Distribution and demographics of Cuvier's beaked whales in the Southern California Bight

Interim Report
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Interim report of on-water surveys in conjunction with Moretti et al. (2017), Marine Mammal Monitoring on Navy Ranges (M3R): Passive Acoustic Monitoring on the Pacific Missile Range Facility and Southern California Offshore Range.

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14. ABSTRACT
The Southern California Offshore Complex (SOCAL) is one of the US Navy's most active training areas, particularly concerning the use of Mid-Frequency Active Sonar (MFAS). Much of SOCAL lies within the Southern California Bight, a productive oceanographic region that hosts a wide variety of marine species. As part of an ongoing study of the distribution and demographics of several marine mammal species within SOCAL, we conducted 43 days of survey effort under this award from 9 January 2016 to 30 July 2017, specifically focusing on the Southern California Anti-submarine Warfare Range (SOAR). The primary goal of these surveys was sighting, photographing, and collecting biopsy samples from Cuvier's beaked whales and fin whales. We had six sea turtle sightings and 185 sightings of marine mammals, including 20 sightings of an estimated 56 Cuvier's beaked whales. We collected 41 biopsy samples, including seven from Cuvier's beaked whales. We also collected fifteen environmental DNA (eDNA) samples from the water during Cuvier's beaked whale encounters. Also included in this report are supporting results from 46 days of ancillary efforts in SOCAL from 16 January 2016 to 13 November 2017. We sighted an additional 119 groups of marine mammals during these surveys, including 10 sightings of an estimated 25 Cuvier's beaked whales, deployed seven tags, and collected nine biopsy samples. Continued focus on photo-identification and biopsy sampling of Cuvier's beaked whales will help elucidate population structure for this species, an important element of any management and mitigation strategy.

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Summary

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Introduction

The US Navy manages SOCAL, a collection of near shore and offshore training areas which includes much of the navigable water from Santa Barbara Island, CA, to northern Baja California, Mexico, extending several hundred miles to the west. It is among the most heavily used tactical training areas in the world, and is used for a variety of aerial, surface, and subsurface exercises. The Southern California Offshore Range (SCORE) is a subset of complexes within SOCAL centered on San Clemente Island. It includes SOAR, a focal area for exercises involving MFAS within the San Nicolas Basin (Figure 1). Through its N45 and LMR programs, the US Navy has funded directed studies on species assemblages, distribution and demographics, foraging ecology, and behavioral responses to MFAS of marine mammals on and around SOAR since 2006 (Falcone & Schorr 2014). In the beginning, the primary objective of these surveys was to provide visual verification of acoustic marine mammal detections on the SOAR hydrophone array in conjunction with the Marine Mammal Monitoring on Navy Ranges (M3R) program (Moretti et al. 2006). These studies documented a high diversity of species on SOAR year-round, though with some seasonal fluctuations in diversity and density (Falcone & Schorr 2014). Photo-ID studies of both Cuvier's beaked whales and fin whales were initiated to better understand the structure of these poorly-known populations. As the surveys progressed, a major goal became the deployment of dive-reporting satellite tags to study both the distribution and diving behavior of both these species, and also to assess any changes associated with MFAS use.

Both satellite tagging and photo-ID data from these studies have indicated high site fidelity within the Southern California Bight for several species, including Cuvier's beaked whales on SOAR and fin whales in the greater Southern California Bight (Falcone et al. 2009, Schorr et al. 2014, Falcone et al. 2017, Scales et al. 2017). Both findings were somewhat unexpected. Fin whales were believed to range broadly along the US West Coast with no population substructure, and individual Cuvier's beaked whale were not expected to preferentially use SOAR, as this species, and beaked whales in general, have been documented to strand in association with MFAS in other regions of the world (e.g. Cox et al. 2006, D'Amico et al. 2009). Therefore, understanding the ecology, behavior, and population dynamics of these two populations in a region of such intense Navy training is critical to effective management, including realistic estimation of takes. It can also provide an important comparison to unexposed populations in other regions.

Long-term studies using photo-identification and genetics to elucidate population size, structure, and trends can provide a particularly robust basis for assessing population-level impacts. Demographic data, including the age-sex class structure of the population, often provide insights into cumulative impacts on long-lived species that might not show up in acoustic or visual density data (e.g. Whitehead & Gero 2015). A recent ONR-supported analysis (Moore et al. 2017) determined that a long-term photo-identification provided the best power to detect an actual decline in the Cuvier's beaked whale population at SOAR if one were occurring, and Booth et al. (2017) suggest photo-identification and biopsy are critical tools for monitoring populations. Further, there are specific inputs to Population Consequences of Disturbance (PCoD) models, currently being developed for beaked whales at SOAR and other Navy ranges, which can only be derived from individual life history data. Therefore, this project specifically supports the continuation of ongoing photo-identification and biopsy data collection for Cuvier's beaked whales, with fin whales as the secondary priority, with goal of providing robust data for monitoring the health of these two populations.

