

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

Department Of The Navy

**2012 ANNUAL REPORT**

**October 1, 2012**  
**FINAL**

*Cover photos from top to bottom:*

Aerial photos of gray whale mother and calf southbound, February 2012 (SES); preparing sonobuoy prior to use from civilian survey airplane, February 2012 (SES); aerial photo of fin whale off Southern California, March 2012 (SES); spectrogram of Bryde's whale BE2 call (SIO); civilian MMO aboard U.S. Navy destroyer, July 2012 (Navy); common dolphins photographed near U.S. Navy destroyer, July 2012 (Navy).

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

**2012 ANNUAL REPORT**

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*Prepared For and Submitted To*

**National Marine Fisheries Service  
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*Prepared By*

**Department Of The Navy**

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Department of the Navy  
2012 Annual Range Complex Monitoring Report for Southern California

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## **EXECUTIVE SUMMARY**

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

Year Four encompassed the period from 02 August 2011 to 01 August 2012. As outlined in the SOCAL Range Complex report and supporting technical reports, significant accomplishments were achieved from visual surveys, deployments of passive acoustic monitoring devices, marine mammal tagging, use of marine mammal observers on U.S. Navy surface ships, and leveraging of additional field efforts from several projects funded by multiple Department of the Navy organizations. A substantial amount of marine species monitoring data was collected, some of which is still undergoing analysis for inclusion in the Comprehensive 5-Year Monitoring Report (due to the National Marine Fisheries Service [NMFS] in Fall 2012).

The U.S. Navy met or exceeded its monitoring goals as stated in the Range Complex-specific Monitoring Plan modified through the 01 October 2011 Hawaii Range Complex -SOCAL Range Complex Monitoring Report submittal to the NMFS (DoN 2011a).

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### **Supporting Technical Reports (listed in order of citation within this report)**

- DoN. 2012. Southern California Range Complex Year Five *Monitoring Plan* 02 August 2012 to 01 August 2013.
- Eguchi, T., and J. Seminoff (SWFSC). 2012. Final Report on the Aerial Survey of the Southern California Bight 2011.
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- Falcone, E. and G. Schorr (Cascadia). 2012. Distribution and Demographics of Marine Mammals in SOCAL Through Photo-Identification, Genetics, and Satellite Telemetry: A summary of surveys conducted 1 July 2011 – 15 June 2012.
- Moretti, D. 2012. Marine Mammal Monitoring on Navy Ranges (M3R)- Southern California Offshore Anti-submarine Warfare Range (SOAR) FY12 Test Summary.
- Southall, B. et al. (multiple). 2012. Biological and Behavioral Response Studies of Marine Mammals in Southern California, 2011 (“SOCAL-11”)- FINAL PROJECT REPORT.

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## LIST OF ACRONYMS

BRS	Behavioral Response Study
CalCOFI	California Cooperative Oceanic Fisheries Investigation
CEE	controlled exposure experiment
DoN	Department of the Navy
EIS/OEIS	Environmental Impact Statement/Overseas Environmental Impact Statement
ENSO	El Niño-Southern Oscillation
ESA	Endangered Species Act
HARP	High-Frequency Acoustic Recording Package
hr	hour(s)
Hz	hertz
ICMP	Integrated Comprehensive Monitoring Program
kHz	kilohertz
LOA	Letter of Authorization
M <sub>3</sub> R	Marine Mammal Monitoring on Navy Ranges
MFAS	mid-frequency active sonar
MMO	marine mammal observer
MMPA	Marine Mammal Protection Act
MSAT	Marine Species Awareness Training
MTE	Major Training Exercise
NAOPA	Northern Air Operating Area
NM	nautical mile(s)
NMFS	National Marine Fisheries Service
OBIS SEAMAP	Ocean Biogeographic Information System Spatial Ecological Analysis of Megavertebrate Populations
ONR	Office of Naval Research
OPNAV N45	Chief of Naval Operations Energy and Environmental Readiness Division
PAM	passive acoustic monitoring
RHIB	rigid-hulled inflatable boat
SES	Smultea Environmental Sciences LLC
SIO	Scripps Institution of Oceanography
SOAR	Southern California Offshore Anti-submarine warfare Range
SOCAL	Southern California
SWFSC	Southwest Fisheries Science Center
U.S.	United States



# INTRODUCTION

## Background and Report Objective

The United States (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, and submits annual reports summarizing monitoring results.

The Range Complex Monitoring Plans utilize a variety of research methods that support Range Complex-specific monitoring and contribute information to a larger U.S. Navy-wide science-based program. A combination of techniques are used in range complex monitoring so that detection and observation of marine animals is maximized and meaningful information can be derived to answer the research questions proposed in the Navy's Integrated Comprehensive Monitoring Program (ICMP). The primary research methods used in the Southern California (SOCAL) Range Complex include visual surveys from airplanes, passive acoustic monitoring (PAM), and marine mammal observers (MMOs) on U.S. Navy surface ships. Each monitoring technique has advantages and disadvantages that vary temporally and spatially; these techniques may support one particular study objective better than another (e.g., DoN 2010a).

In addition to the 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 programs focused on marine mammals and sound. Total investment in this program has been greater than \$150M over the past 8 years. Between 2011-2012, over \$3M in funding was used on funding to academic, agency, and contract scientists specifically in SOCAL. Several significant projects relative to U.S. Navy training impact or lack of impact to marine mammals are currently funded and ongoing within the and SOCAL Range Complex as described in this report and associated technical reports.

The main objective of this annual report is the presentation of data and results from the U.S. Navy-funded marine mammal and sea turtle monitoring conducted in the SOCAL Range Complex from 02 August 2011 to 01 August 2012. Included in this assessment are reportable metrics of monitoring as requested by the National Marine Fisheries Service (NMFS). This Year Four 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 supporting documents provided by the scientists who performed the monitoring work in the Range Complex.

Within the SOCAL Range Complex, the U.S. Navy fully implemented the Monitoring Plan outlined in the U.S. Navy's 2011 Year Three Monitoring Report submitted to NMFS (DoN 2011a) and specified in the U.S. Navy's subsequent 2012-2014 Letter of Authorization (LOA) renewal application for Study Year Four.

Monitoring efforts were funded by the U.S. Pacific Fleet as required for compliance monitoring under the U.S. Navy's MMPA and ESA authorization requirements. Additional marine mammal research within the SOCAL Range Complex, part of a larger research program, was funded by OPNAV N45. Some results from this research monitoring, with objectives complementary to those of the U.S. Navy's compliance monitoring, are presented in this report, where applicable. Monitoring accomplished in Year Four within the offshore waters of the SOCAL Range Complex included aerial and vessel visual marine mammal and sea turtle surveys, the embarkation of MMOs on a U.S. Navy surface ship, and PAM from two bottom-deployed acoustic recording packages.

