MARINE SPECIES MONITORING
for the
U.S. Navy's
Hawaii Range Complex
and
Southern California Range Complex

Department Of The Navy

2011 ANNUAL REPORT

October 1, 2011

THIS PAGE INTENTIONALLY BLANK

MARINE SPECIES MONITORING
FOR THE
U.S. NAVY'S
HAWAII RANGE COMPLEX
AND
SOUTHERN CALIFORNIA RANGE COMPLEX

2011 ANNUAL REPORT

Prepared For and Submitted To

National Marine Fisheries Service

Office of Protected Resources

Prepared by

Department Of The Navy

In accordance with Letter of Authorizations effective:
07 February 2011 (HRC 2011 revised LOA renewal)
13 January 2011 (HRC 2011 BO)
07 February 2011 (SOCAL 2011 revised LOA renewal)
21 January 2011 (SOCAL 2011 BO)

1 OCTOBER 2011

Citation for this report is as follows:

DoN. 2011. Marine Mammal Monitoring for the U.S. Navy's Hawaii Range Complex and Southern California Range Complex- Annual Report 2011. Department of the Navy, U.S. Pacific Fleet.

Authors: Mari A. Smultea and Cathy Bacon (HDR, Inc.) SOCAL Section; Dagmar Fertl (HDR, Inc.) HRC Section; Kristen Ampela (HDR, Inc.) SOCAL and HRC Sections.

With Contributions from:

(Alphabetized by organization) Jessica M. Aschettino, Robin W. Baird, Annie B. Douglas, Erin Falcone, Sabre D. Mahaffy, Gregory S. Schorr and Daniel L. Webster (Cascadia Research Collective), Chip Johnson and Julie A. Rivers (Commander, U.S. Pacific Fleet), Whitlow W. Au (Hawaii Institute of Marine Biology), Mark Cotter, Gregory L. Fulling, Craig Hawkinson, Tom Kieckhefer, Tara Leota, Keri Lestyk and Aliza Milette (HDR EOC), Thomas A. Jefferson (HDR EOC and Clymene Enterprises), Joseph R. Mobley, Jr. (HDR EOC and Marine Mammal Research Consultants), Cathy Bacon, Jenelle Black, Kate Lomac-MacNair and Mari A. Smultea (HDR EOC and Smultea Environmental Sciences, LLC), Andrea Balla-Holden (Naval Facilities Engineering Command Northwest), Justin Fujimoto, Sean F. Hanser, Morgan W. Richie, Robert K. Uyeyama and Kate L. Winters (Naval Facilities Engineering Command Pacific), Jessica Bredvik (Naval Facilities Engineering Command Southwest), John Joseph (Naval Postgraduate School), Amy M. Farak and Joshua M. Frederickson, (Naval Undersea Warfare Center Division, Newport), Kenady Wilson (Ocean Associates Inc.), Charles Littnan (Pacific Island Fisheries Science Center), Hannah Bassett, Simone Baumann-Pickering, Greg Campbell, Amanda Cummins, Kait Frasier, Martin Gassman, Mary Grady, Tyler Helble, Liz Henderson, John Hildebrand, John Hurwitz, Sara Kerosky, Alex Kesaris, Matt Leslie, Sara Pfeil, Lauren Roche, Anne Simonis, Sean Wiggins and Lauren Williams (Scripps Institution of Oceanography, University of California San Diego), Vanessa James, Meggie Moore and David Stecker (Smultea Enviromental Sciences, LLC), David Weller (Southwest Fisheries Science Center), Dominique Camacho (Spatial Ecosystems Spatial Ecosystems), Thomas Kok, Stephen W. Martin and Lori Mazzuca (Space and Naval Warfare Systems Center Pacific), Bernd Würsig (Marine Mammal Research Program, Texas A&M University at Galveston), and Tori Cullins (Wild Dolphin Foundation).

EXECUTIVE SUMMARY

This report presents the U.S. Navy's Year Three level of effort, regulatory compliance, scientific accomplishments, and preliminary data obtained from marine mammal monitoring in the Hawaii Range Complex (HRC) and Southern California (SOCAL) Range Complex.

Year Three encompassed the period from 02 August 2010 to 01 August 2011. As outlined in the HRC and SOCAL Range Complex sections within this report, significant accomplishments were achieved from visual surveys; deployments of passive acoustic monitoring devices; marine mammal tagging, use of marine mammal observers; and leveraging of additional field efforts from several projects funded by multiple Department of the Navy organizations. Substantial data was collected, most of which is still undergoing analysis for use in a future 2012 or 2013 multi-year synthesis of results.

In general, the U.S. Navy met or exceeded its monitoring goals as stated in the Range Complex-specific Monitoring Plans modified through the 01 October 2010 HRC-SOCAL Monitoring Report to the National Marine Fisheries Service.

TABLE OF CONTENTS

TABLE OF CONTENTS (continued)

LIST OF TABLES

LIST OF FIGURES

LIST OF ACRONYMS

AMR	Adaptive Management Review
ASW	anti-submarine warfare
Bf	Beaufort
C2X	Composite Training Unit Exercise
CalCOFI	California Cooperative Oceanic Fisheries Investigation
CRC	Cascadia Research Collective
CREEM	Centre for Research into Ecological and Environmental Modelling
dB	decibel
DoN	Department of the Navy
EAR	Ecological Acoustic Recorder
EIS	environmental impact statement
ESA	Endangered Species Act
ft	feet
GPS	global positioning system
GUNEX	Gunnery Exercise, Surface-to-Surface
HARP	high-frequency acoustic recording package
HRC	Hawaii Range Complex
hrs	hours
IAC	Integrated Anti-submarine Warfare Course
ICMP	Integrated Comprehensive Monitoring Program
JTFEX	Joint Task Force Exercise
kHz	kilohertz
km	kilometer(s)
LOA	Letter of Authorization
m	meter(s)
M3R	Marine Mammal Monitoring on Navy Ranges
MDSU	Mobile Diving and Salvage Unit-1
MFAS	mid-frequency active sonar
MISSILEX	Missile Exercise, Surface-to-Surface
MMC	Marine Mammal Commission
MMO	marine mammal observer
MMPA	Marine Mammal Protection Act
MMRC	Marine Mammal Research Consultants
MTE	Major Training Exercise
nm	nautical mile(s)
nm^2	square nautical mile(s)
NMFS	National Marine Fisheries Service
NOAA	National Oceanographic and Atmospheric Administration
NPAL	North Pacific Acoustics Laboratory
NUWC	Naval Undersea Warfare Center
OEIS	overseas environmental impact statement
ONR	Office of Naval Research
PAM	passive acoustic monitoring
PIFSC	Pacific Islands Fisheries Science Center
PMAP	Protective Measures Assessment Protocol
PMRF	Pacific Missile Range Facility
PTS	permanent threshold shift
R/V	research vessel
RHIB	Rigid hull inflatable boat
RIMPAC	Rim of the Pacific Exercise
SCC	Submarine Commanders Course
SES	Smultea Environmental Sciences
SINKEX	Sinking Exercise
SIO	Scripps Institution of Oceanography
SOAR	Southern California Offshore Anti-submarine warfare Range
SOCAL	Southern California
SSC PAC	Space and Naval Warfare Systems Center Pacific
SUSTEX	Sustainment Exercise
SWFSC	Southwest Fisheries Science Center
TTS	temporary threshold shift
UNDET	Underwater Detonation
USWEX	Undersea Warfare Exercise

INTRODUCTION

Background

The U.S. Navy developed Range Complex-specific Monitoring Plans 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.

This report continues to provide range complex specific monitoring results for Year Three (02 August 2010 to 01 August 2011) within the Navy's Hawaii Range Complex (HRC) and Southern California (SOCAL) Range Complex.

The Range Complex Monitoring Plans were designed as a collection of focused "studies" to gather data that will attempt to address the following National Marine Fisheries Service (NMFS) questions which are described more fully in the previous NMFS' Letters of Authorizations (LOAs) and Navy Monitoring Plans:

1. Are marine mammals and sea turtles exposed to mid-frequency active sonar, especially at levels associated with adverse effects (i.e., based on NMFS' criteria for behavioral harassment, temporary threshold shift, or permanent threshold shift)? If so, at what levels are they exposed?

2. If marine mammals and sea turtles are exposed to mid-frequency active sonar, do they redistribute geographically as a result of continued exposure? If so, how long does the redistribution last?

3. If marine mammals and sea turtles are exposed to mid-frequency active sonar, what are their behavioral responses to various levels?

4. What are the behavioral responses of marine mammals and sea turtles that are exposed to explosives at specific levels?

5. Is the Navy's suite of mitigation measures for mid-frequency active sonar and explosives (e.g., Protective Measures Assessment Protocol and major exercise measures agreed to by the Navy through permitting) effective at avoiding temporary threshold shift, injury, or mortality of marine mammals and sea turtles?

Monitoring methods used for the Range Complex Monitoring Plans include a combination of research elements designed to support both Range Complex specific monitoring, and contribute information to a larger Navy-wide science-based program. The primary research elements include visual surveys from vessel or airplanes, passive acoustic monitoring (PAM), marine mammal observers (MMO), and marine mammal tagging. Each monitoring technique has advantages and disadvantages that vary temporally and spatially, as well as support one particular study objective better than another (e.g., DoN 2010a). The Navy uses a combination of techniques so that detection and observation of marine animals is maximized, and meaningful information can be derived to answer the research questions proposed above. Secondary techniques, such as photo-ID have been used on an increasing basis.

In addition to Fleet-funded Monitoring Plans described above, the Chief of Naval Operations Energy and Environmental Readiness Division (OPNAV N45) and the Office of Naval Research (ONR) have developed a coordinated Science & Technology and Research & Development program focused on marine mammals and sound. Total investment in this program has been greater than $150M over the past eight years. Several significant projects relative to Navy operational impact or lack of impact to marine mammals are currently funded and ongoing within the HRC and SOCAL Range Complexes. For example, in the SOCAL Range Complex, to leverage scientific expertise and funding availability, both U.S. Pacific Fleet and OPNAV N45 programs integrated certain elements of their programs to address the requirements as stated in the SOCAL Range Complex Monitoring Plan (see **Appendix A of SOCAL Range Complex section**).

Integrated Comprehensive Monitoring Program

The Integrated Comprehensive Monitoring Program (ICMP) provides the overarching framework for coordination of the U.S. Navy monitoring program (U.S. Navy 2010). It has been developed in direct response to Navy Range permitting requirements 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 and operating areas for which the Navy sought and received incidental take authorizations.

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 provided by the ICMP, consistent with availability of both funding and scientific resources. As a planning tool, the ICMP is a "living document." It will be routinely updated as the program matures. Initial areas of focus for maturing the document in 2010/2011 included further refinement of monitoring goals, adding a characterization of the unique attributes associated with each range complex / study area to aid in shaping future monitoring projects, as well as a broader description of the data management organization and access procedures.

The ICMP is evaluated annually through the Adaptive Management Review (AMR) process to: (1) assess progress, (2) provide a matrix of goals for the following year, and (3) make recommendations for refinement and analysis of the monitoring and mitigation techniques. This process includes conducting an annual AMR meeting at which the Navy and NMFS jointly consider the prior year goals, monitoring results, and related science advances to determine if modifications are needed to more effectively address monitoring program goals. Modifications to the ICMP that result from AMR discussions are incorporated by an addendum or revision to the ICMP. Official ICMP updates are provided to NMFS by 31 December annually (e.g., U.S. Navy 2010).

Under the ICMP, monitoring measures prescribed in range/project-specific monitoring plans and Navy-funded research relating to the effects of Navy training and testing activities on protected marine species should be designed to accomplish one or more of the following top-level goals as currently prescribed in the 2010 ICMP update (U.S. Navy, 2010):

(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 stressor(s) 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 species 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 (through improved technology or methodology), both specifically within the safety zone (thus allowing for more effective implementation of the mitigation) and in general, to better achieve the above goals. Improved detection technology resulting from these goals will be rigorously and scientifically validated prior to being proposed for mitigation, and meet practicality considerations (engineering, logistic, fiscal).

(f) A better understanding and record of the manner in which the authorized entity complies with the incidental take authorization and incidental take statement.

OPNAV (N45) is responsible for maintaining and updating the ICMP, as necessary, reflecting the results of future regulatory agency rulemaking, AMRs, best available science, improved assessment methodologies, and more effective protective measures. This is done in consultation with Navy technical experts, Fleet Commanders, and Echelon II Commands as appropriate, and as part of the AMR process.

Report Objectives

Design of the Range Complex Monitoring Plans represented part of a new Navy-wide assessment, and as with any new program, there are many coordinating, logistic, and technical details that continue to be refined. The scope of the original 2008 Range Complex Monitoring Plans was to discuss the background for monitoring as well as define initial procedures to be used in meeting study objectives derived from the NMFS-Navy agreements. Monitoring results are presented each

year to the NMFS and the next year's monitoring goals established based on the adaptive management process.

Overall, and in support of the above statement, this report has two main objectives:

1. Present data and results from the Navy-funded marine mammal and sea turtle monitoring conducted in the HRC and SOCAL Range Complex from 02 August 2010 to 01 August 2011.

Included in this assessment are reportable metrics of monitoring as requested by the NMFS. This Year Three report will focus mostly on summarizing collected data and providing a brief description of the major accomplishments from techniques used this year, while referring to the more technical discussions in various Appendices provided by the scientists who performed the monitoring work on the two Range Complexes.

2. Continue the adaptive management process by providing an overview of meetings and initiatives over the past year that support proposed revisions to the Navy's 2012 SOCAL Range Complex and HRC Monitoring Plans as well as presenting progress made towards development of a Strategic Plan for Navy Monitoring that has been facilitated by establishing a Scientific Advisory Group to review and provide recommendations on the Navy's monitoring program. Proposed changes primarily reflect input received from the scientific community and other stake holders. An overview of the events that have prompted these most recent adaptive management actions is provided in the following sections.

HAWAII RANGE COMPLEX

Monitoring in the Hawaii Range Complex

This section reports accomplishments from the Navy's marine species field monitoring efforts in the HRC. The HRC consists of 235,000 square nautical miles (nm^2) of surface and subsurface ocean areas and special use airspace for military training and research, development, testing and evaluation (RDT&E) activities. The HRC includes the Pacific Missile Range Facility (PMRF) on Kauai which is both a Fleet training range and a Fleet and Department of Defense (DoD) RDT&E range. The PMRF includes an instrumented range covering 1,020 nm^2 of ocean area at depths between 1,800 feet (ft) and 15,000 ft. Various subcomponents of the range complex are more fully described in the *Hawaii Range Complex Environmental Impact Statement/Overseas Environmental Impact Statement* (HRC EIS/OEIS; DoN 2008). Monitoring efforts are divided into two major categories – those field efforts implemented by the U.S Pacific Fleet as part of the HRC compliance monitoring, and those funded by the ONR and the Chief of Naval Operations Environmental Readiness Division. Reporting will primarily focus on the U.S. Pacific Fleet's compliance monitoring required under the Fleet's MMPA permit (LOA) and ESA consultation; however, highlights from the Navy's research monitoring are presented in Part III of this Section.

In the HRC Monitoring Plan, the Navy proposed to implement a diversity of field methods to gather field data from marine mammals and sea turtles in conjunction with training events. Studies were specifically designed to meet the questions outlined in the Introduction section of this document. Metrics (e.g., hours or events) were agreed to by the Navy and the NMFS and used as a goal for implementation.

During Study Year Three (02 August 2010 to 01 August 2011), U.S. Pacific Fleet implemented aerial and vessel surveys; embarked MMOs on Navy platforms; tagged a variety of cetaceans and pinnipeds; and deployed PAM devices. This work builds upon U.S. Pacific Fleet-funded fieldwork that has occurred in the Hawaiian Islands since the Rim of the Pacific (RIMPAC) Exercise in 2006.

HRC YEAR THREE (02 AUG 2010 TO 01 AUGUST 2011) MONITORING OBJECTIVES

The goal of the HRC Monitoring Plan as revised (DoN 2010a) is to implement field methods chosen to address the long-term monitoring objectives outlined in the Introduction. **Table H-1** from the final HRC Monitoring Plan shows the FY 2011 monitoring objectives agreed upon by the NMFS and the Navy.

The U.S. Pacific Fleet began conducting aerial and vessel surveys in conjunction with major exercises in 2006. Most aerial and vessel surveys from 2006 to 2008 were conducted only before and after, however, some vessel surveys were conducted during the event as well. These early surveys not only provided data points that will be used in future analysis, but they also provided proof-of-concept data for determining the feasibility of using diverse field methods in the HRC. Based upon lessons learned from those surveys and input from the NMFS, the Navy shaped the studies in the HRC Monitoring Plan with proven field methods that would provide visual and acoustic data to support scientific assessment on the potential effects from Navy training on marine species.

In the HRC Monitoring Plan, the Navy commited to use visual surveys (aerial and vessel) and marine mammal observers aboard Navy vessels during anti-submarine warfare (ASW) and explosive events to meet its goals. Navy also proposed to deploy and analyze data from passive acostic monitoring devices in 2010 and to purchase and deploy tagging devices.

Table H-1. Year Three monitoring commitments for the Hawaii Range Complex (DoN 2010a).

Monitoring Technique	Implementation	
Visual Surveys (aerial or vessel) STUDIES 1, 2, 3, 4, 5	120-160 hours before, during and after anti-submarine warfare (ASW) and/or explosives training events	Adaptive Management Review (AMR) for FY12
Marine Mammal Observers (MMO) STUDIES 1, 2, 3, 4, 5	MMO team aboard Navy surface platforms during 2 ASW and 6 explosive events	
Tagging STUDIES 1, 2, 3	Tag a goal of 15 individual marine mammals	
Passive Acoustic Monitoring (PAM) STUDIES 1, 2, 3	• 4 PAM devices deployed through the year. Begin data analysis. Continue collaboration of data collection and analysis from additional N45/ONR-funded autonomous PAM devices. • Continue use of the Pacific Missile Research Facility instrumented range hydrophones to gather and analyze marine mammal acoustic data.	

HAWAII YEAR THREE MAJOR TRAINING EXERCISE SUMMARY

Given the focus on monitoring around Navy at-sea training events, a list of major training events (MTEs), which occurred in the HRC between 02 August 2010 and 01 August 2011, is provided in **Table H-2**. Marine mammal sightings during MTEs are a form of compliance monitoring and represent substantial numbers of sightings. For the HRC, MTEs may include RIMPAC exercises, Undersea Warfare Exercises (USWEX), and Multi Strike Group Exercises.

Table H-2. Hawaii Range Complex major training events from 02 August 2010 to 01 August 2011.

MTE Type	Dates	# of Days	# of Ships Involved	# of Sea Turtle Sightings	# of Sea Turtles	# of Marine Mammal Sightings	# of Marine Mammals
Koa Kai	12-17 Nov 2010	5	5	0	0	10*	41
USWEX	15-22 Feb 2011	8	6	0	0	19*	46
Totals:		**13**	**11**	**0**	**0**	**29**	**87**

* One acoustic detection with no visual sighting

There were two MTEs in the HRC between 2 August 2010 and 1 August 2011 – one Koa Kai (similar in composition to a USWEX) and one USWEX. During transits and training events during those MTEs, Navy lookouts reported 29 marine mammal sightings for an estimated 87 marine mammals (**Table H-3**). There were 4 marine mammal sightings reported at a range less than 1000 yards (914 meters [m]) concurrent with mid-frequency active sonar (MFAS) use (**Table H-4**).

Table H-3. Total number of marine mammal and sea turtle sightings observed from Navy platforms during Hawaii Range Complex major training events from 02 August 2010 to 01 August 2011.

