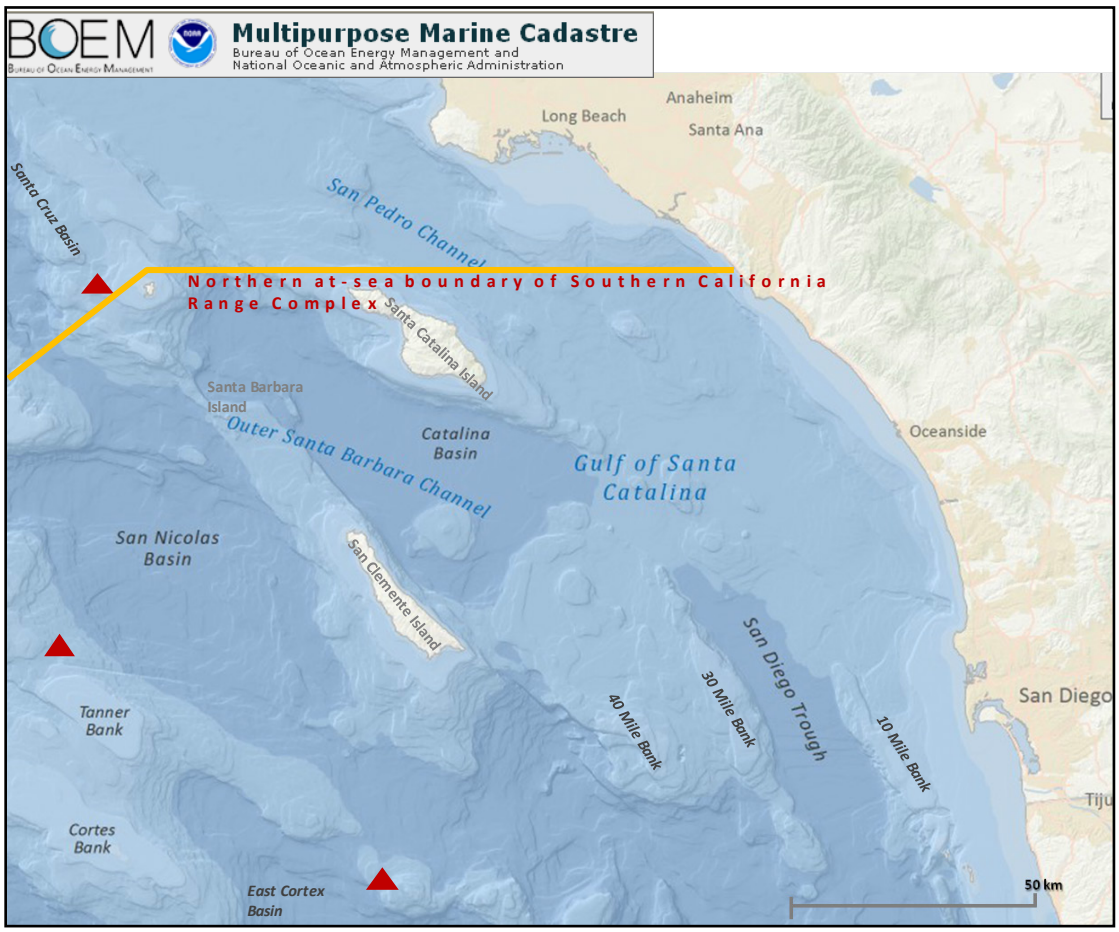

Figure 1-3: The Aerial Survey Monitoring Area and PAM Locations within the Navy's SOCAL Range Complex and Select Bathymetric Features

Note: Icons (red triangles) are approximate locations of U.S. Navy-funded bottom-mounted High-frequency Acoustic Recording Packages.

Initial Monitoring Proposed

Monitoring methods proposed for the SOCAL Range Complex in 2009 initially included a combination of the following research elements designed to support both Range Complex-specific monitoring and to contribute information to the ICMP (Department of the Navy 2009c, 2010b). These research elements included:

- Visual survey – vessel and aerial (in hours of survey accomplished per year)
- PAM (in number of devices deployed)
- MMOs on select Navy ships (in hours of survey)
- Marine Mammal Tagging (opportunistically as available)

Current 2012 Monitoring

During the first year of monitoring, U.S. Pacific Fleet learned that the Navy's Research program was already actively engaged in an ongoing marine mammal tagging project within the SOCAL Range Complex. Subsequently, the opportunistic tagging was dropped from compliance monitoring which instead focused on the remaining three research elements.

Results from Navy research-funded tagging continue to be included within annual SOCAL Range Complex monitoring reports to the NMFS (see also Chapter 4 of this report).

After the second year of monitoring, all visual survey shifted to aerial platforms as a more cost efficient method specific to the SOCAL Range Complex in which to obtain occurrence information over a larger spatial scale as well as document marine mammal behavioral state.

Current 2012–2013 Navy-required monitoring requirements for the SOCAL Range Complex include (Department of the Navy 2012):

- Visual survey: completion of 100–150 hours of visual survey
- PAM: report results from two bottom deployed passive acoustic devices[1]
- MMO: completion of 50–100 hours of MMO deployment

In addition, Navy marine mammal sightings during SOCAL Range Complex MTEs are summarized annual. Finally, any contributions from researchers engaged in the Navy's research funded projects are presented, as available.

Oceanographic and Climatic Considerations on Marine Mammal Occurrence – For any assessment of the monitoring results presented in both Chapter 2 and 3, an understanding of the underlying importance of U.S. west coast oceanographic and climatic conditions on regional marine mammal occurrence is needed. Variation in oceanographic and climatic conditions within Southern California has a dramatic influence on marine mammal distribution, species assemblages likely to be present, foraging, and breeding success. This is especially important in trying to interpret monitoring results specific to discussions of geographic redistribution, or behavioral context of a potential response or lack of response to an activity. For instance, variation in a species distribution between monitoring surveys, or over time, may be in response to natural response to normal seasonal oceanographic shifts, as well as longer-term climatic events (e.g., El Niño, La Niña.

The marine waters of Southern California represent a transitional area between subarctic, central, and equatorial water masses. Within any given year, there is typically a cooler water period more dominated by subarctic water (approximately November–April) and a warmer water period more dominated by central and equatorial water (approximately May–October). These dates are approximate within any given year, due to natural variation in ocean water temperatures, and influences from larger scale processes discussed below. Long-term climatic influences in the region include El Niño-Southern Oscillation (commonly referred to simply as El Niño), Pacific Decadal Oscillation, and global warming. The recurring El Niño pattern is one of the strongest in

[1] Devices are high-frequency acoustic recording packages from Scripps Institution of Oceanography.

the ocean-atmosphere system. El Niño is defined by relaxation of the trade winds in the central and western Pacific, which can set off a chain reaction of oceanographic changes in the eastern Pacific Ocean. Off the coast of California, El Niño events are characterized by increases in ocean temperature and sea level, enhanced onshore and northward flow, and reduced coastal upwelling of deep, cold, nutrient-rich water. During this period, plankton abundance decreases, resulting in a decrease in survivorship and reproductive success of planktivorous invertebrates and fishes. Marine mammals and seabirds, which feed on these organisms, experience widespread starvation, decreased reproductive success, and may adjust their distributions in an attempt to compensate.

Every 20 to 30 years, the surface waters of the central and northern Pacific Ocean, from 20 degrees north toward the pole, shift several degrees from their mean temperature. Such shifts in mean surface water temperature, known as the Pacific Decadal Oscillation, have been detected five times during the past century, with the most recent shift having occurred in 1998. This oscillation affects production in the eastern Pacific Ocean and, consequently, affects organism abundance and distribution throughout the marine food chain. Ocean waters off the coast of California have warmed considerably over the last 40 years. It is not clear if this warming is a consequence of an interdecadal climate shift, or global warming. In response to this phenomena, along with the two discussed above, some marine species have shifted their geographic ranges northward, altering the composition of local assemblages of biota. For instance, over the past couple of decades, large-scale population assessment surveys conducted by the NMFS' Southwest Fisheries Science Center provide evidence for blue whales shifting foraging grounds outside of the California-Oregon-Washington study area (Barlow and Forney 2007, Barlow et al. 2008). This shift in blue whale distribution may be associated with the overall declining trend in zooplankton displacement volumes off California since the 1990s (Goericke et al. 2007, McClatchie et al. 2008). However, NMFS surveys are conducted every 3 to 5 years, primarily in summer and fall, and, as such, do not capture seasonal variability between years, and there is documented variability in blue whale seasonal movements tied to oceanographic conditions (Bailey et al. 2009, Calambokidis et al. 2009, Burrows et al. 2012).

In terms of longer term global warming effects on the Pacific Ocean, Salvadeo et al. (2011) discuss a poleward shift and range expansion of sardines, jumbo squid, Pacific white-sided dolphins, gray whales, and sperm whales through the California Current System including Southern California. Hazen et al (2012) predict that due to global climate change, there could be a "35% change in core habitat for some species, differences in rates and patterns of habitat change across guilds, and a substantial northward displacement of biodiversity across the North Pacific." **Figure 1-4** shows data from the National Weather Service Climate Prediction Service for warm and cold ocean temperature episodes in the Eastern Pacific as a predictor of El Niño and La Niño oceanographic conditions that would also be applicable to Southern California. During the period encompassed by this Comprehensive Report from January 2009 through August 2012, there was a slight warming period (mild El Niño) from approximately October 2009 through April 2010, and a slight cooling period (mild La Niño) from approximately July 2010 through March 2011 (**Figure 1-4**). There was an additional cooler than normal period from September 2011 through February 2012, although not as much as the mild La Niño.

National Weather Service Climate Prediction Center: Warm (red) and cold (blue) episodes based on a threshold of +/- 0.5oC for the Oceanic Niño Index (ONI) [3 month running mean of ERSST.v3b SST anomalies in the Niño 3.4 region (5N-5S, 120-170W)], based on centered 30-year base periods updated every 5 years. For historical purposes cold and warm episodes (blue and red colored numbers) are defined when the threshold is met for a minimum of 5 consecutive over-lapping seasons
http://www.cpc.noaa.gov/products/analysis_monitoring/ensostuff/ensoyears.shtml

Year	DJF	JFM	FMA	MAM	AMJ	MJJ	JJA	JAS	ASO	SON	OND	NDJ
2008	**-1.5**	**-1.5**	**-1.2**	-0.9	-0.7	-0.5	-0.3	-0.2	-0.1	-0.2	-0.4	-0.7
2009	-0.9	-0.8	-0.6	-0.2	0.1	0.4	0.5	0.6	0.7	1.0	**1.4**	**1.6**
2010	**1.6**	**1.4**	**1.1**	0.7	0.2	-0.3	-0.8	**-1.2**	**-1.4**	**-1.5**	**-1.5**	**-1.5**
2011	**-1.4**	**-1.3**	-1.0	-0.7	-0.4	-0.2	-0.2	-0.3	-0.6	-0.8	-1.0	-1.0
2012	-0.9	-0.7	-0.5	-0.3	-0.1	0.0	0.1	0.3	0.4			

warm period scale		*cold period scale*	
	+0.5 to 0.7°C (+0.9 to 1.3°F)		-0.5 to -0.7°C (-0.9 to -1.3°F)
	+0.8 to 1.0°C (+1.4 to 1.8°F)		-0.8 to 1.0°C (-1.4 to 1.8°F)
	≥ +1.1°C (≥ +2.0°F)		≥ -1.1°C (≥ -2.0°F)

Figure 1-4: Warm and Cold Ocean Temperature Episodes Based on Oceanic Niño Index as a Predictor of El Niño and La Niño Oceanographic Conditions within Southern California

Application to SOCAL Range Complex Results – The data presented in Chapter 2 (marine mammal sightings from Navy platforms), Chapter 3 (compliance monitoring visual surveys and passive acoustic monitoring), and Chapter 4 (Navy-funded research projects) do not compare results directly to oceanographic conditions. There is a tendency, however, common to many marine mammal studies, where the typical focus is analyzing and publishing on the occurrence of various species without tying results to ongoing or predicted oceanographic conditions. The concept of climate and oceanographic analysis as a variable in marine mammal publications is still relatively new without guidance as to the best analytical procedures or how to interpret resulting statistical comparisons although there has been some work in the field (Salvadeo et al. 2011, Hazen et al. 2012). There also continues to be new work in marine mammal spatial habitat modeling within the Pacific. Modelers for the NMFS' Southwest Fisheries Science Center have begun improving initially Navy and Department of Defense-funded spatial habitat models to better incorporate predictive capabilities for marine mammal occurrence and density based on regional and long-term oceanographic data (Becker et al. 2012). In partnership with NMFS, U.S. Pacific Fleet has been funding improvement to Pacific spatial habitat models including the U.S. west coast. The goal is to continue development of predictive marine mammal spatial models for both monitoring and density derivation in support of future National Environmental Protection Act analysis (i.e., acoustic impact modeling). U.S. Pacific Fleet investment from 2010 and forecast through the end of 2014 will approach in excess of $450,000. As part of this effort, in 2013–2014, modelers will attempt to integrate existing NMFS marine mammal sighting data with new smaller scale sighting data obtained from U.S. Pacific Fleet-funded visual surveys and Navy research-funded visual surveys.

Ambient Noise – There is a substantial amount of commercial and recreational shipping traffic that passes through the SOCAL Range Complex. In 2010, there were over 1,100 commercial ship transits into and out of the Port of San Diego (San Diego Unified Port District, unpublished data). Eastbound and westbound traffic between Japan and San Diego, as well as northbound and southbound traffic between the Ports of Los Angeles and Long Beach and the Panama Canal or South America pass through most areas of the range complex (**Figure 1-5**). This commercial shipping contributes to the ambient sound levels within the range complex in addition to the episodic Navy training and testing activities. Some early Compliance Monitoring results on ambient noise measurements are discussed in Section 3.4 (Passive Acoustic Monitoring).

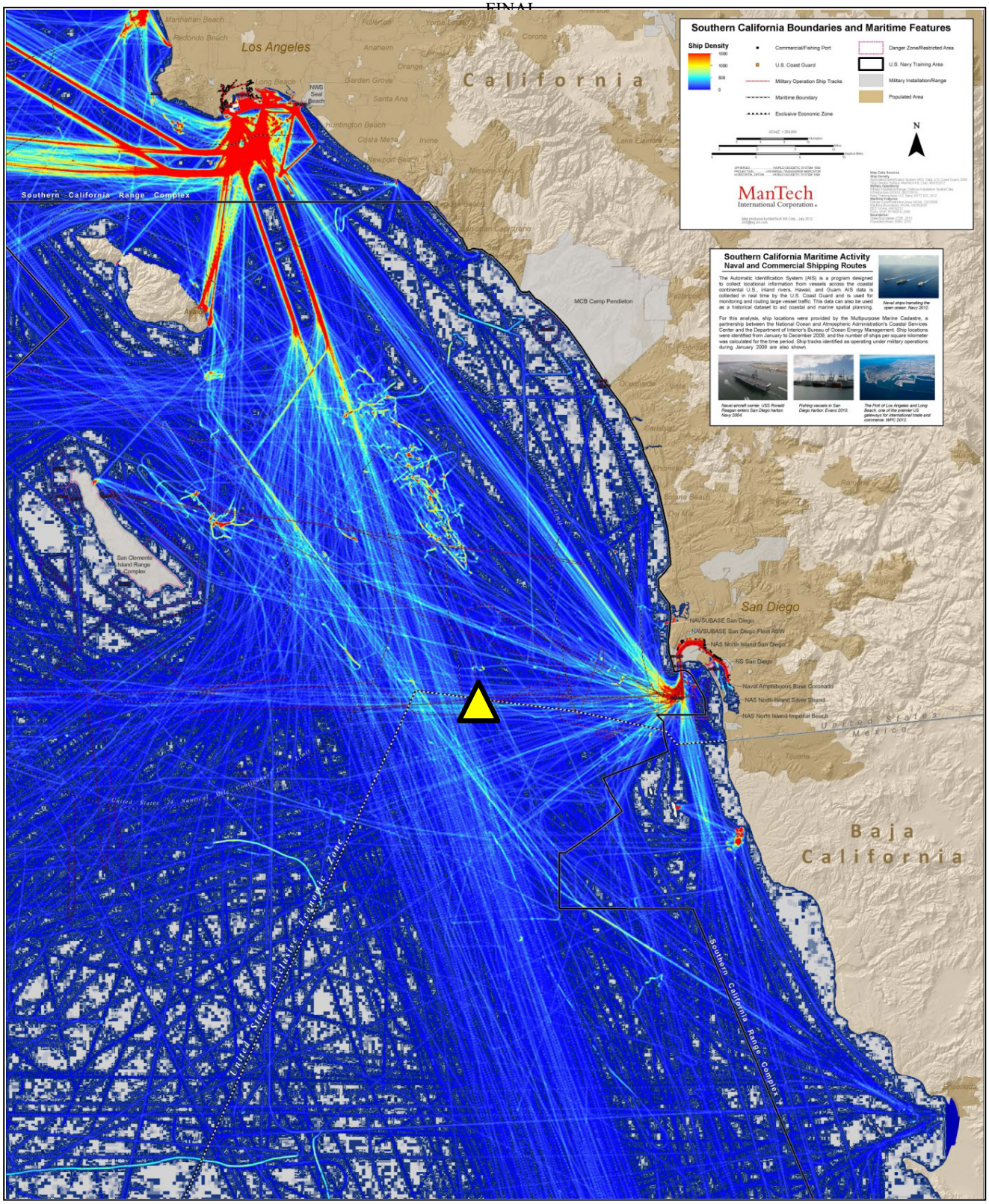

Figure 1-5: Commercial Shipping Routes and Density through the SOCAL Range Complex Based on Automatic Identification System-Plotted Tracks

Notes: Triangle indicates approximate location of new Navy-funded bottom-mounted passive acoustic device deployed in December 2012, recording data for future ambient and shipping noise study. Data will be collected through 2013, with analysis and reporting in 2014.

1.4 MONITORING TEAM AND PERFORMERS

The U.S. Pacific Fleet SOCAL Range Complex monitoring team is comprised of non-Navy civilian academic, government, and contractor scientists along with participation by Navy marine species technical experts.

Aerial visual surveys discussed in Section 1.3 (Southern California Range Complex Monitoring Goals) were conducted by Smultea Environmental Services (which, over the course of the monitoring, became a sub-contractor to HDR, Inc.).

Passive acoustic monitoring was performed by the Marine Physical Laboratory, Scripps Institution of Oceanography, University of California, San Diego.

Marine Mammal Observers were a mix of Navy civilian marine scientists from multiple Navy commands, and a contractor scientist from HDR, Inc. Typical MMO embarks include a team of four scientists.

Specific individuals who participated in SOCAL Range Complex monitoring from 2009 through 2013 include (*alphabetized by affiliation*):

Thomas Norris (Bio-Waves, Inc.); Thomas Jefferson (Clymene Enterprises); Kristen Ampela (HDR, Inc.); Catherine Bacon (HDR, Inc., and Smultea Environmental Sciences, LLC); John Hildebrand, Gregory Campbell, Simone Baumann-Pickering, Ana Širović, Jasmine Buccowich, Amanda Debich, Sarah Johnson, Sara Kerosky, Lauren Roche, Alba Solsona Berga, Sean Wiggins, Amanda Cummins, Lauren Roche, Hannah Bassett, Anne Simonis, and Katherine Whitaker (Marine Physical Laboratory, Scripps Institution of Oceanography, University of California, San Diego); Andrea Balla-Holden (Naval Facilities Engineering Command Northwest); Christiana Boerger and Jessica Bredvik (Naval Facilities Engineering Command Southwest); Stephanie Watwood, Josh Fredrickson (Naval Undersea Warfare Center Division, Newport Rhode Island); Jenelle Black, Megan Blees, Vanessa James, Kate Lomac-MacNair, Meggie Moore, Mari Smultea, and David Steckler (Smultea Environmental Sciences, LLC); Tomoharu Eguchi, Jeffrey Seminoff (Southwest Fisheries Science Center, National Marine Fisheries Service); Bernd Würsig (Marine Mammal Research Program, Texas A&M University at Galveston); Chip Johnson (U.S. Pacific Fleet).

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2 EXERCISE REPORTING SUMMARY

This chapter summarizes marine mammals sightings made from Navy platforms during designated MTEs within the SOCAL Range Complex.

2.1 SOUTHERN CALIFORNIA RANGE COMPLEX MAJOR TRAINING EVENT SUMMARY, 22 JANUARY 2009 TO 1 AUGUST 2012

Major Training Events – There were 27 individual MTEs that took place in the SOCAL Range Complex during this reporting period (**Table 2-1**).

Table 2-1: SOCAL Range Complex Major Training Events from 22 January 2009 to 1 August 2012

Exercise Type	Report Period				Reporting Period Total
	22 Jan 2009–1 Aug 2009	2 Aug 2009–1 Aug 2010	2 Aug 2010–1 Aug 2011	2 Aug 2011–1 Aug 2012	
COMPTUEX	1	2	4	1	8
JTFEX	1	0	2	1	4
IAC II	1	2	3	3	9
SUSTEX	2	1	1	2	6
Total	**5**	**5**	**10**	**7**	**27**

Notes: COMPTUEX = Composite Training Unit Exercise, JTFEX = Joint Task Force Exercise, IAC II Integrated Anti-submarine Warfare Course, SUSTEX = Sustainment Exercise

Marine Mammal Sightings During Major Training Events – There were 1,271 reported sightings of at least 13,243 marine mammals and sea turtles during MTEs in the SOCAL Range Complex from 22 January 2009 to 1 August 2012 (**Table 2-2**). Of these sightings, over 91 percent were observed between 10 and 5,000 yards of the Navy vessel. The Navy's unclassified annual exercise reports from 2009 through 2012 contain tables listing all marine mammals sighted during that reporting year and the range of the sighting.