Methods

Surveys were conducted using a 6.3 to 7.5m rigid-hulled inflatable boat (RHIB), powered by two outboard motors and equipped with a raised bow pulpit. The RHIB was launched from a shore base each morning and surveyed throughout daylight hours as conditions permitted. Surveys focused on SOAR were based at Wilson Cove on the northeast side of San Clemente Island. The RHIB was initially launched at Dana Point at the start of the survey period and remained moored in Wilson Cove for a period of 7-14 days, or until poor weather or conflicting range operations prevented further surveys at SOAR. When SOAR was available for our use, staff from the Naval Undersea Warfare Center's (NUWC) M3R program would monitor hydrophones from the Range Operations Center on North Island in San Diego and direct the RHIB via radio or satellite phone into areas where marine mammal vocalizations were detected. While the RHIB could be directed towards any vocalizations for visual verification, they were preferentially directed to those likely to be beaked whales when conditions were suitable for working with these species (typically winds at Beaufort 3 or less). In general, detections classified as small odontocetes were bypassed in favor of those from beaked or baleen whales.

Each time a group of cetaceans was encountered, the species, time, latitude, longitude, group size and composition, and overall behavioral state were recorded. For encounters with beaked whales, detailed records of surfacing patterns were also collected for as long as contact with the group was maintained. Photographs were taken for species verification where questionable, and for individual identification for species where this methodology is being employed during this study or by collaborators (beaked, fin, blue, humpback, minke, Brydes, and killer whales; bottlenose and Risso's dolphins). Remote tissue biopsies were collected from species of interest both to this study (beaked and fin whales), and also on behalf of collaborators at the Southwest Fisheries Science Center (SWFSC) for use ongoing assessments of offshore populations and stress hormone analyses. Water samples to test for environmental DNA (eDNA) in the footprint of Cuvier's beaked whales were collected as part of a collaboration with Oregon State University (Scott Baker, PI, funded by Office of Naval Research). Additionally, a limited number of satellite tags were deployed on species which regularly inhabit the training range and which may be impacted by training activities in order to provide additional information on distribution, behavior, and overlap with Navy activities.

The tags deployed were of the Low Impact Minimally Percutaneous External-electronics Transmitter (LIMPET) SPLASH10-A design (Andrews et al. 2008, Schorr et al. 2014). Sighting data were collected using a custom-built Access (Microsoft, Redmond, WA) database with integrated GPS. Individual identification photographs of fin whales and beaked whales were processed and compared using methods described in Falcone and Schorr (2014) to build photographic sighting histories.

Additional surveys in 2016 and 2017 were conducted in conjunction with tag development supported by the Department of Defense Environmental Security Technology Certification Program (ESTCP) and Living Marine Resources (LMR) While survey effort and overall sighting summaries in this report pertain only to surveys conducted under this contract, detailed sighting and photo-ID sections on Cuvier's beaked whales include data from all concurrent and previous efforts in the region to improve sample sizes.

Results and Discussion:

Survey effort and sightings

A total of 43 daily surveys were conducted for this project in four different months of 2016 and two months in 2017, with most survey effort occurring within SOAR (Table 1, Figure 1). Four survey days were canceled due to inclement weather conditions in 2016 and 2017. Survey effort was conducted for the first time during the month of February, and we nearly doubled the previous amount of effort in April. An additional 46 daily surveys were conducted within the same general area for ancillary projects (Table 2, Figure 2).

Table 1. Summary of Fleet-supported survey effort by day, January 2016-November 2017. *"Total" for Species is the number of unique species identified throughout the study, and thus not a summation across days.