Species Type	# of sightings	% of total sightings	# of sea turtles or marine mammals	% of total number of sea turtles or marine mammals
Dolphins	4	13	36	43
Whales	22	71	43	51
Pinnipeds	0	0	0	0
Sea Turtles	0	0	0	0
Species not reported	5	16	5	6
Totals:	**31**	**100**	**84**	**100**

Table H-4. Number of marine mammal sightings at ranges less than 1,000 yards observed from Navy platforms during major training events concurrent with MFAS mitigation from 02 August 2010 to 01 August 2011 in the Hawaii Range Complex.

Mitigation Range	# of Sightings	Total Number of Marine Mammals	Breakdown by Species Type		
			# of Dolphins	# of Whales	# of Sea Turtles
< 200 yards	0	0	0	0	0
200-500 yards	1	1	0	1	0
500-1000 yards	3	32	30	2	0
Totals:	**4**	**33**	**30**	**3**	**0**

* Note that many mitigation ranges were not reported by the ships, so these numbers may be an under-representation of the totals in each category.

Ranges associated with potential NMFS criteria levels of permanent threshold shift (PTS) and temporary threshold shift (TTS) (215 and 195 dB re 1 µPa2-s, respectively) are much shorter than 200 yards (183 m). During the HRC MTEs this reporting period, there were no reported sightings of marine mammals or sea turtles at less than 200 yards (183 m) concurrent with MFAS use.

The three categories of mitigation measures (Personnel Training, Lookout and Watchstander Responsibilities, and Operating Procedures) outlined in the HRC EIS/OEIS (DoN 2008) and approved by the NMFS (NMFS 2010, 2011) were effective in detecting and appropriately mitigating exposures of marine mammals to MFAS. Fleet commanders and ship watch teams continue to improve individual awareness and enhance reporting practices. Additionally, a lookout effectiveness study was conducted by the Navy and provided data to demonstrate the effectiveness of the Navy's suite of mitigation measures.

HAWAII YEAR THREE MONITORING ACCOMPLISHMENTS

Marine species monitoring in conjunction with training events has been funded by U.S. Pacific Fleet since 2006. From 2006-2008, surveys focused on visual line transect surveys conducted before and after training events, collecting visual sighting data, photographs, video and behavioral observations. Aerial and vessel surveys were conducted during RIMPAC 2006 (Mobley 2006), USWEX (Cetos 2007, Mobley 2007, Mobley 2008a,b), and RIMPAC 2008 (Mobley 2008c, Smultea and Mobley 2008).

Monitoring during 2009 and 2010 expanded after the finalization of the HRC Monitoring Plan in early 2009. Novel approaches for conducting aerial surveys in close proximity to Navy training events were successfully implemented in 2009 and 2010, providing valuable behavioral observations while ASW was occurring. Additionally, data was collected by embarking marine mammal observers on Navy platforms; tagging Hawaiian monk seals; deploying PAM devices; and conducting aerial and vessel visual surveys (see DoN 2009, 2010b).

During 2011, U.S. Pacific Fleet implemented aerial and vessel surveys; embarked MMOs on Navy platforms; tagged pinnipeds and a variety of cetaceans; and deployed PAM devices. **Table H-5** presents a summary of Navy funded marine mammal monitoring within the HRC during Year Three.

Major Accomplishments from U.S. Pacific Fleet's Year Three Compliance Monitoring in the HRC:

- Visual (Vessel) Survey
    - A small vessel survey during November 11-23, 2010, covered an area of approximately 8,000 nm^2, in an area 80 nm south of Oahu, and 60 nm west of the Big Island (Hawaii). Marine species monitoring occurred before, during, and after the Koa Kai (a USWEX) 11-1 training event. The survey's purpose included investigating the occurrence, distribution, and behavior of target species (marine mammals and sea turtles) using vessel-based line-transect survey in waters adjacent to the area where the Navy exercise was occuring. See **Appendix B**: HDR EOC 2011.
    - A small vessel survey using the *M/V Searcher* was conducted during February 16-20, 2011 to Ka'ula and off the north shore of Kauai during and after SCC 11-1 which took place on the PMRF near Kauai. The primary goals of the survey were to study the presence of marine mammals, including Hawaiian monk seals, at Ka'ula, as well as to deploy satellite tags in order to contribute knowledge regarding how odontocetes are using the range complex and whether they are exposed to MFAS (see *Tagging accomplishments* section). Additionally, sightings of seabirds and marine mammals were recorded (no sea turtles were sighted). See **Appendix C**: Richie and Fujimoto 2011.
    - A small vessel survey was conducted on June 30, 2011 using the *M/V Searcher* to record sightings of seabirds and marine mammals offshore of Ka'ula Island and in the waters between Niihau and Kauai, including the PMRF areas W-186 and W-187. Objectives were to: (1) obtain cetacean dorsal fin photographs for individual identification purposes; (2) deploy a PAM device offshore to the east of the island; and (3) examine the NW shore of the island where Hawaiian monk seals had been sighted. A total of six marine mammal groups were sighted; three groups of bottlenose dolphins, one group of rough-toothed dolphins; one group of spinner dolphins, and two hauled-out Hawaiian monk seals on a short stretch of shoreline. No sea turtles were sighted. See **Appendix D**: Uyeyama et al. , 2011.
    - A small vessel survey during 20 July-8 August was cooperatively funded with the Naval Postgraduate School and N45, and was conducted by Cascadia Research Collective on and near the instrumented range at PMRF offshore Kauai in conjunction with the July SCC. The primary goals were to validate species identifications of acoustic detections by the M3R hydrophone array, as well as to deploy satellite tags in order to contribute knowledge regarding how odontocetes are using the range complex and whether they are exposed to MFAS (see *Tagging accomplishments* section).
- Visual (Aerial) Survey
    - Aerial surveys of the shorelines of the Hawaiian Islands and islets within the vicinity of the November 2010 Koa Kai-11 training event were performed on November 18 and 22, 2010. The objective of the aerial-based monitoring was to conduct coastline and pelagic surveys during and after training events in search of otherwise-undetected strandings. See **Appendix B**: HDR EOC 2011.

- Aerial surveys were conducted in conjunction with two training events during the period February 16 to March 5, 2011: (a) U.S. Navy Submarine Commander's Course (SCC) 11-1 naval training event on the PMRF instrumented range between Kauai and Niihau, Hawaii; and (b) Undersea Warfare Exercise (USWEX) training event south of Oahu and Molokai (**Appendix E**: Mobley 2011). These surveys also coincided with the Ka'ula vessel survey (see *Vessel Survey accomplishments* above) and the Marine Mammal Observers embarked upon a participating U.S. Navy Destroyer (see *Marine mammal observers accomplishments* below). Overall survey effort was divided into four parts as summarized below:

  - Ship follows, SCC event (February 16–18, 2011): involved flying elliptical orbits in front of the guided-missile destroyer (DDG) with the goal of finding target species in the vicinity of the DDG and observing and recording their behavior using focal follow methods.
  - Tagging-support transect surveys (February 19, 2011): to search for marine mammals in support of tagging effort by the Cascadia research group and Ka'ula vessel survey. This effort continued to demonstrate that during certain training events, contracted civilian aircraft may be used as a method for conducting behavioral monitoring of submerged and at-surface marine mammals.
  - Coastline surveys, post-SCC event (February 24 and 26, 2011): following the SCC event, the aircraft flew along the coastlines of Kauai, Niihau, and Ka'ula islands in search of otherwise-undetected marine mammal strandings.
  - Coastline surveys, post-USWEX event (February 28 and March 5, 2011): following the USWEX training event, the aircraft flew along the coastlines of Oahu, the Four Island Region (Maui, Molokai, Lanai, and Kahoolawe), and the Kona coast of the island of Hawaii.

- Passive Acoustic Monitoring
  - Four PAM devices were deployed in areas of the HRC where underwater detonations or anti-submarine warfare exercises may occur nearby.
  - As part of the June 30, 2011 monitoring effort off Ka'ula (see Visual (Vessel) Surveys above), an Ecological Acoustic Recorder (EAR) was deployed at a depth of 537 m east of Ka'ula Island. See **Appendix D**: Uyeyama et al. 2011. Three other EARs were deployed July 26, 2011 nearby, offshore the North, Southwest, and Eastern shores of Niihau at approximately 800 m.
  - Analysis of marine mammal acoustic data collected during FY10. An EAR deployed on July 17, 2010 (during marine species monitoring associated with RIMPAC 2010) at a depth of 800 m off the northwest coast of the island of Ni'ihau was recovered on December 21, 2010 (it had ceased recording on October 22). Beaked whales were detected daily. Most (approximately 87 percent) of the detections occurred at night, which is likely a reflection of the behavior of beaked whales responding to prey movements. Other species detected included the pilot whale, Risso's dolphin, sperm whale, and dolphins in the genus *Stenella*. Pilot whales had the highest number of detections, while beaked whales had the least number of detections. Of note was that the Risso's dolphin was the second most-detected toothed whale

species, while not consistently sighted in Hawaiian waters. See **Appendix F:** HDR/EOC and Au 2011.

- Marine Mammal Observers (MMO)
    - Three ASW training events were monitored: Koa Kai, SCC, and USWEX.
        - A four-person observer team (three Navy civilian MMO and one Navy contractor MMO) conducted the lookout effectiveness study duringthree ASW training events in the Hawaii Range Complex, Koa Kai 11-1 from 12-16 November 2010 (see **Appendix G**: Farak et al. 2011a), and two consecutive events, SCC and USWEX from from 15-22 February, 2011 (see **Appendix H**: Farak et al. 2011b). These MMOs were stationed aboard a U.S. Navy cruiser (CG-A) for Koa Kai, and a U.S. Navy destroyer (DDG-D) for SCC and USWEX. In addition to collection of lookout sighting data, detailed sighting data was collected including species identification, surfacings, and behavior.
        - Four explosive events (underwater detonations: UNDETs) were monitored: Two UNDETs each day during the 26-27 April training event conducted by Mobile Dive and Salvage Unit-1 (MDSU-1) in the Pu'uloa Underwater Training Range. MMOs observed for marine mammals and sea turtles as well as implementation of mitigation measures (**Appendix I**: Uyeyama and Richie 2011).
- Tagging
    - From February 16-20, 2011, CRC conducted research off the island of Kauai (see *Vessel Survey accomplishments* section) (See **Appendix J**: Baird et al. 2011; **Appendix D:** Richie and Fujimoto 2011). The three goals were: (1) photo-identification; (2) biopsy sampling; and (3) tagging to examine habitat use and movement patterns. *The R/V Searcher* and a rigid-hulled inflatable boat (RHIB) were used. Three individual short-finned pilot whales were satellite-tagged. Overall ranging patterns of the whales differed, with one individual moving to Oahu and back, while another moved further west.
    - Ten Hawaiian monk seals were instrumented with "cell phone" tags on Oahu, Kauai and Molokai continuing effort that began with eleven animals tagged in 2010. Of those tags, tracks were obtained from 13 animals – some are still deployed. Data are currently being analyzed to identify home ranges and core areas of use. (**Appendix M:** Wilson and Littnan, 2011.)
- Integration of historical monitoring data
    - The total of visual survey effort conducted for the marine species monitoring program in the HRC was integrated and summed as part of the initial phase of analyzing all years of the monitoring program. Aerial and vessel surveys on civilian and Navy assets from 2007-2011 were included, and the data incorporated into a geo-referenced database. Results included figures representing the layered sum of all survey tracklines as well as sightings by species. See **Appendix L:** Uyeyama 2011.

- **Navy Lookout Effectiveness Study**

  The U.S. Navy undertakes monitoring of marine mammals during Navy exercises and has mitigation procedures designed to minimize risk to these animals. One key component of this monitoring and mitigation is the shipboard lookouts (LOs, also known as watchstanders), who are part of the standard operating procedure that ships use to detect objects (including marine mammals) within a specific area around the ship during events. The watchstanders are an element of monitoring requirements specified by NMFS in the MMPA Letters of Authorization. The goal is to detect mammals entering ranges of 200, 500 and 1000 yards around the vessel, which correspond to distances at which various mitigation actions should be performed. In addition to the lookouts, officers on the bridge search visually and SONAR operators listen for vocalizations during anti-submarine warfare training. We refer to all of these observers together as the "observation team" (OT). The aim of this study is to determine the OT effectiveness in terms of detecting and identifying marine mammals. Of particular interest is the probability of an animal getting within a defined range of the vessel without being observed by the OT, as well as determining the accuracy of the OT (primarily the LO) in determining species group (whale, dolphin, etc.) group size and position. In order to achieve this, experienced MMOs search and collect information on marine mammals that both they and the OT detect.

  Work was previously conducted to design and test a protocol for determining the effectiveness of the LOs in visually detecting marine mammals. The field protocol for the experiments was developed in consultation with members of the Naval Undersea Warfare Center Division, Newport (NUWCDIVNPT); U.S. Fleet Forces Command; NAVFAC; Commander, U.S. Pacific Fleet; and NMFS. The basic concept is that trained Marine Mammal Observers (MMOs) are situated on board a vessel during daylight at-sea exercises, in locations where they can watch for marine mammals and communicate with one another, but not cue the LO. The MMOs then work to set up opportunistic trials, where they detect a surfacing of a marine mammal at a measured location, and record whether that surfacing was also detected (a successful trial) or not (an unsuccessful trial) by the LO.

  It was found to be necessary to have an additional "liaison" MMO (LMMO) stationed with the LO, and in communication with the other MMOs, to help report when and where LOs detected surfacings. It was also necessary to have an additional team member tasked solely with data recording. In addition to recording surfacing events, MMOs attempted to keep track of which surfacings belonged to the same school or animals. The revised protocol (Burt and Thomas 2010) was applied to one further at-sea exercise (off Southern California), making four datasets in total.

  In parallel with field protocol development, methods are being developed for using the data generated during these experiments to estimate the probability of animals entering the stand-off range undetected. An analysis method to allow for intermittent availability is also being developed, since many marine mammal species remain on (or close to) the surface for significant periods between dives, and so are "intermittently available" for detection. The extended methods currently only use information about the location of LO detections, but could conceivably be extended further to use information from the MMO LO trials. As a proof of concept both the instantaneous

and intermittent availability models to data collected in the at-sea experiments will be applied.

Recommendations for future data collection efforts 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, completed a proof of concept for detection functions, consultation with NMFS technical staff for input on analysis methods, and investment in continued refinement of the analytic methods and focus on additional data collection in 2011/2012.

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 becomes available other options for improving lookout training will be evaluated as appropriate.

- **Use of Instrumented Underwater Range Phones for PAM at Pacific Missile Range Facility**

  Analysis was conducted for a focused period during the February 2011 Submarine Commanders Course exercise (SCC) at Pacific Missile Range Facility (PMRF) (Marint and Kok, **Appendix N**). The focus period is between 05:58 and 07:39 HST on 17 February 2011 corresponds with a visual sighting made by marine mammal observers aboard the transmitting ship. This period covers mid frequency active sonar (MFAS) activity in the event termed miniwar III which involved one submarine participant, a U.S. Navy destroyer (DDG) equipped with the AN/SQS-53C sonar system, and two additional surface ships with other sonar systems. This focus period represents the first exposure analysis at PMRF for marine mammals during a SCC. Analysis is ongoing for other detections.

  Animal locations were obtained both from a visual sighting for a small group of unidentified whales and processing of passive acoustic data for one minke whale and one humpback whale. Positions, and estimated headings, of the DDG were obtained from PMRF exercise products. Full report (Appendix N) provides additional details of the exposure analysis, such as the equations used for the calculations, along with more in depth passive acoustic analysis for minke and beaked whales.

  The use of passive acoustics for monitoring during U.S. Navy training with MFAS activity shows promise in estimating exposure levels during exercises on instrumented ranges and can provide position data better than tags. Repeated localizations, such as the minke whale in this case, allows investigation of both spatial updates of the animals location with respect to the MFAS ship (swim speed, direction of travel) and details of the animals calls with MFAS activity nearby in space and time (e.g. call rates, types of calls, differences in call characteristics re. MFAS activity).

Table H-5. U.S. Navy-funded marine mammal monitoring accomplishments within the Hawaii Range Complex from 02 August 2010 to 01 August 2011.

Study Type	U.S. Navy EIS/LOA monitoring	Associated event type	U.S. Navy R&D funded monitoring	Associated event type	MMPA/ESA requirement	Total accomplished
Visual surveys (Studies 1,2,3,4,5)	1) 95.2 hrs – 11-23 Nov 2010 (vessel) 2) 14.1 hrs – 18-22 Nov 2010 (aerial) 3) 46.1 hrs – 16 Feb – 5 Mar 2011 (aerial) 4) 60.2 hrs 15-20 Feb (vessel) 5) 11.5 hrs Ka'ula survey 30 June 6) 72.7 hrs PMRF pre-SCC July/Aug (vessel)	1) Koa Kai (ASW) 2) Koa Kai (ASW) 3) SCC & USWEX (ASW) 4) SCC (ASW) 5) n/a 6) SCC (ASW)	Use of M3R array at PMRF for validation of species ID, animal localization February (baseline and during SCC) and July 2011.	SCC	120- 160 hours before, during and after ASW and/or explosives training events	299.8 hours of aerial and vessel surveys
Marine Mammal Observers (Studies 1,2,3,4,5)	1) 140.5 hrs - 12-17 Nov 2010 2) 118.0 hrs - 15-18 Feb 2011 3) 124.0 hrs - 19-22 Feb 2011 4) 11 hrs - 26-27 Apr 2011	1) Koa Kai (ASW) 2) SCC (ASW) 3) USWEX (ASW) 4) Underwater detonations	n/a	n/a	MMO team aboard Navy surface platforms during 2 ASW and 6 explosive events. (make up for FY10 shortfall of 1 ASW event)	3 ASW events and 4 explosive events. (Note: extra ASW event covers shortfall from next year.) *Note: Lookout effectiveness for 2 explosive events with MDSU-1 originally planned for July 2011 rescheduled and accomplished 10 Aug 2011*
Tagging (Studies 1,2, 3)	1) 10 Hawaiian monk seals tagged 2) 3 cetaceans tagged (pre-SCC Cascadia Research Collective effort off Kauai; 16-20 Feb) 3) 2 tag deployed in conjunction with M3R Jul -Aug 2011 (one successful)	1) ULT (ASW) 2) SCC (ASW) 3) USWEX (ASW)	Use of M3R array at PMRF for validation of species ID, animal localization February (baseline and during SCC) and July 2011.	SCC	Tag a goal of 15 individual marine mammals (make up for FY10 shortfall of 4 tags)	10 Hawaiian monk seals tagged); 4 cetaceans tagged (additional one deployed but fell off) Continuing analyses of tag data from FY 10 monitoring

Study Type	U.S. Navy EIS/LOA monitoring	Associated event type	U.S. Navy R&D funded monitoring	Associated event type	MMPA/ESA requirement	Total accomplished
Passive Acoustic Monitoring (Studies 1, 2, 3)	1) 1 EAR deployed at Ka'ula; 30 June 2) 3 EAR deployments in vicinity of Kauai and Niihau, 26 July 3) Continue use of PMRF hydrophones to gather and analyze marine mammal acoustic data in conjunction w/ SCC.	SCC (ASW)	Use of M3R array at PMRF for validation of species ID, animal localization February (baseline and during SCC) and July 2011.	SCC	4 PAM devices deployed through the year. Begin data analysis. Continue collaboration of data collection and analysis from additional N45/ONR-funded autonomous PAM devices. Continue use of the Pacific Missile Range Facility (PMRF) instrumented range hydrophones to gather and analyze marine mammal acoustic data.	Deployment of 1 EAR near Ka'ula ; Deployment of 3 EARS near Kauai/Niihau Analysis of 2 EARS from near Niihau, 4 near Oahu (historical) and 2 near Kauai (historical) Use of PMRF hydrophones to gather and analyze marine mammal acoustic data in conjunction w/ SCC.