Table 2-2: SOCAL Range Complex Sightings of Marine Mammals and Sea Turtles from U.S. Navy Ships and Aircraft During Major Training Events

Marine Species Type	22 Jan 2009–1 Aug 2009	2 Aug 2009–1 Aug 2010	2 Aug 2010–1 Aug 2011	2 Aug 2011–1 Aug 2012	Reporting Period Total
Animals sighted while mid-frequency active sonar was active					
Dolphin	456	255	1,949	872	3,532
Whale	131	152	123	19	425
Pinniped	16	40	61	10	127
Turtle	0	0	1	0	1
Unknown	6	10	14	4	34
Subtotal	*609*	*457*	*2,148*	*905*	*4,119*
Animals sighted while mid-frequency active sonar was not active, or from ships without sonar					
Dolphin	1,762	707	3,561	1,953	7,983
Whale	255	180	344	91	870
Pinniped	113	25	110	5	253
Turtle	0	0	0	0	0
Unknown	4	0	9	5	18
Subtotal	*2,134*	*912*	*4,024*	*2,054*	*9,124*
Total	**2,743**	**1,369**	**6,172**	**2,959**	**13,243**

SOCAL Range Complex Sonar Mitigation Events – There were 298 total mitigation events by Navy mid-frequency sonar due to sighting of marine mammals within prescribed mitigation zones during MTEs from 22 January 2009 to 1 August 2012. Mitigation consisted of sonar either being powered down or shut off. **Appendix A** contains a table of all individual events.

2.2 EVALUATION OF MITIGATION EFFECTIVENESS

During the 27 MTEs in the SOCAL Range Complex from 22 January 2009 to 1 August 2012 (**Table 2-1**), mitigation procedures were effectively applied in cases of observation of marine mammals and sea turtles within the applicable zone. The three categories of mitigation measures (Personnel Training, Lookout and Watchstander Responsibility, and Operating Procedures) outlined in the SOCAL Final Environmental Impact Statement (EIS)/Overseas EIS of December 2008 and approved by NMFS in subsequent Letters of Authorization (LOA) were effective in appropriately mitigating exposure of marine mammals and sea turtles to sonar. During the entire reporting period, there were 20 instances, out of 1,271 sightings, where a ship neglected to mitigate adequately for a marine mammal sighted within 1,000 yards (98.4 percent effectiveness). Fleet commanders, aircrews, and ship watch teams continue to improve individual awareness, mitigation execution, and reporting practices. This improvement can be attributed to pre-exercise planning practices, mandatory Marine Species Awareness Training, adherence to required mid-frequency active sonar (MFAS) mitigation zones, and application of lessons learned in marine animal sighting and reporting.

For deep diving animals, if exposure did occur, the Navy assesses that these animals would not be exposed at a Level A level for long periods, if at all, based on the moving nature of hull-mounted MFAS use, and even less so from less-frequent and lower-power aviation-deployed MFAS systems (dipping sonar, sonobuoys). During a 1-hour dive by a beaked whale or sperm whale, a MFAS ship moving at a nominal speed of 10 knots (kt) could transit up to 10 nm from its original location, well beyond ranges predicted to have Level A effect (<281 yards) and potentially beyond ranges that could result in biologically significant changes in behavior.

Table A-1 in **Appendix A** lists the 298 mitigation events where sonar was active and ships took action to reduce or eliminate inadvertent exposure of marine mammals and sea turtles to sonar. With or without mitigation, given the rapid relative motion of ships maneuvering at sea and the independent marine mammal movement, the time any given animal would be exposed to MFAS from surface ships is likely to be limited. Of the total mitigations listed in **Table A-1** in **Appendix A**, 25 percent (n=75) were conducted in excess of mandated mitigation zones where ships powered down or shut down sonar at ranges beyond what was required. The percentage of precautionary mitigations for ships in SOCAL MTEs has been trending upward, with rates of 15 percent, 26 percent, 30 percent, and 29 percent over the four annual reporting periods, respectively. Navy leadership looks to reverse this trend in over-mitigating (precautionary mitigation) over the remainder of the reporting period by continuing to make strides in training and mitigation measures familiarity in order to maximize realistic active sonar anti-submarine warfare training in the SOCAL Range Complex.

In support of the 27 MTEs during the reporting period, the Navy conducted over 19,996 hours of Marine Species Awareness Training for 15,641 Navy personnel prior to the beginning of these exercises. While at sea, the Navy spent over 186,302 hours of surface and aerial visual

observation toward the detection of marine mammals and sea turtles. Additionally, over 4,531 hours were spent documenting and reporting marine animal sightings and mitigation events.

There were two instances of Navy ship strike to large whales during this period, with subsequent confirmation from regional NMFS that the whales struck were likely fin whales based on photographs in one case and genetic analysis of a collected blubber sample in the second. Both events occurred in early to mid-2009. There has been no further Navy ship strike in Southern California since 2009 (3 years). The Navy continues to stress protection of marine mammal through ongoing Marine Species Awareness Training. There also continues to be positive reports of Navy ships proactively maneuvering to avoid or avoid crossing the path of marine mammals. For instance, there were 42 reported instances of Navy ships proactively maneuvering to avoid 72 whales during MTEs in the SOCAL Range Complex from January 2009 to August 2012. This statistic is based on reported data collected during MTEs. Additional maneuvering is also likely for individual ships during unit level training within the SOCAL Range Complex. In one MMO embark during July 2012, the Navy destroyer bridge crew was observed by the MMOs on numerous occasions in 1 day actively engaged with ship course changes to avoid whale spouts sighted ahead of the ship.

2.3 UTILITY OF MAJOR TRAINING EVENT DATA

Sighting Per Unit Of Effort – The Navy evaluated marine mammal sighting data across all MTEs from three range complexes (Atlantic Fleet Active Sonar Training, Hawaii Range Complex, and SOCAL Range Complex) to determine if meaningful conclusions could be derived that contribute to addressing the general ICMP monitoring goals (see Section 1.2, Integrated Comprehensive Monitoring Program). The approach used was to compute sightings per unit effort and determine if the results could potentially address any of these ICMP goals. Sighting data was analyzed from MTEs conducted from January 2009 to August 2012 from three range complexes, and only from ships with hull mounted sonars that reported marine mammal sightings (**Table 2-3**).

Table 2-3: Sighting Per Unit Effort from Navy Major Training Events at Three Range Complexes from 2009 to 2012

Sonar Active/Passive	Percent of Time Active/Passive During Major Training Event	# of Sightings	Percent of Sightings
January 2009–August 2012			
Active	9.1%	500	29.3%
Passive	90.9%	1,207	70.7%

Since the actual hours of active sonar use is classified and provided to NMFS in classified versions of annual Exercise Reports, the data in **Table 2-3** is presented in a format to ensure protection of the classified information and still provide meaningful results. The data show marine mammals are sighted less than 2 percent of the time during MTEs, less than 1 percent of the time while sonar was passive, and less than 5 percent of the time while sonar was active. These results are consistent with the number of mitigation actions as reported in **Table 2-2** and **Appendix A**, however, as presented in this analysis or other potential analyses that could be completed with this data set, the data does not adequately support any ICMP monitoring goal. Therefore, the Navy recommends that in future authorizations the MTE marine mammal sighting reporting requirement either be deleted or completely revised.

3 COMPLIANCE MONITORING SUMMARY

This chapter provides a summary of U.S. Pacific Fleet-funded SOCAL Range Complex compliance monitoring with focus on the scientific contributions and major results from each research element. From 2009 to 2012, the U.S. Pacific Fleet maintained compliance with the annual metrics outlined in the SOCAL Range Complex monitoring plan and as amended in each annual LOA renewal request from NMFS.

3.1 NAVY COMPLIANCE MONITORING OVERVIEW

As mentioned in Chapter 1, current SOCAL Range Complex Fleet-funded compliance monitoring consists of the below research elements which has been relatively consistent over the course of the monitoring period (January 2009–January 2014):

- Visual survey: 100–150 (mostly aerial)
- PAM: two bottom devices
- MMO: 50–100 of deployment
- Exercise reporting from MTEs (summarized in Chapter 2)
- Other Navy-funded research (summarized in Chapter 4)

Table 3-1 highlights SOCAL Range Complex monitoring completed between January 2009 and August 2012 as compared to what the Navy committed to for each year.

Table 3-1: Monitoring Plan Metrics Accomplished Annually

Monitoring Year				
Study Type	**Jan 2009–Aug 2009**	**Aug 2009–Aug 2010**	**Aug 2010–Aug 2011**	**Aug 2011–Aug 2012**
Visual survey	Completed: 184 hours effort (114 aerial, 70 vessel) Committed: 120 hours aerial, 60 hours vessel effort	Completed: 1,061 hours effort (85 aerial, 976 boat) Committed: 120 hours total visual effort	Completed: 1,001 hours effort (128 aerial, 873 boat) Committed: 100–150 total visual effort	Completed: 142 hours effort (142 aerial) Committed: 100–150 total visual effort
Passive Acoustic Monitoring	Completed: Deploy two bottom-mounted PAM devices Committed: Begin contracting for 2010; deploy zero	Completed: Continued two bottom-mounted PAM devices Committed: Two PAM deployed	Completed: Continued two bottom-mounted PAM devices Committed: Two PAM deployed	Completed: Continued two bottom-mounted PAM devices Committed: Two PAM deployed
Marine Mammal Observers	Completed: None* Committed: 36 hours effort	Completed: 144 hours effort Committed: 120 hours effort*	Completed: 83 hours effort Committed: 50–100 hours effort	Completed: 124 hours effort Committed: 50–100 hours effort

* Added to next year's committed amount
Note: PAM = Passive Acoustic Monitoring

To date, U.S. Pacific Fleet has invested approximately $3.9 million to accomplish these goals. **Table 3-2** shows annual funding specific to SOCAL Range Complex monitoring and specific to the area shown in **Figure 1-2.** The same monitoring commitments will continue until the re-structuring of the Navy's overall monitoring approach described in Chapter 6. Cost breakdown by monitoring technology is summarized in Chapter 6.

Level of effort through the rest of 2013 will be similar as the past reporting periods.

Table 3-2: Annual U.S. Pacific Fleet Funding for SOCAL Range Complex Monitoring by Fiscal Year (FY09–FY13)

Fiscal Year (FY) (1 Oct–30 Sep)	Funding Amount
FY09	$500,000
FY10	$1,311,000
FY11	$615,000
FY12	$720,000
FY13	$750,000
Total	**$3,896,000**

In terms of raw data collected from this effort, **Table 3-3** shows the annual and cumulative total of information obtained from 2008 through 2012. A grand total of 871 hours of visual survey covering 43,549 nm was accomplished between October 2008 and July 2012. From these surveys, there were 2,748 sightings of an estimated 203,562 marine mammals. Over 46,420 hours of passive acoustic data was also recorded and analyzed. The Navy asserts this data has a much higher spatial and temporal resolution than published NMFS data for Southern California.

3.2 CHRONOLOGICAL TIMELINE OF SOUTHERN CALIFORNIA MONITORING

A timeline as a graphic representation for understanding the progression of monitoring events within SOCAL is provided in **Figure 3-1**. **Table 3-4** supports the timeline in **Figure 3-1** with text about the monitoring events; there is a row in the table for every green box on the timeline.

Table 3-3: Total Effort from U.S. Pacific Fleet-funded Compliance Monitoring in the SOCAL Range Complex from October 2008 through August 2012

Performer	Survey dates or window	Platform	# Days	Total survey time (hours)	Total survey distance (nautical miles)	# Groups	# Individuals	# Species visually sighted	Digital photo IDs taken (#)	Digital video taken (hours)	Total passive acoustic recordings (hours)
Ma/Sm	17-21 Oct 2008	Airplane – Partenavia P-68-C	5	27	2,380	115	12,587	10	2,330	1.6	na
Ma/Sm	15-18 Nov 2008	Airplane – Partenavia P-68-C	4	23	2,140	185	5,732	8	na	na	na
Ma/Sm	5-11 Jun 2009	Airplane – Partenavia P-68-C	6	30	3,192	161	9,489	11	1,099	1.4	na
Ma/Sm	20-29 Jul 2009	Airplane – Partenavia P-68-C	9	34	3,507	240	22,719	10	2,301	0.8	na
Si/C	21-28 Jul 2009	Vessel – R/V *Sproul*	8	70	845	153	2,321	10	13	na	na
Si	17 May 2008–8 Jul 2009	PAM device – HARP "M"	53	na	na	na	na	na	na	na	1,265
Si	19 May 2008–12 Jul 2009	PAM device – HARP "N"	54	na	na	na	na	na	na	na	1,302
Subtotal 2008–2009			**32**	**184**	**12,064**	**854**	**52,848**		**5,743**	**4**	**2,567**
Sm	18-23 Nov 2009	Airplane – Partenavia P-68-C	6	28	2,604	93	12,826	10	2,203	1.5	na
Sm	13-18 May 2010	Airplane – Partenavia P-68-C	6	29	2,641	152	5,453	9	1,350	5.6	na
Sm	27-28 Jul 2010	Helicopter – Bell 206-L-III	2	5.3	242	16	1,971	4	500	1.8	na
Sm	29 Jul–3 Aug 2010	Airplane – Partenavia P-68-C	5	15.7	1,446	70	9,119	5	2,400	4.5	na
Si	11 Mar 2009–25 Mar 2010	PAM device – HARP "M"	320	na	na	na	na	na	na	na	7,591
Si	14 Mar 2009–26 Mar 2010	PAM device – HARP "N"	325	na	na	na	na	na	na	na	7,744
P	22-28 Jul 2010	MMO embark	7	144	400	105	680	7	899	na	na
Subtotal 2009–2010			**671**	**222**	**7,333**	**436**	**30,049**		**7,352**	**13**	**15,335**
Sm	23-28 Sep 2010	Airplane – Partenavia P-68-C	6	27.7	2,116	252	37,874	9	741	2.4	na
Sm	14-19 Feb 2011	Airplane – Partenavia P-68-C	4	17.2	1,724	83	11,131	8	473	1.3	na
Sm	29 Mar–3 Apr 2011	Airplane – Partenavia P-68-C	3	9.5	1,007	71	2,165	8	323	1.6	na

Performer	Survey dates or window	Platform	# Days	Total survey time (hours)	Total survey distance (nautical miles)	# Groups	# Individuals	# Species visually sighted	Digital photo IDs taken (#)	Digital video taken (hours)	Total passive acoustic recordings (hours)
Sm	12-20 Apr 2011	Airplane – Partenavia P-68-C	9	46	5,926	146	14,530	11	424	4	na
Sm	9-14 May 2011	Airplane – Partenavia P-68-C	6	27	2,647	81	3,309	11	976	5	na
Si	9 Apr 2010–10 May 2011	PAM device – HARP "M"	396	na	na	na	na	na	na	na	8,099
Si	9 Apr 2010–12 May 2011	PAM device – HARP "N"	398	na	na	na	na	na	na	na	7,779
P	4-7 Apr 2011	MMO embark	4	83	na	24	599	8	117	na	na
Subtotal 2010–2011			**826**	**210**	**13,420**	**657**	**69,608**		**3,054**	**14**	**15,878**
Sw	7 Sep–2 Oct 2011	Airplane – DeHavilland Twin Otter DHC-6	8	38.3	1,903	209	6,247	9	na	na	na
Sm	30 Jan–5 Feb 2012	Airplane – Partenavia P-68-C	7	34.5	3,225	227	25,520	11	1,868	1.4	na
Sm	13-15 Mar 2012	Airplane – Partenavia P-68-C	3	19.1	1,746	156	11,081	10	1,026	0.9	na
Sm	28 Mar–1 Apr 2012	Airplane – Partenavia P-68-C	5	26.9	2,445	123	5,720	10	921	1	na
Sm/B	16 Mar 2012	Airplane – Partenavia P-68-C	1	4.1	717	6	23	3	30	0.05	1.8
Sm/B	2-3 Apr 2012	Airplane – Partenavia P-68-C	2	7.4	696	17	1,565	7	207	0.7	2
Si	11 May 2011–17 Mar 2012	PAM device – HARP "M"	255	na	na	na	na	na	na	na	6,120
Si	11 May 2011–5 Mar 2012	PAM device – HARP "H"	264	na	na	na	na	na	na	na	6,336
P	23-27 Jul 2012	MMO embark	7	124	na	63	901	5	637	na	na
Subtotal 2011–2012			**552**	**254**	**10,732**	**801**	**51,057**		**4,689**	**4**	**12,460**
Grand Total Oct 2008 to Jul 2012			**2,081**	**871**	**43,549**	**2,748**	**203,562**		**20,838**	**36**	**46,240**

Notes: B = Bio-Waves, HARP = High-frequency Acoustic Recording Package, Ma = Marine Mammal Research Consultants, MMO = Marine Mammal Observer, na = not applicable, P = United States Pacific Fleet, PAM = Passive Acoustic Monitoring, Si = Scripps Institution of Oceanography, Sm = Smultea Environmental Services, Sw = NMFS' Southwest Fisheries Science Center

Table 3-4: Description of Monitoring Efforts and Key Events Related to Monitoring Row Numbers, Corresponding to Green Monitoring Boxes and Orange Event Boxes in Figure 3-1

Row #	Dates Data Field Collected	Location	Objectives	Methods Used	Species Detected/Observed	Notable Outcomes/Events/ Conclusions
E1	**August 2008 – Commence first monitoring year for TAP, Phase 1 Letter of Authorization**					
1	17/19 May 2008	HARP M in Santa Cruz Basin; HARP N in East Cortez Basin	Determine species present in SOCAL Range acoustically by deploying HARPs	HARP devices deployed for acoustic detection and classification of marine mammals	Since HARPs are deployed and left to be retrieved at a later date, no species detected at time of deployment	Early installation since planned for FY10
2	17–21 Oct 2008	Catalina Basin and San Diego Trough; San Nicolas Basin	Observe marine species in area during COMPTUEX exercise, perform focal follows, photo verify species, estimate group size/calf presence, collect behavioral variables using scan sampling, and conduct extended focal follow involving continuous and/or scan sampling and video recording	Aerial visual sampling using distance sampling methodology	115 marine mammal sightings reported including blue, fin, Bryde's whales, bottlenose, short and long beaked common and Risso's dolphins, CA sea lion, and harbor seal	27 hours of survey conducted over 2,380 nm of tracklines. Common dolphin was most frequently indentified cetacean species. Transition between warm and cold seasons.
3	15–18 Nov 2008	Around SCI; Catalina Basin and San Diego Trough; San Nicolas Basin; San Clemente Basin	Observe marine species in area after JTFEX, perform focal follows, photo verify species, estimate group size/calf presence, collect behavioral variables using scan sampling, and conduct extended focal follow involving continuous and/or scan sampling and video recording	Aerial visual sampling using distance sampling methodology	185 Marine Mammal sightings reported including fin, humpback, common, Pacific white-sided, Risso's dolphins, CA sea lion, harbor seal, and northern elephant seal	23-hour survey conducted over 2,140 nm of tracklines. Common dolphin was the most frequently identified cetacean transition between warm and cold seasons.
E2	**SOCAL Monitoring Plan finalized in December 2008 for implementation in January 2009**					
E3	**19–20 February 2009 – OPNAV N45 Marine Mammal Monitoring Workshop**					
4	5–11 Jun 2009	Around SCI; Catalina Basin and San Diego Trough; San Nicolas Basin	Observe marine species in area after JTFEX, perform focal follows, photo verify species, estimate group size/calf presence, collect behavioral variables using scan sampling, and conduct extended focal follow involving continuous and/or scan sampling and video recording	Aerial visual sampling using distance sampling methodology	161 marine mammal sightings included blue, fin and humpback whales, bottlenose, common, Northern right whale and Risso's dolphins, CA sea lion, and harbor seal	24 focal groups circled, along with systematic assessments of reactions by marine mammals to presence of an aircraft at various altitudes. Longest follow for 43 minutes of fin whale.

Row #	Dates Data Field Collected	Location	Objectives	Methods Used	Species Detected/Observed	Notable Outcomes/Events/ Conclusions
5	8/12 Jul 2009	HARP M in Santa Cruz Basin; HARP N in East Cortez Basin	Determine species present in SOCAL acoustically by retrieving HARPs	HARP devices retrieved for acoustic detection and classification of marine mammals	Detected species include blue whale, CA sea lion, beaked whales, fin, humpback, killer, and minke whale, Pacific white-sided dolphin, Risso's dolphin, and sperm whale	2,567 hours of PAM recorded along with periods of MFAS and commercial and Navy ship noise
6	20–28 Jul 2009	Catalina Basin and San Diego Trough; San Nicolas Basin	Observe marine species in area during non-sonar COMPTUEX exercise, perform focal follows, photo verify species, estimate group size/calf presence, collect behavioral variables using scan sampling, and conduct extended focal follow involving continuous and/or scan sampling and video recording	Aerial visual sampling using distance sampling methodology	240 marine mammal sightings. Species included blue, fin and minke whales, Cuvier's beaked whale, bottlenose, common, Pacific white-sided and Risso's dolphins, CA sea lion, and harbor seal. 37 focal groups circled. More blues in June, more fins in July. Risso's most commonly seen	34 hours of survey was conducted over 3,389 nm of tracklines during a SOCAL MTE with no ASW. Collaborative effort between SSIO vessel surveys, PAM studies by M3R and SIO, and tagging and photo-ID by Cascadia.
E4	**October 2009 – Adaptive Management Meeting, NMFS & Navy**					
7	26 Mar 2010	HARP M in Santa Cruz Basin; HARP N in East Cortez Basin	Determine species present in SOCAL acoustically by retrieving HARPs	HARP devices retrieved for acoustic detection and classification of marine mammals	Detected species include blue, fin, killer whale, CA sea lion, beaked whales, humpback, Pacific white-sided dolphin, Risso's dolphin, and sperm whale	15,335 hours of recordings. Anthropogenic sounds include MFAS, echosounders, ship noise, and explosions.
8	9 Apr 2010	HARP M in Santa Cruz Basin; HARP N in East Cortez Basin	Determine species present in SOCAL acoustically by deploying HARPs	HARP devices deployed for acoustic detection and classification of marine mammals	Since HARPs are deployed and left to be retrieved at a later date, no species detected at time of deployment	

Row #	Dates Data Field Collected	Location	Objectives	Methods Used	Species Detected/Observed	Notable Outcomes/Events/ Conclusions
9	13–18 May 2010	Catalina Basin and San Diego Trough; San Nicolas Basin	Survey key Navy areas, providing snapshot of MM numbers, presence, distribution and behavior before, during, and after MTEs. Collect behavior data. Conduct focal follows and video documentation. Locate and identify dead or stranded marine mammals	Aerial visual sampling using distance sampling methodology	Marine Mammal sightings reported including fin, humpback, minke whale, common, Pacific white-sided, Risso's dolphins, CA sea lion, harbor seal, and northern elephant seal	29 hours of survey performed during an MTE. Photographs and focal follows of Risso's moving very fast during MTE.
E5	**17-18 June 2010 – Marine Species Monitoring Contract Kickoff and Coordination Meeting, Navy & HDR/EOC**					
10	22–28 Jul 2010	San Diego Trough; San Clemente Basin	Collect data to assess effectiveness of the Navy LO team. Collect data on marine mammals observed during operations and obtain data to characterize the possible exposure of marine species to MFAS	Marine Mammal Observers on DDG	105 sightings of 680 individuals. Species included blue whale, minke whale, bottlenose dolphin, long-beaked common dolphin, short-beaked common, Risso's dolphins, and CA sea lions.	124 hours of on-effort survey. No MFAS was used during embark. Blue whales and common dolphin most common species seen.
11	27–28 Jul 2010	Catalina Basin and San Diego Trough; San Nicolas Basin	Survey key Navy areas, providing snapshot of MM numbers, presence, distribution and behavior before, during and after MTEs. Collect behavior data. Conduct focal follows and video documentation. Locate and identify dead or stranded marine mammals	Aerial visual sampling using distance sampling methodology	Marine Mammal sightings reported including fin, humpback, minke whale, common, Pacific white-sided, Risso's dolphins, CA sea lion, harbor seal, and northern elephant seal	5 hours of survey. First time using a helicopter specifically for focal follows and proved to be a stable, excellent platform from which to both observe and record video and pictures.
12	29 Jul–3 Aug 2010	Catalina Basin and San Diego Trough; San Nicolas Basin	Survey key Navy areas, providing snapshot of MM numbers, presence, distribution and behavior before, during and after MTEs. Collect behavior data. Conduct focal follows and video documentation. Locate and identify dead or stranded marine mammals	Aerial visual sampling using distance sampling methodology	Marine Mammal sightings reported including fin, humpback, minke whale, common, Pacific white-sided, Risso's dolphins, CA sea lion, harbor seal, and northern elephant seal	16 hours of survey during MTE. Totals from the 4 surveys are 6,933 nm surveyed, 331 sightings of 29,369 MM, 73 focal follows.