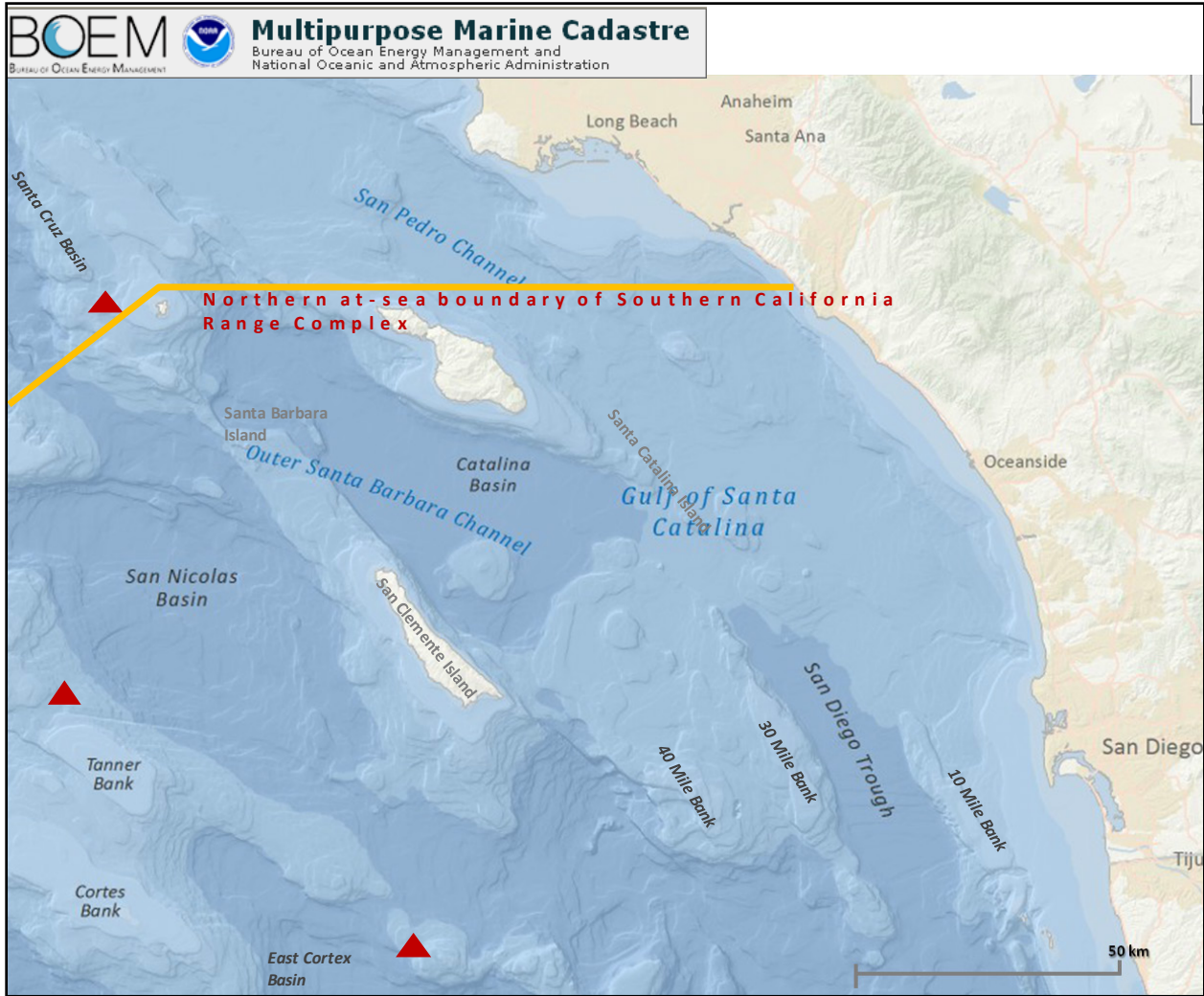
## Report Organization

This report is organized to summarize the U.S. Navy's monitoring commitments and Year Four accomplishments within the SOCAL Range Complex include:

- Compliance monitoring (U.S. Pacific Fleet-funded MMPA and ESA required monitoring)
  - Visual Survey Results
  - Marine Mammal Observers
  - Passive Acoustic Monitoring
  - SOCAL Range Complex Exercise Summary
- Other research (other U.S. Navy-funded research results, as available, independent of MMPA and ESA required monitoring).

## Year Four Monitoring Locations

While all nearshore and offshore ocean areas within the SOCAL Range Complex qualify for potential monitoring activities, certain portions of the Range Complex were designated as "focal areas" based on the scientific merit of study in that location, logistics of being able to safely reach the site especially for shore-based airplane surveys, proximity to key U.S. Navy training areas, and previous field experience from past U.S. Navy monitoring in 2009, 2010, 2011, and January-June 2012. The U.S. Navy's previous 2009, 2010, and 2011 Annual Monitoring Reports discussed the impacts of regional oceanographic conditions on potential marine mammal occurrence within SOCAL (DoN 2009a, DoN 2010a, DoN 2011a). These conditions include the El Niño (warm-water regime) and La Niña (cold-water regime) extremes of the El Niño-Southern Oscillation (ENSO) cycle, the longer-term Pacific Decadal Oscillation, and the effects of global climate change. During Year Four monitoring, there were lowered sea surface temperatures from August 2011 through April 2012 indicative of a cool-water La Niña condition to ENSO-neutral. **Figure 1** shows the general SOCAL areas surveyed most often during Year Four (from 02 August 2011 to 01 August 2012).



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

**Figure 1. The aerial survey monitoring area and PAM locations within the U.S. Navy's SOCAL Range Complex.**

## MONITORING AUGUST 2011-AUGUST 2012

Monitoring methodologies are presented below, along with discussions of accomplishments, metrics of completion, scientific contribution, and overall value to the monitoring program. Detailed discussions of monitoring efforts can be found in supporting reports cited in this report.

Year Four monitoring objectives include reporting annual results from:

- Visual Surveys
- Marine Mammal Observers
- Passive Acoustic Monitoring
- SOCAL Range Complex Navy Exercise Reporting
- Other U.S. Navy-Funded Research Results, as available.

All Year Four monitoring objectives were met, and in some cases significantly exceeded (**Table 1**). U.S. Pacific Fleet-funded SOCAL compliance monitoring in Year Four included 142.5 hours (hr) of aerial survey effort across seven surveys, 124 hr of MMO effort on a U.S. Navy destroyer during a unit-level training, and 12,456 hr of PAM recording. The total field effort within the SOCAL Range Complex for Year Four compliance monitoring is presented in **Table 2a**, and other U.S. Navy-funded research is presented in **Table 2b**.

**Table 1. Overview of U.S. Navy compliance with monitoring requirements in the SOCAL Range Complex.**

Type of Activity	2012 Planned Monitoring as Committed To By The U.S. Navy	2012 Completed Year Four Monitoring Accomplishment
Compliance-Funded Monitoring Visual Survey	100-150 hr effort	142.5 hr of effort completed (see Smultea et al. 2012 and Eguchi and Seminoff 2012)
Marine Mammal Observers	58-100 hr of effort	124 hr of effort completed (see Watwood et al. 2012)
Passive Acoustic Monitoring (PAM)	Continue data analysis from PAM devices	12,456 hr recorded and analyzed (see Hildebrand et al. 2012)
U.S. Navy Exercise Summary	Present marine mammal sighting results from U.S. Navy major training exercises	220 sightings of approximately 2,993 marine mammals
Other U.S. Navy-Funded Research Summaries	Present results for other U.S. Navy-funded research projects as available (tagging, photo-identification, visual, PAM)	Summarized in this report (see Campbell et al. 2012a,b)

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**Table 2a. Total effort and accomplishments from Year Four U.S. Pacific Fleet-funded compliance monitoring within the SOCAL Range Complex from 02 August 2011 to 01 August 2012.**

Navy funding	Performing Organization	Survey Dates or Window	Platform	# Days	Total Survey Time (hr)	Total Survey Distance (NM)	# Groups	# Individuals	# Species visually sighted	Digital Photo/ IDs taken (#)	Digital video taken (hr)	Biopsies (#)	Satellite tags (# tags)	Acoustic recordings (#)	Total passive acoustic recordings (hr)	Acoustic detections (#) (# detection\#species)	PAM (# buoys or hours) (#detections\#species)
P	Sw	07 September- 02 October 2011	Airplane- DeHavilland Twin Otter DHC-6	8	38.3	1,903	209	6,247	9	na	na	na	na	na	na	na	na
P	Sm	30 January- 05 February 2012	Airplane- Partenavia P-68-C	7	34.5	3,225	227	25,520	11	1,868	1.4	na	na	na	na	na	na
P	Sm	13-15 March 2012	Airplane- Partenavia P-68-C	3	19.1	1,746	156	11,081	10	1,026	0.9	na	na	na	na	na	na
P	Sm	28 March - 01 April 2012	Airplane- Partenavia P-68-C	5	26.9	2,445	123	5,720	10	921	1.0	na	na	na	na	na	na
P	Sm/B	07-10 February 2012	Airplane- Partenavia P-68-C	4	12.2	799	15	594	4	56	4.9	na	na	19	5.2	na	12 buoys 5
P	Sm/B	16 March 2012	Airplane- Partenavia P-68-C	1	4.1	717	6	23	3	30	0.05	na	na	9	1.8	na	3 buoys 1
P	Sm/B	02-03 April 2012	Airplane- Partenavia P-68-C	2	7.4	696	17	1,565	7	207	0.7	na	na	15	2	na	8 buoys 3
P	Si	11 May 2011- 17 March 2012	HARP "M"	255	na	na	na	na	na	na	na	na	na	na	6,120	/16	na
P	Si	11 May 2011- 05 March 2012	HARP "H"	264	na	na	na	na	na	na	na	na	na	na	6,336	/16	na
P	P	23-27 July 2012	MMO embark	7	124	na	63	901	5	637	na	na	na	na	na	na	na
Total:				556	266.5	11,531	816	51,815		4,745	9				12,465		

Key: P= U.S. Pacific Fleet, Sm= Smultea Environmental Sciences LLC, B=Bio-Waves Inc, Sw= National Marine Fisheries Service's Southwest Fisheries Science Center, MMO= marine mammal observer, na= not applicable or not reported.