Metrics Met or Exceeded

Visual Surveys: Over 213 hours of visual surveys (vessel and aircraft platforms) were conducted in conjunction with trainin events . This exceeded by more than 50 percent, the 120-160 hours of survey effort before, during, and after ASW and/or explosive events commited to in the HRC monitoring plan covering the period of 02 August thru 01 August 2011.

Marine Mammal Observers: The HRC Monitoring Plan for FY 2011 and the HRC LOA for 2011 calls for an MMO team aboard Navy surface platforms during 2 ASW events. An MMO team embarked during 3 ASW events, the extra event compensating for the shortfall of 1 ASW event in FY 2010.

Tagging: Fifteen individual marine mammals were tagged from 02 August thru 01 August 2011.

Metric Shortfalls

Marine Mammal Observers: The HRC Monitoring Plan for FY 2011 and the HRC LOA for 2011 calls for an MMO team aboard Navy surface platforms during 6 explosive events. Due to an event cancellation, MMO teams embarked during only 4 underwater detonations by the July 31 cutoff, for a shortfall of 2. These two additional events were monitored by an MMO team a few weeks later on August 10, 2011. Therefore this shortfall will be satisfied by the August 10 effort when these events are tabulated for FY12.

Tagging: The Navy's goal was to tag a total of 19 marine mammals, 15 from the FY11 goals, as well as to compensate for a shortfall of 4 tags from FY10. However 15 tags were expended on attempted deployments, 14 successfully, therefore considering the shortfall from FY10, there was an overall shortfall of 4 tags in FY11. The 15 tags for FY11 include: 10 cell phone tags deployed on Hawaiian monk seals by NMFS, and 5 satellite tags (4 successful deployments) by Cascadia Research Collective on two separate field efforts in February and July 2011. The latter effort by CRC encountered unusually difficult summer weather conditions, and despite being vectored to animals by the M3R hydrophone array, more tags were not deployed by the July 31 deadline. However, CRC successfully deployed two additional tags after the deadline durng the same field effort, and these will be counted towards FY12 monitoring accomplishments.

OTHER NAVY-FUNDED RESEARCH IN HAWAII

There were also additional marine protected species research efforts within the HRC that were funded by OPNAV N45 and ONR. ONR funded several projects in the HRC that are related to the U.S. Pacific Fleet's monitoring goals which are summarized below.

1) *Passive Acoustic Methods/Tracking* (Eva Nosal, Dept. of Ocean & Resources Engineering, University of Hawaii). Funded in part by ONR.

   Passive Acoustic Methods for Tracking Marine Mammals Using Widely-Spaced Bottom-Mounted Hydrophones. (ONR Award N00014081142). The main objective of this project is to develop and implement methods to deal with two specific challenges associated with tracking marine mammals using widely-spaced bottom-mounted hydrophone arrays: (1) Multiple animals whose calls cannot be easily separated or associated, and (2) Insufficient receiver coverage, in which case standard time-of-arrival (TOA) tracking methods fail. The main effort is directed toward data collected at Navy Ranges (PMRF and AUTEC). The main species of interest in these datasets are sperm whales, beaked whales, minke whales, and humpback whales. *Ecological Acoustic Recorders* (Whitlow Au and Marc Lammers, Hawaii Institute of Marine Biology), Funded by ONR

   EARs have been deployed from February 2009 to the present time around Oahu and from February 2009 until April 2011 around Kauai. The effort at Kauai has concentrated on deep-diving beaked whales. Since April 2011, EARs in the waters of Kauai have been deployed along the southern coast. With funding support from Pacific Fleet, acoustic data recorded by EARs deployed at various locations around Oahu and Kauai were analyzed for various type of sounds including ambient noise, boat sounds, mid-frequency sonar emissions, dolphins and whales. See **Appendix K**.

   The project received an M3R node in late August 2010which is currently being used to process the data from Kauai and for the EAR off Barbers Point, Oahu, which is at a depth of 581 m. The M3R system is designed to detect both Blainville's and Cuvier's beaked whales. Eventually all the EAR data will be analyzed with the M3R node. *Hearing and Echolocation of Odontocetes* (Paul Nachtigall et al., Hawaii Institute of Marine Biology), Funded by ONR.

   Paul Nachtigall's team of researchers and students published results on the audiogram of a sub-adult Blainville's beaked whale that stranded on the island of Maui in August 2010, The team also worked to build a rugged field-ready portable battery-operated system to use to measure the hearing capabilities of marine mammals in the lab, on ships, on the beach or wherever the opportunity arises. Additional work included finalized publications on dolphin hearing during echolocation (which was referred to in the 2010 HRC monitoring report).

   Related publications: Kloepper et al. 2010; Li et al. 2011; Pacini et al. 2011.

HRC ADAPTIVE MANAGEMENT AND 2012 MONITORING PLAN

Adaptive management is an iterative process of optimal decision making in the face of uncertainty, with an aim to reducing uncertainty over time via system monitoring. Within the natural resource management community, adaptive management involves ongoing, real-time learning and knowledge creation, both in a substantive sense and in terms of the adaptive process itself. Adaptive management focuses on learning and adapting, through partnerships of managers, scientists, and other stakeholders who learn together how to create and maintain sustainable ecosystems. Adaptive management helps science managers maintain flexibility in their decisions, knowing that uncertainties exist and provides managers the latitude to change direction will improve understanding of ecological systems to achieve management objectives; and is about taking action to improve progress towards desired outcomes.

A 2010 Navy-sponsored monitoring meeting in Arlington, VA initiated a process to critically evaluate the current Navy monitoring plans and begin development of revisions/updates to both existing region-specific plans as well as the Integrated Comprehensive Monitoring Program (ICMP). Discussions at that meeting as well as the following Navy/NMFS annual adaptive management meeting (Oct 2010) established a way ahead for continued refinement of the Navy's monitoring program. This process included establishing a Scientific Advisory Group (SAG) of leading marine mammal scientists with the initial task of developing recommendations that would serve as the basis for a Strategic Plan for Navy monitoring. The Strategic Plan 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 Letter of Authorization regulatory requirements. The objective of the Strategic Plan is to continue the evolution of Navy marine species monitoring towards a single integrated program, incorporating SAG recommendations, and establishing a more transparent framework for soliciting, evaluation, and implementing monitoring work across the Fleet range complexes. The Strategic Plan is currently being developed in coordination with NMFS HQ and Marine Mammal Commission (MMC) input and will establish the process for soliciting, reviewing, and selecting the most appropriate monitoring projects to invest in across the Navy. It is anticipated that some current efforts will continue but the level of effort and investment may be allocated differently across Navy Ranges.

Originally, five study questions were developed between NMFS and the Navy as guidance for developing monitoring plans (as presented in the Introduction), and all existing range-specific monitoring plans attempted to address each of these study questions. 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 Navy monitoring program has historically been compartmentalized by range-complex and focused on effort-based metrics (survey days, trackline covered, etc.).

Navy established the SAG in 2011 with the initial task of evaluating current Navy monitoring approaches under the ICMP and existing LOA's to develop objective scientific recommendations that would form the basis for the Strategic Plan. While recommendations were fairly broad and not prescriptive from a range complex perspective, the SAG did provide specific programmatic

recommendations that serve as guiding principles for the continued evolution of the Navy Marine Species Monitoring Program and provide a direction for the Strategic Plan development. The meeting resulted in refinement of the five study questions of the ICMP into six study goals, as earlier described in detail in the Background section of the Introduction of this report. The SAG also provided three general recommendations that apply broadly across the Navy's monitoring program:

- Transparency, collaboration, and data accessibility;
- Specific Programmatic recommendations in four key areas: (1) overall monitoring objectives and scope; (2) operational methodology; (3) data analysis and integration; and (4) procedural logistics.
- The importance of monitoring the effects of all types of training exercises, including low-frequency active sonar and explosives.

Specific to the HRC, the SAG recommended a broad suite of monitoring for this area including passive acoustic monitoring, and non-systematic surveys incorporating biopsy, tagging and photo-identification studies. It was noted that the fixed hydrophone array off Kauai allows for acoustic monitoring and would provide potential synergy with boat-based monitoring efforts. In June 2011, the Navy hosted a Marine Mammal Monitoring Workshop with guidance and support from NMFS that included scientific experts and representatives of environmental non-governmental organizations (NGOs). The purpose of the workshop was to present a consolidated overview of monitoring activities accomplished in 2009 and 2010 pursuant to the Final Rules currently in place, including the SAG review, outcomes of selected monitoring-related research and lessons learned, and to seek feedback on future directions. A significant outcome of this workshop was to continue consolidating monitoring efforts from individual range complex plans and develop a single Strategic Plan for Navy Monitoring that will improve the return on investment by focusing specific objectives and projects where they can most efficiently and effectively be addressed throughout the Navy range complexes. The Strategic Plan is currently in development and will be incorporated as a primary component of the ICMP.

Results of recent meetings, recommendations from the SAG as well as success and challenges in the field are under review and will be further discussed with NMFS at the annual adaptive management meeting in October 2011. Results will be used to revise and improve the monitoring progam in the coming years, while maintaining the same level of effort. Therefore, other than adding more flexible language to the PAM section, no changes are being recommended for the 2012-2014 LOA Renewal period at this time (see **Table H-6**). Once review of current monitoring methods and metrics are completed, they will be incorporated into revised monitoring plans.

Table H-6. 2012-2014 Monitoring Commitments

Monitoring Technique	Implementation	
Visual Surveys (aerial or vessel)	120-160 hours before, during and after ASW and/or explosives training events	Adaptive Management Review (AMR) for FY12
Marine Mammal Observers (MMO)	MMO team aboard Navy surface platforms during 2 ASW and 6 explosive events	
Tagging	Tag a goal of 15 individual marine mammals	
Passive Acoustic Monitoring (PAM)	• Utilize a combination of autonomous recording devices, and/or sonobuoys and/or towed arrays to gather acoustic data. Continue collaboration of data collection and analysis from additional N45/ONR-funded autonomous PAM devices. • Continue use of the Pacific Missile Range Facility instrumented range hydrophones to gather and analyze marine mammal acoustic data.	

LITERATURE CITED

Baird, R. W., G. S. Schorr, D. L. Webster, S. D. Mahaffy, J. M. Aschettino, and T. Cullins. 2011. Movements and Spatial Use of Satellite-tagged Odontocetes in the Western Main Hawaiian Islands: Results of Fieldwork Undertaken off O'ahu in October 2010 and Kaua'i in February 2011. Annual progress report under Grant No. N00244-10-1-0048 from the Naval Postgraduate School

Burt, M.L. and Thomas, L. 2010. Calibrating US Navy lookout observer effectiveness. Information for Marine Mammal Observers. Version 2.1. Prepared for Department of the Navy.

Cetos. 2007. Marine Mammal and Sea Turtle Monitoring Survey in Support of Navy Training Exercises in the Hawai'i Range Complex November 11-17, 2007. Final Field Summary Report. Prepared by: Cetos Research Organization, Oakland, CA, under Contract No. N62742-07-P-1915, Naval Facilities Engineering Command Pacific. EV2 Environmental Planning, Pearl Harbor, HI. Authors: Smultea, M.A., J.L. Hopkins, A.M. Zoidis. January 30, 2008.

DoN. 2008. Hawaii Range Complex: Final Environmental Impact Statement/Overseas Environmental Impact Statement (EIS/OEIS). May 2008.

DoN. 2009. Marine Mammal Monitoring for the U.S. Navy's Hawaiian Range Complex (HRC) and Southern California (SOCAL) Range Complex - Volume 1 Annual Report 2009. Authors: Chip Johnson and Julie Rivers. Department of the Navy, United States Pacific Fleet.

DoN. 2010a. Hawaii Range Complex Year Three Monitoring Plan and Adaptive Management Discussion for the period 02 August 2010 to 01 August 2011. Draft Plan, October 2010.

DoN. 2010b. Marine Mammal Monitoring for the U.S. Navy's Hawaii Range Complex and Southern California Range Complex - Annual Report 2010. Department of the Navy, U.S. Pacific Fleet. Authors: Julie Rivers and Chip Johnson.

Farak, A., M.W. Richie, J.A. Rivers, and R.K. Uyeyama. 2011a. Cruise Report, Marine Species Lookout and Effectiveness Study: Koa Kai, November 2010, Hawaii Range Complex. Prepared for Commander, U.S. Pacific Fleet.

Farak, A., T. Jefferson, J. Rivers, and R. Uyeyama. 2011b. Cruise Report, Marine Species Monitoring and Lookout Effectiveness Study: Submarine Commanders Course 11-1 and Undersea Warfare Exercise, February 2011, Hawaii Range Complex. Prepared for Commander, U.S. Pacific Fleet.

HDR EOC Inc. 2011. Koa Kai-11 Marine Species Monitoring Surveys, Vessel- and Aerial-based Monitoring Surveys, November 2010. Final Report. Prepared for Department of the Navy. June 2011.

HDR EOC Inc., and W.W.L. Au. 2011. Preliminary Results from a Deep-water Ecological Acoustic Recorder (EAR) deployed off NW Ni'i hau during RIMPAC-2010. Prepared for NAVFAC PAC.

Kloepper, L. N., P. E. Nachtigall, R. Gisiner, and M. Breese. 2010. Decreased echolocation performance following high-frequency hearing loss in the false killer whale (*Pseudorca crassidens*). Journal of Experimental Biology 213:3717-3722.

Li, S., P. E. Nachtigall, and M. Breese. 2011. Dolphin hearing during echolocation: Evoked potential responses in an Atlantic bottlenose dolphin (*Tursiops truncatus*). Journal of Experimental Biology 214:2027-2035.

Martin, S. and T. Kok. 2011. Report on analysis for marine mammals before, during and after the Feb 2011 Submarine Commanders Course training exercise. Prepared 8 Sept 2011.

Mobley, J.R., Jr. 2006. Results of 2006 RIMPAC Aerial Surveys of Marine Mammals in Kaulakahi and Alenuihaha Channels. Final Report submitted to Environmental Division, Commander, U.S. Pacific Fleet, 12 pp.

Mobley, J.R., Jr. 2007. Aerial Surveys of Marine Mammals Performed in Support of USWEX Exercises Nov. 11-17, 2007. Final Report submitted to Environmental Division, Commander, U.S. Pacific Fleet, 10 pp.

Mobley, J. R., Jr. 2008a. Aerial Surveys of Marine Mammals Ferformed in Support of USWEX Exercises: March 23-30, 2008. Final Report submitted to Environmental Division, Commander, U.S. Pacific Fleet, 10 pp.

Mobley, J. R., Jr. 2008b. Aerial Surveys of Marine Mammals Performed in Support of USWEX Exercises May 26-27 & June 2-4, 2008. Final Report submitted to Environmental Division, Commander, U.S. Pacific Fleet, 7 pp.

Mobley, J.R., Jr. 2008c. Aerial Surveys of Marine Mammals and Sea Turtles Performed in Conjunction with RIMPAC 2008 Exercises Between Kauai and Niihau, Hawaii July 13-17, 2008. Final Report submitted to Environmental Division, Commander, U.S. Pacific Fleet, 10 pp.

Mobley, J. R., Jr. 2011. Aerial Survey Monitoring for Marine Mammals and Sea Turtles in the Hawaii Range Complex in Conjunction With Two Navy Training Events. SCC February 16 - March 5, 2011. Final Field Report.

NMFS. 2010a. Letter of Authorization for U. S. Navy Training in the Hawaii Range Complex, January 15 2010, through January 14, 2011.

NMFS. 2011. Letter of Authorization for the Hawaii Range Complex. Period January 15, 2011, through January 14, 2012.

Pacini, A. F., P. E. Nachtigall, C. T. Quintos, T. D. Schofield, D. A. Look, G. A. Levine, and J. P. Turner. 2011. Audiogram of a stranded Blainville's beaked whale (*Mesoplodon densirostris*) measured using auditory evoked potentials. Journal of Experimental Biology 214:2409-2415.

Richie, M.W., and J. Fujimoto. 2011. Ka'ula / Kaua'i Field Report, HRC Marine Species Monitoring, February 15-20, 2011. Prepared for Commander, U.S. Pacific Fleet by Naval Facilities Engineering Command, Pacific.

Smultea, M., and J.R. Mobley, Jr. 2008. Vessel Surveys of Marine Mammals and Sea Turtles Performed in Conjunction with RIMPAC 2008 Exercises Between Kauai and Niihau, Hawaii July 12-17, 2008. Final Report submitted to Environmental Division, Commander, U.S. Pacific Fleet, 31 pp.

Uyeyama, R.K., and M.W. Richie. 2011. Final Cruise Report, Marine Mammal Observer UNDET Monitoring Hawaii Range Complex, 26-27 April, 2011. Prepared for Commander, U.S. Pacific Fleet by Naval Facilities Engineering Command, Pacific.

Uyeyama, R.K., M.W. Richie, K.L. Winters, and J. Fujimoto. 2011. Ka'ula Island Ship-based Marine Mammal Survey June 30, 2011, Hawaii Range Complex. Final Report. Prepared for Commander, U.S. Pacific Fleet by Naval Facilities Engineering Command, Pacific.

Uyeyama, R.K. 2011. Summary Report: Compilation of Total Visual Survey Effort and Sightings for Marine Species Monitoring in Hawaii Range Complex, 2007-2011. Prepared for Commander, U.S. Pacific Fleet by Naval Facilities Engineering Command, Pacific. 31 August. 30 pp.

Wilson, K., and C. Littnan. 2011. Habitat Use and Behavioral Monitoring of Hawaiian Monk Seals in Proximity to the Navy HRC. Project Annual Report for August 2010 to July 2011.

END OF HRC SECTION

SOUTHERN CALIFORNIA RANGE COMPLEX

Monitoring in the Southern California Range Complex

This section reports results from the Navy's Year Three field monitoring efforts in the Southern California Range Complex from 02 August 2010 to 01 August 2011.

The Navy fully implemented the monitoring plan outlined in the Navy's 2009 Year Two Monitoring Report to NMFS (DoN 20106) and specified in the Navy's subsequent 2010 Letter of Authorization renewal application for study Year Three from 02 August 2010 to 01 August 2011 within the Southern California Range Complex. Monitoring efforts were funded by the Navy's U.S Pacific Fleet as required for compliance monitoring under the Navy's annual Letter of Authorization. Additional marine mammal monitoring within Southern California, part of a larger research program, was funded by the Energy and Environmental Readiness Division of the Chief of Naval Operations. Some results from this research monitoring with complementary objectives as Navy's compliance monitoring are presented in this report, where applicable. Monitoring fieldwork in the Southern California Range Complex was performed by civilian scientific organizations and companies with significant experience in ocean monitoring for marine species. These include Scripps Institute of Oceanography, Smultea Environmental Services, Cascadia Research Collective, and National Marine Fisheries Service's Southwest Fisheries Science Center. Experienced civilian field biologists from various Navy commands participated in the marine mammal observer event.

Monitoring accomplished in Year Three within the offshore waters of Southern California included aerial and vessel visual marine mammal and sea turtle surveys, the embarkation of marine mammal observers on a Navy surface ship, and passive acoustic marine mammal monitoring from multiple bottom-mounted acoustic recording packages.

Report Organization

This report is organized to summarize the Navy's monitoring commitments and Year Three accomplishments within the Southern California Range Complex. Specific subsections include:

- Visual Survey Results
- Marine Mammal Observers (MMO)
- Passive Acoustic Monitoring (PAM)
- Southern California Range Complex Exercise Summary
- Other Navy Funded Research Results- Other visual surveys, marine mammal tagging, Marine Mammal Mitigation on Navy Ranges (M3R), and photographic identification (PhotoID).