Row #	Dates Data Field Collected	Location	Objectives	Methods Used	Species Detected/Observed	Notable Outcomes/Events/ Conclusions
13	23–29 Sep 2010	SOAR Range and NAOPA	Survey key Navy areas, providing snapshot of MM numbers, presence, distribution and behavior before, during, and after MTEs. Collect behavior data. Conduct focal follows and video documentation. Locate and identify dead or stranded marine mammals	Aerial visual sampling using distance sampling methodology	252 sightings of 37,874 individuals. Species included Bryde's, minke and sei whales, long-beaked, bottlenose and Risso's dolphins, CA sea lion, and northern elephant sea.	28.6 hours of flight time. Coordinated with BRS study. Common dolphins most abundant. Took place during and after MTE.
E6	**19–20 October 2010 – Navy Marine Species Monitoring Review Meeting and Adaptive Management Meeting, NMFS & Navy**					
E7	**1–2 March 2011 – Scientific Advisory Group Meeting, HDR/EOC & Navy**					
14	14–19 Feb 2011	SOAR Range and NAOPA	Survey key Navy areas, providing snapshot of MM numbers, presence, distribution and behavior before, during, and after MTEs. Collect behavior data. Conduct focal follows and video documentation. Locate and identify dead or stranded marine mammals	Aerial visual sampling using distance sampling methodology	Marine mammal sightings included common, Risso's dolphin, CA sea lion, bottlenose, fin, gray, northern right whale dolphin, minke whale, and Dall's porpoise	Surveys took place before during and after MTE. 83 sightings of 11,131 individuals. 17.2 hours flown over 3,193 km. Calf and cow gray whales seen, along with Dall's first time
15	29 Mar–3 Apr 2011	SOAR Range and NAOPA	Provide advantage of surveying key Navy areas, providing snapshot of mm numbers, presence, distribution and behavior before, during, and after MTEs. Collect behavior data known to be indices of stress/disturbance. Conduct focal follows and video documentation. Locate and identify dead floating or stranded marine mammals	Aerial visual sampling using distance sampling methodology	Marine mammal sightings included common, Risso's dolphin, CA sea lion, bottlenose, gray, northern right whale dolphin, and minke whale	9.5 hours of flight time covering 1,865 km. Total of 71 groups of 2,165 individuals. No MTE taking place.
16	4–7 Apr 2011	South of SCI	Collect data to assess effectiveness of the Navy LO team. Collect data on marine mammals observed during operations and obtain data to characterize the possible exposure of marine species to MFAS	Marine Mammal Observers on DDG	25 sightings of 599 marine mammals. Species included CA sea lion, long-beaked common dolphin, Risso's dolphin, and minke whale	83 hours on effort. This took place during a ULT and no MFAS was used.

Row #	Dates Data Field Collected	Location	Objectives	Methods Used	Species Detected/Observed	Notable Outcomes/Events/ Conclusions
17	10 Apr 2011	HARP M in Santa Cruz Basin; HARP N in East Cortez Basin	Determine species present in SOCAL acoustically by retrieving HARPs	HARP devices retrieved for acoustic detection and classification of marine mammals	Detected species include blue, fin, Bryde's, gray, humpback and minke whales, CA sea lion, Risso's, Pacific white-sided, killer whales, and Cuvier's and Baird's beaked whales	15,878 hours of recorded data. HARP N appears to be frequented by calling baleen whales more than HARP M. Anthropogenic sounds include MFAS, echosounders, ship noise, and explosions.
18	12–19 Apr 2011	SOAR Range and NAOPA	Survey key Navy areas, providing snapshot of MM numbers, presence, distribution and behavior before, during, and after MTEs. Collect behavior data. Conduct focal follows and video documentation. Locate and identify dead or stranded marine mammals	Aerial visual sampling using distance sampling methodology	Marine mammal sightings included common, Risso's dolphin, CA sea lion, bottlenose, fin, gray, minke whale, humpback, and Dall's porpoise	46 hours flown, covering 10,976 km. No MTE. Gray whale and calf interaction.
19	11 May 2011	HARP M in Santa Cruz Basin; HARP H off Tanner Bank	Determine species present in SOCAL acoustically by deploying HARPs	HARP devices deployed for acoustic detection and classification of marine mammals	Since HARPs are deployed and left to be retrieved at a later date, no species detected at time of deployment	New HARP deployed site H. HARP N had hardware failure
20	9–14 May 2011	SOAR Range and NAOPA	Survey key Navy areas, providing snapshot of MM numbers, presence, distribution and behavior before, during, and after MTEs. Collect behavior data. Conduct focal follows and video documentation. Locate and identify dead or stranded marine mammals	Aerial visual sampling using distance sampling methodology	Marine mammal sightings included common, Risso's dolphin, CA sea lion, bottlenose, fin, blue, gray, northern right whale dolphin, minke whale, humpback, harbor seal, sperm whale, and Dall's porpoise	27 hours flown, covering 2,647 nm. No MTE. First time sperm whales seen in mixed groups with Risso's and northern right whale dolphins. Dead humpback along with whale shark also observed.
E8	**8–9 June 2011 – Marine Mammal Monitoring Workshop, public meeting**					
E9	**22–23 September 2011 – Navy Passive Acoustic Monitoring Working Group, Scripps Institute of Oceanography**					
E10	**20 October 2011 – Adaptive Management Meeting, NMFS & Navy**					

Row #	Dates Data Field Collected	Location	Objectives	Methods Used	Species Detected/Observed	Notable Outcomes/Events/ Conclusions
21	28 Mar–3 Apr 2012	Santa Catalina Basin; San Nicolas Basin	Survey key Navy areas, providing snapshot of MM numbers, presence, distribution and behavior before, during, and after MTEs. Collect behavior data. Conduct focal follows and video documentation. Locate and identify dead or stranded marine mammals	Aerial visual sampling using distance sampling methodology	140 sightings of 7,285 individuals representing 10 species. Species included blue, fin, gray, minke whales, and Risso's.	34.3 hours of survey conducted over 3,141 nm
22	5/17 Mar 2012	HARP M in Santa Cruz Basin; HARP H off Tanner Bank	Determine species present in SOCAL acoustically by retrieving HARPs	HARP devices retrieved for acoustic detection and classification of marine mammals	Detected species included blue, fin, Bryde's, gray, humpback whales, Risso's, Pacific white-sided dolphins, killer whales, sperm whale, and Cuvier's and Baird's beaked whales	12,456 hours of recorded data. Ship noise more common at site M than H. MFAS detected at both sites and explosions mainly recorded at H.
23	23–27 Jul 2012		Collect data to assess effectiveness of the Navy LO team. Collect data on marine mammals observed during training. Obtain data to characterize the possible exposure of marine species to MFAS	Marine Mammal Observers on DDG	63 sightings of 1,065 individuals. Species included blue whale, short-beaked common, Risso's and bottlenose dolphins, and CA sea lions.	124 hours of on-effort survey. No MFAS was used during embark. Blue whales and common dolphin most common species seen
E11	**10–11 September 2012 – Expert Workgroup Data Analysis Planning Meeting HDR/EOC & Navy**					
E12	**25 October 2012 – Adaptive Management Meeting, NMFS & Navy**					
24	15–16 Nov 2012	Silver Strand Training Complex, Training Area Kilo	As monitoring obligated under SSTC Incidental Harassment Authorization, have civilian marine mammal observers watch for marine mammals during UNDET exercises. Mitigation requirements met	Monitoring for marine mammals during an EOD UNDET exercise	4 sightings of 98 individuals. Two species seen were CA sea lion and long-beaked common dolphin.	First type of this kind of monitoring to take place on SSTC. Observations included sea lions coming into the area after UNDET, apparently looking for any dead fish.

Row #	Dates Data Field Collected	Location	Objectives	Methods Used	Species Detected/Observed	Notable Outcomes/Events/ Conclusions
25	25–30 Mar 2013	Santa Catalina Basin; San Nicolas Basin	Survey key Navy areas, providing snapshot of MM numbers, presence, distribution and behavior before, during, and after MTEs. Collect behavior data. Conduct focal follows and video documentation. Locate and identify dead or stranded marine mammals	Aerial visual sampling using distance sampling methodology	180 sightings of 14,173 individuals. Species included both common dolphins, CA sea lion, gray, fin, minke whale, humpback, Bryde's whales, Risso's, bottlenose, northern right whale dolphin, and northern elephant seal.	25.4 hours covering 2,658 nm. Most abundant sightings were common dolphin and sea lions. First time northern elephant seal seen on aerial surveys.
26	22–26 May 2013	Santa Catalina Basin; San Nicolas Basin	Survey key Navy areas, providing snapshot of MM numbers, presence, distribution and behavior before, during, and after MTEs. Collect behavior data. Conduct focal follows and video documentation. Locate and identify dead or stranded marine mammals	Aerial visual sampling using distance sampling methodology	Completed 26 May 2013. Data analysis ongoing and will be reported for 2013 annual report.	
27	29 May 2013	Silver Strand Training Complex, Training Area Kilo	As monitoring obligated under SSTC Incidental Harassment Authorization, have civilian marine mammal observers watch for marine mammals during UNDET exercises. Mitigation requirements met	Monitoring for marine mammals during an EOD UNDET exercise	Completed 29 May 2013. Data analysis and report preparation ongoing.	
28	Jun 2013	HARP N and H Data Retrieved	Determine species present in SOCAL acoustically by retrieving HARPs	HARP devices retrieved for acoustic detection and classification of marine mammals	Will be completed June 2013	
29	17–18 Jun 2013	Silver Strand Training Complex, Training Area Kilo	As monitoring obligated under SSTC Incidental Harassment Authorization, have civilian marine mammal observers watch for marine mammals during UNDET exercises. Mitigation requirements met	Monitoring for marine mammals during an EOD UNDET exercise	Will be completed June 2013	

Row #	Dates Data Field Collected	Location	Objectives	Methods Used	Species Detected/Observed	Notable Outcomes/Events/ Conclusions
30	18–23 Jul 2013	Santa Catalina Basin; San Nicolas Basin	Survey key Navy areas, providing snapshot of MM numbers, presence, distribution and behavior before, during, and after MTEs. Collect behavior data. Conduct focal follows and video documentation. Locate and identify dead or stranded marine mammals	Aerial visual sampling using distance sampling methodology	Will be completed July 2013	
31	Jul 2013	MMO Embark on DDG	Collect data to assess effectiveness of the Navy LO team. Collect data on marine mammals observed during operations and obtain data to characterize the possible exposure of marine species to MFAS	Marine Mammal Observers on DDG	To Be Determined	

Notes: ASW = Anti-submarine Warfare, BRS = Behavioral Response Study, COMPTUEX = Composite Training Unit Exercise, DDG = destroyer, EOD = Explosive Ordnance Disposal, FY = Fiscal Year, HARP = High-frequency Acoustic Recording Package, JTFEX = Joint Task Force Exercise, km = kilometers, M3R = Marine Mammal Monitoring on Navy Ranges, MFAS = Mid-frequency Active Sonar, MM = marine mammal, MTE = Major Training Event, NAOPA = Northern Air Operating Area, Navy = United States Department of the Navy, nm = nautical miles, NMFS = National Marine Fisheries Service, OPNAV N45 = Office of the Chief of Naval Operations Energy and Environmental Readiness Division, PAM = Passive Acoustic Monitoring, SCI = San Clemente Island, SOAR = SOCAL Anti-submarine Range, SOCAL = Southern California, SSTC = Silver Strand Training Complex, TAP = Tactical Training Theater Assessment and Planning, ULT = Unit Level Training, UNDET = Underwater Detonation

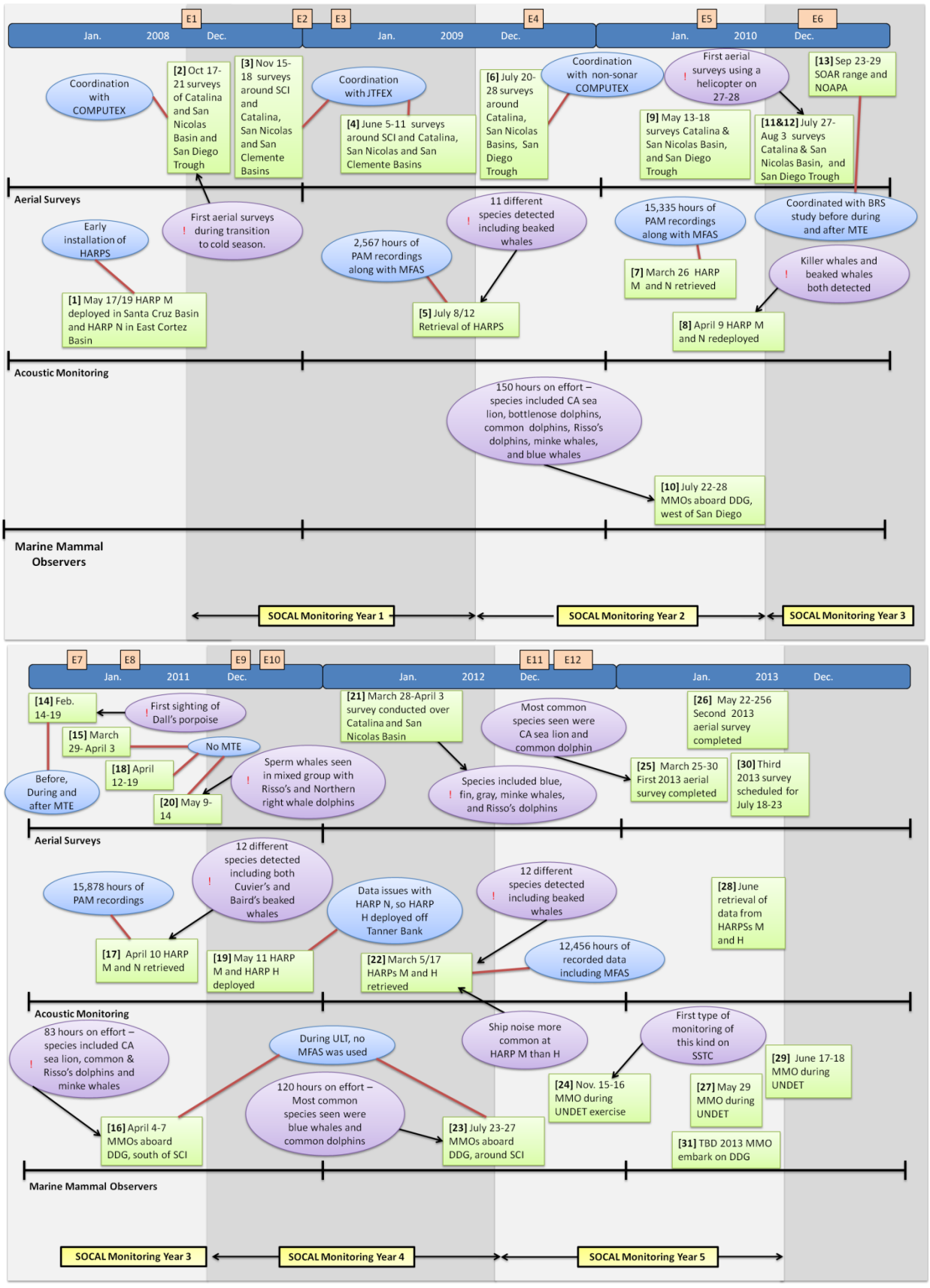


Figure 3-1: Visual Timeline

The following sections describe and summarize results by research element (Visual Survey [Aerial Monitoring], Passive Acoustic Monitoring, and Marine Mammal Observers).

3.3 VISUAL SURVEY (AERIAL MONITORING)

The Fleet-funded aerial survey effort from 2008 to 2012 represented one of the most comprehensive marine mammal abundance and behavior studies to date within the SOCAL Range Complex. The initial concept was to obtain both baseline marine mammal behavioral states and then attempt flights in close proximity to Navy training events to document if any changes to these behavioral states could be discerned.

A key lesson learned at the outset, however, was that due to the very high demand for Navy, Marine Corps, and Air Force aircraft training in the region with rigorously controlled airspace restrictions, getting flight approval for a civilian survey aircraft was difficult to schedule around military training events. Therefore, most survey flights were scheduled either when there was no military activity, or the given approval for parts of the SOCAL Range Complex distant (30–50 miles) from any training activity.

Even given flight clearance restrictions, important baseline accomplishments obtained from aerial surveys were still achievable under the SOCAL Monitoring Plan. A summary is provided below with more technical discussion and data in **Appendix B.**

In general, out of the aerial survey effort come several notables:

- High quality, up-to-date season specific population density estimates were derived for many target species (in particular, blue whale, fin whale, humpback whale, gray whale, Risso's dolphins, bottlenose dolphins, Pacific white-sided dolphins, short-beaked common dolphins, long-beaked common dolphins, and California sea lion).[2] **Figure 3-2** shows, for instance, all blue whale sighting locations from these surveys.
- First-observed behavior across multiple variables was recorded. Similarly, a large number of focal follows were performed, leading to a large database of detailed surface behavior over significant time periods for all target species.
- A systematic protocol for comprehensively documenting the abundance and behavior of marine mammals from the air was designed, refined, field tested, and documented.
- Post-survey analysis revealed a large number of highly intriguing, previously undocumented results. These include relationships between deep undersea topographic features and a wide variety of marine mammal surface behaviors. These environmental relationships lead to a number of descriptive hypotheses involving California current upwelling, predator avoidance, and sea-floor sound wave propagation, and the influence of these factors on marine mammal distribution and behavior.

[2] High priority species included federally listed threatened and endangered species (e.g., fin, blue, humpback, and sperm whales), gray whales, Risso's dolphins, bottlenose dolphins, common dolphins and as possible, beaked whales.

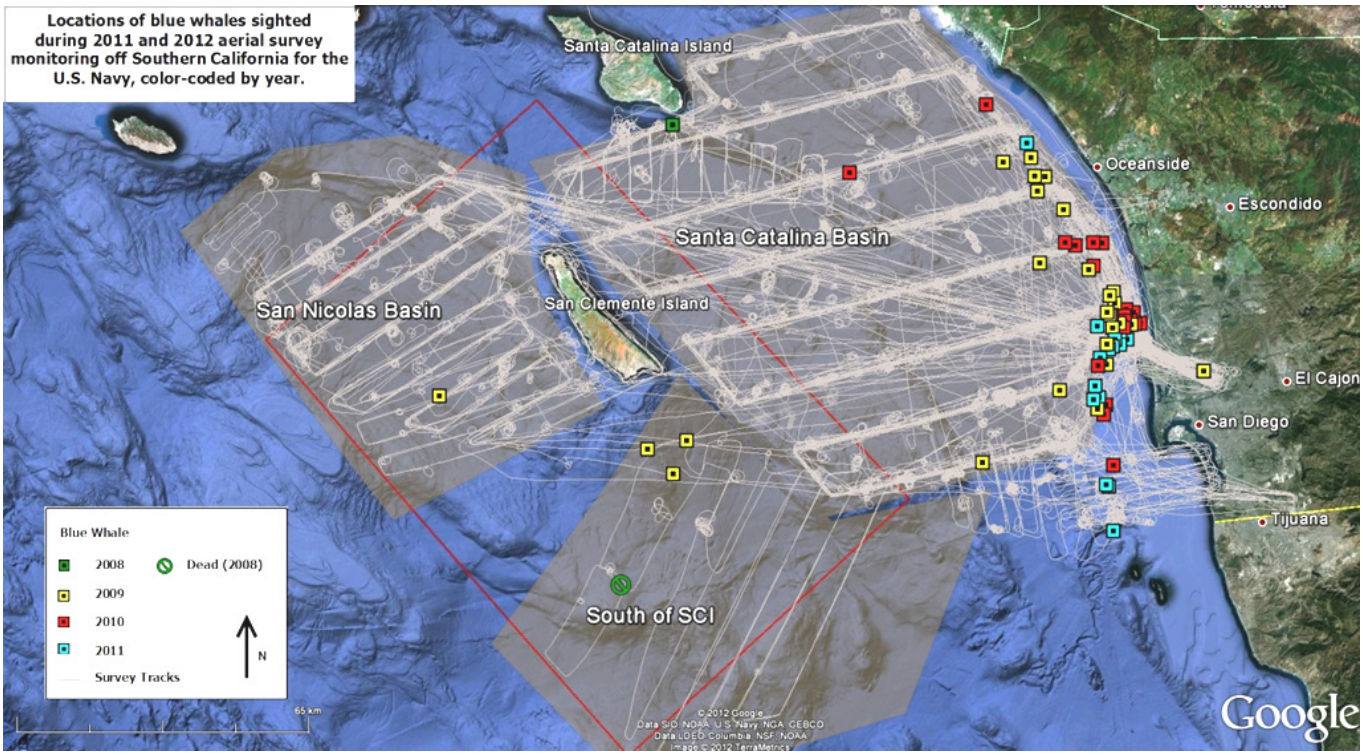


Figure 3-2: Blue Whale Sightings in the SOCAL Range Complex Study Area from 2008 to 2012

Notes: No sightings of blue whales in 2012, though all survey effort in 2012 and most in 2011 occurred during the cold-water period (November–April). Light-colored lines indicate all survey effort 2008–2012.