Date	Effort (hr)	Distance (nmi)	Number of sightings	Number of species	Number of biopsies	Number of eDNA samples	Number of tags
09-Jan-16	2.9	60					
10-Jan-16	9.7	101	1	1			
11-Jan-16	9.9	68	3	2			1
12-Jan-16	6.1	88	2	2			
15-Jan-16	4.8	80	1	1			
21-Feb-16	3.6	52					
22-Feb-16	6.7	63	6	5	1		
23-Feb-16	11.7	102	5	5	1		
24-Feb-16	11.9	120	10	7	5		
25-Feb-16	8.3	87	5	2			
26-Feb-16	7.4	43	6	2	3		2
27-Feb-16	6.9	106	4	3	2		
01-Apr-16	4.5	54	2	1			
02-Apr-16	11.3	107	6	6	1		
03-Apr-16	4.0	40	1	1			
04-Apr-16	8.6	69	5	4	2		
05-Apr-16	12.9	108	5	4			
06-Apr-16	9.2	68	2	2			
07-Apr-16	8.4	68	3	3	1		
08-Apr-16	8.9	84	3	2			
10-Apr-16	9.6	74	4	2	5		
19-Aug-16	3.3	53					
20-Aug-16	6.0	66	3	2			
26-Aug-16	5.4	73	2	2			
05-Nov-16	9.2	82	1	1			
10-Nov-16	11.6	105	5	2	2		
13-Nov-16	9.5	84	1	1			
01-Apr-17	5.7	84	4	2			
02-Apr-17	7.3	62	7	4	1		1
03-Apr-17	10.1	104	10	4	3		
04-Apr-17	11.8	102	25	9	6		1
05-Apr-17	10.1	102	11	4	1		
06-Apr-17	7.9	72	4	4			
07-Apr-17	11.6	70	9	5	3	6	
08-Apr-17	2.8	52	1	1			
22-Jul-17	7.1	89	7	3		5	
23-Jul-17	11.0	102	4	1			
24-Jul-17	10.4	85	6	3			
25-Jul-17	10.0	82	5	3		4	1
26-Jul-17	8.4	77	1	1			
28-Jul-17	7.2	80					
29-Jul-17	12.8	89	6	2	2		
30-Jul-17	3.8	63	5	1			
Total: 43	350.4	3420	191	14	39	15	6

Table 2. Summary of ancillary survey effort by day, January 2016-November 2017. "Total" for Species is the number of unique species identified throughout the study, and thus not a summation across days.

Date	Effort (hr)	Distance (nmi)	Number of sightings	Number of species	Number of biopsies	Number of eDNA	Number of tags
16-Jan-16	6.8	113	2	1			
29-Feb-16	7.2	84					
01-Mar-16	3.8	27	4	3			1
11-Apr-16	8.1	98	8	6	2		1
12-Apr-16	6.0	55	3	1	1		1
04-Nov-16	3.8	55					
07-Nov-16	11.3	95	4	3			
08-Nov-16	9.1	93	4	4			
09-Nov-16	7.9	90	4	3			
11-Nov-16	11.3	104	7	3			1
12-Nov-16	8.9	89	2	2			
14-Nov-16	2.3	51					
05-Jan-17	4.0	52	1	1			
06-Jan-17	9.1	76	3	3			
07-Jan-17	10.4	98	5	3			
08-Jan-17	11.6	94	9	4	1		1
09-Jan-17	3.6	29	2	2			
10-Jan-17	9.8	96	7	4	5		1
12-Jan-17	2.9	53	1	1			
03-Nov-17	3.7	54	3	2			
04-Nov-17	9.6	105	8	4			
05-Nov-17	3.3	39	3	1			
06-Nov-17	8.9	88	8	5			
07-Nov-17	10.8	112	9	3			
08-Nov-17	11.5	88	4	3			1
09-Nov-17	6.2	83	9	4			
11-Nov-17	7.1	88	7	4			
12-Nov-17	2.3	52	2	1			
13-Nov-17	9.1	158					
Total: 46	210.4	2320	119	14	9	0	7