6 DoN. 2010. Marine Mammal Monitoring For the U.S. Navy's Hawaii Range Complex and Southern California Range Complex-2010 Annual Report. Department of the Navy, U.S. Pacific Fleet. 582 pp.

Year Three Monitoring Locations

While all nearshore and offshore ocean areas within Southern California Range Complex are acceptable for monitoring depending on the technique being used, certain portions of the range complex were designated as "focal areas" based on scientific merit for study in that location, logistics of being able to safely reach the site especially for shore-base airplane surveys, proximity to key Navy training areas, and previous field experience from past Navy monitoring in 2009 and 2010.

Figure S-1 shows the general Southern California focal areas surveyed the most during Year Three (from 02 August 2010 to 01 August 2011). The Navy added a fourth focal area for Year Three monitoring within the Southern California Range Complex. This forth area located closer to San Diego was primarily focused on visual survey.

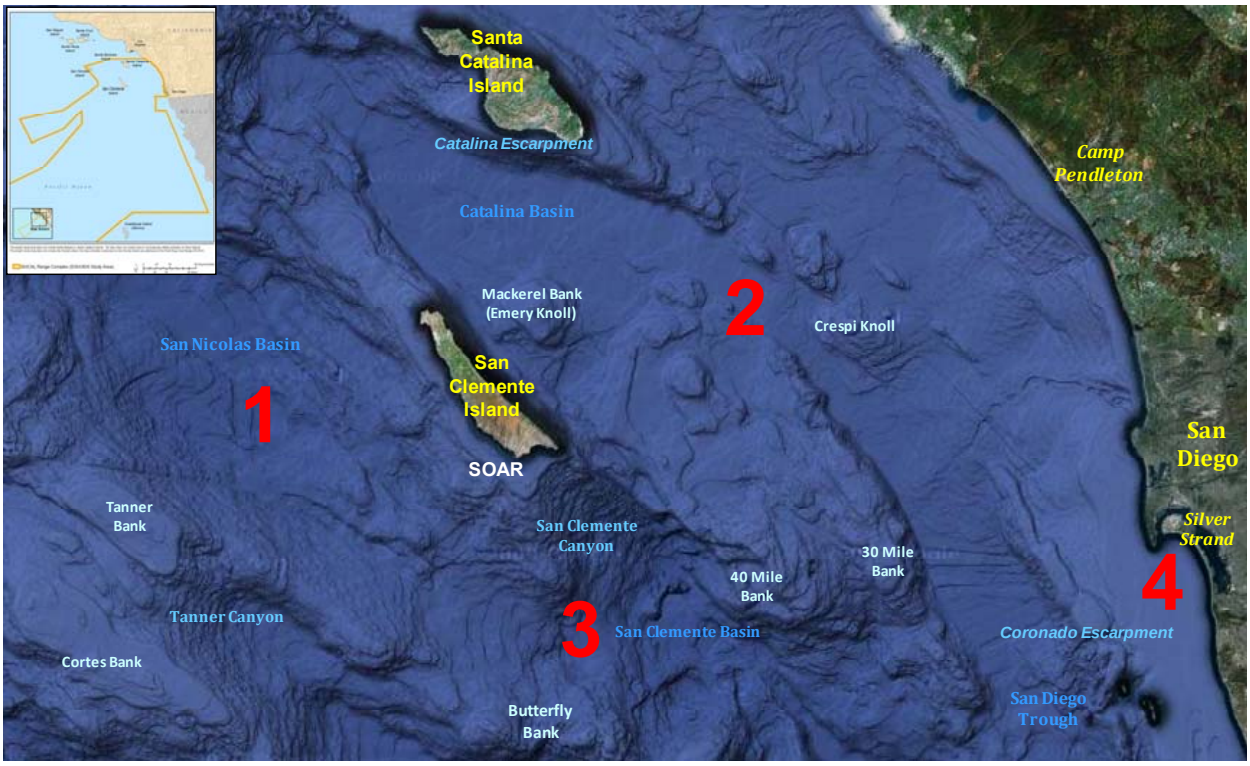


Figure S-1. Study focal areas for Year Three monitoring within the Southern California Range Complex.

Oceanographic Conditions

The Navy's previous 2009 and 2010 Monitoring Reports discussed the importance of regional oceanographic conditions on potential marine mammal occurrence within Southern California (DoN 20097, DoN 2010). These include the El Niño (warm water regime) and La Niña (cold water regime) oscillations, the longer term Pacific Decadal Oscillation, and global climate change. While the Navy's 2009 Monitoring Report highlighted these changes from 1950 to 2009 (DoN 2009), **Figure S-2** instead shows an updated summary of Pacific sea surface temperatures as an indicator of oceanographic condition covering the period from 2008 through 2011, with the Navy's Year Three range complex monitoring period indicated in **Figure S-2** by the dashed lines around the appropriate months.

Eastern Pacific Warm and Cold Water Periods 2008-2011

DESCRIPTION: Warm (red) and cold (blue) episodes based on a threshold of +/- 0.5°C for the Oceanic Niño Index (ONI) [3 month running mean of ERSST.v3b SST anomalies in the Niño 3.4 region (5°N-5°S, 120°-170°W)], based on the 1971-2000 base period. 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.
From: National Weather Service Climate Prediction Center
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	-1.4	-1.4	-1.1	-0.8	-0.6	-0.4	-0.1	0.0	0.0	0.0	-0.3	-0.6
2009	-0.8	-0.7	-0.5	-0.1	0.2	0.6	0.7	0.8	0.9	1.2	1.5	1.8
2010	1.7	1.5	1.2	0.8	0.3	-0.2	-0.6	-1.0	-1.3	-1.4	-1.4	-1.4
2011	-1.3	-1.2	-0.9	-0.6	-0.2	0						

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 S-2. Warm and cold ocean temperature episodes base on Oceanic Niño index as a predictor of El Niño and La Niña oceanographic conditions within SOCAL from 2009 to 2011.

During Year Three monitoring, there were lowered sea surface temperatures from August 2010 through May 2011 indicative of a cool water La Niña condition. Current indications through summer of 2011 indicate a return to an El Niño\La Niña neutral condition.

7 DoN. 2009. Marine Mammal Monitoring for the U.S. Navy's Hawaii Range Complex and Southern California Range Complex-2009 Annual Report. Department of the Navy, U.S. Pacific Fleet. 582 pp

SOUTHERN CALIFORNIA RANGE COMPLEX YEAR THREE MONITORING ACCOMPLISHMENTS

To assess the Year Three SOCAL Range Complex monitoring, each monitoring objective in this year's effort is presented along with discussions of accomplishments, metrics of completion, scientific contribution, and overall value to the monitoring program. Following a brief summary, individual subsections will discuss each monitoring subject. Longer field reports from various researchers are either included within these subsections, or placed in an accompanying appendix if lengthy.

Year Three monitoring objectives include reporting annual results from:

- Visual Surveys
- Marine Mammal Observers
- Passive Acoustic Monitoring
- Southern California Range Complex Navy Exercise Summary
- Other Navy Funded Research Results- visual surveys, marine mammal tagging, passive acoustic monitoring, photographic identification (PhotoID), and population assessments

Year Three Overview

Tables S-1 and S-2 compares the Navy's Year Three monitoring accomplishments in terms of regulatory commitments to the National Marine Fisheries Service.

Table S-1. Overview of Navy compliance with monitoring requirements in the Southern California Range Complex.

Type of Monitoring	2011 Planned Monitoring as Committed To By The Navy	2011 Completed Year Three Monitoring Accomplishment
Compliance Funded Monitoring Visual survey	100-150 hours effort	1,001 hours of effort completed
Marine Mammal Observers	50-100 hours of effort	83 hours of effort completed
Passive Acoustic Monitoring	Continue data analysis from passive acoustic devices	20,704 hours recorded
Navy Exercise Summary	Present marine mammal sighting results from Navy major training exercises	428 sightings of approximately 5,848 marine mammals
Other Navy Funded Research Summaries	Present results for other Navy funded research projects as available (tagging, photoID, visual, passive)	14 satellite tags deployed during Year Three; provided in this report

Table S-2. Summary of Navy funded monitoring accomplishments within the Southern California Range Complex from 02 August 2010 to 01 August 2011.

Monitoring Study Type	U.S. Navy Fleet funded Compliance monitoring	Associated Navy training event	U.S. Navy funded Research monitoring	Associated Navy training event	Total YEAR Three (2010-2011) accomplished
Visual Surveys (VS)	28 hrs (A) 23-29 Sept 10	During/After MTE	57.5 hrs (R) 4-11 Jan 11	No MTE	**1,001 hours visual survey**
	17 hrs (A) 14-19 Feb 11	Before/During/After MTE	48.5 hrs (R) 4-11 Jan 11	No MTE	
	9.5 hrs (A) 29 Mar - 3 Apr 11	No MTE	59.3 hrs (R) 30 April – 7 May 11	Before/During MTE	
	46 hrs (A) 12- 19 Apr 11	No MTE	56.1 hrs (R) 1-7 May 11	Before/During MTE	
	27 hrs (A) 9-14 May 11	During MTE	46.1 hrs (R) 18 – 23 June 11 40.1 hrs (R) 21-25 July 11 111 hrs (R) 30 July 10 - 26 April 11 455 hrs (S) 30 July 10 - 26 April 11	No MTE No MTE Multiple Multiple	
Marine Mammal Observers (MMO)	83 hrs 4-7 April 11	During ULT	Not applicable	Not applicable	**83 hours of MMO**
Marine Mammal Tagging (MMT)	Not applicable	Not applicable	14 LIMPET satellite tags 4-11 Jan 11 30 April – 7 May 11 18-23 June 11 5 fin, 1 sei/fin, 1 Baird's beaked whale, 2 Risso's, 1 killer whale, 1 sperm whale, 3 Cuvier's beaked whale	No MTE Before/During MTE No MTE	**14 tags**
Passive Acoustics Monitoring (PAM)	2 Pacific Fleet Funded PAM devices (SIO's HARP) April 2010 to April 2011 15,878 hrs recorded	Not applicable	M3R on Navy instrumented range west of San Clemente Island continued field validation 2010, 2011	Before\ During\ After MTEs and ULTs	**2 PAM devices deployed for total of 15,878 hours of HARP recording;** **4,056 hrs from M3R, plus 770 hrs from other passive**

Notes:

A= airplane platform, H= helicopter platform, S= ship platform, R= Rigid Hulled Inflatable Boat (RHIB)

MTE= major training event; ULT= unit level training;

SIO= Scripps Institute of Oceanography, HARP= high frequency acoustic recording package;

M3R= Marine Mammal Monitoring on Navy Ranges;

LIMPET= Low Impact Minimally Percutaneous External-electronics Transmitter satellite tag

As indicated in **Table S-1**, all Year Three monitoring objectives were met, and in some cases significantly exceeded.

Year Three Objective and Scientific Summary

The Navy met and vastly exceeded all of its Year Three monitoring objectives within the Southern California Range Complex (**Table S-2**). The total field effort of Year Three monitoring within the Southern California Range Complex is presented in **Table S-3**.

To date, the Navy's monitoring programs in Southern California have generated an extraordinary amount of data on marine mammal biology within the region, a significant amount of which is new to science. Some preliminary results will be presented in later subsections within this report, although data analysis continues with the goal of producing a more complete synthesis by the end of the NMFS authorization under which this monitoring occurs.

Highlights for Year Three monitoring include:

- 1,001 hours of survey effort
- 21,196 nm of ocean surveyed
- 1,225 sightings representing over 100,594 marine mammals
- Over 20,704 hours of passive acoustic recordings made
- 21,524 digital photographs of marine mammals taken
- 18.8 hours of digital video of marine mammals taken
- 44 tissue biopsies taken
- 14 medium term satellite tracking tags put on marine mammals

Table S-3. Cumulative total effort and accomplishments from Year Three Navy funded monitoring within Southern California from 02 Aug 2010 to 01 Aug 2011

N= CNO N45, P= U.S. Pacific Fleet, NPG= Naval Postgraduate School; Si= Scripps Institute of Oceanography, C= Cascadia Research Collective, Sm= Smultea Environmental Services

Navy funding	Performing Organization	Survey Dates or Window	Participating Vessels	# Days (days)	Total Survey Time (hrs)	Total Survey Distance (nm)	# Groups	# Individuals	# Species visually sighted	Digital Photo/ IDs taken (#)	Digital video taken (hrs)	Biopsies (#)	Satellite Tags (# tags)	# Passive recordings (#)	Total passive recording (hrs)	# Acoustic detection (#)	# Species acoustically detected (#)	# Passive sonobuoys (# buoys)
P	Sm	23-28 September 2010	airplane- Partenavia P-68-C	6	27.7	2,116	252	37,874	9	741	2.4	na	na	na	na	na	na	na
P	Sm	14-19 February 2011	airplane- Partenavia P-68-C	4	17.2	1,724	83	11,131	8	473	1.3	na	na	na	na	na	na	na
P	Sm	27 March - 3 April 2011	airplane- Partenavia P-68-C	3	9.5	1,007	71	2,165	8	323	1.6	na	na	na	na	na	na	na
P	Sm	12-20 April 2011	airplane- Partenavia P-68-C	9	46	5,926	146	14,530	11	424	4	na	na	na	na	na	na	na
P	Sm	9-14 May 2011	airplane- Partenavia P-68-C	6	27	2,647	81	3,309	11	976	5	na	na	na	na	na	na	na
N/NPS	C	4-11 Jan 2011	Zodiac RHIB	6	48.5	526	30	688	9	na	0.5	1	4	na	na	na	na	na
N/NPS	C	30 April - 7 May 2011	Zodiac RHIB	7	59.3	577	26	663	9	na	0.5	10	3	na	na	na	na	na
N/NPS	C	18-23 June 2011	Zodiac RHIB	5	46.1	561	43	936	10	na	0.5	5	3	na	na	na	na	na
	C	deployed under SCORE funding, not SCORE field time	Zodiac RHIB	0	0	0	0	0	0	0	0	0	4	na	na	na	na	na
N	Si	4-11 Jan 2011 SCI-M3R	RHIB-Si	8	57.5	550	34	2,371	8	2,791	1	6	na	8	0.75	na	4	na
N	Si	1-7 May 2011 SCI-M3R	RHIB-Si	7	56.1	558	42	4,476	8	2,831	1	11	na	14	1.45	na	4	na
N	Si	21-25 July 2011 SCI-M3R	RHIB-Si	5	40.1	396	31	2,902	5	1,612	1	5	na	8	0.3	na	4	na
N	Si	02 August 2010 - 30 July 2011 SIO/SWFSC bimonthly San Diego coastal surveys	RHIB-Si	19	111	795	118	6,150	7	8,753	na	6	na	15	1.5	na	4	na
N	Si	30 July 2010 - 26 April 2011 Four CalCOFI cruises	SHIP-Si/NOAA	76	455	3,813	268	13,399	14	2,600	na	na	na	113	872	344	11	221
Totals:				161	1001	21,196	1,225	100,594	117	21,524	18.8	44	14	158	876	344	27	221

Visual Surveys (Aerial Summary)

Under terms and conditions of the Navy's Year Three 01 August 2010 to 02 August 2011 Monitoring Plan, the Navy completed 1,001 hours of visual surveys out of a planned 100-150 hours. Of the 1,001 hours of visual survey effort, aerial visual surveys accounted for 127.4 hours (**Table S-3**). Aerial visual surveys provide the opportunity to rapidly survey large tracks of ocean in the fraction of time needed by ship based surveys, although on-station time is typically limited by the amount of fuel available aboard a given airplane. Typical on-station survey times for a single flight were around 3-5 hours for a civilian airplane (Partenavia P-68-C or P-68-OBS or Twin Commander 685). While all visual survey effort is presented in **Table S-2** and **S-3**, specific aerial visual survey accomplishments in Year Three include: Completion of five aerial survey periods, a 28 hour airplane survey from 23-28 September 2010; a 17 hour airplane survey 14-19 February 2011; a 9.5 hour airplane survey from 29 March – 3 April 2011; a 46 hour airplane survey from 12-20 April 2011; and a 27 hour airplane survey from 9-14 May 2011. Some of these aerial surveys represented relatively rare winter marine mammal effort in Southern California, with the exception of the visual and passive efforts coming out of the Navy's research funded CalCOFI surveys (Appendix D).

- Over 13,240 nm surveyed
- 623 sighting of approximately 68,757 marine mammals
- 2,937 hi-resolution digital photos taken
- 14.3 hours of digital video taken

Completion of 71 focal follows greater than 5 min each of various marine mammals for total of 30.1 hours of detailed behavioral focal follows. SES 2011 report combines July 2010 and September 2010 field efforts (**Appendix B**). Only September 2010 effort is summarized in this report. The Navy's 2010 Monitoring Report (DoN 2010) contains the July 2010 field discussions. Aerial surveys within the Southern California Range Complex have a distinct contribution they can make to the overall monitoring plan. These kinds of surveys:

1. Provide advantage of surveying key Navy areas of interest within one day, providing a "snapshot" of marine mammal numbers, presence, distribution and behavior before, during and after major training events,
2. Collect quantifiable behavioral data known to be indices of stress/disturbance,
3. Conduct focal follows of priority cetacean species including video-documentation of underwater behavior,
4. Provide a platform from which behavior and potential reactions of cetaceans to Navy training may be studied without confounding results (vs. from vessels), and
5. Locate and identify dead floating or stranded marine mammals.

The Navy will continue to use aerial surveys in next year's monitoring for both spatial coverage, but more importantly to continue to gather baseline behavioral data on marine mammals at-sea. For instance, although compiled from just one survey (9-14 May 2011), **Figures S-3a and S-3b** show some of the basic observations, in this case for dolphins and whales, being obtained from aerial surveys in Southern California.

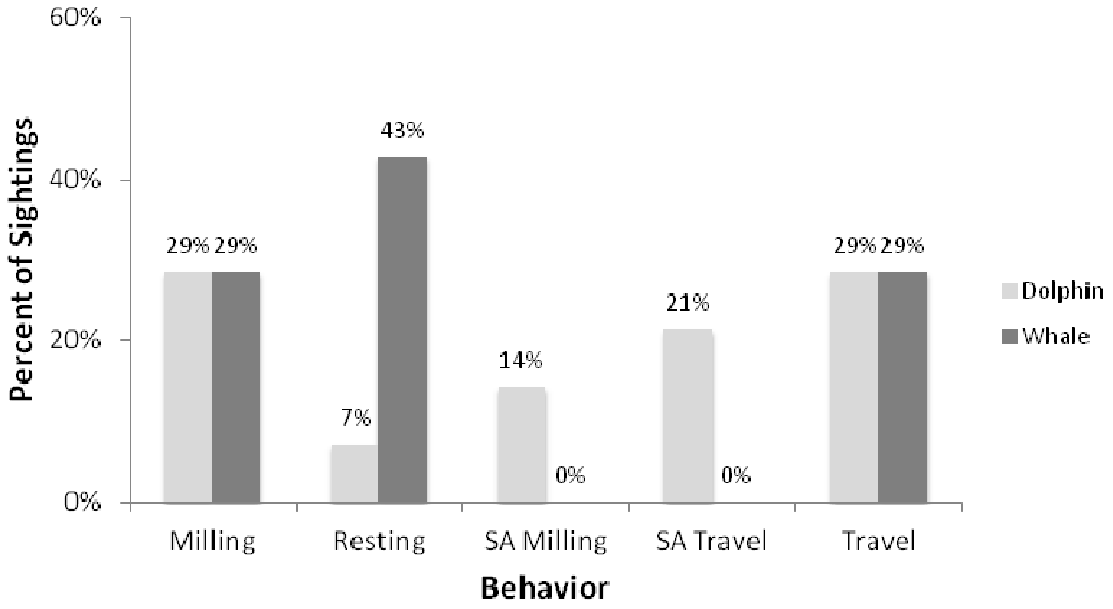


Figure S-3a. Frequency of initially observed behavioral states for dolphins and whales during May 2011 Southern California aerial survey. Note: SA = surface active.