Overview – Between October 2008 and April 2012, 15 aerial surveys were conducted in subregions of the SOCAL Range Complex to monitor and obtain baseline data on the occurrence, distribution, density, abundance, and behavior of marine mammals and sea turtles on behalf of the Navy. The purpose of these surveys was to provide a comparative baseline with which to assess potential effects (or lack thereof) of MFAS, and other Navy training activities on these animals. The behavior of cetaceans in offshore Southern California Bight waters is poorly described. Previous systematic aerial surveys for multi-species density are over 12 years old (Carretta et al. 2000). No sea turtles were seen during this survey period; therefore, they are not further discussed.

Survey Methodology – Surveys were conducted primarily (n=14; 93 percent) from a high-winged, twin-engine Partenavia aircraft; the remaining survey (n=1; 7 percent) was conducted from an Aero Commander aircraft. Survey personnel consisted of two observers, one recorder/photographer/videographer, and one or two pilots. Surveys included five primary modes:

1. Systematic line-transect "search" effort along east-to-west oriented lines located east and west of San Clemente Island (**Figure 1-2**) (flown at 244–305 meters [m] altitude and 100 kt)
2. "Verify" involving breaking from line transect effort to circle and photograph sightings to verify species, numbers, and behavior with photographs

3. "Focal follow" involving circling (at 365 to 457 m altitude and 0.5 to 1.0 kilometer [km] radial distance) of high priority species to video and collect focal behavior (i.e., "focal follow") data for periods of 5 to 60 minutes (typically 15 to 20 minutes)
4. Circumnavigation of the shoreline and nearshore waters of San Clemente Island to search for possible stranded animals
5. Visual-acoustic behavior follows involving deployment of sonobuoys simultaneous with real-time acoustic and video monitoring of behavior

Species – High priority species included federally listed threatened and endangered species (e.g., fin, blue, humpback, and sperm whales), gray whales, Risso's dolphins, bottlenose dolphins, and, as possible, beaked whales. Data were collected using custom-developed software on an event recorder or notebook computer equipped with Wide Area Augmentation System-enabled global positioning system. Approximately 190,310 individuals in 2,151 groups representing at least 6 mysticete, 10 odontocete, and 3 pinniped species were seen. The most commonly seen species group was unidentified common dolphins (n=461 groups), followed by California sea lions (n=422), Risso's dolphins (n=286), fin whales (n=122), and bottlenose dolphins (n=103). Calf presence was associated with 5 percent of all the 331 mysticete sightings. Two percent (n=36) of all sightings consisted of mixed-species of marine mammals. Beginning in April 2011, systematic counts of ocean sunfish (*Mola mola*) and boats were recorded, resulting in 300 ocean sunfish sightings and 244 boats (15 percent of which were U.S. Navy ships).

Timeframe – At least one survey occurred in every calendar month except December, with effort in 2011 and 2012 limited to winter when few previous surveys were conducted. A total of 72,467 km of flight effort occurred over the 5-year period.

Overall, 99 percent of the total 65,238 km of flight time was associated with a Beaufort (Bf) sea state less than 4.

Data Analysis – Data analyses focused on four tasks:

1. Estimating density and abundance by applying standard line-transect analysis approaches
2. Identifying first-observed behavior of sightings including group size, behavior state, heading, and dispersal distance between nearest neighbors within a group
3. Determining relative occurrence, distribution and abundance using resource selection function (RSF) analyses
4. Analyzing focal follow behavioral data collected on Risso's dolphins, including video

DISTANCE, multiple and linear regression, sequential, and summary statistical analyses were used to describe and quantify the potential influence of selected explanatory variables on the aforementioned response variables. Results of these analyses are summarized separately below.

Density and Abundance – Totals of 15,406 km of observation effort and 863 marine mammal sightings during 2008–2012 were suitable for estimating density and abundance because they were seen during acceptable sighting conditions (i.e., on-effort sightings during systematic lines flown in Bf 4 or less) (**Figure 3-3**). These sightings represented at least 19 species of marine

mammals. Gray whales were not seen during the warm-water season (May–October) and blue whales were not seen during the cold season (November–April).

Several other species were observed for which sightings were too few to estimate numbers present and/or were seen only during off-effort periods: minke whale (n=6 on-effort groups), northern elephant seal (n=5), northern right whale dolphin (n=5), Dall's porpoise (n=3), Cuvier's beaked whale (n=2), killer whale (n=2), harbor seal (n=1), Bryde's whale (n=1), and sperm whale (n=1).

Density and abundance estimates obtained during the 2008–2012 aerial surveys provide the most up-to-date and one of the largest marine mammal databases collected within the SOCAL Range Complex. Results also provide winter density and abundance estimates, whereas relatively few other surveys have been conducted in this region during the winter period. Further density results are presented in **Appendix B**.

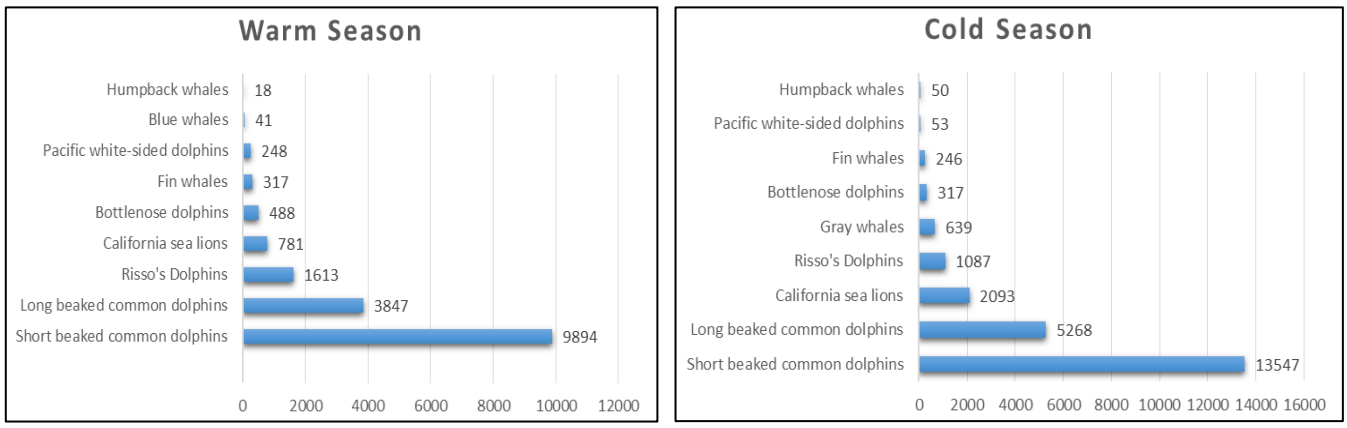


Figure 3-3: Count of Individuals Sighted by Species and Season During Aerial Surveys within the SOCAL Range Complex from 2008 to 2012

(Top panel: WARM season [May–Oct]; bottom panel: COLD season [November–April])

First-Observed Behavior – The purpose of first-observed behavior analyses was to describe and quantify typical baseline behavioral parameters of marine mammal species occurring in the study area relative to selected environmental and other explanatory variables, as very little is known about behavioral parameters for most of them. First-observed behavior analyses used the following response variables recorded at the initial sighting of each marine mammal group:

- Group size
- Travel direction (compass heading)
- Maximum dispersal (in body lengths)
- Behavior state

Seven species or species groups were deemed to have adequate sample sizes (n>20) and were analyzed statistically using this approach: Risso's dolphin, common dolphin (combining short-beaked, long-beaked and unidentified common dolphins), bottlenose dolphin, fin whale, blue

whale, gray whale, and California sea lion. Behavior and group characteristics differed across species as illustrated in the graphs in **Figure 3-4** and **Figure 3-5**.

Statistical analyses showed that group size and behavior state, and to a lesser extent maximum dispersal, were significantly related to a number of explanatory variables for most of the seven species examined. See **Appendix B** for a complete description of the function, variables, and resources analyzed. The most interesting results are summarized below.

Important Variables – The most significant explanatory variables associated with response variables were:

- Subregion (east versus [vs.] west of San Clemente Island)
- Time of year
- Time of day
- Slope aspect (compass direction the undersea slope faced)
- Presence of a calf

Heading was highly variable for most species and significant associations with this variable were rare.

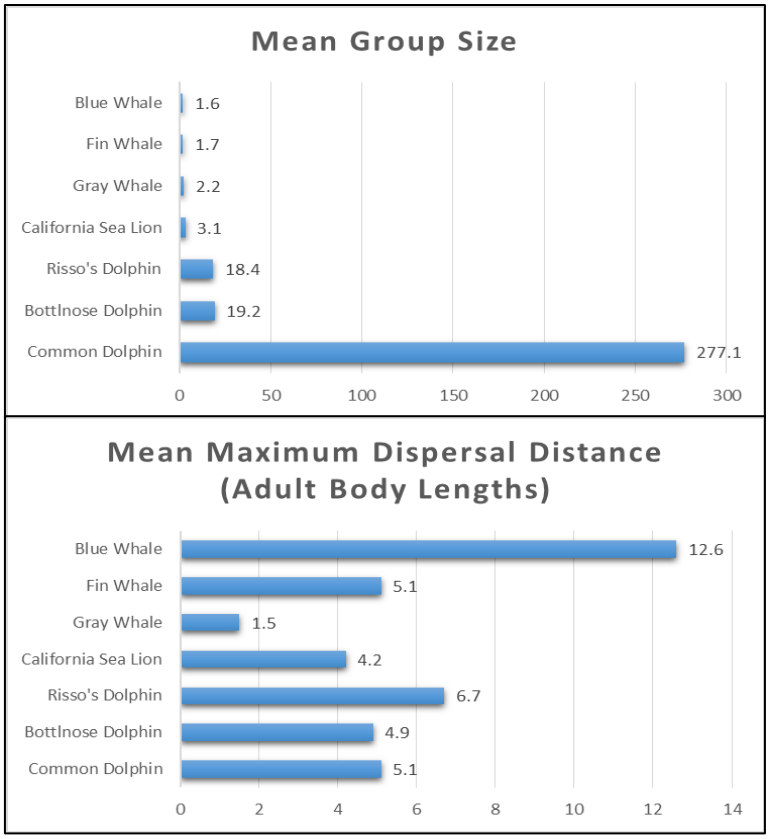


Figure 3-4: Mean Group Size and Mean Maximum Dispersal Distance of Marine Mammals Observed During SOCAL Range Complex Aerial Surveys from 2008 to 2012

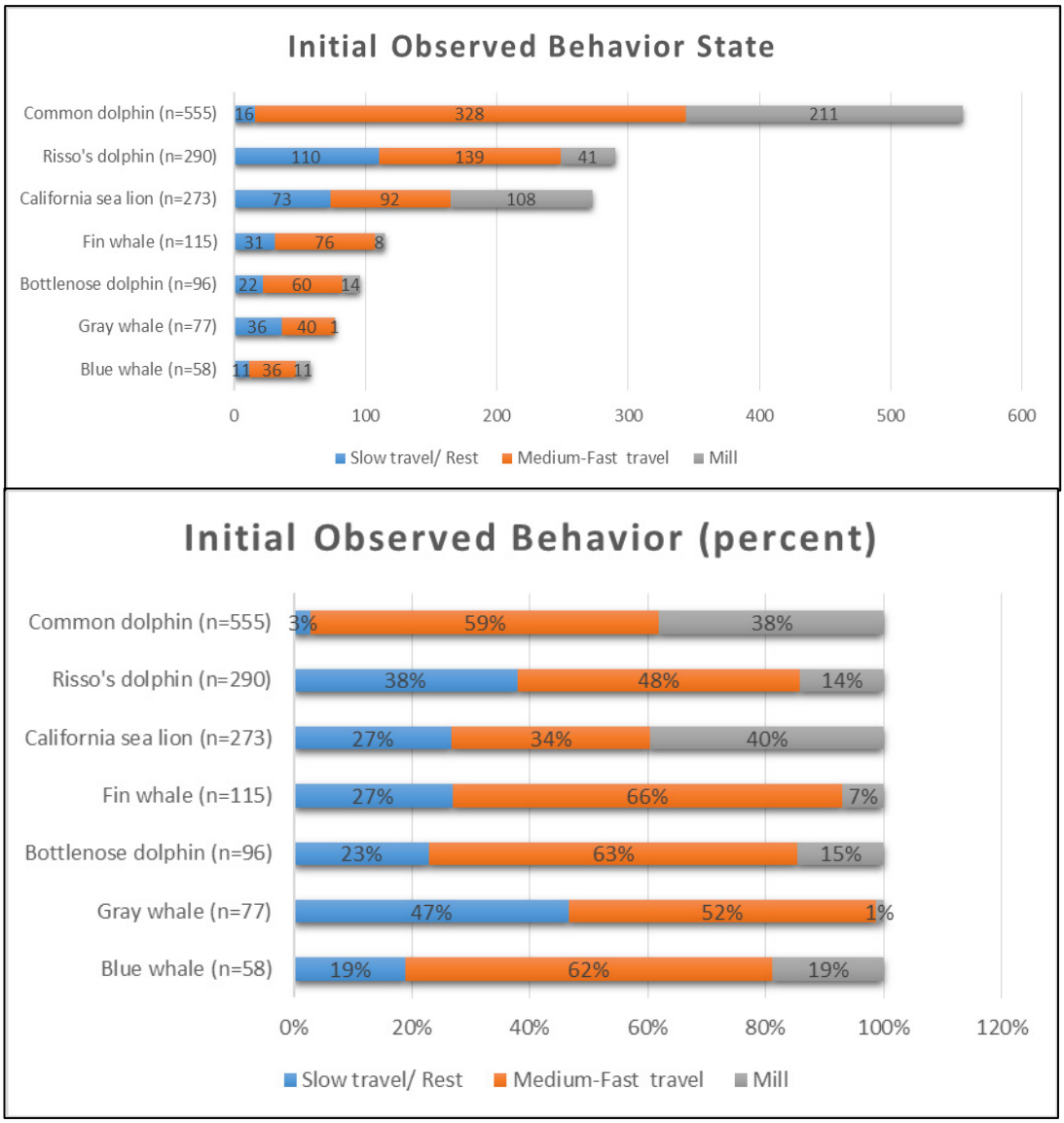


Figure 3-5: Initial Observed Behavioral State and Percentage from Marine Mammals Observed During SOCAL Range Complex Aerial Surveys from 2008 to 2012

Species Highlights – Statistical Relationships for Each Species:

- Risso's dolphin: behavior was significantly influenced by time of year, time of day, calf presence, the presence of other marine mammal species, and water depth.
- Common dolphin: behavior was significantly associated with calf presence, subregion, time of year, slope aspect, time of day, and water depth.
- Bottlenose dolphin: behavior was significantly associated with calf presence, time of year, time of day, water depth, and slope aspect.
- Blue whale: behavioral patterns were seasonal and concentrated primarily close to shore in the study area. Group size more than tripled in fall compared to spring when feeding aggregations of blue whales were relatively common.
- Fin whale: apparent courting/reproductive, foraging, and nursing behaviors occur in the study area. Differential use of habitat is most notably related to subregion, time of day,

and calf presence. Fin whale behavior was also highly dependent on the type of sea-floor thousands of feet beneath them, including a preference for deeper water and behavior differences over steep slopes.

- Gray whale: behavior was significantly influenced by subregion, season, and slope aspect. Notably, group size, and maximum dispersal distance were larger west vs. east of San Clemente Island. In addition, slope aspect was strongly associated with behavior state: slow travel was five times more frequent over south-facing vs. north-facing slopes.
- California sea lion: One of the strongest predictive models was the influence of subregion on maximum dispersal distance and also behavior state. Maximum dispersal distance was significantly larger between individuals west (3.3 body lengths [BL]) vs. east of San Clemente Island (1.6 BL). In addition, milling was 2.4 times more likely to occur west vs. east of San Clemente Island.

Habitat Function – The distribution, occurrence, and relative abundance of marine mammals was assessed by applying RSF analyses to identify areas commonly used by and presumably important to marine mammals. RSF modeled the relative probability of use at locations in the study area as a function of the site characteristics and behavior.

Species Patterns – Some significant associations between habitat use and behavior were revealed for all five species examined.

1. Bottlenose dolphin. Travel significantly decreased from east to west in the Santa Catalina Basin (i.e., east of San Clemente Island) (too few sightings occurred west of San Clemente Island for RSF). Highest probability of occurrence was along the mainland coast and near Santa Catalina Island with very low predicted occurrence in the center of the basin. Travel frequency also decreased significantly with deeper water depths and increasing distance from shore.
2. Risso's dolphin. Slow travel/rest was strongly associated with deep water over steep slopes, while medium/fast travel was more likely in the middle of basins. Both behaviors were significantly more likely to occur in the eastern portion of the study area and closer to shore.
3. California sea lion. Milling was significantly more likely in the far western edge of the study area, with decreasing probability to the east. Medium/fast travel was significantly more likely in the western half of the study area compared to slow travel/rest which was more dispersed and patchy across the study area. Highest habitat use occurred along steep slopes surrounding the center of the San Nicolas Basin and nearby islands.
4. Fin whale. The fin whale was the only species for which approximately 50 percent of the San Nicholas Basin (west of San Clemente Island) had high probability of use. However, localized high-use areas occurred throughout the study area. Slow travel/rest/mill was highest along steep slopes where medium/fast travel was least likely to occur. In contrast, medium/fast travel was most likely over relatively flat basins and underwater plateaus where slow travel/rest/mill was unlikely to occur. Fin whales also preferred deeper vs. shallower waters.
5. Gray whale. While the nearshore coastal waters provide an important migratory path for gray whales, habitat use extended throughout all but the far west margin of the study area. Importantly, gray whale mother/calves used offshore waters. Mill/slow travel/rest

were strongly associated with seafloor aspect: gray whales were unlikely to engage in this behavior over north-facing slopes.

Relevance – RSF revealed high-use areas and associated geographical features with behavior and biological function (e.g., foraging, courting, resting, etc.) (**Appendix B**).

Risso's Dolphin Focal Follows – Opportunistic focal behavioral observations (i.e., focal follows) (Altmann 1974, Mann 1999) were conducted on 17 marine mammal species. Data consisted of periods of at least 5 minutes when a selected focal group was circled by the aircraft. However, analyses were limited to selected focal behavioral data for Risso's dolphins given this species had the largest sample size, its tendency to remain for long periods near the water surface, and its identification as a priority species within the Navy's SOCAL Marine Species Monitoring Plan. High-definition video was taken of focal Risso's dolphin groups and behavioral data were recorded with an event recorder in a customized datasheet using custom software. Post-field analysis involved transcribing behavioral data from video onto a custom Excel spreadsheet. Analyses focused on a subset of three response variables consisting of: (1) Heading (in degrees magnetic), (2) Maximum dispersal distance, and (3) Behavior state.

There were 51 Risso's dolphin groups recorded during focal-follow sessions ranging in duration from 5 to 59 minutes (mean duration = 21.6, standard deviation = 12.9). The number of 30-second scan periods with relevant data (e.g., reorientation rate, maximum dispersal distance, or behavior state) for all focal follows combined totaled 1,446 useable data points for reorientation rate, 1,275 data points for maximum dispersal, and 1,359 data points for behavior state.

Results

- The behavior of Risso's dolphins was significantly related to calf presence and time of day. Notably, Risso's dolphins were 13 times more likely to slow travel/rest than common dolphins and 1.7 times more likely than bottlenose dolphins. This difference is likely related to the presumed predominant nocturnal foraging habits of Risso's dolphins.
- A significant tendency to slow travel-rest indicates that Risso's dolphins are a good candidate focal species to study relative to potential effects of Navy training activities. If Risso's dolphins were to react to such activity, a change in behavior state to medium-fast travel away from the disturbance would be expected. This behavior state transition has frequently been reported among other delphinids as a significant change in response to anthropogenic disturbance, including vessels and human swimmers (e.g., Orams 1997; Constantine 2001; Constantine et al. 2003, 2004). A more detailed examination of video and field data, including other response (e.g., dive and surface duration) and explanatory variables, may reveal other significant baseline patterns that may be sensitive indices of disturbance.

Aerial Conclusions

1. In summary, results indicate that a number of environmental and other variables influence behavior, group size, abundance, and habitat use patterns of marine mammal species in the SOCAL Range Complex. Not only were significant difference found between the subregions west and east of San Clemente Island, other highly unexpected baseline results emerged from these surveys that merit additional scientific research (**Appendix B**).

2. It is important to note that, in many cases, cetaceans are part of a socially complex group of animals, and while some species can occur individually, in SOCAL they are often part of either conspecies or mixed species assemblages. It is critically necessary that an evaluation of disturbance includes evaluation of group behaviors, social interactions, distances apart, potential changes or masking of vocalizations, and—as possible—assessments of changes in affiliations. Changes in overall group behavioral patterns and social disruption are likely to be important as responses to anthropogenic activities.