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**Table 2b. Total effort and accomplishments from other U.S. Navy-funded research within the SOCAL Range Complex from 02 August 2011 to 01 August 2012.**

Navy funding	Performing Organization	Survey Dates or Window	Platform	# Days	Total Survey Time (hr)	Total Survey Distance (NM)	# Groups	# Individuals	# Species visually sighted	Digital Photo/ IDs taken (#)	Digital video taken (hr)	Biopsies (#)	Satellite tags (# tags)	Acoustic recordings (#)	Total passive acoustic recordings (hr)	Acoustic detections (#) (# detection\#species)	PAM (# buoys or hours) (#detections\#species)
N	Si	27 July-13 August 2011	CalCOFI vessel survey	17	127	1,305	148	3,930	9	432	na	na	na	32	95	78/6	63 buoys/234 hr 10/2
N	Si	16 October-02 November 2011	CalCOFI vessel survey	18	101	961	70	4,959	8	1,023	na	na	na	23	60	54/6	37 buoys/196 hr 17/3
N	Si	27 January-12 February 2012	CalCOFI vessel survey	17	85	820	67	2,540	11	1,724	na	na	na	22	71	57/8	49 buoys/257 hr 24/5
N	Si	25 March- 06 April 2012	CalCOFI vessel survey	13	78	882	94	2,474	11	2,550	na	na	na	20	72	43/5	52 buoys/156 hr 16/2
N	Si	02 July- 26 July 2012	CalCOFI vessel survey	18	132	1,190	139	6,611	10	2,149	na	na	na	30	87	106/8	57 buoys/308 hr 94/5
N	Si/Sw	01 August 2011 – 31 July 2012 San Diego Coastal Surveys	RHIB- Paula Christine	14	77	617	104	4,112	10	6,220	na	28	na	nr	20	20/3	1 buoy/1 hr nr/nr
N	C	14 small boat surveys between 1 July 2011 to 1 June 2012	RHIB	nr	144	1,485	112	3,739	14	190	na	12	21	na	na	na	na
N	Nu	Marine Mammal Monitoring on Navy Ranges (M3R)	Southern California Offshore Anti-Submarine Range (fixed bottom mounted hydrophones)	na	na	na	na	na	na	na	na	na	na	na	nr	nr	na
Total:				97	744	7,260	734	28,365		14,288		40	21		405		

Key: N= CNO N45, Si= Scripps Institution of Oceanography, CalCOFI = California Cooperative Oceanic Fisheries Investigations, Sw= NMFS' Southwest Fisheries Science Center; C= Cascadia Research Collective; RHIB= rigid-hulled inflatable boat, na= not applicable; nr= not reported.

Highlights for Year Four U.S. Pacific Fleet compliance monitoring (**Table 2a**) include:

- 235.5 hr of visual survey effort
- 11,531 nautical miles (NM) of ocean visually surveyed
- 817 visual sightings representing 51,651 marine mammals
- Over 12,456 hr of PAM recordings made
- 4,108 digital photographs of marine mammals taken
- 9 hr of digital video of marine mammals taken.

Highlights from U.S. Navy research projects this year in addition to those summarized in **Table 2b** (Campbell et al. 2012a, 2012b, Falcone and Schorr 2012) include:

- 744 hr of visual survey effort
- 7,260 NM of ocean visually surveyed
- 734 visual sightings representing 28,365 marine mammals
- Over 405 hr of passive acoustic data recorded; although this figure does not factor in the near 24/7 amount of data being collected from the Navy's instrumented range and bottom mounted hydrophones under the M3R research program
- 14,288 digital photographs of marine mammals taken
- 21 satellite tracking tags attached to four different species
- 40 tissue biopsies taken.

[Effort from ONR and OPNAV N45 Navy funded Behavioral Response Study (SOCAL-11, see Southall et al. 2012) is not included in the Table 2b and text above]

## U.S. Pacific Fleet Compliance Monitoring

### Visual Surveys (Aerial Summary)

The U.S. Navy completed 235.5 hr of visual surveys in the SOCAL Range Complex between 02 August 2011 and 01 August 2012, which exceeds the 100-150 hr specified in the Year Four Monitoring Plan. Aerial surveys accounted for 142.5 hr of total visual survey (**Tables 1, 2a, and 2b**). Aerial surveys provide the opportunity to rapidly survey large tracks of ocean in a fraction of the 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 hr for a civilian airplane (Partenavia P68-C, DeHavilland Twin Otter DHC-6).

While all visual survey effort (from both vessel and aerial platforms) is presented in **Table 2**, specific aerial survey accomplishments in Year Four included: completion of four aerial survey periods: 07 September–02 October 2011 (38.3 hr of effort) (see Eguchi and Seminoff 2012); 30 January–05 February 2012 (35 hr of effort) (see Smultea et al. 2012); 13-15 March 2012 (19 hr of effort) (see Smultea et al. 2012); and 28 March–01 April 2012 (27 hr of effort) (see Smultea et al. 2012).

The September-October 2011 aerial survey was conducted by NMFS' Southwest Fisheries Science Center-(SWFSC) (Eguchi and Seminoff 2012) under joint NMFS and U.S. Navy funding. The study area was defined from Point Conception to the U.S.-Mexico border. Nine marine mammal species were observed, including blue whale (*Balaenoptera musculus*), fin whale (*Balaenoptera physalus*), sperm whale (*Physeter macrocephalus*), and Baird's beaked whale (*Berardius bairdii*). No sea turtles were observed during the survey.

The 2012 aerial surveys were conducted by Smultea Environmental Sciences, LLC (SES) under contract to HDR, Inc. (Smultea et al. 2012). Unlike in past years, surveys in Year Four did not overlap with any major training exercises (MTEs) and occurred only in the Northern Air Operating Area (NAOPA [Santa Catalina Basin]) and the Southern California Anti-Submarine Warfare Range (SOAR [San Nicolas Basin]). The Silver Strand area (located south of Point Loma) was not surveyed in 2012 (but was flown in winter 2011)(see DoN 2011a). Effort focused on line-transect surveys only, rather than on both line-transect surveys and focal-behavioral follows. Opportunistic focal-behavior follows were conducted as time and effort allowed. Eleven marine mammal species were observed, including blue whale, fin whale, gray whale (*Eschrichtius robustus*), minke whale (*Balaenoptera acutorostrata*), Risso's dolphin (*Grampus griseus*), northern right whale dolphin (*Lissodelphis borealis*), and Dall's porpoise (*Phocoenoides dalli*). No sea turtles were observed.

Twenty-three hours of aerial survey effort were used to deploy sonobuoys (for PAM) to match and further describe cetacean vocalizations with confirmed species identification and group/behavior characteristics. The acoustic-visual behavior survey periods were 07-10 February 2012 (12 hr of effort), 16 March 2012 (4 hr of effort), and 02-03 April 2012 (7 hr of effort) (**Table 2**) (Smultea et al.