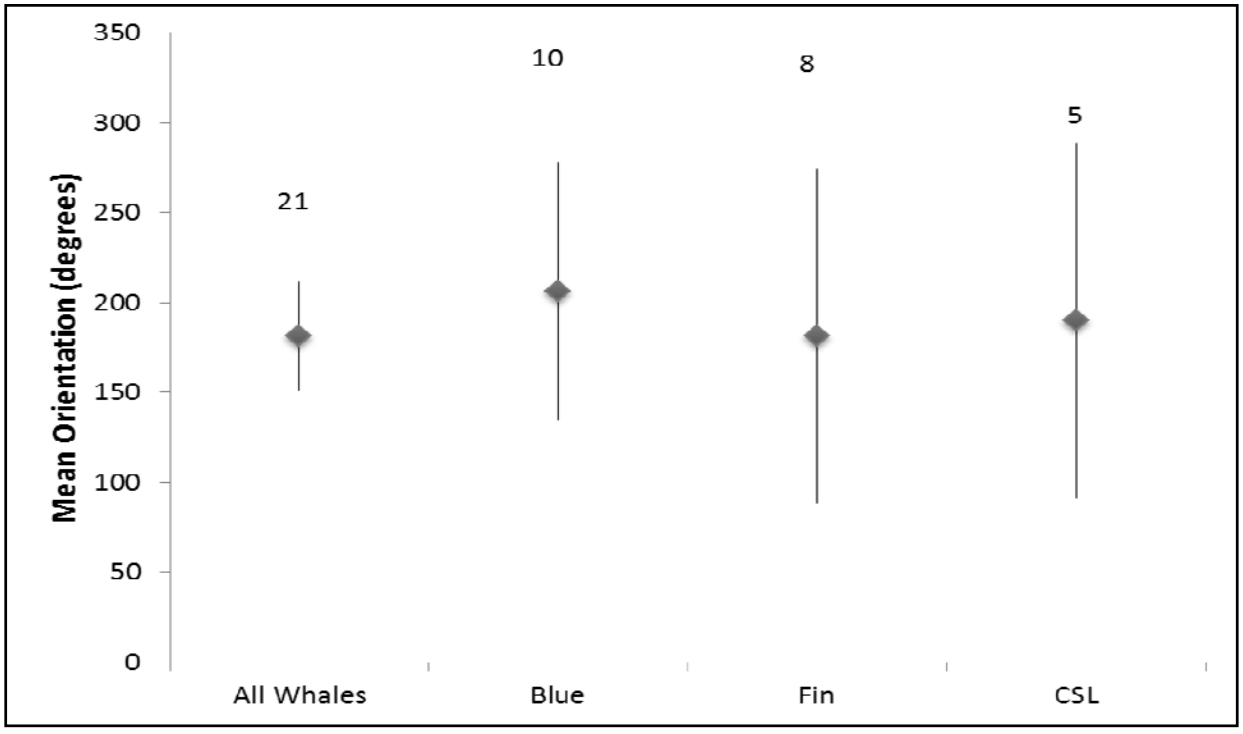


Figure S-3b. Mean and standard deviation of orientation/heading in degrees magnetic between nearest neighbors within a subgroup by whale and California sea lion (CSL) species during the May 2011 SOCAL aerial survey. Sample sizes indicated above bars.

The following photographs over the next few pages highlight some of the unique sightings within the Southern California Range Complex during Year Three.

For the first time since SOCAL aerial monitoring surveys began in fall 2008, sperm whales were seen (a group of 20 including 4 calves). They were associated with both Risso's dolphins and northern right whale dolphins. The sighting occurred on May 14, 2011 approximately 24 NM west of San Diego near the edge of an underwater ridge. A sperm whale (Physeter macrocephalus) nursery group was observed from the aircraft using a telephoto lens during the May 2011 aerial marine mammal monitoring survey off San Diego, California, demonstrating the ability to observe cetaceans and behavior sub-surface during an aerial survey. Photos by David Steckler courtesy of Smultea Environmental Sciences. The Navy had a major training exercise ongoing in the Southern California Range Complex on this day. However, in an analysis of ship positions and sonar use, the ships involved with the training were 30-50 nautical miles to the east of the sperm whale sighting location. San Clemente Island would have been between the two locations (the sperm whale site and Navy ship concentration). The nearest other Navy surface ship to the sighting was 30 nautical miles due south (i.e., not in the "shadow" of San Clemente Island), but was not using sonar at the time of the sighting or for the morning prior to the sighting time. At this time, it is unknown if the observation was an as yet, unseen natural behavior in response to foraging, predator avoidance, or some other natural phenomena, or a reaction to or avoidance of an anthropogenic event. This sighting highlights the importance of continuing to collect baseline marine mammal behavioral information to build the science on what could constitute normal behavior for marine mammal species.

(Top) Sperm whales mixed with northern right whale dolphins and Risso's dolphins; (Below) Risso's dolphin approaches another sperm whale from front. Note: sperm whale's open jaw.

Below is a photo from a rare (for Southern California) sighting of a Bryde's whale (Balaenoptera edeni/brydei) *observed on September 24, 2010 from the aircraft during the September 2010 aerial marine mammal monitoring survey off San Diego, California. Photograph taken by Bernd Würsig courtesy of Smultea Environmental Sciences.*

Below are photos from a sighting of two minke whales (Balaenoptera acutorostrata) *observed on September 24, 2010 from the aircraft during the September 2010 aerial marine mammal monitoring survey off San Diego, California. Photographs taken by Bernd Würsig courtesy of Smultea Environmental Sciences.*

Marine Mammal Observers

Under terms and conditions of the Navy's Year Three 01 August 2010 to 02 August 2011 Monitoring Plan, the Navy completed 83 hours of Marine Mammal Observers (MMO) out of a planned 50-100 hours of MMOs.

There was one MMO event in the Southern California Range Complex within Year Three. Four Navy civilian marine science biologists embarked on a Navy destroyer from 4 to 7 April 2011. The ship then proceeded to sea within the Southern California Range Complex where it engaged in various sonar and non-sonar training events during a planned unit-level training.

The following pages provide details for the April 2011 Southern California MMO event.

During the four-day MMO underway period, the MMOs made 24 sightings of approximately 599 marine mammals. In fact, the frequency of sightings when compared to MMO events on other Navy range complexes was such that the MMO team identified several study protocol and data recording procedure modifications needed to account for the faster rate of sighting marine mammals within Southern California. These changes will be incorporated into future MMO events within California.

Some of the analysis from this event will be folded into a Navy-wide lookout effectiveness study using MMO events on Navy ships along the Atlantic Coast, Hawaii, and Southern California. This pooled data study will be reported in later submissions to the National Marine Fisheries Service in the 2012-2013 timeframe.

Navy Lookout Effectiveness Study

The U.S. Navy undertakes monitoring of marine mammals during Navy exercises and has mitigation procedures designed to minimize risk to these animals. One key component of this monitoring and mitigation is the shipboard lookouts (LOs, also known as watchstanders), who are part of the standard operating procedure that ships use to detect objects (including marine mammals) within a specific area around the ship during events. The watchstanders are an element of monitoring requirements specified by NMFS in the MMPA Letters of Authorization. The goal is to detect mammals entering ranges of 200, 500 and 1000 yards around the vessel, which correspond to distances at which various mitigation actions should be performed. In addition to the lookouts, officers on the bridge search visually and SONAR operators listen for vocalizations during anti-submarine warfare training. We refer to all of these observers together as the "observation team" (OT). The aim of this study is to determine the OT effectiveness in terms of detecting and identifying marine mammals. Of particular interest is the probability of an animal getting within a defined range of the vessel without being observed by the OT, as well as determining the accuracy of the OT (primarily the LO) in determining species group (whale, dolphin, etc.) group size and position. In order to achieve this, experienced MMOs search and collect information on marine mammals that both they and the OT detect.

Work was previously conducted to design and test a protocol for determining the effectiveness of the LOs in visually detecting marine mammals. The field protocol for the experiments was developed in consultation with members of the Naval Undersea Warfare Center Division, Newport (NUWCDIVNPT); U.S. Fleet Forces Command; NAVFAC; Commander, U.S. Pacific

Fleet; and NMFS. The basic concept is that trained Marine Mammal Observers (MMOs) are situated on board a vessel during daylight at-sea exercises, in locations where they can watch for marine mammals and communicate with one another, but not cue the LO. The MMOs then work to set up opportunistic trials, where they detect a surfacing of a marine mammal at a measured location, and record whether that surfacing was also detected (a successful trial) or not (an unsuccessful trial) by the LO.

It was found to be necessary to have an additional "liaison" MMO (LMMO) stationed with the LO, and in communication with the other MMOs, to help report when and where LOs detected surfacings. It was also necessary to have an additional team member tasked solely with data recording. In addition to recording surfacing events, MMOs attempted to keep track of which surfacings belonged to the same school or animals. The revised protocol (Burt and Thomas 20108) was applied to one further at-sea exercise (off Southern California), making four datasets in total.

In parallel with field protocol development, methods are being developed for using the data generated during these experiments to estimate the probability of animals entering the stand-off range undetected. An analysis method to allow for intermittent availability is also being developed, since many marine mammal species remain on (or close to) the surface for significant periods between dives, and so are "intermittently available" for detection. The extended methods currently only use information about the location of LO detections, but could conceivably be extended further to use information from the MMO LO trials. As a proof of concept both the instantaneous and intermittent availability models to data collected in the at-sea experiments will be applied.

Recommendations for future data collection efforts 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, completed a proof of concept for detection functions, consultation with NMFS technical staff for input on analysis methods, and investment in continued refinement of the analytic methods and focus on additional data collection in 2011/2012.

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 becomes available other options for improving lookout training will be evaluated as appropriate.

8 Burt, M.L. and Thomas, L. 2010. Calibrating US Navy lookout observer effectiveness. Information for Marine Mammal Observers. Version 2.1. Prepared for Department of the Navy.

APRIL 2011 CRUISE REPORT- MARINE SPECIES MONITORING & LOOKOUT EFFECTIVENESS STUDY DURING SOUTHERN CALIFORNIA UNIT LEVEL TRAINING EXERCISE DDG-E

Prepared by Ms. Morgan Richie, Naval Facilities Engineering Command – Pacific; Mr. Josh Frederickson, Naval Undersea Warfare Center, Newport; Mrs. Andrea Balla-Holden, Naval Facilities Engineering Command – Northwest; Dr. Thomas Jefferson, Clymene Enterprises

Introduction

The U.S. Navy undertakes monitoring of marine mammals during Navy exercises and has mitigation procedures designed to minimize risk to these animals. One key component of this monitoring and mitigation is the shipboard lookouts (LOs, also known as watchstanders), who are part of the standard operating procedure that ships use to detect objects (including marine mammals) within a specific area around the ship during events. The watchstanders are an element of monitoring requirements specified by NMFS in the MMPA Letters of Authorization. The goal is to detect mammals entering ranges of 200, 500 and 1000 yards around the vessel, which correspond to distances at which various mitigation actions should be performed. In addition to the lookouts, officers on the bridge search visually and SONAR operators listen for vocalizations during anti-submarine warfare training. We refer to all of these observers together as the "observation team" (OT). The aim of this study is to determine the OT effectiveness in terms of detecting and identifying marine mammals. Of particular interest is the probability of an animal getting within a defined range of the vessel without being observed by the OT, as well as determining the accuracy of the OT (primarily the LO) in determining species group (whale, dolphin, etc.) group size and position. In order to achieve this, experienced MMOs search and collect information on marine mammals that both they and the OT detect.

Work was previously conducted to design and test a protocol for determining the effectiveness of the LOs in visually detecting marine mammals. The field protocol for the experiments was developed in consultation with members of the Naval Undersea Warfare Center Division, Newport (NUWCDIVNPT); U.S. Fleet Forces Command; NAVFAC; Commander, U.S. Pacific Fleet; and NMFS. Trials were conducted during three at-sea exercises (one in Kauai and two in JAX; see DoN 2010 for details on the effectiveness studies conducted off JAX), and lessons learned from these trials resulted in the protocol being further refined. The basic concept is that trained Marine Mammal Observers (MMOs) are situated on board a vessel during daylight at-sea exercises, in locations where they can watch for marine mammals and communicate with one another, but not cue the LO. The MMOs then work to set up opportunistic trials, where they detect a surfacing of a marine mammal at a measured location, and record whether that surfacing was also detected (a successful trial) or not (an unsuccessful trial) by the LO.

It was found to be necessary to have an additional "liaison" MMO (LMMO) stationed with the LO, and in communication with the other MMOs, to help report when and where LOs detected surfacings. It was also necessary to have an additional team member tasked solely with data recording. In addition to recording surfacing events, MMOs attempted to keep track of which surfacings belonged to the same school or animals. The revised protocol was applied to one further at-sea exercise (off Southern California), making four datasets in total.

As part of the monitoring plan for the Southern California Range Complex Marine Mammal Protection Act compliance, four civilian marine mammal observers (MMOs) participated in a unit-level training exercise (ULT) from April 4-7, 2011. These MMOs were stationed aboard a U.S. Navy destroyer, hereafter referred to as DDG-E. The goals of the monitoring and this study were to:

1. Collect data to assess the effectiveness of the Navy lookout team.
2. Obtain data to characterize the possible exposure of marine species to mid-frequency active sonar (MFAS).

Shipboard Monitoring

MMO surveys were conducted on a not-to-interfere basis, which means that the MMOs would not replace required Navy lookouts, would not dictate operational requirements/maneuvers, and would remove themselves from the bridge wing if necessary for DDG-E to accomplish its training objectives. The exceptions would be if a marine mammal was sighted by the MMO within the shut-down mitigation zone during mid-frequency active sonar (MFAS) use (200 yards [yds], 183 meters [m]) and was not seen by the Navy lookout team, or if the vessel was in danger of striking a marine species. In these cases, the MMO would report the sighting to the Navy lookout team for appropriate reporting and action.

The MMO survey on DDG-E was conducted on the bridge wings (elevated 66 feet [ft; 20 m] above the waterline), with two MMOs actively searching for marine mammals, one MMO recording data, and one MMO acting as a liaison with the bridge team/lookouts to relay their sightings. While on effort, MMOs used naked eye and 7 X 50 magnification binoculars to scan the area from dead ahead to just aft of the beam.

Results

Shipboard Monitoring

Effort and environmental information was collected when the MMOs began effort, at each rotation, and as significant weather changes occurred. The MMO team spent 20 hours 57 minutes, and 05 seconds searching for marine species during the exercises (**Table 1).**

Table 1. Effort Hours and Environmental Conditions

Date	Team Hours On-Effort	Beaufort Sea State (range)	% Cloud Cover (range, conditions)	Visibility
4 April	2.23	3-4	5% - 100%	Moderate -Good
5 April	7.32	2-5	40%-100%	Poor – Moderate
6 April	8.07	4-5	100%	Poor - Moderate
7 April	3.33	3-5	40%-100%	Moderate
Total	**20.95**	**2-5**	**5%-100%**	**Poor – Good**

For all four observers, a total of 83 hours, 48 minutes, and 20 seconds of marine mammal shipboard monitoring was conducted. Beaufort Sea States ranged from 2 to 5, with the majority of the time occurring in Sea States 4 – 5. The Beaufort Sea State was a 6 for 1 hour and 32 minutes on 4/6/2011, and the team went off effort (**Figures 1 and 2**). The majority of effort was conducted in an area south of San Clemente Island (**Figure 3**).

In total, 24 sightings of marine mammals including 23 sightings of cetaceans, one sighting of a pinniped, and zero sightings of turtles were recorded during the four days of observation (**Table 4**). Nineteen of the sightings were made independently by the MMOs, that is, not seen by the Navy lookout team. However, it should be noted that there was no MFAS being used at these sighting times, so Navy lookout responsibility during non-MFAS steaming and training is for sighting of marine mammal for near-ship collision avoidance vice mitigation at ranges < 1000 yards (914 m). Additionally, two sightings were made by the Navy lookout team, but were not sighted by the MMOs. Three sightings were sighted by both the MMOs and Navy lookout team (**Table 2**). Four sightings were identifiable to species; one sighting of long-beaked common dolphins (*Delphinus capensis*), one sighting of Risso's dolphins (*Grampus griseus*), one sighting of a Minke whale (*Balaenoptera acutorostrata*), and one sighting of a California sea lion (*Zalophus californianus*) (**Table 3**).