3. Eight publications based on U.S. Pacific Fleet-funded aerial monitoring have been either published (Bacon et al. 2012, Smultea et al. 2012) or are in preparation for submission to be published (Bacon et al. 2013 in prep, Jefferson et al. 2013 in prep, Smultea et al. 2013a in prep, 2013b in prep, 2013c in prep, 2013d in prep).

3.4 PASSIVE ACOUSTIC MONITORING

The Marine Physical Laboratory of Scripps Institution of Oceanography, University of California, San Diego designs, fabricates, calibrates, deploys, and analyzes data from bottom deployed high-frequency acoustic recording packages (HARPs). In general, a HARP records marine mammal vocalizations, echolocation clicks, and anthropogenic sounds between 10 hertz (Hz) and 100 kilohertz (kHz). The length of deployment has improved over the years with improvements to battery design and currently a typical deployment can last for up to 8 months on continuous duty cycle. A more detailed discussion of HARP technical specification is available at: http://cetus.ucsd.edu/technologies_AutonomousRecorders.html

As part of the U.S. Pacific Fleet-funded compliance monitoring, two HARPs were deployed starting in 2009. One HARP is just north of the SOCAL Range Complex at the edge of the Santa Cruz Basin at approximately 2,950 feet (ft.) (900 m). A second HARP is deployed south-southwest of San Clemente Island at approximately 4,265 ft. (1,300 m) (**Figure 3-6**).

Over 46,240 hours of passive acoustic data were collected and analyzed by Scripps from 2009 through 2012. Results were all summarized by Scripps and are part of the Navy's SOCAL Range Complex annual Monitoring Reports (Department of the Navy 2009a, 2010a, 2011a, 2012). Scripps advanced the science of passive acoustic data presentation with the generation of species-specific annual weekly detection plots and seasonal/diel occurrence plots. This facilitates understanding and visualizing of occurrence at two different time scales (**Figure 3-7** and **3-8**). Because of the evolution of the passive acoustic analysis through the course of this monitoring, Scripps' 2011 and 2012 technical reports have the most updated analysis. However, while the 2011 and 2012 reports were used for many of the figures in this Comprehensive Report, for the text discussion below, the general observations pertain to all reports since 2009.

Biological Observations

- There were consistent, frequent detections of typical Southern California species over the monitoring period. In particular: fin whale 20 Hz and 40 Hz calls (the most common baleen whale species detected) (**Figure 3-7**), blue whale "A" and "B" calls (social) and "D" calls (foraging), Risso's dolphin echolocation clicks, Cuvier's beaked whale echolocation clicks, unidentified dolphin echolocation clicks (likely dominated by common dolphin clicks).
- Bryde's whale – Bryde's whale vocalizations, a species not sighted frequently in Southern California by NMFS large-scale vessel surveys, were detected passively from approximately early fall through mid-winter. Documentation of these detections based on Navy-funded research and monitoring was published in Kerosky et al. 2012. (Similar Bryde's whale in Southern California discussion based on visual sighting data was published in Smultea et al. 2012).
- Cuvier's beaked whale – Cuvier's beaked whale are detected throughout the year at both sites with a higher number of occurrences at the on-range "N." There was no clear diel or seasonal pattern but there can be periods of lower detections from approximately July to October (**Figure 3-8**).
- More periodic, infrequent, or rare call types detected include Baird's beaked whale, California sea lion, gray whale, killer whale, minke whale, Pacific white-sided dolphin, unidentified likely Mesoplodon spp. beaked whale, and sperm whale.

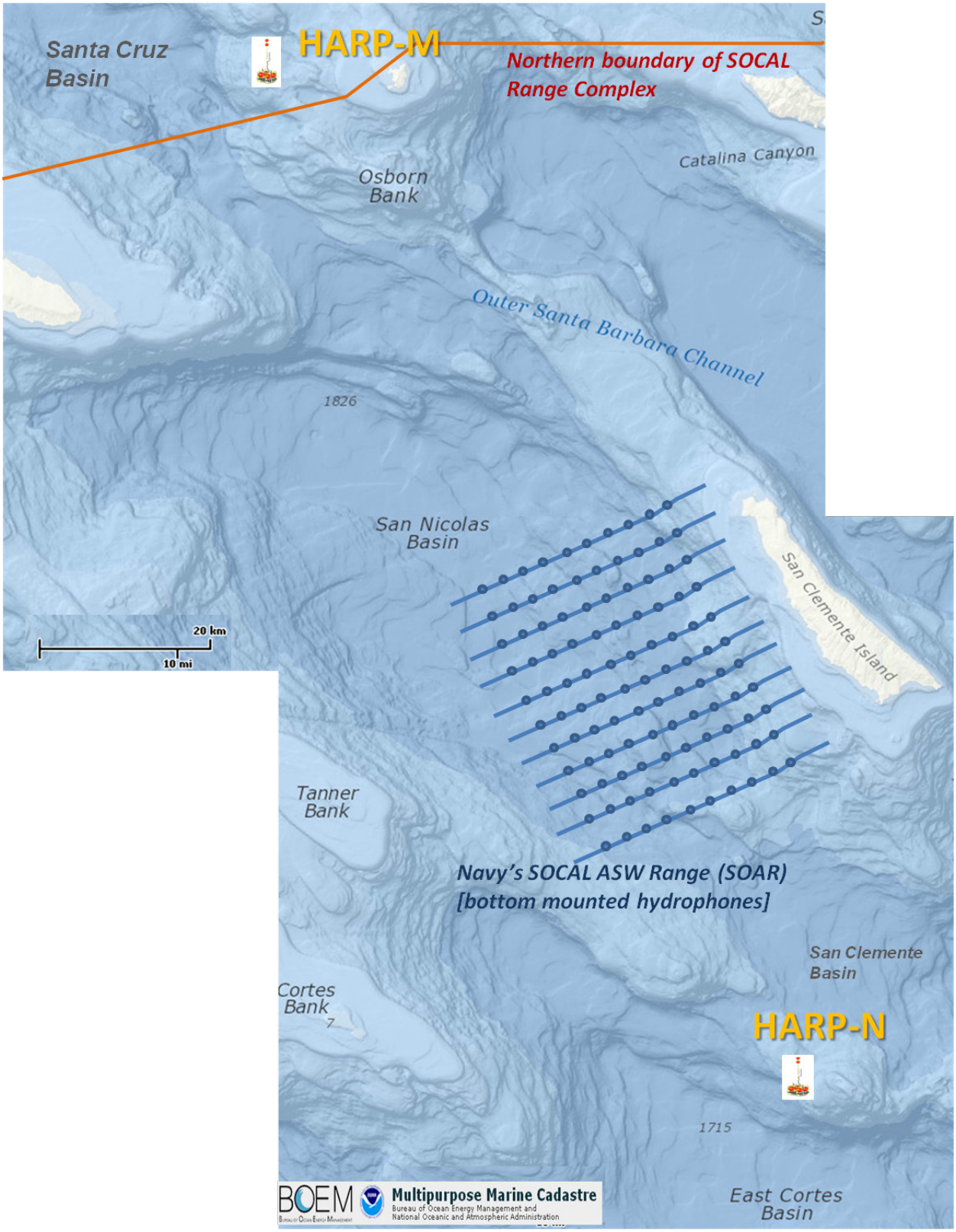
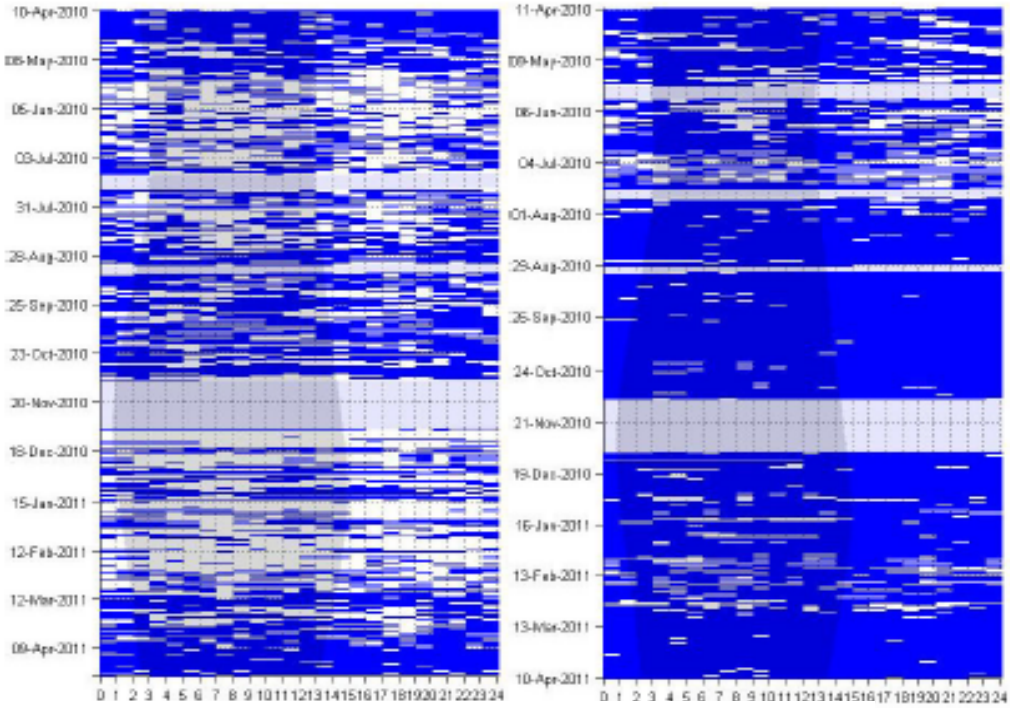


Figure 3-6: Location in Relation to SOCAL Range Complex for Two Fleet-Funded HARPs from 2009 to 2013

2010-2011 fin whale 20 Hz calls [Off range "M" left, on range "N" right]



2010-2011 blue whale "D" calls [Off range "M" left, on range "N" right]

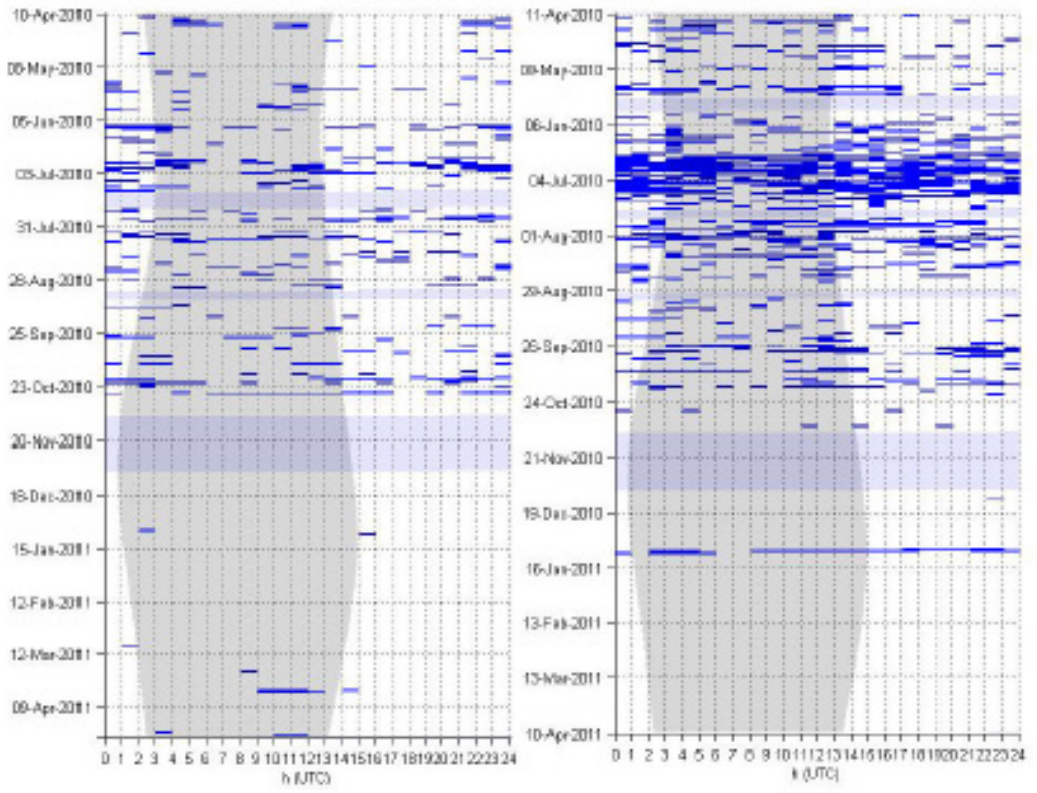


Figure 3-7: Fin Whale 20 Hz Calls (top) and Blue Whale "D" Calls at Two HARPs

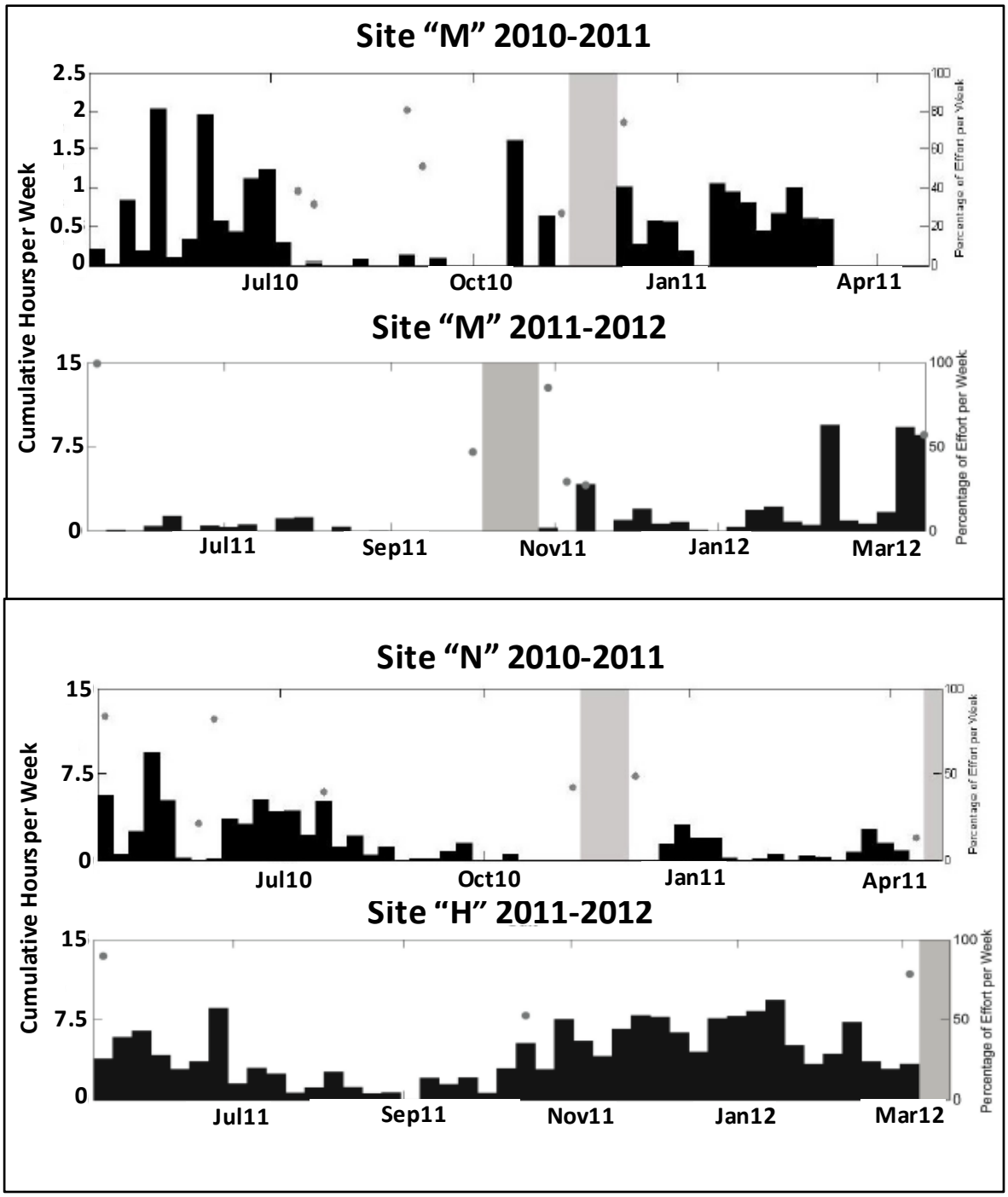


Figure 3-8: Weekly Cuvier's Beaked Whale Echolocation Click Presence

Note: For 2010 through 2012 while off range site ("M"– top two panels), and for two on range sites ("N" 2010–2011 and "H" 2011–2012)*

* In 2012, a hardware failure occurred while the on range HARP-N was deployed. Scripps used a research-funded HARP (on range HARP-H) just north of HARP-N for that year's analysis.

Ambient Noise Observations – Starting in Scripps' 2011 analysis, monthly average plots of ambient noise spectrum were generated for both the on range ("N") and off range HARPs ("M")

(**Figure 3-9**). Underwater noise at the HARPs has spectral shapes with higher low frequencies, primarily owing to the presence of ship noise with secondary contributions from local wind and waves (Hildebrand 2009, Department of the Navy 2011a, 2012).

Ambient noise at the off range HARP ("M") are typically 5 decibels (dB) higher than at the on range HARP ("N"), consistent with "M's" greater exposure to commercial ship traffic associated with the Ports of Los Angeles and Long Beach. Noise levels at both sites are 5–10 dB less in the fall relative to spring, probably related to diminished noise from wind and waves. A prominent peak is observed at 20–30 Hz and at 47 Hz related to the blue and fin whale vocalizations.

Anthropogenic Sound Observations – Ship noise was a common anthropogenic sound detected in all years with more frequent detections at the off range HARP ("M").

A major commercial shipping routes south of the Channel Islands and to/from the Ports of Los Angeles and Long Beach is to the north of "M."

- MFAS was detected at both HARPs during all years with more detailed analysis and plots available in the 2011 and 2012 analysis. In the 2012 analysis, the on range HARP-H had a total of 51,121 MFAS pings detected with a maximum of 177 dB referenced to (re) 1 micropascal (μPa) and a median of 128 dB re 1μPa.

- HARP-M (in southern Santa Cruz Basin) was originally placed in an area just north of the SOCAL Range Complex initially as a control HARP to sample in a less impacted basin separate from the range (**Figure 3-6**). PAM results since monitoring began in 2009 revealed some Navy mid-frequency sonar detections at "M" and it is suspected these might be propagation from Navy training events on or near the Southern California Anti-submarine Range (SOAR) to the south (**Figure 3-6**).

Summaries of sonar detection for HARP-M are provided in the Navy's 2012 annual monitoring report (Department of the Navy 2012). For the period 2011–2012 at "M," there were 3,777 detected MFAS pings. Maximum ping was 167 dB re 1μPa with a median value was 123 dB re 1μPa.

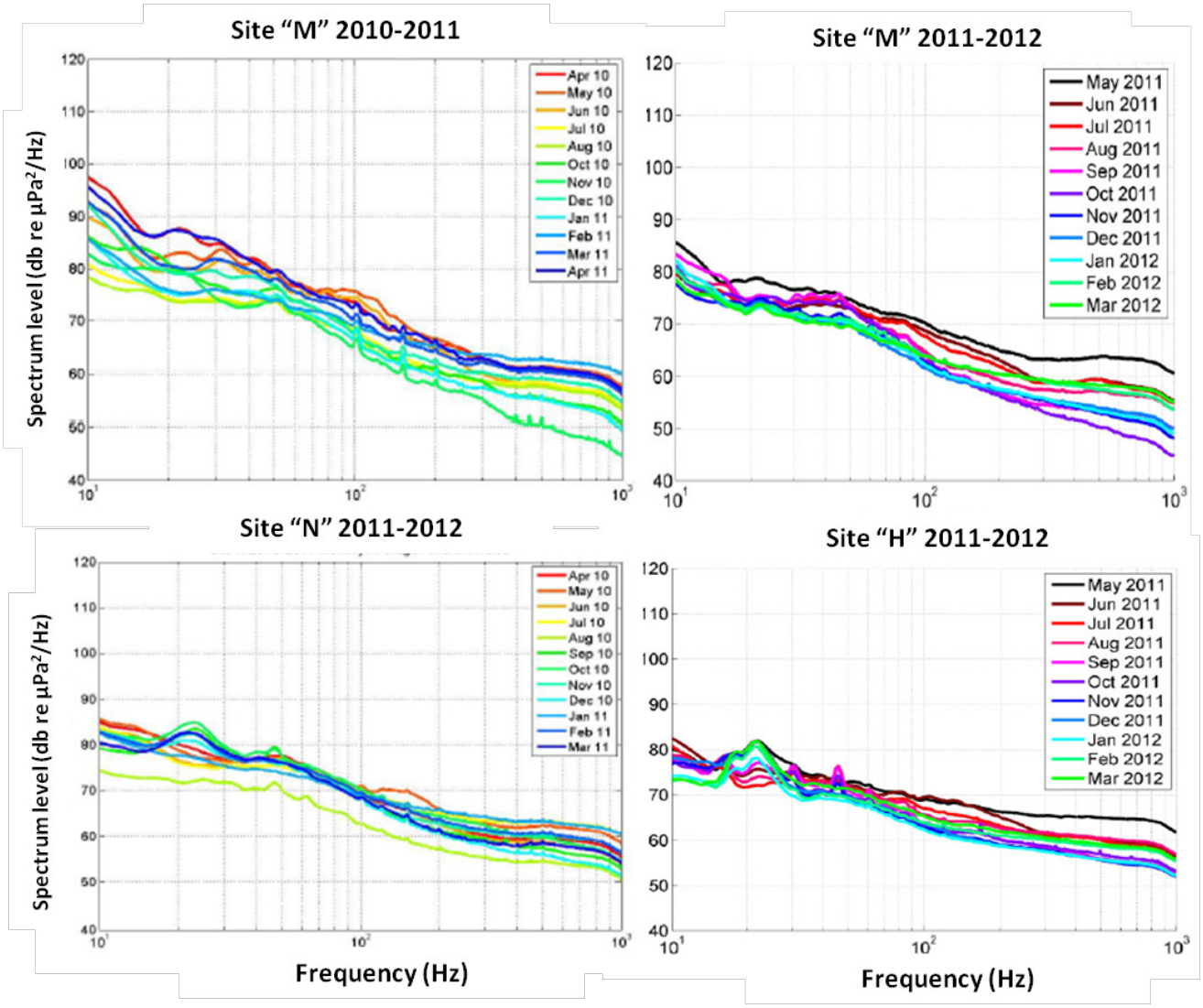


Figure 3-9: Monthly Averaged Ambient Noise at Three Sites in Southern California

Note: HARP-M off range, HARP-N on range, HARP-H on range*

* In 2012, a hardware failure occurred while the on range HARP-N was deployed. Scripps used a research-funded HARP (on range HARP-H) just north of HARP-N for that year's analysis.