2012). Smultea et al. (2012) includes results from the first year of deploying sonobuoys from the aircraft to simultaneously monitor both acoustic- and visually-observed behaviors (Smultea et al. 2012). Opportunistic focal-behavior -follow data are mentioned briefly in Smultea et al. 2012. Five marine mammal species were visually and acoustically detected, including fin whale, gray whale, humpback whale (*Megaptera novaeangliae*), bottlenose dolphin (*Tursiops truncatus*), and Risso's dolphin.

Specific accomplishments of aerial surveys this year include:

- Over 11,531 NM surveyed
- 753 sightings of approximately 50,750 marine mammals representing 14 species
- 4,108 high resolution digital photos taken
- 9 hr of digital video taken
- 23 PAM sonobuoys deployed, with five species detected
- 39 focal-behavior follows over 5 minutes each, totaling 54 hr of detailed focal-behavior follows.

Aerial surveys performed in 2012 addressed the overall SOCAL Range Complex Monitoring Plan in the following ways:

1. Surveyed key U.S. Navy areas of interest and provided a “snapshot” of marine mammal numbers, presence, distribution, and behavior before, during, or after MTEs.
2. Systematically collected quantifiable behavioral data known to be indices of stress/disturbance in order to build knowledge of baseline marine mammal behavioral information in SOCAL.
3. Conducted focal follows of priority cetacean species, including video-documentation of surface and near-surface underwater behavior, in order to build knowledge of baseline marine mammal behavioral information in SOCAL.
4. Provided a platform from which behavior and potential reactions of cetaceans to U.S. Navy training may be studied without confounding results (vs from vessels).
5. Located and identified dead, floating or stranded marine mammals.

**Figures 2 and 3** show two sightings of interest that occurred during Year Four aerial monitoring surveys in the SOCAL Range Complex. Multi-species groups of cetaceans are occasionally observed in SOCAL during aerial surveys. **Figure 2** is a photograph taken of a multi-species group of Risso's dolphins and bottlenose dolphins. During the 2012 survey season, 5 of the 78 Risso's dolphin groups seen, were multi-species groups. For the first time since SOCAL aerial monitoring surveys began in fall 2008, northern right whale dolphin mother-calf pairs were seen. **Figure 3** is a photograph taken of two northern right whale dolphin mother-calf pairs. Since 2008, there have been only 12 sightings of the northern right whale dolphin. See Smultea et al. (2012) for more aerial survey photos from Year Four monitoring.



**Figure 2. A multi-species group of Risso's dolphins (*Grampus griseus*) and bottlenose dolphins (*Tursiops truncatus*) observed on 13 March 2012 off San Diego, California.**

Photo by Dave Steckler under NMFS permit 14451.



**Figure 3. Two northern right whale dolphin (*Lissodelphis borealis*) mother/calf pairs observed on 03 February 2012 off San Diego, California.**

Photo by Jenelle Black under NMFS permit 14451.

## Marine Mammal Observers

Under terms and conditions of the U.S. Navy's Year Four 02 August 2011 to 01 August 2012 Monitoring Plan, the U.S. Navy completed a Marine Mammal Observer (MMO) embark within the SOCAL Range Complex. Three U.S. Navy civilian marine science biologists and one contract civilian scientist embarked on a U.S. Navy destroyer from 23-27 July 2012 (**Figure 4**)(Watwood et al. 2012). The ship then proceeded to sea within the SOCAL Range Complex where it engaged in various unit level training events. No sonar was used during this underway period.



**Figure 4. Civilian MMOs aboard a U.S. Navy destroyer during 23-27 July 2012.**

During the five day MMO underway period, the MMOs had 63 sightings representing a best estimate of 1,065 individuals (Watwood et al. 2012). Species identified included: blue whale, short-beaked common dolphin, Risso's dolphin, bottlenose dolphin, and California sea lion. MMO team effort was 31.1 hours. For all three observers not counting a fourth data entry person, a total of 124.4 hours of marine mammal shipboard monitoring was conducted.

**Figures 5** and **6** show photographs of some of the more frequently-sighted marine mammals—blue whales and common dolphins—during this embark. Watwood et al. (2012) contains the more detailed technical report of this embark.

Additional MMO opportunities during this period were limited due to training requirements and subsequent forward deployment of a number of U.S. Navy strike groups, maintenance availability, and commitment of surface ships to a large multi-national exercise in the Hawaii Range Complex – Rim of the Pacific 2012. However, sightings data collected during these embarks will contribute to the development of more robust platform- and species-specific detection functions for use in animal density estimation using line-transect survey methods.





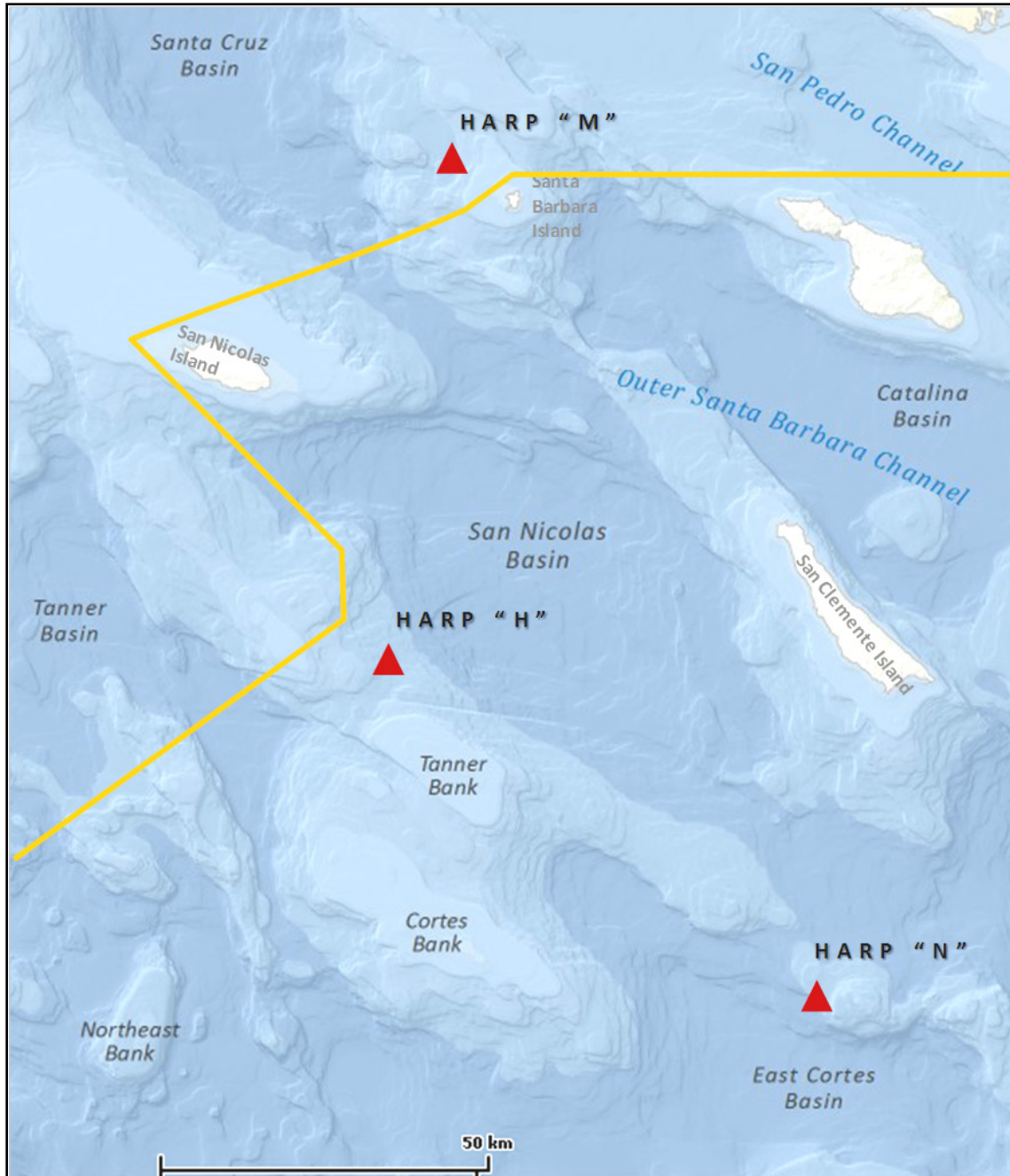
**Figure 5. Blue whale (*Balaenoptera musculus*) swimming adjacent to a U.S. Navy destroyer observed by MMOs on 24 July 2012 off San Diego, California.**



**Figure 6. Group of common dolphins (*Delphinus* spp.) engaged in surface-active travel near a U.S. Navy destroyer observed by MMOs on 26 July 2012 off San Clemente Island, California.**

## Passive Acoustic Monitoring

The U.S. Navy continued deployment of and analysis from two bottom-mounted PAM devices within and adjacent to the SOCAL Range Complex (**Figure 7**).