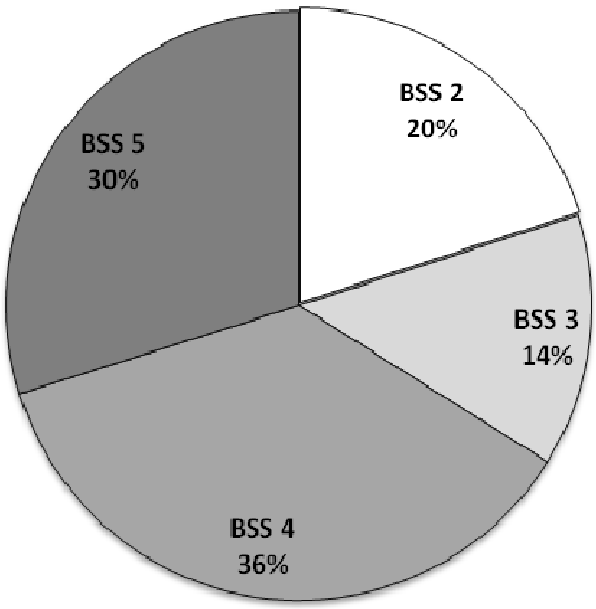


Figure 1. Total Percentage of Effort at Beaufort Sea States

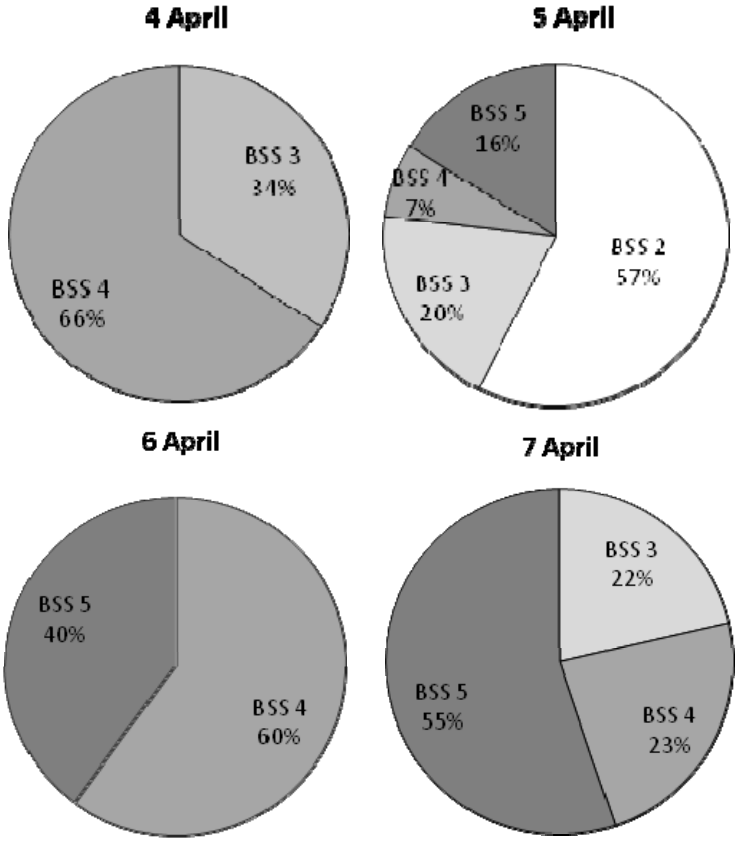


Figure 2. Daily percentage of effort at Beaufort Sea State

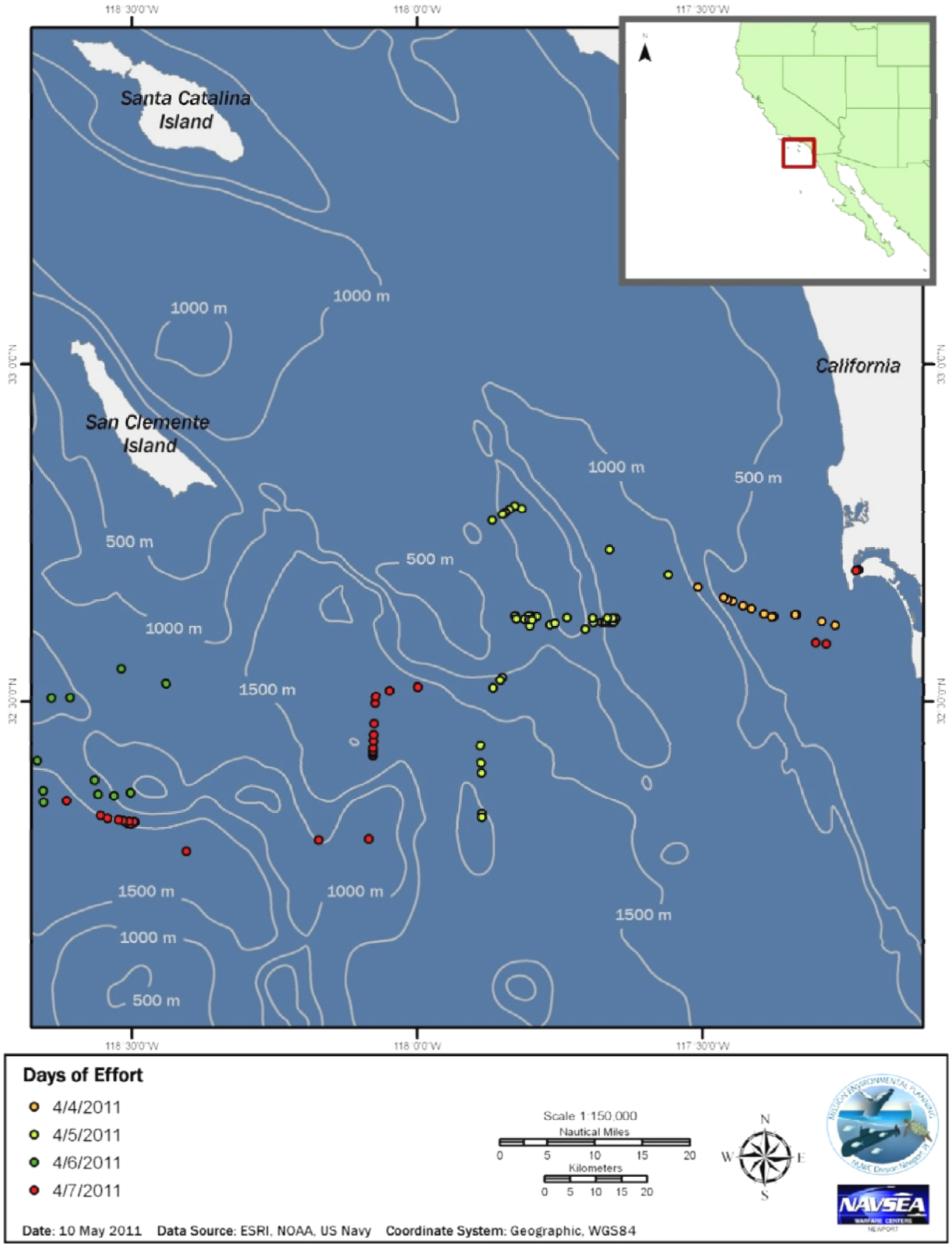


Figure 3. Location of MMO Effort April 2011.

Table 2. Marine Mammal and Sea Turtle Sightings by Observer

Date	Independent MMO Sightings	Independent Navy Lookout Team Sightings	Sightings by both Teams
4 April	9	0	1
5 April	6	0	2
6 April	2	0	0
7 April	2	2	0
Total	**19**	**2**	**3**

Table 3. Unique sightings by species

Species	Unique animal group sightings	Total number of animals (based on best group size estimate)
Long-beaked common dolphin	1	15
Risso's dolphin	1	12
California Sea Lion	1	1
Minke whale	1	1
Delphinus species	7	528
Unidentified dolphin	4	32
Unidentified balaenopterid	4	5
Unidentified whale	5	5
Total	**24**	**599**

Table4. Marine Mammal and Sea Turtle Sightings

Data Category	Sighting 1	Sighting 2	Sighting 3	Sighting 4	Sighting 5	Sighting 6	Sighting 7
Sightings Information							
Effort (on/off)	On	On	On	On	On	On	On
Date	4/4/2011	4/4/2011	4/4/2011	4/4/2011	4/4/2011	4/4/2011	4/4/2011
Time	155031	155031	160224	160309	161302	161751	162416
Location	32.61883 117.29227	32.61883 117.29227	32.62902 117.33572	32.62895 117.33847	32.62587 117.37580	32.62998 117.39310	32.63765 117.41520
Detection Sensor	MMO	MMO	MMO	MMO	MMO	MMO	MMO
Species/Group	Long-beaked common dolphins	California sea lion	Unidentified Delphinus spp	Unidentified Delphinus spp	Unidentified Delphinus spp	Unidentified whale	Unidentified balaenopterid
Group Size (min/max/best)	10/15/15	1/1/1	30/48/39	52/107/78	9/22/16	1/1/1	1/2/1
# Calves							
Bearing (rel)	270	120	315	90	315	350	300
Distance (m)	20	50	1009	2343	896	2755	3350
Environmental Information							
Wave height (ft)	Moderate	Moderate	Moderate	Moderate	Moderate	Moderate	Moderate
Visibility	Good	Good	Good	Good	Good	Good	Good
BSS	4	4	4	4	4	4	4
% cloud cover	p0% s5%	p0% s5%	p0% s5%	p0% s5%	p0% s5%	p0% s5%	p0% s5%
% glare	P35% s10%	P35% s10%	P35% s10%	P35% s10%	P35% s10%	P35% s10%	P35% s10%
Operational Information							
Sonar on/off	Off	Off	Off	Off	Off	Off	Off
Ship bearing (true)	287	287	265	265	295	295	295
Animal motion	Parallel	None			Closing	None	None
Sighting Cue/ Behavior	Body	Body	Splash	Birds	Body	Blow	Blow
Mitigation implemented	None	None	None	None	None	None	None
Comments	Photos taken (#014-119, blank 120)		Dolphins. Photos 121-131				Nearby dolphins detected passively by ship sonar

Table 4 (Con't). Marine Mammal and Sea Turtle Sightings

Data Category	Sighting 8	Sighting 9	Sighting 10	Sighting 11	Sighting 12	Sighting 13	Sighting 14
Sightings Information							
Effort (on/off)	On	On	On	On	On	On	On
Date	4/4/2011	4/4/2011	4/4/2011	4/5/2011	4/5/2011	4/5/2011	4/5/2011
Time	163334	165107	190929	083936	084600	084951	090002
Location	32.64868 117.44798	32.66982 117.50903	32.77982 117.84490	32.61803 117.67770	32.61793 117.66380	32.61808 117.65680	32.62382 117.65417
Detection Sensor	MMO	MMO	MMO	MMO	MMO	MMO	MMO
Species/Group	Unidentified dolphin	Unidentified balaenopterid	Minke whale	Unidentified dolphin	Delphinus spp	Delphinus spp	Delphinus spp
Group Size (min/max/best)	7/12/9	1/1/1	1/1/1	4/13/7	1/1/1	1/1/1	65/475/294
# Calves							
Bearing (rel)	275	290	315	270	290	315	0
Distance (m)	1009	2041	2755	2041	2041		2041
Environmental Information							
Wave height (ft)	Moderate	Light	Light	Light	Light	Light	Light
Visibility	Good	Good	Good	Good	Good	Good	Good
BSS	4	4	3	2	2	2	2
% cloud cover	p0% s5%	p0% s 0%	p15% s5%	p100% s100%	p100% s100%	p100% s100%	p100% s100%
% glare	P35% s10%	P 35% s 0%	p45% s0%	p0% s0%	p0% s0%	p0% s0%	p0% s0%
Operational Information							
Sonar on/off	Off	Off	Off	Off	Off	Off	Off
Ship bearing (true)	295	295	315	90	90	90	90
Animal motion	Closing	None	Parallel	Parallel	Closing	Closing	Closing
Sighting Cue/ Behavior	Body	Blow	Splash	Splash, body	Splash	Body	Body
Mitigation implemented	None	None	None	None	None	None	None
Comments	Passed beam		Minke breached 3 times	Passed abeam at 0843		Second sighting by crew member, did not give bearing or distance. LO asked bridge to log sighting.	Bridge crew called them "seals." Some closed to bowride. Pod was spread out.

Table 4 (Con't). Marine Mammal and Sea Turtle Sightings

Data Category	Sighting 15	Sighting 16	Sighting 17	Sighting 18	Sighting 19	Sighting 20	Sighting 21
Sightings Information							
Effort (on/off)	On	On	On	On	On	On	On
Date	4/5/2011	4/5/2011	4/5/2011	4/5/2011	4/6/2011	4/6/2011	4/7/2011
Time	100125	102917	103402	130510	081115	181651	084249
Location	32.62638 117.79150	32.62298 117.82722	32.62198 117.81320	32.53147 117.85460	32.38283 118.69468	32.31875 118.50855	32.41910 118.07755
Detection Sensor	MMO	MMO	MMO	MMO	MMO	MMO	MMO
Species/Group	Risso's dolphin	Unidentified whale	Unidentified dolphin	Unidentified dolphin	Unidentified whale	Delphinus spp	Unidentified balaenopterid
Group Size (min/max/best)	6/20/12	1/1/1	4/7/5	5/10/8	1/1/1	50/225/93	2/2/2
# Calves							
Bearing (rel)	38	290	300	358	30	3	45
Distance (m)	1154	4298	2041	4298	4298	3350	3350
Environmental Information							
Wave height (ft)	Light	Light	Light	Light	Moderate	Moderate	Light
Visibility	Good	Good	Good	Good	Poor	Moderate	Moderate
BSS	2	2	2	3	4	4	3
% cloud cover	p100% s100%	p80% s80%	p80% s80%	p50% s50%	p100% s100%	p100% s100%	p100% s98%
% glare	p0% s0%	p25% s0%	p25% s0%	p15% s20%	p0% s0%	p0% s0%	p0% s1%
Operational Information							
Sonar on/off	Off	Off	Off	Off	Off	Off	Off
Ship bearing (true)	270	100	94	224	309	104	0
Animal motion	Closing, parallel		Parallel	Closing	None	Closing	Closing
Sighting Cue/ Behavior	Body	Blow	Body	Body	Blow	Dorsal fin	Blow
Mitigation implemented	None	None	None	None	None	Yes	None

Data Category	Sighting 15	Sighting 16	Sighting 17	Sighting 18	Sighting 19	Sighting 20	Sighting 21
Operational Information (continued)							
Comments	Turned to move parallel to the ship, toward the stern			Not a trial – went off effort due to potential radio interference with ammunition		1821 informed bridge (waypoint #82). Animals were outside the mitigation zone; - ship and animals were closing on each other. Gunnery Exercise secured and ship changed course as a precaution.	

Table 4 (Con't). Marine Mammal and Sea Turtle Sightings

Data Category	Sighting 22	Sighting 23	Sighting 24
Effort (on/off)	On	On	On
Date	4/7/2011	4/7/2011	4/7/2011
Time	173349	091208	091539
Location	32.42635 118.07703	32.49780 118.07327	32.50735 118.07253
Detection Sensor	LO	LO	MMO
Species/Group	Unidentified whale	Unidentified whale	Unidentified balaenopterid
Group Size (min/max/best)	1/2/1	1/1/1	1/1/1
# Calves			
Bearing (rel)	90	300	300
Distance (m)		2755	2000
Environmental Information			
Wave height (ft)	Light	Moderate	Moderate
Visibility	Moderate	Moderate	Moderate
BSS	3	4	4
% cloud cover	p100% s98%	p70% s90%	p70% s90%
% glare	p0% s1%	p0% s5%	p0% s5%
Operational Information			
Sonar on/off	Off	Off	Off
Ship bearing (true)	0	0	0
Animal motion	Closing	None	None
Sighting Cue/Behavior	Blow	Blow	Blow
Mitigation implemented	None	None	None
Comments	LO did not give estimate of distance	Distance estimated by MMO	

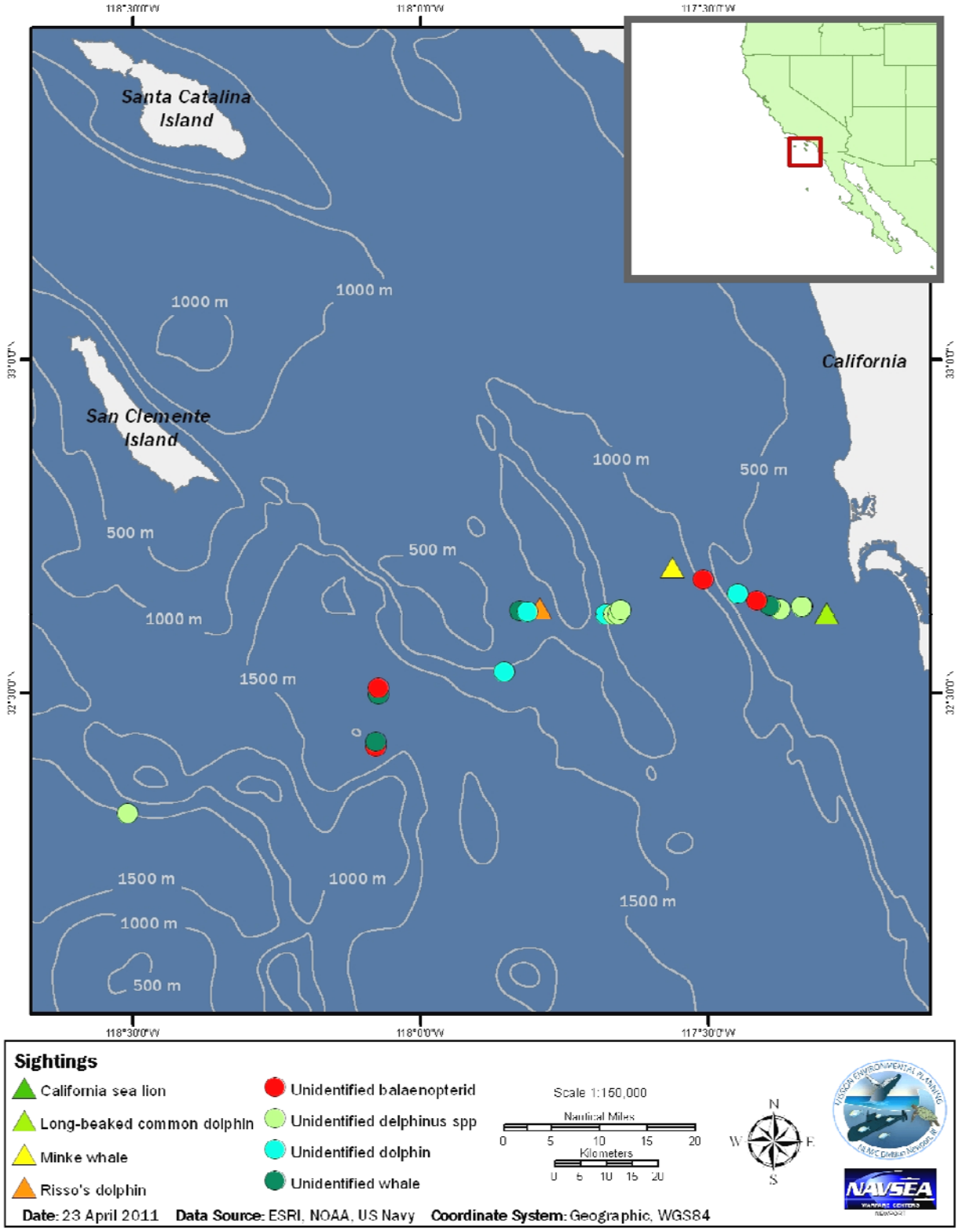


Figure 4. Marine mammal sighting locations during MMO embark of April 2011

Nineteen of the sightings (79%) were considered trials for the lookout effectiveness study. Trials were conducted on all days of the study, for an average rate of .91 trials per hour across all four days (**Table 4**).

Table 5. Effort Hours, Sighting Rates, and Trial Rates

Date	Hours MMO Team Effort	# of Unique Sightings*	Sightings/ Hour	# of Trials	Trials/Hour
4/4/2011	02:13:46	10	4.49	8	3.59
4/5/2011	07:19:27	8	1.09	7	.96
4/6/2011	08:04:19	2	.25	2	.25
4/7/2011	03:19:33	4	1.2	2	.6
Total	**20:57:05**	**24**	**1.15**	**19**	**.91**

Conclusions

In parallel with field protocol development, methods are being developed for using the data generated during these experiments to estimate the probability of animals entering the stand-off range undetected. An analysis method to allow for intermittent availability is also being developed, since many marine mammal species remain on (or close to) the surface for significant periods between dives, and so are "intermittently available" for detection. The extended methods currently only use information about the location of LO detections, but could conceivably be extended further to use information from the MMO LO trials. As a proof-of-concept, both the instantaneous and intermittent availability models to data collected in the at-sea experiments, will be applied.

Recommendations for future data collection efforts 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 trails, 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, completed a proof of concept for detection functions, consultation with NMFS technical staff for input on analysis methods, and investment in continued refinement of the analytic methods and focus on additional data collection in 2011/2012.

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 becomes available other options for improving lookout training will be evaluated as appropriate.

SECTION 3 SELECT PHOTOGRAPHS FROM DDG-E DURING APRIL 2011 EMBARK

Figure 5. MMOs embarked on DDG-E April 2011

(Top four pictures: visual survey from ship bridge wings; Bottom two pictures: data collection, recording and entry)

Figure 6. Ship photos taken with permission during DDG-E training in SOCAL April 2011

Top picture: ship underway at-sea; Bottom left picture: prepare .50 cal M2 and 7.62mm M240 machine guns for gunnery exercise (GUNEX); Bottom right picture: bullet splashes from machine gun GUNEX.

Figure 7. Photos of various marine species during April MMO embark

Top left: Long-beaked common dolphin (*Delphinus capensis*); Top right: unidentified common dolphins near ship's bow; Bottom left: bow-riding common dolphins; Bottom right: ocean sun fish (*Mola mola*)

Passive Acoustic Monitoring

Under terms and conditions of the Navy's Year Three 01 August 2010 to 02 August 2011 Monitoring Plan, the Navy continued deployment of two bottom mounted passive acoustic monitoring (PAM) devices within the Southern California Range Complex (**Figure S-4**).