Future Direction

A growing body of data on marine mammal vocalization and echolocation has been collected within the SOCAL Range Complex during the U.S. Pacific Fleet-funded PAM from 2009 to 2013. Each HARP generates about a terabyte of data per deployment. In addition, the HARPs have shown they can also detect anthropogenic sounds such as sonar, and summary statistics of detected signals can be generated (e.g., **Figure 3-10**). Under previously provided FY12 and continuing FY13 U.S. Pacific Fleet funding, the next area of investigation is to combine the various passive acoustic datasets obtained so far into a more focused assessment of potential Navy training impacts. In particular, vocalization and echolocation data will be analyzed to document, if possible, sonar effects or lack of effects on a species-specific basis for the most

commonly occurring species (e.g., Cuvier's beaked whale, fin whale, blue whale, Risso's dolphins, and perhaps common dolphins). Unfortunately, passive acoustic impact determinations cannot always account for individual animal behavioral state. Instead the passive detection of some signals, such as beaked whale echolocation clicks, can be a surrogate to direct observation if based on directed behavioral response studies (see Chapter 4) or other known data sets. In the case for beaked whales, for instant, this is predicated on the assumption echolocation is a direct measure of active beaked whale foraging and that changes in echolocation would indicate changes in foraging.

An enhanced passive acoustic study is underway by Scripps for the SOCAL Range Complex. This effort was begun near the end of FY12, and results are not available for this Comprehensive Report. A detailed presentation of future analysis will be provided in the Navy's 2013 SOCAL Range Complex annual Monitoring Report, due 1 October 2013.

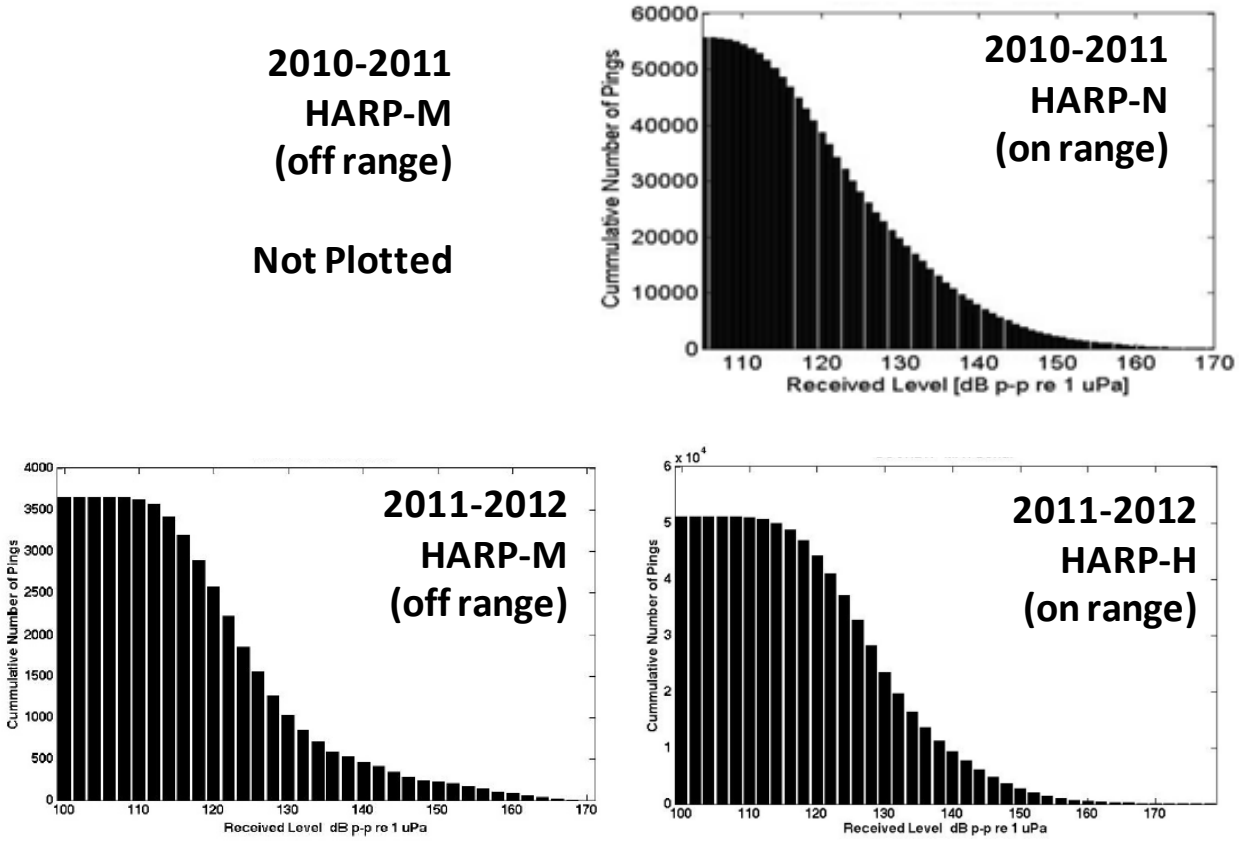


Figure 3-10: Cumulative Distribution of the Number of Mid-Frequency Active Sonar Pings Detected at Three HARP Sites

Notes: On range HARP-N (2010–2011 [top right]) , on range HARP-H (2011–2012 [bottom right]),* and off range HARP-M (2011–2012 [bottom left]). No 2010–2011 plot is currently generated for the off-range "M."

* In 2012, a hardware failure occurred while the on range HARP-N was deployed. Scripps used a research-funded HARP (on range HARP-H) just north of HARP-N for that year's analysis.

3.5 MARINE MAMMAL OBSERVERS

Marine Mammal Observers were embarked on Navy sonar equipped surface ships to evaluate watchstander effectiveness, and document compliance with proscribed mitigation for sonar and explosive use (e.g., gunnery exercises).

While initially focused on all Navy surface ship platforms, it quickly became apparent that sticking to a single ship type would be more conducive to across range complex comparisons (e.g., same line of sight from the bridge). Therefore, attempts to always embark MMOs on Arleigh Burke class destroyers (DDGs) were made.

Due to high likelihood of marine mammal sightings, the SOCAL Range Complex was recognized as a key location in which to conduct MMO embarks. However, a number of logistic limitations have made scheduling effective MMO embarks from San Diego a challenge. Naval Base San Diego is a critical surface ship Fleet concentration area in the Pacific. While this provides a greater number of potential ship platforms, it also means a much higher maintenance, training and deployment tempo. Furthermore, ship participation in MTEs within the SOCAL Range Complex often leads to strains on available spare berthing with the addition of exercise evaluators, trainers, and equipment support personnel who get underway during these events.

Therefore, for the SOCAL Range Complex MMO embarks, Fleet focused on finding available ships with sufficient berthing that would be conducting offshore unit level training for periods lasting up to 7 days. This in itself was often complicated by ships often moving from unit level training to integrate with a larger strike group for MTEs with no in-between stops back in San Diego. This would lead to longer at sea periods that could be supported by the civilian MMO availability. In addition, long term maintenance upkeep and out-of-area surface ship deployments often further limited available platforms.

Finally, the pool of available MMOs, consisting of Navy civilian biologists, is spread out from Navy commands on the east coast to Hawaii. There is an inherent scheduling difficulty in coordinating availability for a team of four MMOs, each with unique and diverse travel arrangements.

Limitations notwithstanding, three successful DDG MMO embarks were conducted in 2010, 2011, and 2012:

2010: 22-28 July	105 sightings of 680 marine mammals (common dolphin dominated)
2011: 4-7 April	24 sightings of 599 marine mammals (common dolphin dominated)
2012: 23-27 July	63 sightings of 1,065 marine mammals (blue whale, common dolphin, Risso's dolphin)

Further details on these embarks are reported in the Navy's annual Monitoring Reports for the SOCAL Range Complex (Department of the Navy 2010a, 2011a, 2012). **Figure 3-11** shows representative plots of marine mammal sightings during these MMO embarks.

Recommendations for future data-collection efforts are to focus on a single vessel type and an area where the number of trials-per-cruise is likely to be maximized. Resources would be devoted to extending the intermittent-availability models so that they use both the locations of observed animals and the outcomes of the MMO trials, thereby unifying the models developed to date for instantaneous and intermittent availability.

Major accomplishments related to this project to date include initial development of data-collection protocols and analytic methods, data-collection trials, completion of a proof-of-concept for detection functions, consultation with NMFS technical staff for input on analysis methods, investment in continued refinement of the analytic methods, and focus on additional data collection for the future.

Navy Fleet training organizations are currently evaluating the preliminary results from the proof-of-concept phase to determine if improvements in lookout training programs are warranted. Initial steps in progress include evaluating incorporation of marine mammal survey techniques into watchstander training and revision of Marine Species Awareness Training. As more data become available, other options for improving lookout training will be evaluated as appropriate.

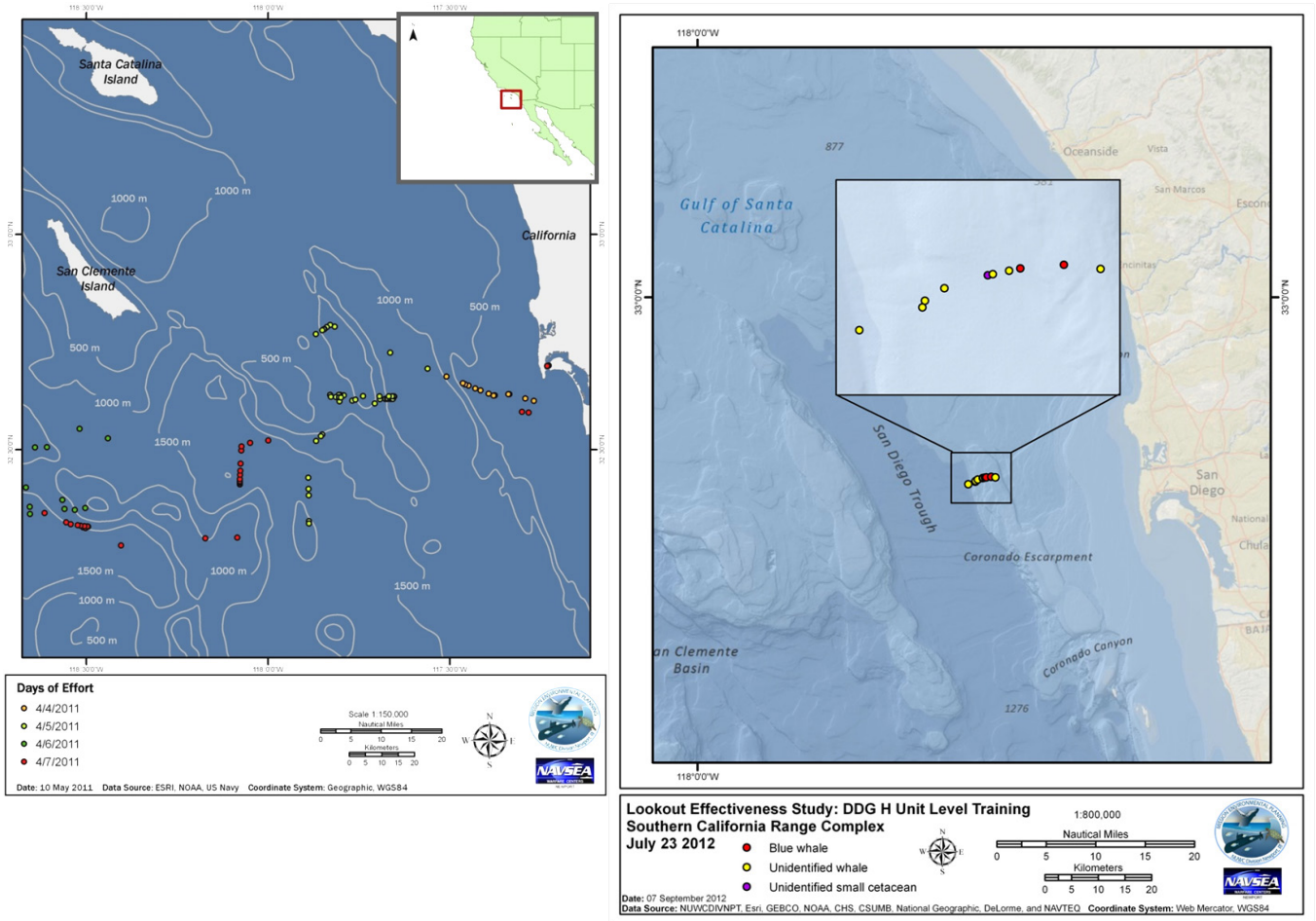


Figure 3-11: Marine Mammal Sighting Locations During MMO Embarks 2011 and 2012

(*Right*): All sightings locations, 4-7 April 2011; (*Left*): species sighting locations, 23 July 2012

4 NAVY BASIC AND APPLIED RESEARCH SUMMARY

Marine mammal research projects at various locations around the United States are funded by the Office of Naval Research (ONR) under its Marine Mammals & Biological Oceanography Program (basic research) and OPNAV N45 under its Marine Species Research Program (applied research).[3] A number of these projects utilized the SOCAL Range Complex due to the high density of marine mammals in Southern California, and availability of academic, government, and contractor scientists.

Four major multi-year OPNAV N45 research-funded projects have been ongoing within and adjacent to the SOCAL Range Complex during the period of this report (2009–2012).

One project concluded in 2012 (Section 4.1), two will conclude at the end of 2014 (Sections 4.2 and 4.3), and one will conclude at the end of 2015 (Section 4.4).

Results from these projects have been summarized in the Navy's annual monitoring reports, when information was available from the various individual researchers (Department of the Navy 2009a, 2010a, 2011a, 2012).

For the period from 2009 through 2012, the Navy's research-funded projects accomplished:

- 3,567 visual survey hours completed
- 32,054 nm of survey effort completed
- 2,903 sightings made for an estimated 134,719 marine mammals
- 241 tissue biopsies taken
- 70 satellite tracking tags attached
- 6,226 hours of passive acoustic data collected from sonobuoys and towed arrays

Specific research projects are discussed in Sections 4.1 through 4.4 below.

4.1 MARINE MAMMAL SURVEYS CONDUCTED DURING REGULARLY SCHEDULED CALIFORNIA COOPERATIVE OCEANIC FISHERIES INVESTIGATIONS FIELD CRUISES WITHIN SOUTHERN CALIFORNIA

The California Cooperative Oceanic Fisheries Investigations (CalCOFI) cruises, a joint agency field effort, have been ongoing within Southern California for over 61 years. More information on the overall history of the CalCOFI program is available at: http://www.calcofi.net/.

Beginning in 2004, the Navy funded the collection of marine mammal visual and passive acoustic data during regularly scheduled CALCOFI cruises, which occur four times per year. The CalCOFI marine mammal efforts represent some of the few cool water period (i.e., winter, spring) vessel surveys within the region with the exception of the U.S. Pacific Fleet's ongoing aerial surveys which have also sampled during cool water periods (Chapter 3). Each CalCOFI cruise consists of sampling the same survey track lines including coverage offshore (>100 nm).

[3] In 2012, the OPNAV N45 program underwent a formal revision to become the Living Marine Resources Program with administration of the program passing from OPNAV N45 to Naval Facilities Engineering and Expeditionary Warfare Center in Port Hueneme, CA.

Spatial and temporal distribution patterns, density, and abundance of cetaceans in the Southern California were assessed through visual and acoustic methodologies.

Visual monitoring incorporated standard line-transect protocol during all daylight transits while PAM employed a towed hydrophone array during transits and sonobuoys at oceanographic sampling stations. The Navy research-funded CalCOFI project began in 2004 and concluded in 2012. During this period, over 28,078 nm of ocean have been surveyed.

Annual CalCOFI marine mammal sighting summaries have been graciously provided by the Marine Physical Laboratory of Scripps Institution of Oceanography, and these summaries have been included as supplemental parts of the Navy's previous SOCAL Range Complex annual Monitoring Reports (Department of the Navy 2009a, 2010a, 2011a, 2012).

Scripps begun synthesizing and analyzing the collected data in late 2012 to derive marine mammal densities and document if annual or seasonal variation was evident by species (**Figure 4-1** and **4-2**). The goal of this effort is eventual future publication in 2013.

Initial Composite Summary – New density and abundance estimates of 11 cetacean species frequently encountered in the study area were developed based on 16 surveys conducted from 2004-2008; more extensive density estimates were calculated for common dolphins using data from surveys from 2004 to 2012.

Current analyses include comprehensive density and abundance estimates for 12 species across 32 surveys from 2004 to 2012, as well as investigating the association between cetacean distribution and biological and physical oceanographic variables measured during CalCOFI surveys (**Figures 4-1** and **4-2**).

Seasonal variations in encounter rates and distributions were evident for some species:

- Grey whales and Dall's porpoise were sighted primarily in winter, whereas blue and humpback whales were primarily observed during spring and summer.
- Pacific white-sided dolphins were observed in all seasons except summer 2011.
- Sperm whales were only sighted during fall and winter cruises.
- There was no apparent seasonal pattern to sightings of bottlenose, common and Risso's dolphins.

Spatial variations in visual detections as a function of species were also evident:

- Bottlenose, Risso's, and long-beaked common dolphin, as well as humpback and gray whale detections were concentrated in coastal and shelf waters, whereas sperm whale detections occurred exclusively in pelagic waters.
- Short-beaked common dolphin, Pacific white-sided dolphin, Dall's porpoise, fin, and blue whales had a broader distribution with encounters occurring in coastal, shelf, and pelagic waters.

Each species showed distinct spatial and temporal distribution patterns across the study area indicative of species-specific habitat preferences within the California Current ecosystem.

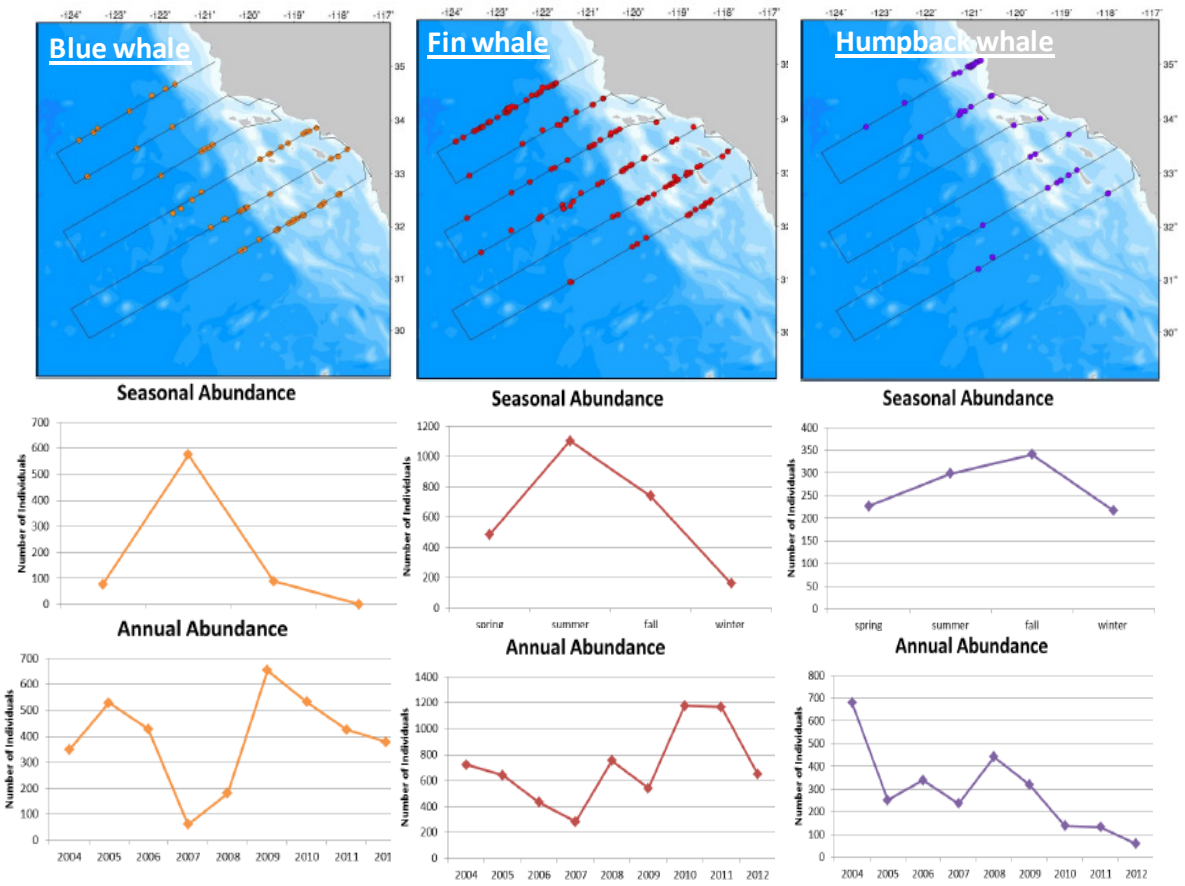


Figure 4-1: Sighting Location, Seasonal Abundance, and Annual Abundance for Three Baleen Whale Species Based on 2004–2012 CalCOFI Sightings

(Graphics courtesy of Greg Campbell, Scripps Institution of Oceanography)