**Figure 7.** Map of the northwestern corner of the SOCAL Range Complex where high-frequency acoustic packages (HARPs) are deployed. The Range Complex is defined by the yellow line. North of the yellow line is outside the Range Complex. The red triangles show the rough location of each HARP.

PAM and data analysis was conducted from May 2011 to March 2012 to detect the presence of marine mammal and anthropogenic sounds. High-frequency Acoustic Recording Packages (HARPs) recorded sounds between 10 hertz (Hz) and 100 kilohertz (kHz) with nearly continuous temporal coverage at a site near Santa Barbara Island (Site M) and at a site west of San Clemente Island (Site H) (**Figure 7**). The detailed technical analysis for these HARPs is contained in Hildebrand et al. 2012. HARP N, discussed in previous SOCAL Range Complex Annual Monitoring Reports in 2009, 2010, and 2011, experienced a hardware failure during this deployment cycle. Analysis of HARP H (see **Figure 7**) data was substituted for the cost of deployment of HARP N in this year's monitoring effort. HARP H data analysis was not originally funded by Fleet, but after HARP N failed, Fleet funding was directed toward analysis of HARP H data.

Data analyses consisted of visual and auditory detection of sounds of marine mammal vocalizations and anthropogenic sounds using long-term spectral averages and spectrograms. Automated computer detection algorithms were also used when possible. Representative sounds are presented in Hildebrand et al. 2012. Five baleen whale species were detected: blue whale, fin whale, Bryde's whale (*Balaenoptera edeni/brydei*), gray whale, and humpback whale. At least 11 species of odontocetes were detected. There were six species with known species-specific acoustic signal characteristics: Risso's dolphin, Pacific white-sided dolphin (*Lagenorhynchus obliquidens*), killer whale (*Orcinus orca*), sperm whale, Cuvier's beaked whale (*Ziphius cavirostris*), and Baird's beaked whale. The data most likely included three species whose sounds cannot yet be differentiated to species: short-beaked common dolphin (*Delphinus delphis*), long-beaked common dolphin (*Delphinus capensis*), and bottlenose dolphin, grouped as "unidentified dolphins." There were possibly two additional species of beaked whales that were detected: the "43-kHz beaked whale" and an unidentified beaked whale (Hildebrand et al. 2012).

Ship noise was a common anthropogenic sound at Site M and less common at Site H (**Figure 7**). Mid-frequency active sonar (MFAS) was detected at both locations, although the received sound pressure level at Site M was lower. Echosounder pings were found primarily at Site H. Explosions were also recorded primarily at Site H, but their small size and nighttime pattern suggest that they may be associated with commercial fishing activity (Hildebrand et al. 2012).



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## Major Training Exercise Summary

There were seven MTEs conducted in the SOCAL Range Complex this reporting period (02 August 2011 to 01 August 2012)(Table 3). In support of these MTEs, the U.S. Navy conducted over 2,934 hr of Marine Species Awareness Training (MSAT) for 2,634 U.S. Navy personnel prior to the beginning of these training exercises. Over 61 MTE days, the U.S. Navy performed over 43,882 hr 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 3).

**Table 3. SOCAL Range Complex major training exercises that occurred between 02 August 2011 and 01 August 2012.**

MTE Type	Dates	# of Days	# of Ships Involved	# of Observation Hours	# of Marine Mammal Sightings	# of Marine Mammals
SUSTEX	17-29 Sept 2011	13	8	12,048	17	183
IAC II	21-23 Sept 2011	3	8	3,615	23	544
C2X	22 Sept-11 Oct 2011	20	9	12,052	77	766
IAC II	25-27 Sept 2011	3	9	2,127	31	855
JTFEX	01-05 Oct 2011	5	9	6,025	17	108
SUSTEX	05-18 July 2012	14	7	6,297	34	331
IAC II	12-14 July 2012	3	7	1,718	21	206
<b>Total</b>		<b>61</b>	<b>57</b>	<b>43,882</b>	<b>220</b>	<b>2,993</b>

Key: C2X= Composite Training Unit Exercise; IAC II= Integrated Anti-submarine Warfare Course Phase 2; JTFEX= Joint Task Force Exercise; SUSTEX= Sustainment Exercise

### SOCAL Range Complex Major Training Exercise Marine Mammal Observations

There were 220 sightings of an estimated 2,993 marine mammals over the course of seven MTEs in the SOCAL Range Complex between 02 August 2011 and 01 August 2012 (Table 3). Breakdown of sightings by species type are shown in Table 4.

**Table 4. Total number of marine mammal sightings observed from U.S. Navy platforms during SOCAL Range Complex major training exercises 02 August 2011 to 01 August 2012.**

Species Type	# of Sightings	% of Total Sightings	# of Marine Mammals	% of Total Number of Marine mammals
Dolphins	125	56.8%	2,857	95.5%
Whales	78	35.5%	112	3.7%
Pinnipeds	8	3.6%	15	0.5%
Not recorded	9	4.1%	9	0.3%
<b>Total</b>	<b>220</b>		<b>2,993</b>	

Dolphin species in SOCAL typically occur in larger groups than whales, hence the higher number of dolphins and larger percentage of total numbers seen in these counts. During this reporting period, dolphin sightings accounted for 56.8 percent of all sightings and 95.5 percent of all individuals sighted (Table 4).

### SOCAL Range Complex Major Training Exercise Mitigations

Sonar mitigation- Table 5 shows the number of marine mammal sightings (out of the total 220 sightings reported this period; Table 4) that occurred at ranges less than 1,000 yards and indicates how many sonar mitigations (shut-down or power-down) were applied (third column in Table 5). Other sightings within these ranges were instances in which sonar was not on, hence sonar mitigation was not necessary (fourth column in Table 5). Within the sonar mitigation shut-down zone, less than 200 yards, there were only three sonar shut-downs applicable to three dolphin sightings (110 total individuals).

Ship maneuvering to avoid marine mammals- There were also 19 instances of U.S. Navy ships proactively maneuvering to avoid marine mammals or avoid crossing the path of marine mammals.

Of these 19 maneuvers, 16 were to avoid whales ( $n=22$ ), and three were to avoid dolphins ( $n=95$ ). There were also two instances during this reporting period of bowriding dolphins.