Two high-frequency acoustic recording packages (HARP) remained deployed this reporting period, and analyzed by the Whale Acoustic Lab, Marine Physical Laboratory of Scripps Institute of Oceanography (Dr. John Hildebrand) (http://cetus.ucsd.edu/). The HARP records broadband acoustic data (10 Hz – 100 kHz), including both marine species sounds and anthropogenic sounds. One HARP is located southwest of San Clemente Island near the eastern slope of the East Cortes Basin. The other HARP is located just north of the Southern California Range Complex northern boundary, northwest of San Clemente Island in the southern part of the Santa Cruz Basin (**Figure S-4**).

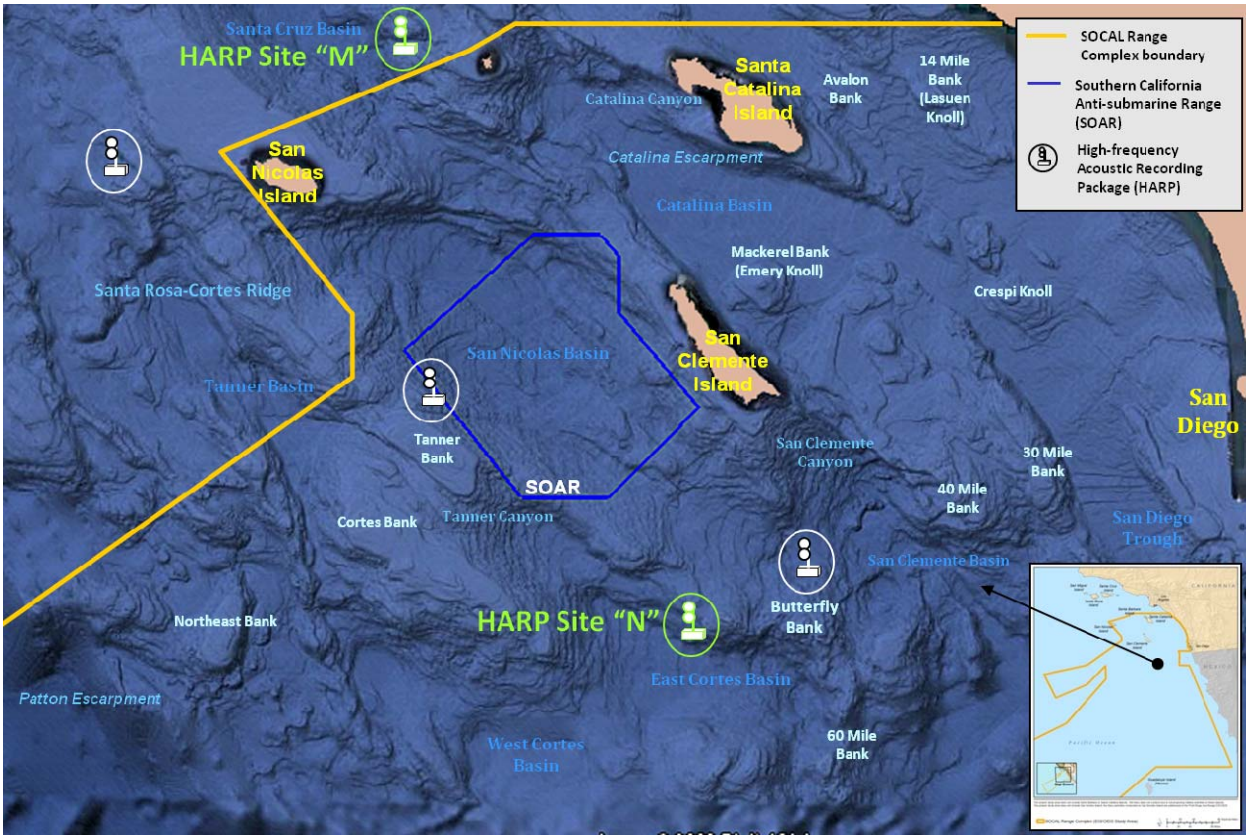


Figure S-4. Map of Navy funded bottom mounted high-frequency acoustic recording packages (HARPs) deployed within or adjacent to the Southern California Range Complex.

(HARPs "M" and "N" are funded by U.S. Pacific Fleet and data results reported here)

Preliminary analysis of these two HARPs for the time period April 2010 to April 2011 is contained in **Appendix C**. The reporting period of April to April is based on service time required for the HARPs (retrieve HARP, gather data, re-deploy HARP), and to allow analysis time for inclusion within **Appendix C**.

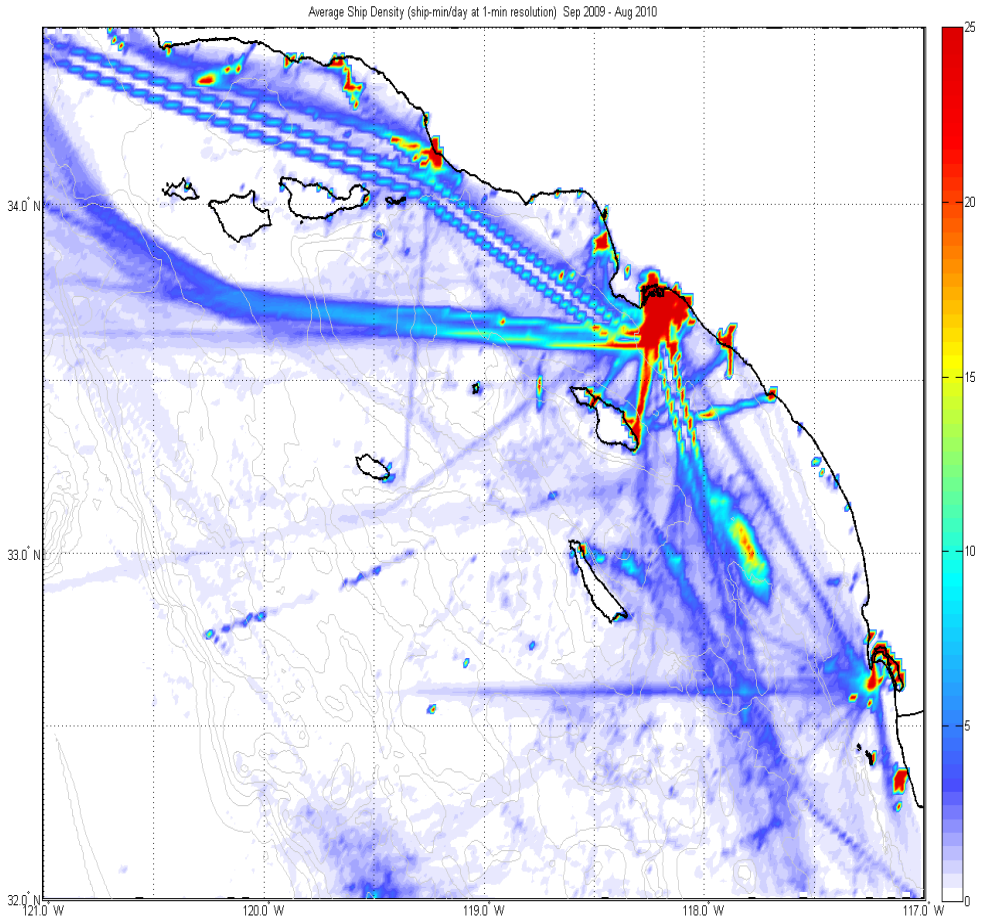
While **Appendix C** contains PAM results from the two Navy compliance monitoring funded PAM devices, it should be noted that substantial amounts of additional passive acoustic data were also collected this past year for Navy research funded HARPs both within and outside of the Southern California Range Complex (see **Figure S-4**). Analysis of data from these other HARPs, which are sometimes shifted in location within Southern California, are ongoing and not contained in this report.

Specific HARP PAM highlights accomplished in Year Three include:

- Passive acoustic monitoring was conducted at two sites in the Navy's Southern California Range Complex during April 2010 – April 2011. These data provide information on the presence of marine mammals and anthropogenic sound sources. High-frequency acoustic recording packages documented sounds between 10 Hz and 100 kHz with nearly continuous temporal coverage at a site near Santa Barbara Island (site M) and a site south of San Clemente Island (site N). Data analysis methods consisted of analyst scans of long-term spectral averages and spectrograms. The data were divided into three frequency bands and each band was analyzed for the sounds of marine mammal species or anthropogenic sources. Representative sounds are presented.
- Six baleen whale species were recorded: blue whales, fin whales, Bryde's whales, gray whales, humpback whales, and minke whales. Site N has more calling baleen whales than site M, as blue, fin, humpback, and Bryde's whale calls were all detected during more hours at site N. However, gray whale calls were detected only at site M. Pinniped barks, presumably made by California sea lions, were recorded during just a single week and only at site M. The largest number of odontocete detections by echolocation clicks and whistles were attributed to "unidentified dolphin" which is primarily comprised of short- and long-beaked common dolphins as well as bottlenose dolphins. Unidentified dolphins were detected throughout the year with a peak acoustic activity in late summer and fall months. Overall numbers of detections were slightly higher at site N than M. There was a distinct diel acoustic activity likely due to nighttime foraging, which was more apparent for click and less for whistle detections. Risso's dolphin echolocation clicks occurred throughout the year with increased detections in winter and early spring at site M. They were generally more frequent at site M than N. Two kinds of Pacific white-sided dolphin echolocation clicks were detected: Type A were present more often at site N and with higher numbers of detections at night indicating nighttime foraging, whereas type B were overall very seldom with highest detections at site M and a higher rate of detections during daytime. Sperm whale echolocation clicks were distributed throughout the year with more frequent detections at site M. Cuvier's beaked whales were detected throughout the year at both sites with higher numbers of occurrences at site N. A few detections were made of Baird's beaked whale and Stejneger's beaked whale, as well as two unidentified beaked whales with peak echolocation signal frequencies at 43 kHz and 50 kHz.
- Ship noise was the most common anthropogenic noise at both sites M and N. Both sites had Mid-Frequency Active (MFA) sonar events throughout the period April 2010 – April

2011. At site N, over 55,000 MFA sonar pings were detected ranging from 105 to 170 dB pp re 1 µPa. While site M had MFA sonar events recorded, the received levels and the number of pings were often much lower (e.g. < 120 dB pp re 1 µPa and 10's of pings/event) than at site N. Echosounder pings with a variety of primary frequencies (8 – 80 kHz) were found at both sites M and N. More echosounders were present at site M than at site N. Explosions were recorded at both sites up to 40 hours per week.

In contrast to military ship traffic, Southern California including portions of the Southern California Range Complex lie along major shipping routes to and from South America, and from the port of San Diego to Japan and Hawaii. **Figure S-5**, provided by the Naval Postgraduate School in Monterey CA, shows average commercial ship density within Southern California for the period of September 2009 to August 2010.



(Graphic courtesy of J. Joseph, Naval Postgraduate School, Ocean Acoustics Lab)

Figure S-5. Average commercial ship density in Southern California based on analysis on cumulative Automatic Identification System (AIS) data from September 2009 to August 2010.

Major Training Exercise Summary

For the eleven major training exercises conducted in the Southern California Range Complex this reporting period (02 Aug 2010 to 01 Aug 2011), the Navy conducted over 9,755 hours of Marine Species Awareness Training for 7,537 Navy personnel prior to beginning the training exercise. In addition, over the 134 non-consecutive major training exercise days in this same period (Table S-4), the Navy performed over 86,871 hours of visual observation (when counting the number of individual watchstanders engaged in lookout or navigation duties times the number of ships involved times the number of days at-sea).

Table S-4. SOCAL Range Complex major training exercises that occurred between 02 August 2010 and 01 August 2011.

MTE Type	Dates	# of Days	# of Ships Involved	# of Marine Mammal Sightings	# of Marine Mammals
C2X	23 JUL - 12 AUG 2010 *	11	10	77	1,049
SUSTEX	5 AUG - 20 AUG 2010	16	5	40	541
IAC	31 AUG - 2 SEP 2010	3	7	15	131
IAC	20 OCT - 22 OCT 2010	3	5	29	1,184
C2X	25 OCT - 15 NOV 2010	22	5	68	1,121
C2X	4 NOV - 19 NOV 2010	21	4	3	261
C2X	30 NOV - 20 DEC 2010	21	7	69	488
JTFEX	4 FEB - 9 FEB 2011	6	8	8	195
IAC	18 FEB - 20 FEB 2011	3	7	11	211
C2X	6 MAY - 27 MAY 2011	22	11	69	413
JTFEX	3 JUN - 8 JUN 2011	6	8	39	254
Total		**134**	**77**	**428**	**5,848**

Note: * This exercise was conducted over two reporting periods (2010 Monitoring Report and 2011 Monitoring Report). The data shown in this table reflects only the numbers from this reporting period (2011).

Key: C2X= Composite Training Unit Exercise; IAC= Integrated Anti-submarine Warfare Course; JTFEX= Joint Task Force Exercise; SUSTEX= Sustainment Exercise

SOCAL Range Complex Major Training Exercise Marine Mammal Observations

There were approximately 428 sightings of an estimated 5,848 marine mammals over the course of eleven major training exercises in the Southern California Range Complex. Breakdown of sightings by species type are shown in **Table S-5** and **Figure S-6**.

Dolphin species in Southern California typically occur in larger pods than whales, hence the higher number of dolphins and larger percentage of total numbers seen in these counts.

Table S-5. Total number of marine mammal sightings observed from Navy platforms during SOCAL Range Complex major training exercises 02 August 2010 to 01 August 2011.

Species Type	# of sightings	% of total sightings	# of marine mammals	% of total number of marine mammals
Dolphins	171	40%	5,255	90%
Whales	223	52%	435	7%
Pinnipeds	20	5%	136	2%
Not recorded	13	3%	22	1%
Totals:	**428**		**5,848**	

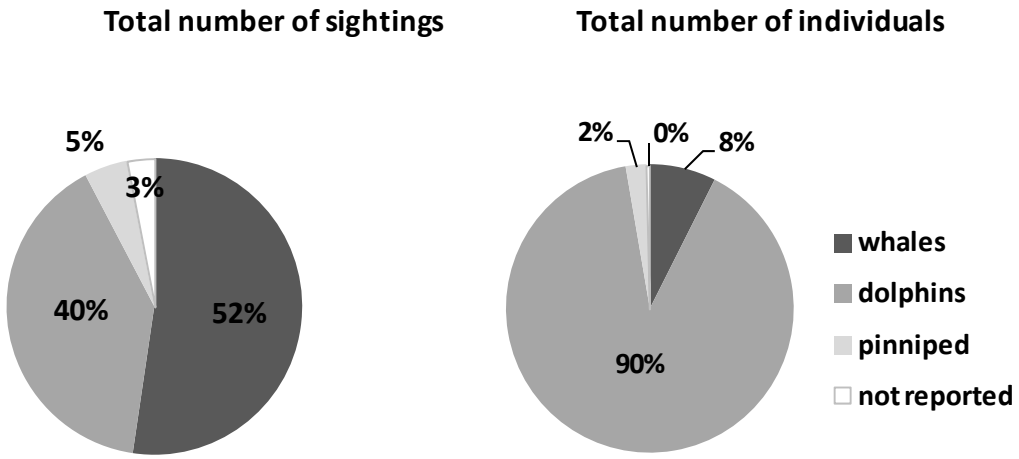


Figure S-6. Chart of marine mammal sightings (left) and number of individuals by species categories (right) during SOCAL Range Complex major training exercises 02 August 2010 to 01 August 2011.

SOCAL Range Complex Major Training Exercise Mitigations

From Table S-5, of the 428 Navy marine mammal sightings during major training exercises this reporting period, there were 110 sightings within 1,000 yards that qualified as mitigation exercises. In other words, mid-frequency active sonar units had their sonar on, and followed the appropriate mitigation (secure or power down) depending on the range to the marine mammal. There were 59 sonar shutdowns at ranges <200 yards (Table S-6), and 51 sonar powerdowns at ranges between 200-1,000 yards.

There were also 12 instances of Navy ships actively maneuvering to avoid marine mammals. Of these 12 maneuvers, 10 were to avoid whales (n=14 whales), and 2 were to avoid pods of dolphins (one pod of 30 and another of 200).

Table S-6. Number of marine mammal sightings at ranges less than 200 yards observed from Navy platforms during major training exercises concurrent with sonar shutdown mitigation 02 August 2010 to 01 August 2011.

Shutdown mitigation range	Total # of sightings	Total # of marine mammals	Breakdown by species type			
			# of whales	# of dolphins	# of pinnipeds	# of not reported
< 200 yards	59	890	28 times for 41 whales	24 times for 838 dolphins	4 times for 4 pinnipeds	3 times for 7 individuals

SUMMARY: Mitigation Effectiveness and Navy Safety Zone Adherence

During this year's major training exercises in the Southern California Range Complex, proscribed NMFS safety zones were effectively applied greater than 99% of the time in cases of observation of marine mammals within the applicable safety zone. There was only one instance of a ship powering down vice turning sonar off when a group of 10 dolphins were sighted at a 200-yard range. There were 9 instances this reporting period of bowriding dolphins. As detailed in previous Monitoring Reports, there is no sonar powerdowns or shutdowns in the case of bowriding dolphins.

The three categories of mitigation measures (Personnel Training, Lookout and Watchstander Responsibility, and Operating Procedures) outlined in the SOCAL Final Environmental Impact Statement/Overseas Environmental Impact Statement of December 2008 and approved by NMFS in subsequent Letters of Authorization in 2009, 2010 and 2011 were effective in appropriately mitigating exposure of marine mammals to mid-frequency sonar. During this year's major training exercises, the proscribed NMFS safety zones were adhered to, and vessels and aircraft applied mitigation measures when marine mammals were visually observed within the requisite zone. Fleet commanders, aircrews and ship watch teams continue to improve individual awareness and enhance reporting practices. This improvement can be attributed to the various pre-exercise conferences, mandatory Marine Species Awareness Training, adherence to required

MFAS mitigation zones, and application of lessons learned in marine mammal sighting and reporting.

Other Navy Funded Research

Navy research funded monitoring and marine mammal science within the Southern California Range Complex included several visual survey efforts, marine mammal tagging, and other relevant topics.

Specific field reports are included in **Appendix D** of this report, and include:

- Scripps Institute of Oceanography and National Marine Fisheries Service Southwest Fisheries Science Center small boat based marine mammal surveys in Southern California: Report of Results for August 2010 - July 2011
- Marine mammal surveys conducted during regularly scheduled California Cooperative Oceanic Fisheries Investigation (CalCOFI) field cruises within Southern California
- Cascadia Research Collective small vessel surveys and satellite tagging of marine mammal at SCORE[9] and surrounding areas of Southern California in 15 June[10] 2010- and 24 June 2011

Scripps Institute of Oceanography and National Marine Fisheries Service, Southwest Fisheries Science Center small boat surveys in Southern California

Primary objectives of this research is to use sighting, photo-identification, biopsy and acoustical sampling techniques to assess the occurrence, distribution and population structure of small cetaceans in a region that is subject to frequent naval exercises. Surveys are conducted from a 6.8 m rigid-hulled inflatable boat (RHIB). Survey effort is focused on the Southern California Offshore Range (SCORE) near San Clemente Island as part of an ongoing collaborative study to assess cetacean populations occurring in this active Navy training area. Additional surveys were conducted at peripheral locations including Catalina Island and the San Diego coastline. This geographically broad approach was designed to increase the effectiveness of our Southern California monitoring efforts by collecting similar data at multiple sites across a large temporal scale, providing a regionally comprehensive assessment of small cetacean populations inhabiting the area. While the current small boat effort in Southern California incorporates data collection from all cetacean species encountered, bottlenose and Risso's dolphins were selected as initial focal species due to their accessibility, existing baseline data and varying life history patterns. Small vessel surveys were conducted at San Clemente and Catalina Island from 4-11 January 2011, 1-7 May 2011, and 21–25 July 2011. In addition, nineteen surveys were conducted along the San Diego coastline and offshore waters during this same time period. Monitoring results are shown in **Table S-7** with specific study accomplishments for this year provided **Appendix D**.