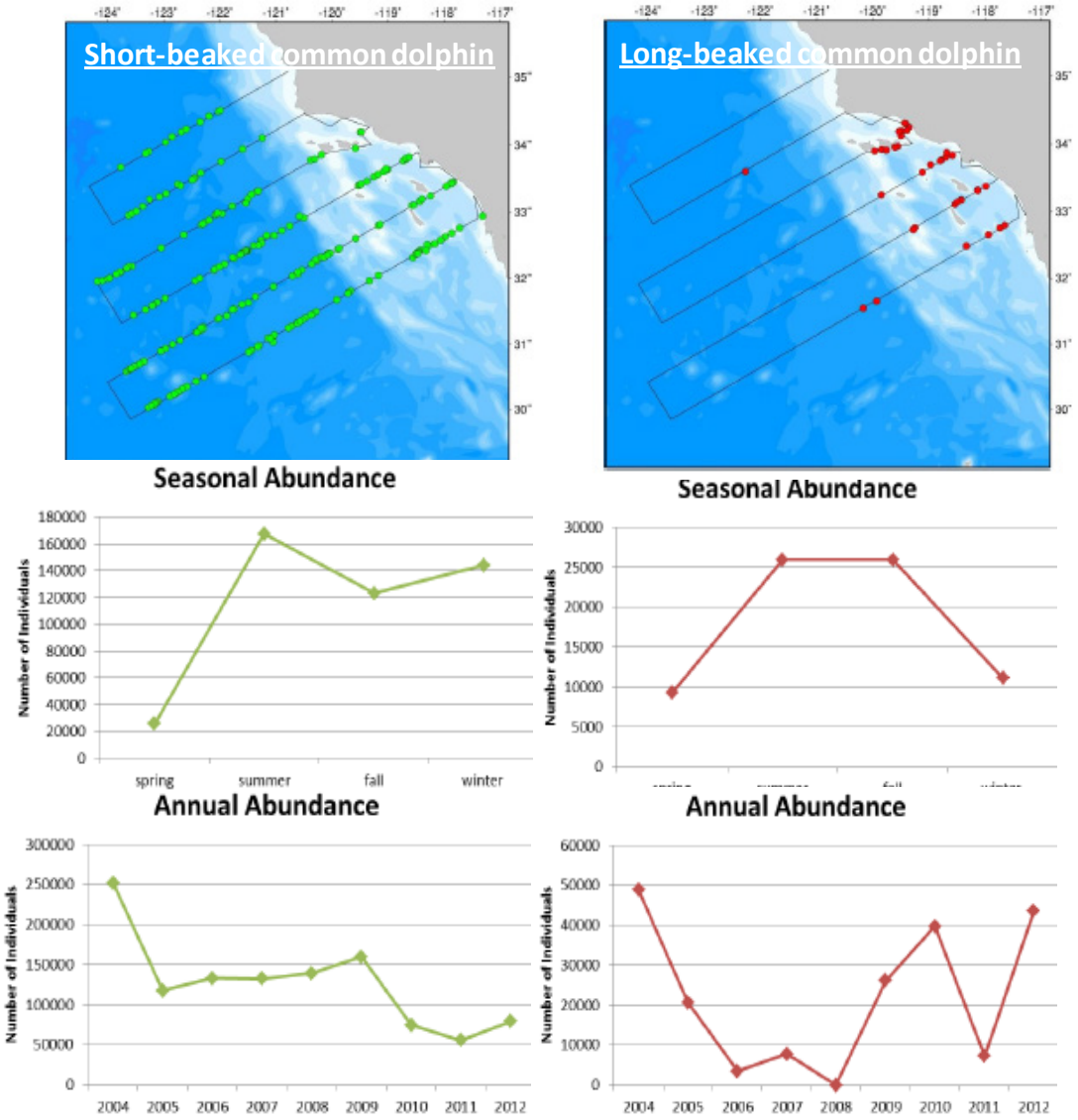


Figure 4-2: Sighting Location, Seasonal Abundance, and Annual Abundance for Common Dolphins Based on 2004–2012 CalCOFI Sightings

(Graphics courtesy of Greg Campbell, Scripps Institution of Oceanography)

4.2 DISTRIBUTION AND DEMOGRAPHICS OF MARINE MAMMALS IN SOUTHERN CALIFORNIA THROUGH PHOTO-IDENTIFICATION, GENETICS, AND SATELLITE TELEMETRY

Results from the years one and two of a 3-year project (under Navy research funding) investigating the distribution, demographics, and behavior of cetaceans in the SOCAL Range Complex are summarized in Falcone and Schorr 2011 and in Falcone and Schorr 2012 as reported in Department of the Navy 2012.

- Forty-one small vessel surveys for cetaceans, which included species verification tests in conjunction with Marine Mammal Monitoring on Navy Ranges (M3R) acoustic monitoring at SOAR, as well as photo-identification, satellite tagging, and biopsy sampling of species of interest were conducted (see **Figure 3-5** and discussion in Section 4.3 below).
- Forty-six satellite tags, some depth reporting, were deployed on five species, with an emphasis on Cuvier's beaked and fin whales. Species tagged include: Baird's beaked whale (n=1; tag deployment 32 days), Cuvier's beaked whale (n=8; tag deployments 10 to 90 days), fin whale (n=21; tag deployments from 1 to178 days), Killer whale (n=3; tag deployment 9 to 16 days), and Risso's dolphin (n=6; tag deployments 7 to 20 days).
- Among other findings, preliminary results of photo-identification studies combined with results from satellite tag data suggest Cuvier's beaked whales and fin whales may have population sub-units with an as yet currently unquantified residency within the Southern California Bight and within the Navy's SOCAL Range Complex.

Beaked whales particularly show higher than expected residency on SOAR. From Navy research-funded work from 2006 through 2008, published in Falcone et al. 2009:

- 37 groups of Cuvier's beaked whale were sighted
- Multiple age (adult, subadult, and calf) and sex (male and female) classes were observed. One-third of the sightings contained more than one adult male
- 78 photographs of 58 unique Cuvier's beaked whales were obtained

Additional work through 2012, and reported in the Navy's 2012 annual SOCAL Range Complex Monitoring Report (see Falcone and Schorr et al. in Department of the Navy 2012), continues this effort. From 2011 through 2012, 18 additional surveys within the SOCAL Range Complex and SOAR in particular were conducted.

- Photo ID of Cuvier's beaked whales continues with approximately 100 unique individuals identified (15 percent have been seen in more than 1 year, with sighting spans up to 4 years).
- Three Cuvier's beaked whales were tagged with time-depth satellite tags resulting in 3,720 hours of dive data being collected. Two whales remained within San Nicolas Basin (i.e., within SOAR) while a third traveled 127 nm southeast until tag transmission ceased. Consistent with previous sightings and tag deployments, the beaked whales showed a preference for the deep water mid-Basin area as well as the western and northern basin slopes.
- A comparison of Cuvier's beaked whale movement with concurrent MFAS use is underway and journal submission in preparation.

- In addition, to beaked whale effort, 100 unique fin whale photographs were obtained both within the SOCAL Range Complex and north of the range complex adjacent to the Ports of Los Angeles and Long Beach.
- Over 367 hours of dive behavior was obtained from a tagged fin whale and 33 hours of dive behavior obtained from a tagged Risso's dolphin. These are the first extended dive records from either of these species. Data from the fin whale (n=1) showed an extensive use of near-surface waters.

4.3 MARINE MAMMAL MONITORING ON NAVY RANGES

Overview – The M3R utilizes the existing bottom-mounted hydrophones west of San Clemente named SOAR (see also **Figure 3-5**). As of January 2013, SOAR consists of 177 bottom-mounted hydrophones forming an array covering 695 square miles (1,800 square kilometers) of ocean bottom at depths up to 6,070 ft. (1,850 m). Eighty-eight of the original hydrophones were refurbished in 2010–2011 to ensure continuous tracking and communication coverage on SOAR in support of safe, effective undersea warfare training. This refurbishment increased bandwidth from 8–40 kHz to 50 Hz–40 kHz. Eighty-nine new bidirectional 8–40 kHz hydrophones were installed in 2012.

M3R is set up to record marine mammal vocalizations from these hydrophones, and apply detection algorithms for species identification (**Figure 4-3**). Field validation continues with in-lab monitoring with supporting on-water visual confirmation (as mentioned in Section 4.2).

Data Collection – From 2009 through 2012, M3R carried out several monitoring efforts to determine the spatial and temporal distribution of cetacean species on SOAR, document reaction of these species to sonar with a focus on beaked whales, and continue refinement of long-term PAM via M3R. The species verification and tagging effort entailed opportunistically monitoring vocalizing marine mammals on SOAR with and without active sonar. From 2011 to 2012, data were collected with and without active sources present on range and were compared to ship tracks associated with MFAS. Satellite tags were placed on individual "sound sensitive" Cuvier's beaked whales along with several additional species. In addition to Cuvier's beaked whales, other target species include common dolphins, Risso's dolphins, and Pacific white-sided dolphins.

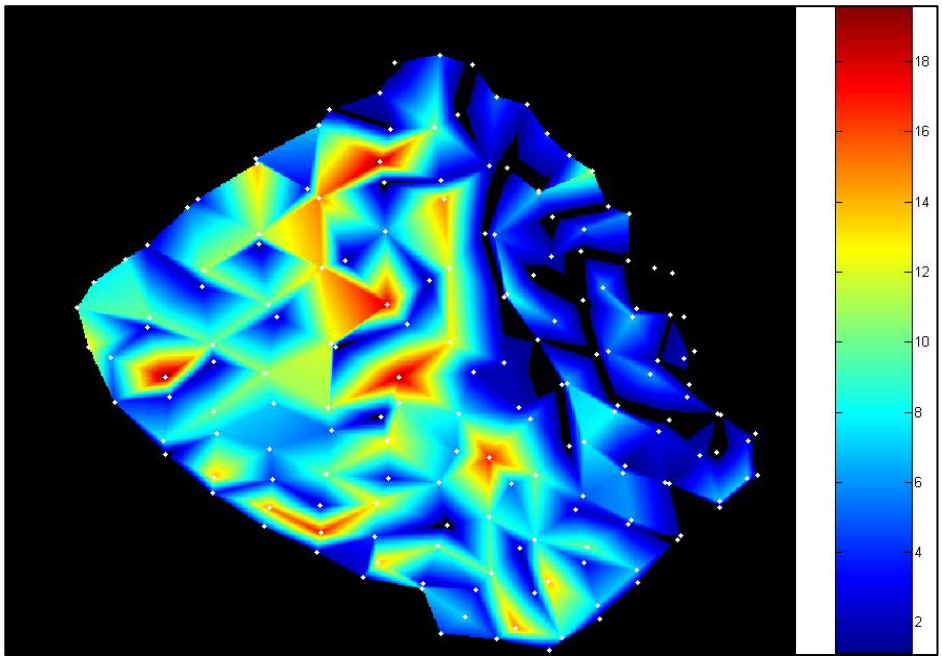


Figure 4-3: Number of Vocal Groups Present as Detected by M3R on the SOAR Range

Note: Image created by plotting number of times a hydrophone was at center of a vocalizing group and using a linear interpolation in MATLAB. Color bar indicated number of center hydrophones per vocal group period.

Analytical Results: Passive Acoustic Derivation of Cuvier's Beaked Whale Density at SOAR – Based on M3R and related survey efforts at SOAR, a peer-reviewed journal paper is in preparation that will provide the first ever Cuvier's beaked whale density estimates specific to SOAR based on passive acoustic data. Passive acoustic methods to estimate the density of Blainville's beaked whales have been developed and demonstrated at the Atlantic Undersea Test and Evaluation Center (AUTEC) in the Bahamas (Marques et al. 2009, Moretti et al. 2010). Like SOAR, the AUTEC range consists of a set of bottom-mounted hydrophones that are routinely used to detect beaked whale echolocation clicks.

Two general Blainville's beaked whale passive acoustic density methods have been developed. The first is based on a count of echolocation clicks (Marques et al. 2009), while the second uses dive starts (Moretti et al. 2010). In terms of Southern California, there are significant confounding effects from other non-beaked whale echolocating species at SOAR as compared to AUTEC. Common dolphin echolocation clicks and vocalizations, for instance, are a consistent and frequent detection at SOAR. This makes classification of individual Cuvier's beaked whale clicks difficult as they are easily confused with those from other species, in terms of current algorithm performance. The performance of existing Cuvier's beaked whale classifiers, in particular, their false classification rate in the presence of dolphins, is poorly characterized. Consequently, in order to account for the increased clutter from dolphin clicks, the method based on dive counting is being modified for Cuvier's beaked whale specific to SOAR.

Both Blainville's beaked whale and Cuvier's beaked whale are known to associate and dive together in small groups (Zimmer et al. 2005, Johnson et al. 2006, Falcone et al. 2009, Falcone and Schorr 2012 in Department of the Navy 2012). Echolocation clicks detected on a hydrophone can be used as a proxy for a group of diving animals as the animals only produce

such clicks at depth during deep foraging dives. The dive counting method requires the detection of vocalizing groups of animals within the field of sensors, their association into discrete "Group Vocal Periods" (GVP), and an estimate of the average group size. Group size estimates are being derived from visual data collected during M3R species verification tests with expert visual observers at SOAR (Falcone et al. 2009, Falcone and Schorr 2012 in Department of the Navy 2012). During these tests, an observer rigid hull inflatable boat is vectored to vocalizing animals that are detected on the SOAR hydrophones using the M3R system.

Concurrently, Cuvier's beaked whale groups are being isolated from M3R detection archives at SOAR. The archives contain time-synchronized detection reports for transient signals including detections of Cuvier's beaked whale echolocation clicks. M3R tools, first developed for Blainville's beaked whale at AUTEC, are being modified for Cuvier's beaked whales at SOAR. The tools are used to associate the detections on adjacent phones with a Cuvier's beaked whale group foraging dive and to mark the start and stop times of Cuvier's beaked whale GVPs.

These data will be used to estimate the density using generalize formula given by (Moretti et al. 2010):

$$D = \frac{D_s * g}{d * T * A * P}$$

a = animal abundance
g = average group size
D_s = total dive starts
d = dive rate (dives/hr)
T = time period over which the measurement was made
A = measurement area
P = probability of detecting a vocalizing group

4.4 BEHAVIORAL RESPONSE STUDY

The SOCAL Behavioral Response Study (SOCAL-BRS) is a multi-year effort (2010–2015) designed to better understand marine mammal behavior and reactions to sound. It is an interdisciplinary research collaboration, building on previous efforts in the Bahamas and Mediterranean Sea. The overall objective is to provide a better scientific basis for estimating risk and minimizing effects of active sonar for the Navy and regulatory agencies. SOCAL-BRS is also part of a larger international collaboration to measure the impacts of noise marine mammals using opportunistic and experimental approaches (including controlled exposure experiments [CEE]). In particular, SOCAL-BRS is a dedicated effort to study a variety of marine mammal species in areas around the Southern California coast and the Channel Islands, from Morro Bay to San Diego. The most current SOCAL-BRS field season (SOCAL-12) just concluded at the end of 2012 and data analysis is ongoing. Any summary results will be provided in the 2013 SOCAL Range Complex Annual Monitoring Report.

SOCAL-11 was the second field season this multi-year effort and was conducted in July through September 2011 (Southall et al. 2012). Specific objectives for SOCAL-11 included:
(1) Obtaining baseline behavioral data; (2) Conducting CEEs on baleen whales, beaked whales, and Risso's dolphin; (3) Testing optimal configuration for subsequent studies, which may have included realistic/actual military sources; and (4) Obtaining data to support the U.S. Navy's SOCAL Range Complex monitoring efforts.

During a scouting phase and two operational legs, researchers observed, photographed, and/or tracked thousands of individuals of 18 marine mammal species. Thirty-eight tags were secured on 35 individual animals of four different marine mammal species. This included a large number

of tags for certain focal species, including expanding the large sample size of blue whales from SOCAL-10, a greater than expected success with Risso's dolphins, and a second successful tag and CEE on a very difficult to tag, yet important species—Cuvier's beaked whale (Southall et al. 2012). Other species (e.g., fin whale, sperm whale, Baird's beaked whale, and killer whale) that were tagged in SOCAL-10 were either not encountered or were not tagged in SOCAL 11 (Southall et al. 2012).

Researchers conducted 18 CEEs on 18 individuals of three marine mammal species affixed with suction cup acoustic tags and tracked both visually and acoustically. Simulated military sonar signals (several orders of magnitude less intense than real sonar) and noise bands of comparable frequency (identical to SOCAL-10) were presented as experimental stimuli under very specific protocols and protective measures to ensure animals were not harmed. Some changes in behavior from baseline conditions were measured as a function of sound exposure. Preliminary results based primarily on clearly observable behavior in the field and from initial data assessment were similar to those made in SOCAL-10, but extended sample size considerably in blue whales and Risso's dolphins. These preliminary results indicate variable responses (ranging from no observable response to apparent temporary avoidance behavior), depending on species, type of sound, and behavioral state during the experiments.

Additional analysis and interpretation is underway of the nearly 200 hours of tag data, as well as thousands of marine mammal observations, photographs, biopsy tissue samples, and passive acoustic data.

5 PROGRESS ON MONITORING QUESTIONS, FEASIBILITY, AND COST-BENEFIT COMPARISON

Sections 1.3 (Southern California Range Complex Monitoring Goals) and 3.1 (Navy Compliance Monitoring Overview) of this report discuss the derivation of the original SOCAL Monitoring Plan and subsequent allocation of Compliance Monitoring research elements (visual, MMO, PAM) and technology based metric of accomplishment (number of hours, number of devices).

The remaining monitoring period under the SOCAL Range Complex current authorization through the August 2013 field monitoring year will maintain essentially the same approach and metrics as preceding years (2009–2012).

Navy research-funded projects (Chapter 4), while exceedingly valuable scientifically, were at early stages of development in 2009 and not intended to be linked directly, at least initially, to the ICMP based Compliance Monitoring objectives. In addition, research field effort and data analysis was not tied into concurrent SOCAL Range Complex Compliance Monitoring due to multi-year project objectives and reporting for research projects as compared to annual monitoring and reporting for Compliance Monitoring. The Navy has attempted to summarize to the best extent practical the annual status of research-funded projects within Southern California in the SOCAL Range Complex annual Monitoring Reports.

Since 2009, however, the ICMP has advanced in structure, and the valuable science originating from the Navy research-funded projects in Southern California is beginning to contribute to several of the current ICMP objectives.

In terms of the Navy's commitment and obligation under the SOCAL Range Complex authorization from the NMFS, a few observations on the cost verses benefit can be made, along with a qualitative assessment of what each Compliance Monitoring element contributed.

Cost Assessment of Compliance Monitoring – As discussed originally in Chapter 3 (see Section 3.1, Navy Compliance Monitoring Overview), the Navy's Compliance Monitoring funding within the SOCAL Range Complex was $720,000 in FY12 and is anticipated to be approximately $750,000 in FY13. **Table 5-1** contains a breakdown of the approximate FY13 costs by SOCAL-specific research element.

In general, any type of monitoring within the ocean is expensive given the harsh environment (e.g., depth of deployment, weather, ocean conditions), and distances from shore based infrastructure (ports, power supplies, airfields). The Navy's Compliance Monitoring is no exception and faces many of the same challenges. In addition, to just field effort, an important lesson learned over the course the SOCAL Range Complex Compliance Monitoring was that data analysis actual adds additional costs to a given research element that were not initially foreseen. For the SOCAL Range Complex, across the duration of the monitoring so far (2009–2012), costs have actually remained the same (MMO) or in most cases gone up (PAM, aerial), primarily due to increased costs for analysis needed for the volume of data being collected.

If a rough approximation of per unit cost for hours of data is obtained, dividing an estimated 4 years of research element funding amount by the associated accomplishments, and only using

hours as a metric of accomplishment (summed by element from **Table 3-1**), a dollar cost per hour can be quantified (**Table 5-1**).

For aerial survey, this was $3,258 per hour; for PAM, $22/hour; and for MMO, $467 per hour.

However, this is strictly a mathematical ratio and grossly misrepresents what each research element has contributed in terms of science and ICMP accomplishment which is discussed next in the qualitative assessment.

Table 5-1: Matrix of SOCAL Range Complex Monitoring Obligations under NMFS' Authorizations, and Associated Anticipated 2013 Unit Costs

	Required Research Element			Additional Reporting	Additional Elements
	Visual	**PAM**	**MMO**	**Exercise Report**	**Additional**
Research Element and FY13 Navy Obligation	100–150 hours completed	Maintain/ analyze data from two HARPs	50–100 hours completed	Summarize major training events including marine mammal sightings from Navy platforms	Present results from Navy-funded research projects (visual, tagging, M3R) as available
Cost	$160,000	$125,000	$41,000	$417,500[1]	$0[2]
Unit	Per survey	Per HARP	Per event	Annual	Annual
Amplifying Comments	Includes $100K per 5-day field survey cost, and $60K for post-survey analysis, reporting, and density recalculations	Includes minimum $50K field costs and $75K analysis cost	Assuming 3 Navy civilian biologists plus one contractor. Navy salary and travel cost $30K + contractor cost $11K	Used to fund staffing support to promulgate data collection standards for all major training events, collect data by event, and conduct summary analysis	
ESTIMATED FY13 ANNUAL TOTAL	$360,000 [3]	$250,000	$41,000 (up to $123,000) [4]		
Approximate Cost Over 4 years [5] (2009–2012)	$1,440,000	$1,000,000	$164,000		
Cumulative Data 2009–2012	442 hours flown for 2,403 sightings	46,236 hours recorded	351 hours for 192 sightings		
Hour per dollar cost ($/hour)	$3,258	$22	$467		

[1] Not a direct cost to the programmed SOCAL Range Complex Monitoring Program, but still an internal Navy cost.
[2] In-house U.S. Pacific Fleet staff salary costs (i.e., not a direct charge to the SOCAL Monitoring Program). While not accounted for in this discussion, still an annual cost to the Navy.
[3] Report costs include all aerial data collection [i.e., ($100K per survey x 3 surveys) + $60K analysis and reporting. Either two or, more typically, three, long surveys are done each year. In some years, additional funding became available to allow for a fourth survey].
[4] Highest value assuming three MMO embarks per year. Three MMO embarks are planned out each year, but as discussed in the text, practical logistic constraints may limit the total number of MMO events in a given year.
[5] Calculated by multiplying the "Estimated FY13 Annual Total" by four, recognizing that this is a simplification of the actual amounts spent which are variable by year (2009–2012) and element.
Notes: FY = Fiscal Year, HARP = High-frequency Acoustic Recording Package, M3R = Marine Mammal Monitoring on Navy Ranges, MMO = Marine Mammal Observer, Navy = U.S. Department of the Navy, PAM = Passive Acoustic Monitoring, SOCAL = Southern California, U.S. = United States

Final estimated FY13 amount of $750,000 for all U.S. Pacific Fleet-funded SOCAL Range Complex Compliance Monitoring also factors in internal Navy costs for administration, management, and other oversight functions.