**Table 5. Number of marine mammal sightings at ranges less than 1,000 yards observed from U.S. Navy platforms during major training exercises from 02 August 2011 to 01 August 2012.**

Ranges	Marine Mammal Type	Sightings Within a Given Range With Mitigation (i.e., sonar was on prior to sighting and sonar mitigation was applied)	Sightings Within a Given Range With No Mitigation Required (i.e., sonar not on so sonar mitigation was not needed)
<b>&lt; 200 yards</b>			
	Whales	0 times	4 sightings of 4 whales
	Dolphins	3 times for 110 dolphins	13 sightings of 384 dolphins
	Pinnipeds	0 times	2 sightings of 6 pinnipeds
<b>200-500 yards</b>			
	Whales	1 time for 1 whale	5 sightings of 8 whales
	Dolphins	6 times for 155 dolphins	7 sightings of 378 dolphins
	Pinnipeds	1 time for 4 pinnipeds	1 sighting of 1 pinniped
<b>501-1,000 yards</b>			
	Whales	5 times for 5 whales	28 sightings of 48 whales
	Dolphins	11 times for 156 dolphins	32 sightings of 796 dolphins
	Pinnipeds	3 times for 3 pinnipeds	0 sightings

### **SUMMARY: Mitigation Effectiveness and U.S. Navy Safety Zone Adherence**

During this year's MTEs in the SOCAL Range Complex, prescribed NMFS mitigation zones were effectively applied in cases of observation of marine mammals within the applicable zone. As detailed in previous Annual Monitoring Reports, there are no sonar power-downs or shut-downs 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 (EIS)/Overseas Environmental Impact Statement (OEIS) of December 2008 and approved by NMFS in subsequent LOAs in 2009, 2010, 2011, and 2012 were effective in appropriately mitigating exposure of marine mammals to sonar (DoN 2008, 2009b, 2010b, 2011b, 2012). 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 and mandatory MSAT, with over 2,934 hr completed this year, representing training to 2,634 U.S. Navy personnel, adherence to required mitigation zones (Table 5), and application of lessons learned in marine mammal sighting and reporting.

## **Other U.S. Navy-Funded Research**

U.S. Navy-funded marine species monitoring and research programs within the SOCAL Range Complex included several visual and marine mammal tagging surveys.

Specific field reports as cited and by author include:

- Marine mammal surveys conducted during regularly scheduled California Cooperative Oceanic Fisheries Investigation (CalCOFI) field cruises within Southern California (see Campbell et al. 2012a)
- Scripps Institution of Oceanography (SIO) and NMFS-SWFSC small boat-based marine mammal surveys in SOCAL: Report of results for August 2011-July 2012 (see Campbell et al. 2012b)
- Distribution and Demographics of Marine Mammals in SOCAL Through Photo-Identification, Genetics, and Satellite Telemetry: A summary of surveys conducted 1 July 2011 – 15 June 2012 (see Falcone and Schorr 2012)
- Marine Mammal Monitoring on Navy Ranges (M3R) (see Moretti 2012)
- Behavioral response study (SOCAL-BRS) around the Southern California coast and the Channel Islands: Report of results for SOCAL-11 (see Southall et al. 2012)

## **Scripps Institution of Oceanography marine mammal surveys during California Cooperative Oceanic Fisheries Investigations (CalCOFI) surveys**

The Navy's Research Program funded marine mammal surveys during regularly occurring CalCOFI field cruises. SIO, Marine Physical Laboratory participates as MMOs 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 SOCAL, consistent sampling of the same survey track lines, and coverage of a significant amount of offshore area. Spatial and temporal distribution patterns, density and abundance of cetaceans in the SOCAL Bight were assessed through visual and acoustic surveys during five CalCOFI cruises from August 2011 to July 2012. Visual monitoring incorporated standard line-transect protocol during all daylight transits while PAM employed a towed hydrophone array during transits and sonobuoys at oceanographic sampling stations.

Visual effort included:

- 523 hr of visual survey effort over 5,129 NM
- 518 sightings of 20,514 marine mammals
- 7,878 digital photographs taken
- 1,151 hr of passive acoustic recording of marine mammal vocalizations.

Spatial and temporal distribution patterns, density and abundance of cetaceans in the southern California Bight were assessed through visual and acoustic surveys during five California CalCOFI cruises from August 2011 – July 2012. Visual monitoring incorporated standard line-transect protocol during all daylight transits while acoustic monitoring employed a towed hydrophone array during transits and sonobuoys at oceanographic sampling stations.

Fin whales were the most frequently sighted baleen whale species, followed by blue, gray, and humpback whales. Common dolphins were the most frequently sighted odontocete species, followed by bottlenose dolphin, Risso's dolphin, Dall's porpoise, Pacific white-sided dolphin, and sperm whale.

Seasonal variations in encounter rates and distributions were evident for some species. Grey whales and Dall's porpoise were sighted primarily in winter, whereas blue and humpback whales were primarily observed during spring and summer. Pacific white-sided dolphins were observed in all seasons except summer 2011. Sperm whales were only sighted during fall and winter cruises. There was no apparent seasonal pattern to sightings of bottlenose, common and Risso's dolphins. Spatial variations in visual detections as a function of species were also evident. Bottlenose, Risso's and long-beaked common dolphin as well as humpback and gray whale detections were concentrated in coastal and shelf waters, whereas sperm whale detections occurred exclusively in pelagic waters. Short-beaked common dolphin, Pacific white-sided dolphin, Dall's porpoise, fin, and blue whales had a broader distribution with encounters occurring in coastal, shelf and pelagic

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

New density and abundance estimates of eleven cetacean species frequently encountered in the study area were developed based on 16 surveys conducted from 2004-2008; more extensive density estimates were calculated for common dolphins using data from surveys from 2004-2011. Current analyses include comprehensive density and abundance estimates for 12 species across 32 surveys from 2004-2012 as well as investigating the association between cetacean distribution and biological and physical oceanographic variables measured during CalCOFI surveys. Modeling of cetacean habitat preferences in conjunction with our new density and abundance estimates will provide data <sup>1</sup> needed to evaluate potential impacts from anthropogenic activities and ultimately for the development of comprehensive management protocols.

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<sup>1</sup> The Navy's U.S. Pacific Fleet has committed FY12 and pending FY13 funding to modelers's affiliated with NMFS' Southwest Fisheries Science Center to attempt to integrate existing NMFS spatial habitat models, based on NMFS West Coast ship surveys, with augmented data from CalCOFI and other Navy funded visual surveys to derive a new Southern California specific spatial habitat density model



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

Primary objectives of this research are 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-meter rigid-hulled inflatable boat (RHIB). Survey effort is focused within the SOCAL Range Complex near San Clemente Island as part of an ongoing collaborative study to assess cetacean populations occurring in this active U.S. 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 in SOCAL 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 boat vessel surveys were conducted along the San Diego coastline and offshore waters from 1 August 2011 to 31 July 2012. Monitoring results are shown in **Table 6** with specific study accomplishments for this year and more details in Campbell 2012b.

SIO small-boat surveys accomplishments within the SOCAL Range Complex include:

- 77 hr of visual survey effort over 617 NM
- 104 sightings of 4,112 marine mammals, and 6,220 digital photographs taken
- Continuation of photo-identification catalogs for offshore stock of bottlenose dolphin
- Continuation of photo-identification catalogs for Risso's dolphin.

**Table 6. Cumulative total of Scripps Institution of Oceanography small boat surveys within the SOCAL Range Complex from 02 August 2011 to 01 August 2012.**

Species	Number of Groups	Number of Individuals	Number of ID Images	Number of Recordings	Number of Biopsies
Coastal Bottlenose Dolphin	34	309	3,692	9	5
Offshore Bottlenose Dolphin	3	50	250	0	2
Risso's Dolphin	2	47	226	0	0
Pacific White-Sided Dolphin	3	60	11	9	2
Short-Beaked Common Dolphin	12.5	3,031	415	2	0
Long-Beaked Common Dolphin	7.5	296	68	0	0
Common Dolphin, Species unknown	5	214	0	0	0
Minke Whale	1	1	9	0	
Fin Whale	20	79	1,328	0	16
Humpback Whale	8	13	100	0	2
Gray Whale	7	11	97	0	1
Blue Whale	1	1	24	0	0
<b>Total</b>	<b>104</b>	<b>4,112</b>	<b>6,220</b>	<b>20</b>	<b>28</b>