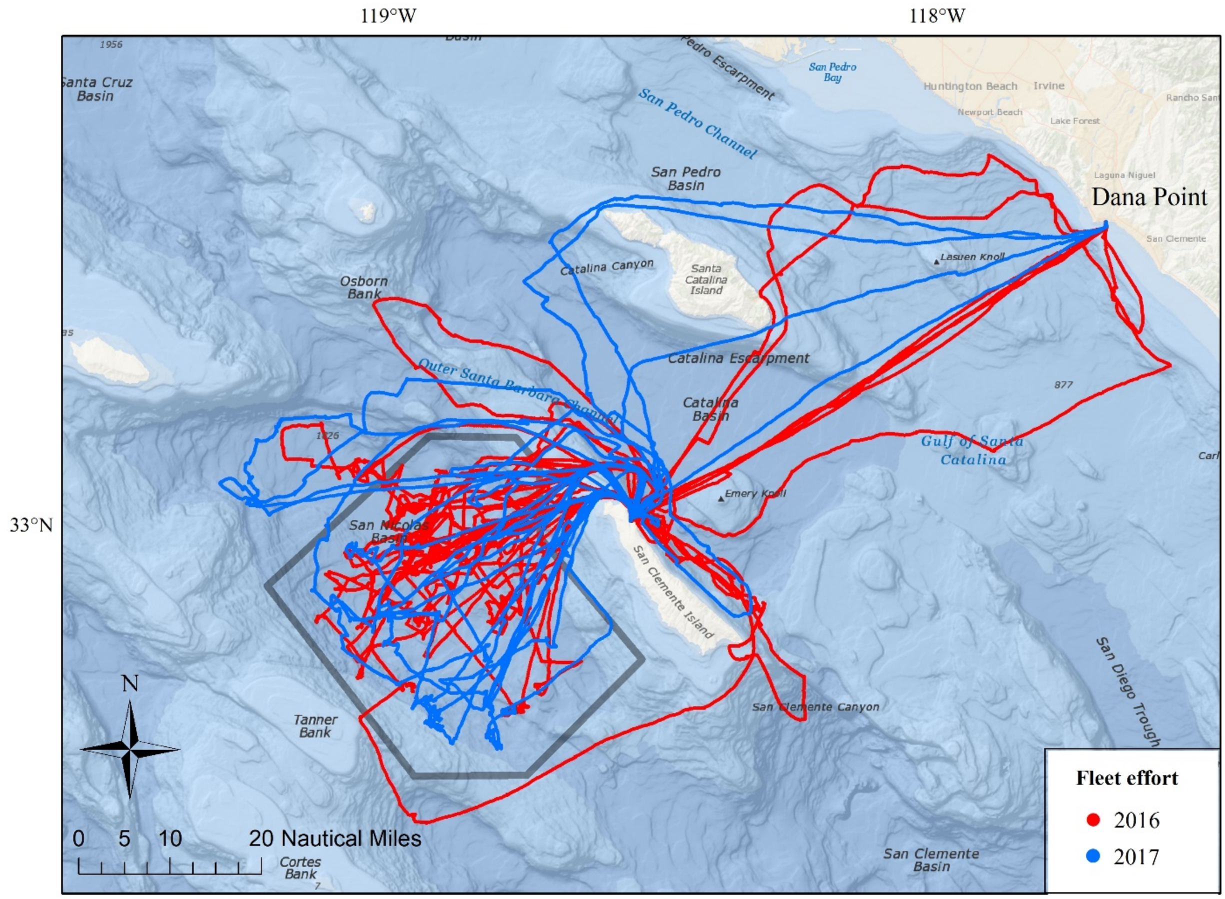

Figure 1. Vessel track lines from Fleet surveys conducted January 2016 through November 2017. The black polygon west of San Clemente Island is the SOAR range boundary.