Qualitative Assessment of Compliance Monitoring Research Elements – Cost is only one way in which to assess the relative merits of the Compliance Monitoring performed from 2009–2013 in the SOCAL Range Complex. Each research element (visual, PAM, MMO) brings an entirely different set of pros and cons to implementation and can provide vastly different scales of data in terms of addressing the ICMP goals.

The MMO embarks are uniquely different from all other monitoring with distinct goals of measuring mitigation compliance as well as overall species occurrence in proximity to a single ship. Given this uniqueness, the following discussion really focuses on the other SOCAL Range Complex elements (visual, PAM).

Visual

Pros: Visual surveys, primarily aerial surveys for this discussion, cover a large spatial scale over a rapid temporal window on the order of about 6 hours, the duration of a typical flight in the SOCAL Range Complex before the plane had to return to the airfield to refuel. Connecting various combination of offshore and nearshore tracklines over several days could lead to spatial coverage on the order of 1,500–5,000 nm of ocean surveyed.

Cons: Military airspace restrictions specific to certain offshore waters of the SOCAL Range Complex limited the ability to fly the plane near Navy training events. Many times survey flight windows had to be established when no Navy training was ongoing. This limits direct visual observations of marine mammal reaction/lack of reaction to specific training events.

Significance of data obtained: Aerial surveys in the SOCAL Range Complex, as discussed in Section 3.2 (Chronological Timeline of Southern California Monitoring) provided important new information on Southern California marine mammal at-sea baseline behavior, a body of data lacking from many other research projects. Surveys covered key Navy training sub-areas so marine mammal behavioral observations are directly applicable to future CEEs and other future impact analysis. For instance, before a behavior can be called "abnormal" some information on the range of "normal" behavior is needed. Results obtained from aerial surveys so far also indicate that a number of environmental and other variables might influence behavior, group size, abundance, and habitat use patterns of marine mammals in the SOCAL Range Complex.

Finally, although not an original intention when beginning these aerial surveys, a secondary benefit was the collection of sufficient sighting data to derive both warm season and cool season marine mammal densities for the most commonly occurring species. In particular, by flying tracklines similar to ones used in past years by the NMFS for occurrence and density monitoring, direct comparisons of species-specific densities between Navy-funded and NMFS-funded surveys is possible.

For 2013–2014, the Navy (U.S. Pacific Fleet) has funded spatial habitat modelers also affiliated with NMFS' Southwest Fisheries Science Center to attempt to integrate seasonal sighting and density data from these aerial surveys with existing NMFS surface ship and aerial data, as well

as sighting data from the Navy research-funded CalCOFI project (see Section 4.1). Results from this modeling effort will be used in future Navy MMPA and ESA impact analysis for pending National Environmental Policy Act documents (i.e., future Navy EISs and associated permitting).

Passive Acoustic Monitoring

Pros: PAM, as deployed under the SOCAL Range Complex Compliance Monitoring program (i.e., static bottom placed HARPs), provides long-term persistent temporal coverage. Scripps Institution of Oceanography has been able to generate new yearly marine species occurrence plots based on vocalization and echolocation detections since 2009. This work has been heavily leveraged with previous and, at times, concurrent Navy research-funded HARP deployments both within and outside of Southern California. Passive acoustic data has the ability to be analyzed for changes in vocalizations and echolocations as a marker of potential behavioral changes due to anthropogenic exposure. Scripps is just beginning this phase of analysis for the SOCAL Range Complex.

Cons: There are inherent risks in placing any long-term oceanographic instrument on the ocean bottom for long periods of time and data may not necessarily be obtained for a specific monitoring period. Even given the best pre-deployment calibrations and testing, there is the potential for equipment failure that will not be known until a future field service call. In 2011–2012, one of the U.S. Pacific Fleet-funded HARPs in the SOCAL Range Complex experienced a battery/hard drive issue that precluded effective recording. By happenstance, another Navy research-funded HARP was available and deployed over the same period from which to conduct the analysis reported in the Navy's 2012 annual SOCAL Range Complex Monitoring Report (Department of the Navy 2012). In another case, a research-funded HARP in the Pacific Northwest in 2010 went missing and given it's relatively shallow depth on the shelf (600 ft. [183 m]) might have been displaced by dragged fishing gear. Finally, a non-Navy-funded HARP near the Santa Barbara channel went missing and was presumed lost sometime in 2010. A year later, a U.S. Marine Corps representative reported the finding of the HARP when it was recovered washed ashore near a fishing village in Okinawa, Japan.

Another consideration for PAM is the sheer volume of passive acoustic data being collected and the time and associated costs for detailed analysis. Advances in automated marine mammal classifiers continue, but there are still manual elements to a full analysis. Scripps which also conducts similar deployments and analysis at other Navy range complexes (e.g., Northwest Training Range Complex, Gulf of Alaska, Atlantic Fleet Active Sonar Training) and for other non-Navy scientific projects throughout the world, has admitted that at some times the volume of data can saturate the work load of their available analyst.

Significance of data obtained: The key significance for the SOCAL Range Complex HARP (and other passive acoustic data) is the long-term nature of the data set coupled with the potential to analyze before, during, and after a Navy training event for changes in vocalizations and echolocation. In addition to basic marine species occurrence already being reported, effects analysis can address if there might be a response in terms of vocalization or echolocation, and document the length of time until return to presumed normal vocalizations. Passive acoustic data cannot address periods when marine mammals might not be vocalizing for any number of natural

biological life functions, however. There will always be differences between visual and passive acoustic detections in a given region as Oleson et al. (2007a,b) have documented for Southern California.

It is also unknown at present if changes in a vocalization or echolocation are accompanied by actual behavioral changes, or just a change (cessation, increase) in the vocalization. In other words and for instance, does a non-vocalizing animal still feed if disturbed by an anthropogenic sound, or does the change in vocalization equate to a change in foraging? There is a growing body of literature based on animal tagging results for making a direct correlation of beaked whale echolocation clicks with deep foraging dives.

While the state of the science is advancing, the same degree of information on behavioral reactions to sound as available for beaked whales may not be available for all Southern California marine mammal species. Continued time-depth-sound tag deployments on multiple species might assist in providing a better understanding of links between vocalization rates and behavior. To that end, data coming out of the Navy research-funded BRS project may help advance the state of knowledge in this field.

Summary

All of the Compliance Monitoring technologies have contributed to basic ICMP questions on marine mammal distribution and occurrence within the SOCAL Range Complex to a much higher spatial and temporal resolution than any data collection previously. In terms of passive acoustic analysis of potential impact or lack of impact, the detailed analysis is underway. A key issue in the passive acoustic field is defining the scope, structure, and analytical products that will be needed to adequately delineate a marine mammal response based on passive acoustic data. This particular field of analysis is still in its infancy.

Future efforts (2014–2018) described in Chapter 6 would seek to build on the lessons learned from Compliance Monitoring from 2009 through 2013 to integrate these and other monitoring techniques into a more robust, study question-specific focus that will further advance ICMP goals.

6 FUTURE DIRECTION

6.1 REVISED MONITORING PROGRAM APPROACH

Originally, five study questions were developed between NMFS and the Navy as guidance for developing monitoring plans, and all existing range-specific monitoring plans attempted to address each of these study questions (Department of the Navy 2009b,c). However, the state of knowledge for the various Range Complexes is not equal, and many factors, including level of existing information, amount of training activity, accessibility, and available logistics resources all contribute to the ability to perform particular monitoring activities. In addition, the U.S. Navy monitoring program has historically been compartmentalized by Range Complex and focused on effort-based metrics (survey days, trackline covered, etc.).

A 2010 Navy-sponsored monitoring meeting in Arlington, Virginia initiated a process to critically evaluate the current Navy monitoring plans and begin development of revisions/updates to both existing region-specific plans and the ICMP. Discussions at that meeting, and at the U.S. Navy/NMFS annual adaptive management meeting in October 2010, established a way forward for continued refinement of the Navy's monitoring program. This process included establishing a Scientific Advisory Group (SAG) composed of leading marine mammal scientists, with the initial task of developing recommendations that would serve as the basis for a Strategic Planning Process for marine species monitoring.

In June 2011, the U.S. Navy hosted a Marine Mammal Monitoring Workshop with guidance and support from NMFS, which included scientific experts and representatives of environmental non-governmental organizations (Department of the Navy 2011b). The purpose of the workshop was to present a consolidated overview of monitoring activities accomplished in 2009 and 2010 pursuant to the MMPA Final Rules currently in place, including outcomes of selected monitoring-related research and lessons learned, and to seek feedback on future directions. An outcome of this workshop was to continue consolidating monitoring efforts from individual Range Complex plans in order to improve the return on investment by focusing on specific objectives and projects which can most efficiently and effectively be addressed throughout the Navy's Range Complexes.

Scientific Advisory Group – The SAG was established in 2011 with the initial task of evaluating current naval monitoring approaches under the ICMP and existing authorizations to develop objective scientific recommendations (Scientific Advisory Group 2011). While recommendations were fairly broad from a geographic perspective, the SAG did provide specific programmatic recommendations that serve as guiding principles for the continued evolution of the Navy Marine Species Monitoring Program.

Notable keystone recommendations from the SAG include:

- Working within a conceptual framework of knowledge, from basic information on the occurrence of species within each range complex, to more specific matters of exposure, response, and consequences
- Striving to move away from a "box-checking" mentality—monitoring studies should be designed and conducted according to scientific objectives, rather than on merely cataloging effort expended

- Approaching the monitoring program holistically and select projects that offer the best opportunity to advance understanding of the issues, as opposed to establishing range-specific requirements
- Facilitating collaboration among researchers in each region, with the intent to develop a coherent and synergistic regional monitoring and research effort

In addition to broader programmatic and conceptual recommendations, the SAG evaluated each range complex for a series of factors including level of Navy activity, diversity and density of marine mammals, need for information on basic occurrence, presence of species of concern, and ability to most effectively address questions related to exposure, response, and consequences.

Adaptive Management and Strategic Planning Process (>2013) – The objective of the Strategic Planning Process is to continue the evolution of Navy marine species monitoring towards a single integrated program, incorporating expert review and recommendations, and establishing a more transparent framework for evaluating and implementing monitoring work across the Navy range complexes and study areas. The Strategic Planning Process is intended to be a primary component of the ICMP and provide a "vision" for Navy monitoring across geographic regions, serving as guidance for determining how to most efficiently and effectively invest the marine species monitoring resources to address ICMP top-level goals and satisfy MMPA LOA regulatory requirements. The Strategic Planning Process has five major implementation steps:

1. Identify overarching intermediate scientific objectives
2. Develop individual monitoring project concepts
3. Evaluate, prioritize, and select monitoring projects
4. Execute selected monitoring projects
5. Report and Evaluate progress and results

These steps serve three primary purposes: (1) facilitate the Navy in developing specific projects addressing one or more intermediate scientific objectives; (2) establish a more structured and collaborative framework for developing, evaluating, and selecting monitoring projects across all areas where the Navy conducts training and testing activities; and (3) maximize the opportunity for input and involvement across the research community, academia, and industry. This Strategic Planning Process will serve as the single marine species monitoring requirement for all Navy testing and training activities under the Hawaii Southern California Training and Testing (HSTT) MMPA LOA, which will supersede the current LOAs for the SOCAL Range Complex and the Hawaii Range Complex beginning in 2014. Along with the ICMP it clearly identifies the goals and objectives of the Navy monitoring program, presents the guidance and expert review that will be used to direct efforts, and defines the process for evaluating and selecting how the Navy's marine species monitoring program budget is invested.

6.2 SOUTHERN CALIFORNIA RANGE COMPLEX LESSONS LEARNED

Many of the general lessons learned for various Compliance Monitoring elements have been discussed in Chapters 3 and 5.

Below is a broader assessment of accomplishments and applicability to addressing ICMP objectives resulting from all Navy monitoring (compliance and research) conducted from 2009 to 2012 specifically within the SOCAL Range Complex. The closest associated ICMP objective(s), shown in the text box to the right, are listed after each statement:

- Aerial surveys are an effective way to survey marine mammal distribution and some life functions across a large spatial scale. In part this is assisted by the relatively high marine mammal densities found within Southern California. [ICMP a, b(2)(4)]
- Long-term fixed PAM (i.e., HARPs, M3R) in the SOCAL Range Complex is an effective way to determine seasonal species-specific occurrence of vocalizing and potentially foraging animals. It does not account for non-vocalizing animals. PAM can also be used to record natural and anthropogenic sounds leading to better assessment of ambient noise conditions. [ICMP a, b(1)(2)]
- PAM has the potential via expanded analysis to begin addressing potential impacts of anthropogenic sources on marine mammal vocalization and echolocation, with the assumptions that changes in vocalizations and echolocation rates are indicative of behavioral changes. [ICMP b(2)(3)(4), c, d]
- MMOs can document mitigation compliance. [ICMP f]
- Satellite tracking tag can be an effective indicator of marine mammal distribution and movement patterns at short (days to weeks) and long time scales (months). [ICMP a, b(2)(4)]
- Satellite time-depth-exposure tags can be an effective direct measurement of individual animal exposure and response/lack of response to an anthropogenic stressor. [ICMP b(3)(4), c, d]
- BRS integrating visual, tagging, and passive acoustics can be a direct measurement of species-specific response/lack of response to an anthropogenic stressor as well as assist in determining if there is a behavioral context to any response/lack of response. [ICMP b(3),(4), c, d]

ICMP OBJECTIVES

(a) Increase understanding of likely occurrence of marine mammals and/or ESA-listed marine species in vicinity of action (i.e., presence, abundance, distribution, and/or density of species).

(b) Increase understanding of nature, scope, or context of likely exposure of marine mammals and/or ESA-listed species to any of potential stressors associated with the action (e.g., sound, explosive detonation, or expended materials), through better understanding of one or more of: (1) nature of the action and its surrounding environment (e.g., sound-source characterization, propagation, and ambient noise levels); (2) affected species (e.g., life history or dive patterns); (3) likely co-occurrence of marine mammals and/or ESA-listed marine species with the action (in whole or part); and/or (4) likely biological or behavioral context of exposure to the stressor for marine mammal and/or ESA-listed marine species (e.g., age class of exposed animals or known pupping, calving, or feeding areas).

(**c)** Increase understanding of how individual marine mammals or ESA-listed marine animals respond (behaviorally or physiologically) to specific stressors associated with the action (in specific contexts, where possible, e.g., at what distance or received level).

(d) An increase understanding of how anticipated individual responses, to individual stressors or anticipated combinations of stressors, may impact either: (1) long-term fitness and survival of an individual; or (2) population, species, or stock (e.g., through effects on annual rates of recruitment or survival).

(**e)** Increase understanding of effectiveness of mitigation and monitoring measures, including increasing probability of detecting marine mammals to better achieve above goals (through improved technology or methodology), both generally and more specifically within the mitigation zone (thus allowing for more effective implementation of the mitigation). Improved detection technology will be rigorously and scientifically validated prior to being proposed for mitigation, and should meet practicality considerations (engineering, logistic, and fiscal).

(f) Better understanding and record of manner in which authorized entity complies with MMPA and ESA authorizations.

- The Navy Basic Research program from ONR and Applied Research program under the LMR program (see Section 4, Navy Basic and Applied Research Summary, and **Figure 6-1**), provide the best funding sources to design, test, and validate new marine mammal detection and monitoring technologies. [ICMP e]

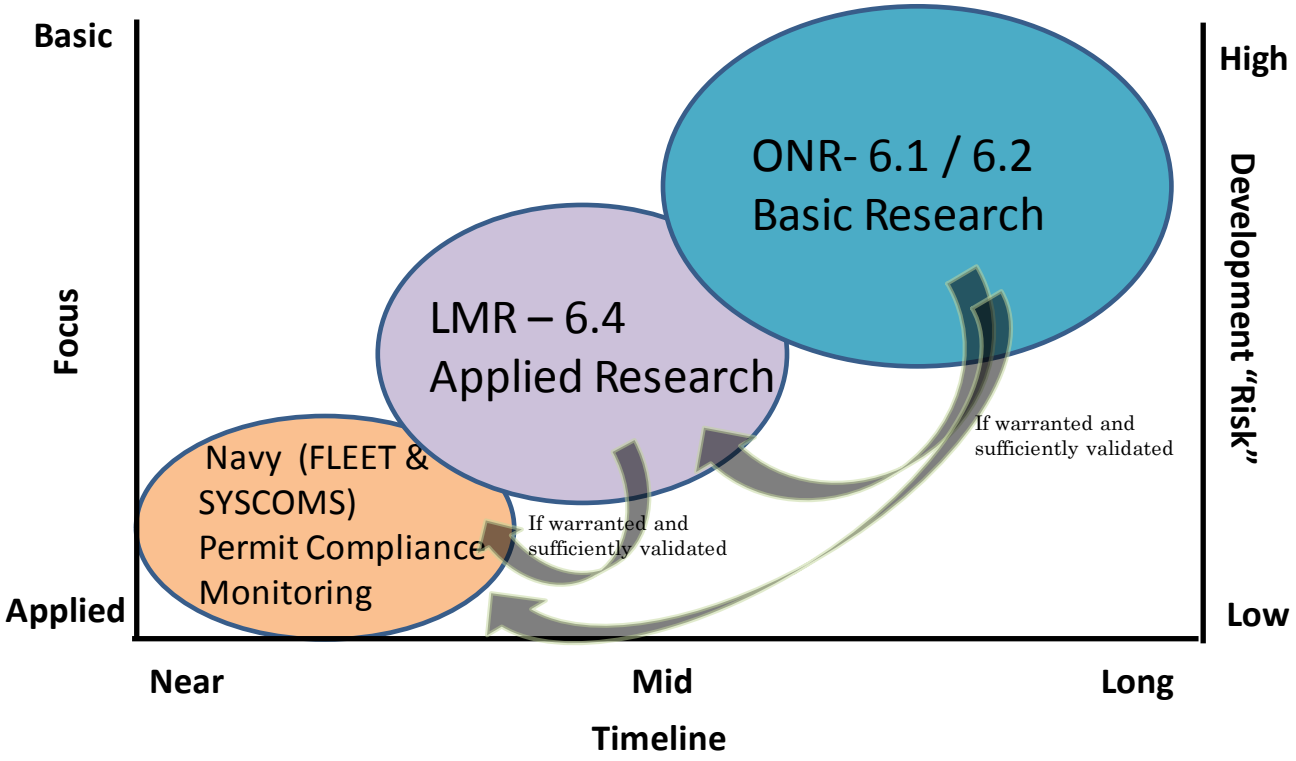


Figure 6-1: Transition Path from Navy-funded Research to Application and Monitoring Use under Three Navy Funding Programs

6.3 POTENTIAL 2014–2018 SOUTHERN CALIFORNIA MONITORING

As the Strategic Planning Process (Section 6.1, Revised Monitoring Program Approach) moves forward, specific to the follow-on HSTT LOA Compliance Monitoring, the eventual Navy-funded monitoring conducted in the SOCAL Range Complex will be regionally focused while continuing to address current ICMP objectives. This also includes the flexibility through the adaptive management process for annually modifying regional monitoring in collaboration with local researcher specified needs, and future changes in ICMP goals and objectives.

Table 6.1 illustrates some potential future SOCAL Range Complex Compliance Monitoring research study questions that could be applied under the HSTT LOA Compliance Monitoring.

The scope of the future HSTT Compliance Monitoring Plan for the period 2014–2018 is still in review and under consideration in collaboration with the NMFS. **Table 6-1**, therefore, is representative only and not indicative of what the final SOCAL Range Complex specific questions will be. The questions proposed here do cover key, common ESA and MMPA species that have been the focus of previous Navy and NMFS research within Southern California over the past decade.

Table 6.1: Illustrative SOCAL Range Complex Region-Specific Research Study Questions Starting in 2014

Priority *	Regional Study Question	Proposed or Potential Methods **
1	What are the behavioral reactions of cetaceans to anthropogenic sound, and the effects of naval training activities on these species within the northern SOCAL Range Complex? What are individual level impacts? What are the population level impacts? Species studied will include: a) Cuvier's beaked whale b) blue whale c) fin whale d) common dolphin (Delphinus spp.) or Risso's dolphins (possible alternative, additional species for consideration) Areas studied will include (but may not be limited to): a) San Nicolas Basin (i.e., in vicinity of SOAR) b) Other sub-areas (e.g., east of San Clemente Island to shore)	Behavioral Response Studies, PAM, tagging, photo ID, visual survey
2	What are the densities, annual occurrence, movement patterns, and, more importantly, residence times of Cuvier's beaked whales, blue whales, and fin whales within the northern SOCAL Range Complex as compared to their resident pattern/time within other parts of the Pacific (i.e., off range)? a) San Nicolas Basin (i.e., in vicinity of SOAR) b) Other sub-areas (e.g., east of San Clemente Island to shore)	Tagging, visual survey, PAM

* Prioritization based on attempts to define impacts to marine mammals from Navy training and testing activities first, followed by other ICMP-derived objectives (e.g., occurrence, distribution, etc.).
** Any range of proposed methods can be used either singularly or in combination; lists within this column are estimated and can be changed or have addition techniques applied if these techniques address the regional study question.
*** "Northern" part of the SOCAL Range Complex includes the area from the U.S.-Mexico EEZ boundary north to a line from San Nicolas Island to the mainland shore, and from the surf line of the California coast west to the Patton Escarpment, approximately 160 nm (see **Figure 1-2**).
Notes: EEZ = Exclusive Economic Zone, ICMP = Integrated Comprehensive Monitoring Program, Navy = U.S. Department of the Navy, nm = nautical miles, PAM = Passive Acoustic Monitoring, SOAR = Southern California Anti-submarine Warfare Range, SOCAL = Southern California, U.S. = United States

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