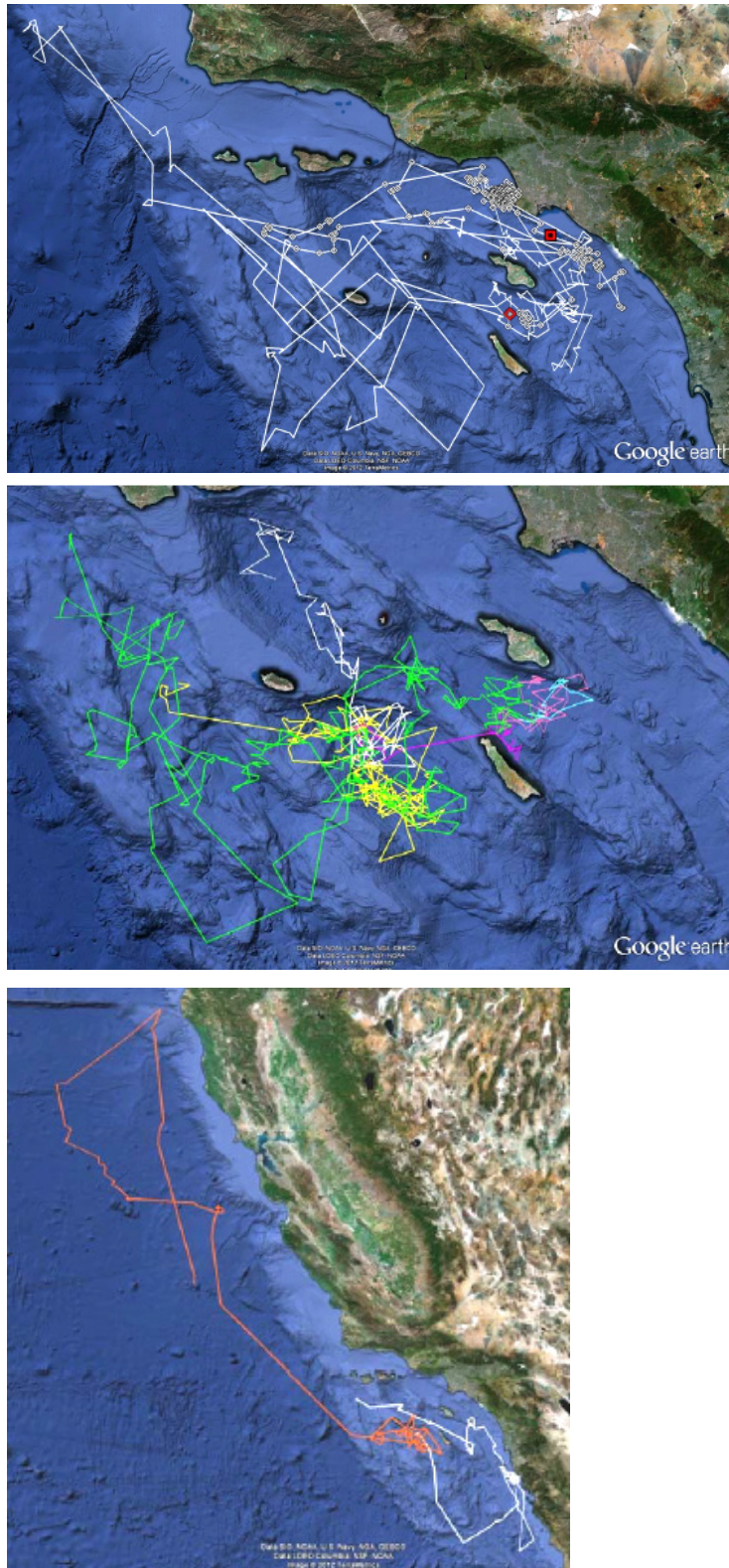
## **Distribution and Demographics of Marine Mammals in SOCAL Through Photo-Identification, Genetics, and Satellite Telemetry: A summary of surveys conducted 1 July 2011 – 15 June 2012**

Results from the second year of a three-year project (under OPNAV N45 funding) investigating the distribution, demographics, and behavior of cetaceans in the U.S. Navy's Southern California operational area are summarized (see Falcone and Schorr 2012). Eighteen small vessel surveys for cetaceans, which included species verification tests in conjunction with M3R (Marine Mammal Monitoring on Navy Undersea Ranges) acoustic monitoring at the Southern California Offshore Anti-submarine Warfare Range (SOAR), as well as photo-identification, satellite tagging, and biopsy sampling of species of interest, were conducted in July 2011 and January and March 2012. 112 groups of 14 cetacean species were encountered.

Twenty-one satellite tags, some depth reporting, were deployed on four species, with an emphasis on Cuvier's beaked and fin whales. **Figure 8** shows a composite of fin whale tagging results from Falcone and Schorr 2012.

Among other findings, preliminary results of photo-identification studies combined with results from satellite tag data suggest that both Cuvier's beaked whales and fin whales may have population sub-units with higher than expected residency to the Southern California Bight. Beaked whales particularly show this higher than expected residency to SOAR.

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**Figure 8. Fin whale tagging results reported in Falcone and Schorr 2012.**  
(top) Fin whale movement through 150 days (Bp Tag 031); (middle) movements of six fin whales tagged in March 2012 over a periods from 2-49 days; (bottom) Extra-regional movements of two fin whales tagged in the San Nicolas Basin in March 2012 for 38 and 42 days.

## Marine Mammal Monitoring on Navy Ranges (M3R)

During FY2012 (Oct 2011-Sep 2012), M3R carried out several monitoring efforts to determine the spatial and temporal distribution of cetacean species on the Southern California Offshore Anti-submarine Range (SOAR), document reaction of these species to sonar with a focus on beaked whales, and to continue refinement of long-term passive acoustic monitoring via M3R. Specifically, M3R participated in several marine mammal species visual verification and tagging efforts (see Falcone and Schorr 2012), participated in Office of Naval Research (ONR)-sponsored underwater glider tests, and supported the Navy's Southern California Behavioral Response Study (SOCAL-12) 2011-12 experiment (see Southall et al. 2012). Moretti 2012 provides a more detailed discussion of M3R accomplishments.

The species verification and tagging effort entailed opportunistically monitoring vocalizing marine mammals on SOAR with and without active sonar. In FY12, data were collected with and without active sources present on range and were compared to ship tracks associated with Mid-Frequency Active (MFA) sonar. Satellite tags were placed on individual "sound sensitive" Cuvier's beaked whales (*Ziphius cavirostris*) along with several additional species.

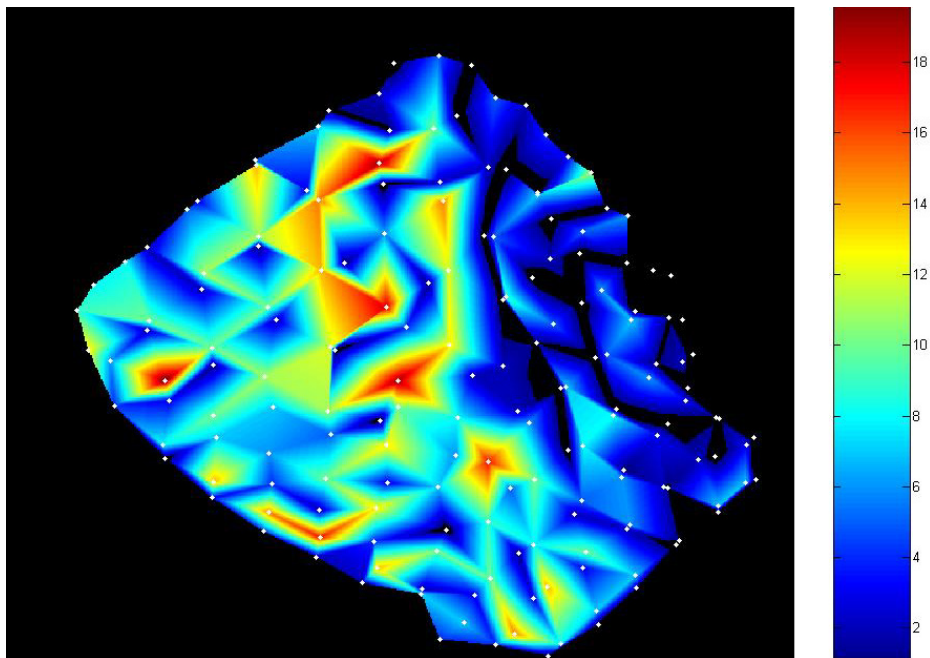
M3R's ability to locate and identify beaked whales was also used to support the ONR test of underwater passive acoustic equipped gliders for the detection of beaked whales at SOAR in 2011 and 2012 (Figure 9). Such semi-autonomous devices may provide a future means of acoustic density estimation, but it is critical to measure the glider detection capability as a function of distance before such survey methods can be developed. Comparison of in-situ glider detection statistics to M3R baseline data provided a means of estimation.