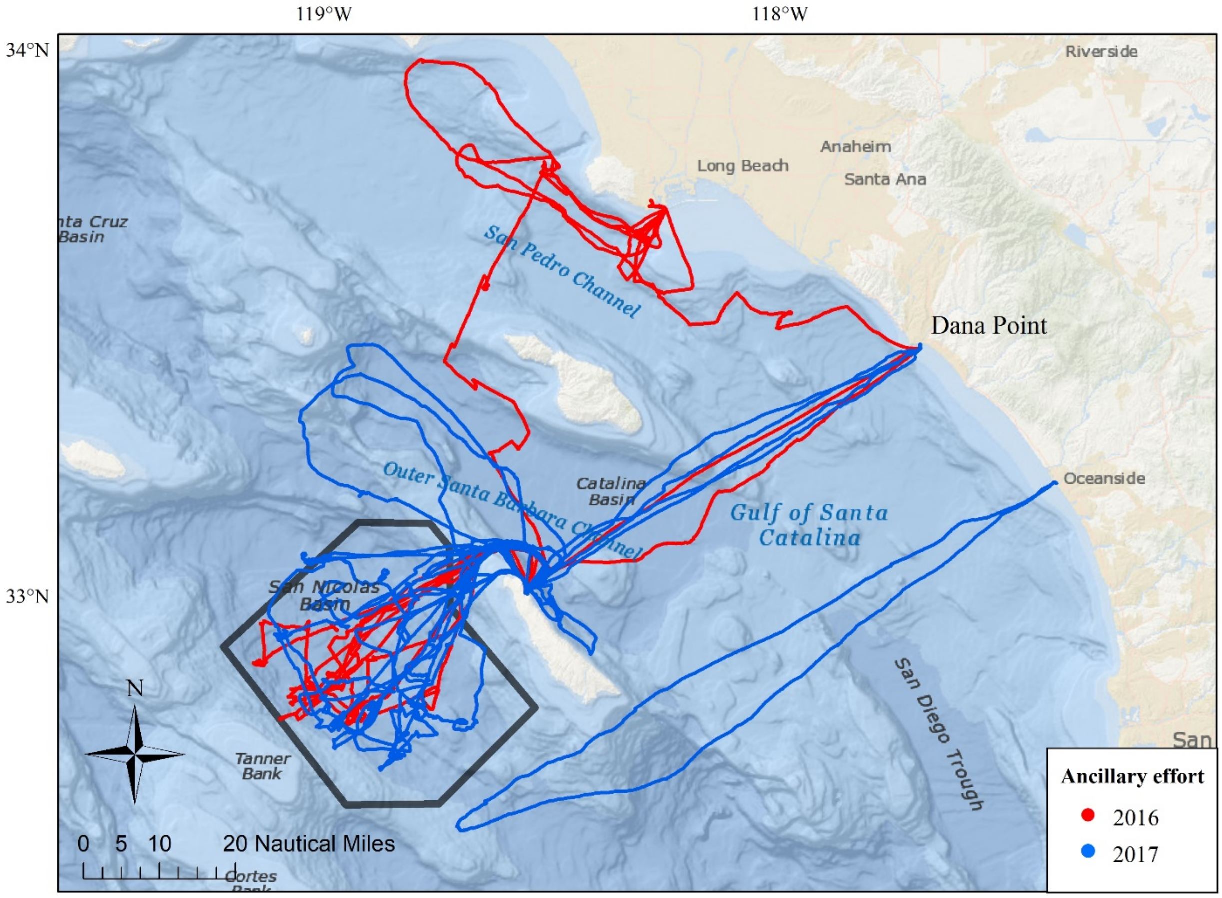

Figure 2. Vessel track lines from ancillary surveys conducted January 2016 through November 2017. The black polygon west of San Clemente Island is the SOAR range boundary.

During Fleet-supported survey efforts in 2016-2017, 185 sightings of fourteen cetacean species were recorded, along with six sightings of juvenile loggerhead turtles (Figures 3A-D, Table 1, Appendix I). There were 119 additional sightings documented during ancillary survey efforts in the region (Figures 4A-D, Table 2). Cuvier's beaked whales have been sighted around San Clemente Island in all months when effort has been undertaken (Table 3).

Table 3. Cuvier's beaked whale sightings (groups visually detected) by month, for all surveys associated with M3R acoustic monitoring efforts at SCORE since 2006. Note that sighting rates nearly double in January over all other months where effort has occurred.

Month	Vessel Days	Zc Sightings	Zc Sightings/Day
1	30	32	1.07
2	7	2	0.29
3	21	8	0.38
4	27	7	0.26
5	5	3	0.60
6	15	7	0.47
7	24	13	0.54
8	42	5	0.12
10	38	19	0.50
11	13	7	0.54