9 SCORE is an older acronym for Southern California Offshore Range, and is the equivalent of the newer designation for the Southern California Range Complex.

10 Cacadia report includes 15 June, 2010 through 24 June 2011 field efforts (**Appendix D**). Only effort from 2 August 2010 through 24 June 2011 is summarized in this report.

Scripps small boat surveys accomplishments in parallel with Year Three monitoring in the Southern California Range Complex include:

- 111 hours of visual survey effort over 795 nm
- 118 sightings of 6,150 marine mammals, and 8,753 digital photographs taken
- Continuation of photoID catalogs for offshore stock of bottlenose dolphins
- Continuation of photoID catalogs for Risso's dolphins

Table S-7. Cumulative total of Scripps Institute of Oceanography small boat surveys within the Southern California Range Complex from August 2010 to August 2011.

Species	Number of Groups	Number of Individuals	Number of ID Images	Number of Recordings	Number of Biopsies
Coastal Bottlenose Dolphin	79	729	7592	15	2
Offshore Bottlenose Dolphin	2	18	59	-	-
Risso's Dolphin	1	26	307	-	3
Pacific White-Sided Dolphin	4	29	79	-	1
Short-Beaked Common Dolphin	5	3634	14	-	-
Long-Beaked Common Dolphin	7	1615	43	-	-
Common Dolphin, Species unknown	4	69	-	-	-
Fin Whale	-	-	-	-	-
Humpback Whale	-	-	-	-	-
Gray Whale	6	7	34	-	
Blue Whale	10	23	625	-	-
Total	**118**	**6,150**	**8,753**	**15**	**6**

Scripps Institute of Oceanography marine mammal surveys during California Cooperative Oceanic Fisheries Investigations (CalCOFI) surveys

The Navy's Research monitoring program funds marine mammal surveys during regularly occurring California Cooperative Oceanic Fisheries Investigation (CalCOFI) field cruises. Scripps Institute of Oceanography, Marine Physical Laboratory participates as marine mammal observers during these Southern California CalCOFI cruises.

More information on the 61-year history of the CalCOFI program is available online at: http://www.calcofi.net/

The CalCOFI marine mammal efforts represents some of the few winter vessel surveys within Southern California, consistent sampling of the same survey track lines, and coverage of a significant amount of offshore area. Specific accomplishments for marine mammal surveys during CalCOFI cruises from 02 August 2010 to 01 August 2011 include:

- 455 hours of survey effort covering 3,183 nm
- 268 sightings of 13,399 marine mammals
- 2,600 digital photographs of marine mammals taken
- 872 hours of passive acoustic recording of marine mammal vocalizations
- **Appendix D** has a more complete discussion of CalCOFI results

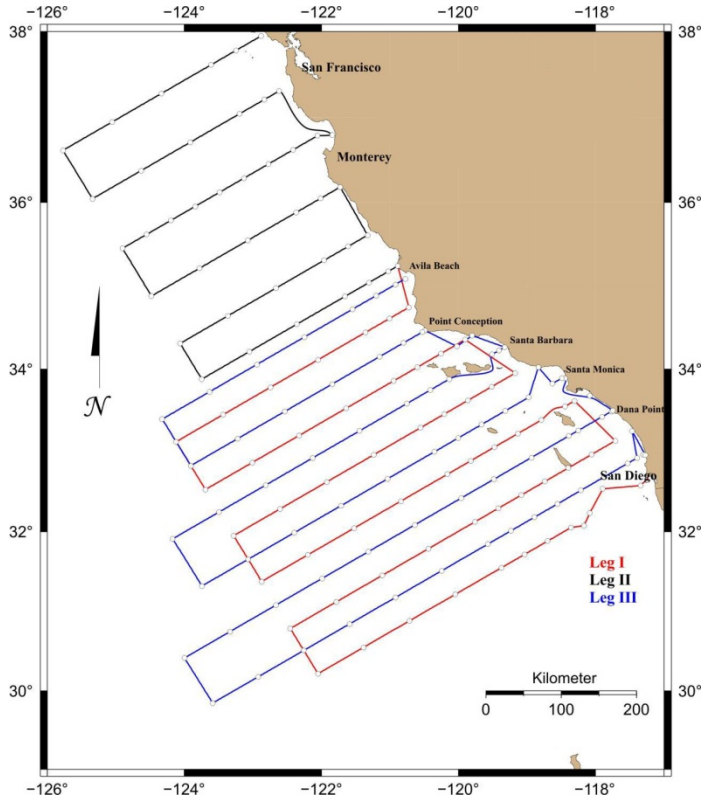


Figure S-7. CalCOFI station positions for standard transect (blue), trawling transect (red), and northern transect (black). Image courtesy of CalCOFI program.

Distribution and Demographics of Marine Mammals in SOCAL through Photo-Identification, Genetics, and Satellite Telemetry:

A summary of surveys conducted 15 June 2010 – 24 June 2011

Cascadia Research participated in the fifth and sixth year of collaborative marine mammal surveys centered on the Southern California Offshore Range (SCORE) [i.e. the Southern California Range Complex]. The primary mission of these surveys since their inception has been to provide visual verification of passive acoustic detections on the Navy instrumented underwater passive acoustic monitoring range and array using the Navy's Marine Mammal Monitoring (M3R) system (Moretti et al. 2006)[11]. Over time, these surveys have evolved to include focal studies of several species of interest to the Navy, including beaked whales and ESA listed baleen whales, via photo-identification, tissue sampling, and the deployment of medium duration satellite tags.

This work has produced some of the first U.S. West Coast tagging of Cuvier's beaked whales (see **Appendix D**). Processing and analysis of photo-identification data for all species is underway.

Cascadia survey, photoID, and tagging accomplishments in parallel with Year Three monitoring in the Southern California Range Complex include:

- 154 hours of visual survey effort over >1,664 nm
- 99 sightings of 2,287 marine mammals
- 16 biopsies taken
- 14 medium duration Low Impact Minimally Percutaneous External-electronics Transmitter (LIMPET) satellite tracking tags deployed
- Five fin whales, one sei/fin, one Baird's beaked whale, two Risso's dolphin, one killer whale, one sperm whale and three Cuvier's beaked whale

Tagging Highlights

Figure S-8 shows the long-term movement of five tagged Cuvier's beaked whale from the June 2010 and January 2011 surveys. Three of the five individuals showed movements away from the San Nicolas Basin, two of the three returned. This represents one of the first indications that Southern California beaked whales may engage in non-local, out of area movement, although the biological significance for this activity is not understood, nor is it known at this time if this is indicative for all beaked whales. **Figure S-9** Shows movement of fin whales tagged during the contract period in the San Nicholas Basin. While there was some limited use of nearshore waters among the Channel Islands, including within the three-mile vessel exclusion area around SWAT 1 and 2 on the north end of San Clemente Island, individuals largely spent time in deep water, and farther offshore. **Figure S-10** showing movements of three tagged Risso's Dolphins, June 2010 thru May 2011.

11 Moretti D., Morissey R., DiMarzio N., and Ward J. 2006. Verified passive acoustic detection of beaked whales (*Mesoplodon densirostris*) using bottom-mounted hydrophones in the tongue of the ocean, Bahamas. Applied Acoustics 67:1091–1105.

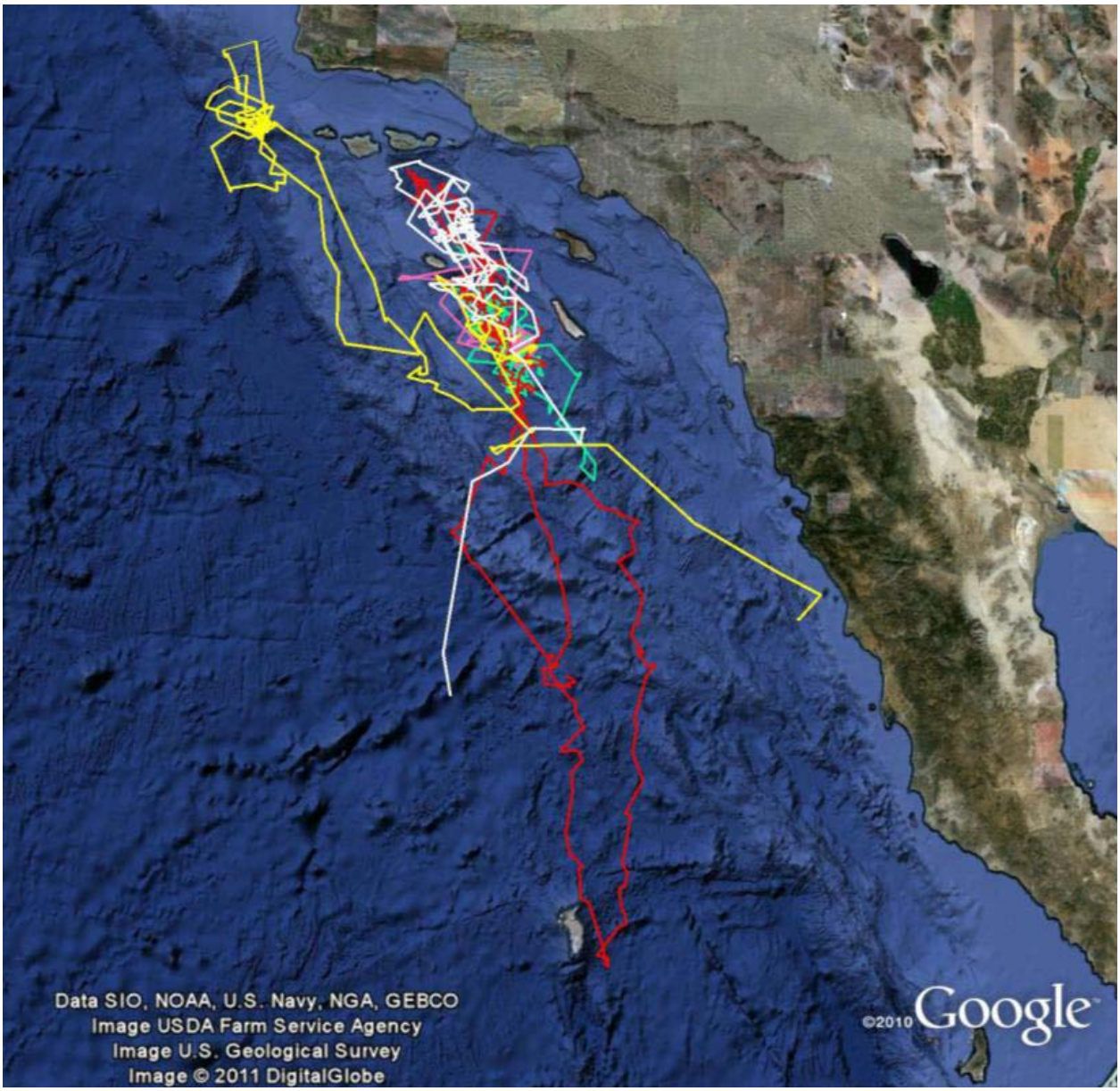


Figure S-8. Movements of five tagged Cuvier's beaked whales.

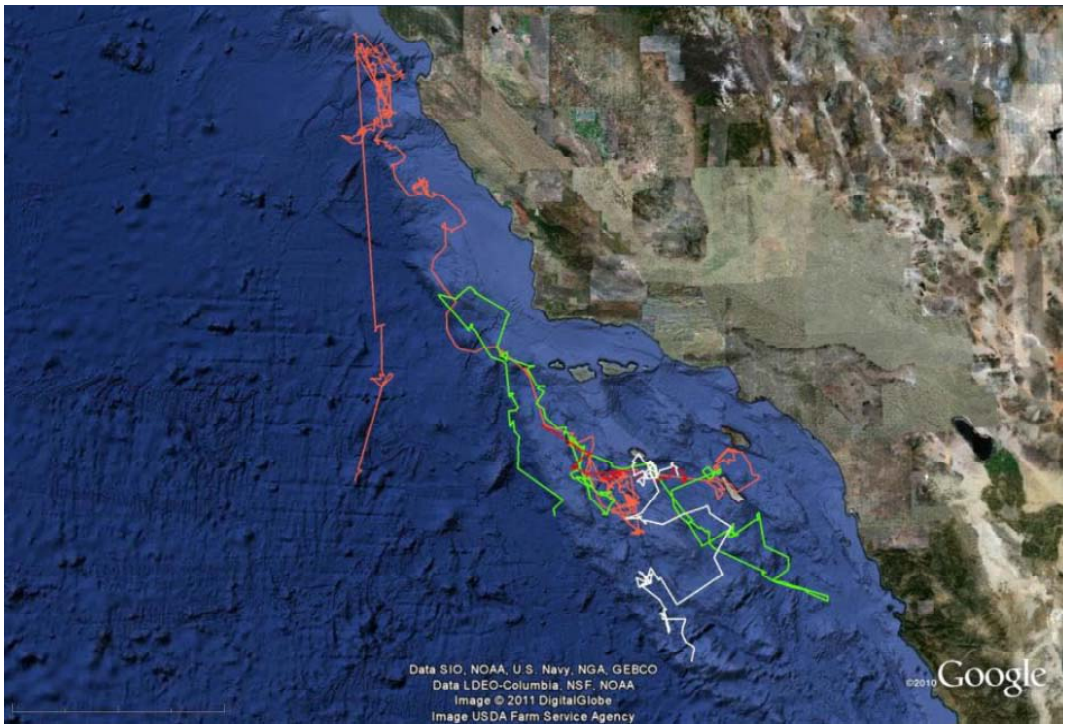


Figure S-9. Movement of fin whales tagged during the contract period in the San Nicholas Basin.

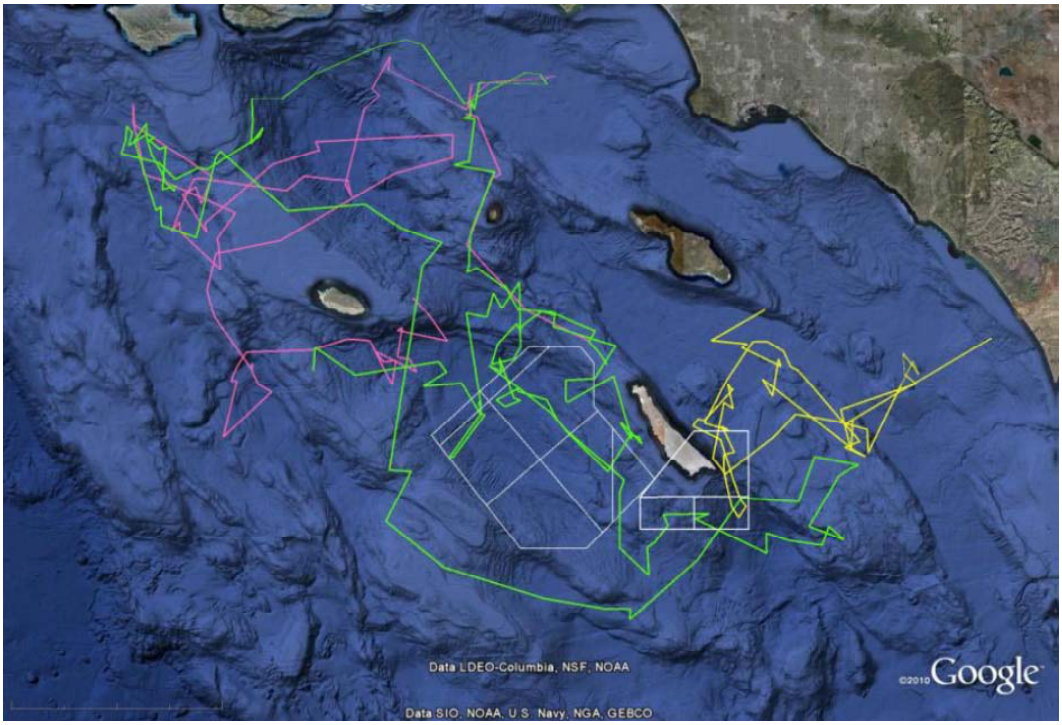


Figure S-10. Map showing movements of three tagged Risso's Dolphins, June 2010 thru May 2011. Note the SOAR and SHOBA ranges outlined in white.

SOCAL-10

SOCAL-10 was a scientific research project conducted in Aug-Sept 2010 in important biological areas near southern California. It extended previous studies in the Bahamas (2007-08) and Mediterranean Sea (2009) of whether and how marine mammals change their behavior when they are exposed to different sounds. Each of these studies has integrated behavioral response studies to controlled sound exposures with ongoing research on diving, foraging, and social behavior. The overall objective was to provide a better basic understanding of marine mammal behavior, while providing direct scientific information for the Navy and regulatory agencies to estimate risk and minimize the effect of human sounds, particularly military sonar. SOCAL-10 was the first in a five-year dedicated effort to study a variety of marine mammal species in areas around the southern California coast and Channel Islands.

SOCAL-10 involved an interdisciplinary collaboration of experts in marine mammal biology, behavior, and communication, as well as underwater acousticians and specialized field researchers. During a preliminary scouting phase and two research legs on different research vessels, SOCAL-10 observed, photographed, and/or tracked in detail, individuals of 21 different marine mammal species. Sixty-three tags (of six different varieties) were successfully secured on 44 individual animals of nine different marine mammal species, including several which had never been studied using tag technologies previously. Scientists also conducted 28 controlled sound exposure experiments; in these experiments, animals were monitored with suction cup acoustic sensors, remote listening devices and specialized observers with high-powered binoculars. Sounds were then played to the animals under specific protocols and protective measures (to ensure animals were not harmed) and changes in behavior were measured.

Preliminary results based primarily on clearly observable behavior in the field and from initial data assessment indicate variable responses, depending on species, type of sound, and behavioral state during the experiments. Some observations in certain conditions suggest avoidance responses, while in other cases subjects seemed to not respond, at least overtly. Additional analysis and interpretation is underway of the nearly 400 hours of tag data from the project, as well as thousands of marine mammal observations, photographs, tissue samples, and acoustic measurements.

http://www.sea-inc.net/SOCAL10/

Southern California marine mammal tagging efforts under the SOCAL-10 project in September 2010. Photos courtesy of SOCAL-10.

CONCLUSIONS FOR SOUTHERN CALIFORNIA RANGE COMPLEX YEAR THREE MONITORING

The Navy achieved all of its planned annual monitoring objectives in Year Three from 02 August 2010 to 01 August 2011. Most of the data collected will continue to be pooled with previous year's effort for continued scientific analysis over the full five-year Southern California Range Complex authorization.

Significant contributions were made in Year Three to learn more about baseline marine mammal occurrence, movement, and behavior within the Southern California Range Complex. To this end, over 21,196 nm of coastal and offshore waters within the Southern California were visually surveyed. These surveys occurred both during and without Navy major training events. Refinement on techniques and procedures continued for satellite tagging of ESA-listed baleen whales, Cuvier's beaked whales, and other species of interest. Passive acoustic monitoring provided the first long-term analysis of marine mammal vocalizations as an indicator of presence or absence across both warm and cold seasons. In the spirit of collaboration and information sharing within the marine science community, visual survey data from the Navy's Year One (2008-2009), Year Two (2009-2010) and Year Three (2010-2011) efforts will be made available online for download by the spring or early summer of 2012.

Finally, **Appendix A** contains the Navy's proposed Year Four Southern California Range Complex Monitoring Plan for the period 02 August 2011 to 01 August 2012. Most of the same techniques used as measures of accomplishments for Year Three will also apply in Year Four.