M3R's real-time monitoring capability contributed to the BRS SOCAL-12 experiment, which is ongoing. The SOCAL BRS project was designed to investigate the effects of sonar on marine mammals tagged with acoustic recording devices. M3R's responsibility involved real-monitoring of hydrophones to direct tagging vessels to vocalizing animals. M3R was also responsible for designing and operating the playback source during these controlled-exposure experiments.

As part of a SOAR replacement hydrophone reconfiguration, software to detect and localize baleen species was developed and installed. This software provides an extension of the existing M3R Fourier transforms (FFT)-based detector. A bandwidth of 0-3 kHz is monitored with a bandwidth resolution of 1.46 Hz. Localization software was developed and integrated into the "mammal" monitoring software and the new software was tested on-range in parallel with the low frequency detection. The prototype software was used to isolate fin whale (*Baleonaptera physalus*) vocalizations that were verified by the on-water observers.

Finally, aerial surveys including focal follows, were completed as part of the on-going Integrated Comprehensive Monitoring Plan (ICMP) and the Navy's Southern California Range Complex Monitoring Plan (see Smultea et al 2012). In parallel with aerial surveys, broadband recordings

were made using the M3R packet recorder and M3R detection archives were created. These data will be correlated and used to create a database that will be available for follow-on efforts to investigate potential methods of passive acoustic density estimation. Several possibilities exist; these include cue-counting methods (clicks, whistles), group counting, and using energy density as a proxy for animal density or group size. Target species include common dolphins, Risso's dolphins (*Grampus griseus*), and Pacific white-sided dolphins (*Lagenorhynchus obliquidens*). At the same time, visual and passive acoustic data from other species, both mysticetes and odontocetes, will be recorded and used to help improve passive acoustic detection and classification of these species.



**Figure 9. Number of vocal groups present as detected by M3R on the SOAR range during ONR-sponsored underwater glider tests.**

(Figure from Moretti 2012. Image created by plotting number of times a hydrophone was at center of a vocalizing group and using a linear interpolation in MATLAB. Color bar indicated number of center hydrophones per vocal group period)

## Behavioral Response Study SOCAL-11

SOCAL-11 was the second field season of a multi-year effort (2010-2014) behavioral response study (BRS), more generally referred to as “SOCAL-BRS”, which was conducted in July-September 2011 (Southall et al. 2012). SOCAL-12 began in late July and the results will appear in next year’s SOCAL Annual Monitoring Report.

SOCAL-BRS is a dedicated effort to study a variety of marine mammal species in areas around the SOCAL coast and the Channel Islands, from Morro Bay to San Diego. The overall objective of SOCAL-BRS was to provide a better basic understanding of marine mammal behavior, while providing direct scientific information for the U.S. Navy and regulatory agencies to estimate risk and minimize the effect of human sounds, in particular, military sonar.

SOCAL-11 involved an interdisciplinary collaboration of experts in marine mammal biology, behavior, and communication, as well as underwater acousticians and specialized field researchers. Participants in this multi-year effort included: NMFS-SWFSC; Southall Environmental Associates; Cascadia Research Collective; Naval Postgraduate School; SIO; Woods Hole Oceanographic Institution; Naval Undersea Warfare Center, Newport Rhode Island; and Southern California Offshore Range.

Specific objectives for SOCAL-11 included:

- Obtaining baseline behavioral data
- Conducting controlled exposure experiments (CEEs) on baleen whales, beaked whales, and Risso’s dolphin
- Testing optimal configuration for subsequent studies, which may have included realistic/actual military sources
- Obtaining data to support the U.S. Navy’s SOCAL Range Complex monitoring efforts.

During a scouting phase and two operational legs, researchers observed, photographed, and/or tracked thousands of individuals of 18 marine mammal species. Thirty-eight tags were secured on 35 individual animals of four different marine mammal species. This included a large number of tags for certain focal species, including expanding the large sample size of blue whales from SOCAL-10, a greater than expected success with Risso’s dolphins (**Figure 10**), and a second successful tag and CEE on a very difficult to tag, yet important species—Cuvier’s beaked whale (Southall et al. 2012). Other species (e.g., fin whale, sperm whale, Baird’s beaked whale, and killer whale) that were tagged in SOCAL-10 were either not encountered or were not tagged in SOCAL-11 (Southall et al. 2012).





**Figure 10. Risso's dolphin (*Grampus griseus*) tagged during the SOCAL-11 Behavioral Response Study in August 2011.**

Photo courtesy of SOCAL-11 taken under NMFS permit 14534.

Researchers conducted 18 CEEs on 18 individuals of three marine mammal species affixed with suction cup acoustic tags and tracked both visually and acoustically. Simulated military sonar signals (several orders of magnitude less intense than real sonar) and noise bands of comparable frequency (identical to SOCAL-10) were presented as experimental stimuli under very specific protocols and protective measures to ensure animals were not harmed. Changes in behavior from baseline conditions were measured as a function of sound exposure. Preliminary results based primarily on clearly observable behavior in the field and from initial data assessment were similar to those made in SOCAL-10, but extended sample size considerably in blue whales and Risso's dolphins (DoN 2011a). These preliminary results indicate variable responses (ranging from no observable response to apparent temporary avoidance behavior), depending on species, type of sound, and behavioral state during the experiments. Additional analysis and interpretation is underway of the nearly 200 hr of tag data, as well as thousands of marine mammal observations, photographs, biopsy tissue samples, and PAM data.



## Conclusions for SOCAL Range Complex Year Four Monitoring

The U.S. Navy achieved all of its planned annual monitoring objectives in Year Four from 02 August 2011 to 01 August 2012. Most of the data collected will continue to be pooled with previous years' effort for continued scientific analysis over the full 5-year SOCAL Range Complex authorization and will be included in the Comprehensive 5-Year Monitoring Report.

To date, the U.S. Navy's monitoring program in SOCAL have generated an extraordinary amount of data on marine mammal biology within the region, a considerable amount of which is new to science. Some preliminary results will be presented within the supporting technical reports, although data analysis continues with the goal of producing a more complete synthesis by the end of the NMFS authorization (LOA) under which this monitoring occurs.

Significant contributions were made in Year Four to learn more about baseline marine mammal occurrence, movement, and behavior within the SOCAL Range Complex. To this end, over 18,791 NM of coastal and offshore waters within the Southern California were visually surveyed when considering both Navy programs, U.S. Pacific Fleet Compliance Monitoring and ONR/OPNAV N45 Research. This represents sightings of 1,551 groups and an estimated 80,016 individual marine mammals. Visual surveys occurred during and without U.S. Navy MTEs concurrent within the SOCAL Range Complex. Passive Acoustic Monitoring continues to provide long-term analysis of marine mammal vocalizations as an indicator of presence or absence across both warm-water and cold-water regimes.

In the spirit of collaboration and information sharing within the marine science community, visual survey data from the U.S. Navy's U.S. Pacific Fleet Compliance Monitoring for Year One (2008-2009), Year Two (2009-2010), and Year Three (2010-2011) efforts has been published online and are available for download from the Ocean Biogeographic Information System Spatial Ecological Analysis of Megavertebrate Populations (OBIS-SEAMAP) data repository (<http://seamap.env.duke.edu/>). Data from 2008-2011 is currently available on OBIS-SEAMAP at: <http://seamap.env.duke.edu/dataset/756>. Year Four data (2011-2012) will be added to this collection by fall 2012 or winter 2013.

The Navy's proposed monitoring within the SOCAL Range Complex for the period through August 2013 (Year Five) is detailed in DoN 2012.

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