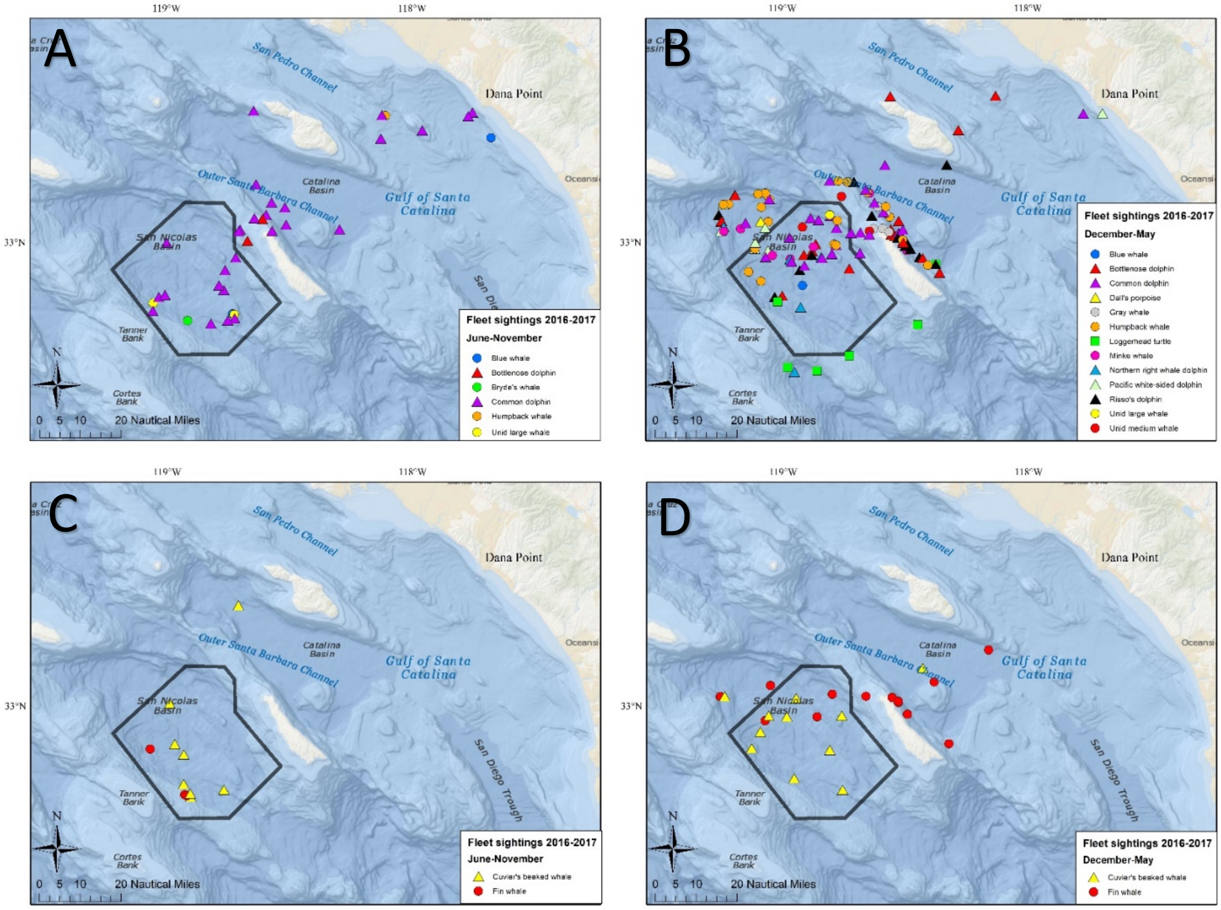

Figure 3. Fleet-supported effort: (A) Warm season (June-November) and (B) cold season (December-May) locations of cetacean (except Cuvier's beaked whales and fin whales) and sea turtle sightings by species. (C) Warm season (June-November) and (D) cold season (December-May) Cuvier's beaked whales and fin whale sightings by species. The black polygon west of San Clemente Island is the SOAR range boundary.

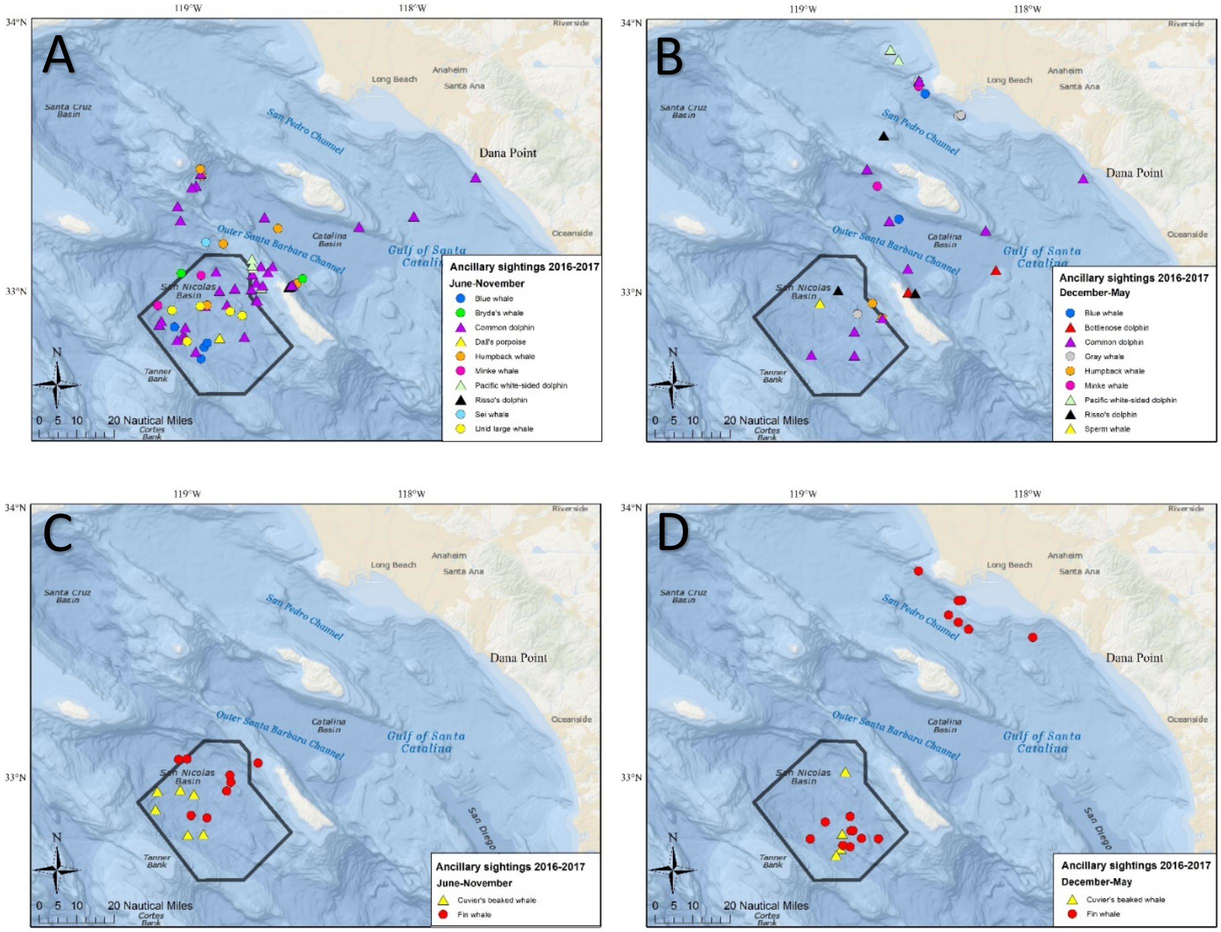

Figure 4. Ancillary-supported effort: (A) Warm season (June-November) and (B) cold season (December-May) locations of cetacean (except Cuvier's beaked whales and fin whales) and sea turtle sightings by species. (C) Warm season (June-November) and (D) cold season (December-May) Cuvier's beaked whales and fin whale sightings by species. The black polygon west of San Clemente Island is the SOAR range boundary.

Cuvier's beaked whales

Cuvier's beaked whales were encountered during all field efforts, with the largest number of sightings occurring during November in 2016 and July in 2017. In the 350 hours of effort associated with this project, 20 sightings totaling 56 whales were made, for an average of one sighting per 17.5 hours of effort. Median group size was three, with a range of one to five individuals. We had ten additional Cuvier's sightings totaling 25 whales during ESTCP- and LMR-supported effort. Photo-IDs and biopsy samples collected during all efforts are summarized in Table 4.

Identification photos of suitable quality were collected from 68 of the estimated 81 individual Cuvier's beaked whales encountered in 2016-2017. These represented 48 unique individuals, with eight of these whales sighted on two different days, and another three on three different days during the study period. Nineteen (39%) of these whales had been sighted in previous years. Many more whales identified in 2016 had been sighted in a previous year (16/28 individuals, 57%), compared to 2017 (5/22 individuals, 23%), though both years had sightings of whales seen as early as 2007. Six whales identified in the study period had been tagged prior to 2016: five with satellite tags as part of this work, and one with a suction cup tag as part of the SOCAL BRS project. In 2016, photo-ID data from this study were included in a power analysis to determine the probability of detecting a population-level change in abundance or survival using various approaches, as part of an ONR-funded collaboration with the Southwest Fisheries Science Center (Moore et al. 2017). The analysis will be updated with data collected in 2017 and prepared for publication in the coming year. A key finding of the preliminary work was that continued data collection at approximately the same level of effort as has been conducted at SCORE in the past ten years is more likely to detect a population change than increased effort over a shorter period time, and thus these surveys should be continued into the future (Figure 5).

There were three adult females photographed in 2016 that had been sighted with calves in previous years, one of which was associated with her second calf. Additionally, a fourth adult female, first identified in 2015 without a calf, was subsequently sighted in 2016 with a calf. The latter whale was sighted for a third consecutive year in 2017, this time without a calf, along with two other adult females with calves who had not been previously sighted. These sightings of known reproductive females with and without calves over time (n = 45) are providing critically needed calving and weaning rate data for Population Consequences of Disturbance (PCoD) models currently being developed for this species on SOAR.

Table 4. Details of Cuvier's beaked whale sightings during three concurrent projects in Southern California from 2016-2017: the Fleet-funded surveys that are the focus of this report ("SCORE"), a tag development project funded by the Environmental Security Technology Certification Program (ESTCP), and a behavioral study funded by Living Marine Resources (LMR).

Date	Project	Sighting	Est. Group Size	Num Calves	Actual ID's	Total Samples	Total Tags
11-Jan-16	SCORE	2	2	0	2		1
11-Jan-16	SCORE	3	1	0	1		
15-Jan-16	SCORE	1	2	0	2		
23-Feb-16	SCORE	3	3	0	1		
24-Feb-16	SCORE	5	2	0	2	1	
02-Apr-16	SCORE	5	1	0	1		
05-Apr-16	SCORE	4	5	2	5		
06-Apr-16	SCORE	2	3	0	2		
07-Apr-16	SCORE	3	1	0	1		
07-Nov-16	ESTCP	3	4	0	3		
10-Nov-16	SCORE	4	5	0	5	2	
10-Nov-16	SCORE	5	5	unk	0		
11-Nov-16	ESTCP	1	6	0	5		
11-Nov-16	ESTCP	2	1	0	0		
11-Nov-16	ESTCP	4	3	0	4		1
11-Nov-16	ESTCP	7	3	1	3		
13-Nov-16	SCORE	1	2	0	1		
06-Jan-17	ESTCP	3	2	0	2		
07-Jan-17	ESTCP	4	2	0	2		
08-Jan-17	ESTCP	5	1	0	1		1
08-Jan-17	ESTCP	6	2	0	2		
04-Apr-17	SCORE	24	4	0	4	1	
07-Apr-17	SCORE	3	3	0	2		
07-Apr-17	SCORE	7	4	0	4	3	
22-Jul-17	SCORE	5	3	1	3		
24-Jul-17	SCORE	4	2	1	2		
25-Jul-17	SCORE	3	2	0	2		
25-Jul-17	SCORE	5	3	0	3		
29-Jul-17	SCORE	4	3	0	3		
04-Nov-17	LMR	1	1	0	0		
			81		68	7	3

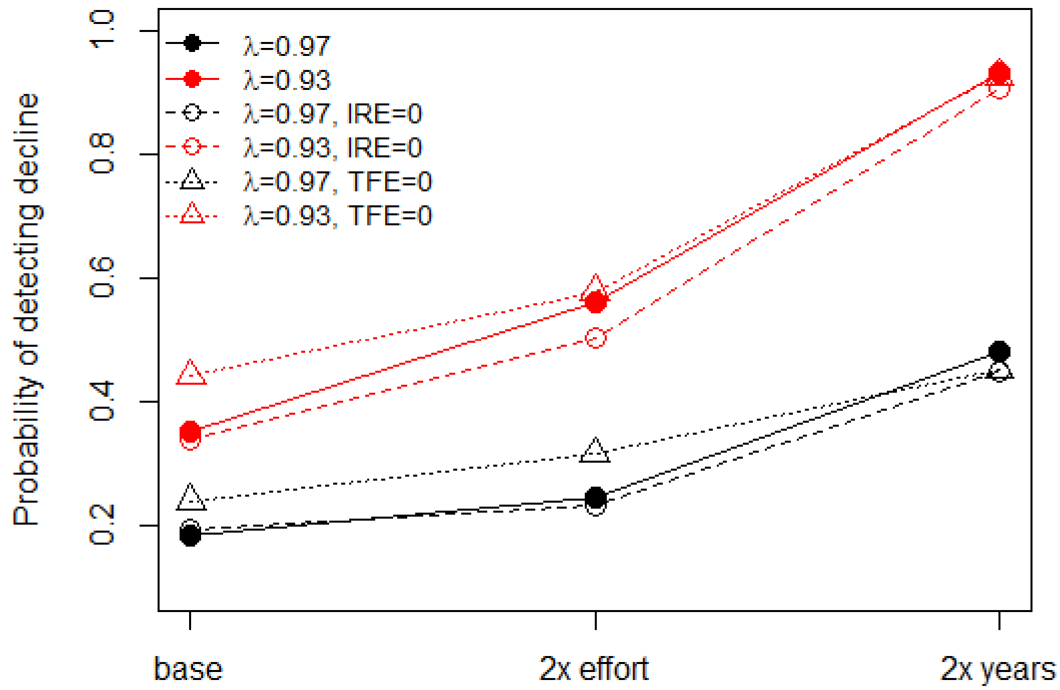

Figure 5. Results from model simulations of the probability of detecting a given population level trend in Cuvier's beaked whales within the SOAR training range via photo-identification under several scenarios. The 'base' scenario is the probability to detect a change in population trend with the current data, '2x effort' models the probability of detecting a trend with double the amount of effort per year compared to the base, and '2x years' represents the probability of detecting a population level trend with the same level of effort but twice the length of time. Probability of detecting a decline was measured as the percentage of simulations in which, given model convergence, the upper confidence limit (97.5th percentile) for λ was less than 1. Black points and lines represent scenarios with λ of 0.97. Red points and lines represent scenarios with λ of 0.93. Solid points and lines represent Scenarios 1 to 6 with σtFE2 = σtRE2 = 0.125 and σiRE2=0.25. Open circles and dashed lines represent Scenarios 7 to 12 with σiRE2=0. Open triangles and dotted lines represent Scenarios 13 to 18 with σtFE2= and σtRE2 = 0.25.. (see Moore et al. 2017 for a full explanation).

Seven biopsy samples were collected from six different Cuvier's beaked whales during this effort and transferred to NOAA's Southwest Fisheries Science Center for archiving and processing. All were successfully sexed, with five individuals, including one sub-adult, determined to be female and one male. Along with the females sighted with calves and males with erupted teeth, these genetically-sexed whales formed the basis for adapting of a recently published quantitative method for sexing whales by scarring rates (Coomber et al. 2016) to this population, providing another essential parameter to ONR-funded PCoD modeling. Additionally, in 2018 or early 2019, with support provided by this project, twenty-two genetic samples collected from collaborators at Guadalupe Island, Mexico (Gustavo Cardenas-Hinojosa, PI) will be sexed and genotyped for assessment of population structure. Stable isotope analyses may also be conducted on samples from the two regions to look for possible differences in foraging strategies and further assessment of population structure. Additionally, fifteen eDNA samples were collected in the footprint of Cuvier's beaked whales in collaboration with Oregon State University (Scott Baker, PI).

Fin whales

Fin whale sightings were noticeably low during dedicated surveys in 2016 and 2017, with only 17 sightings during SCORE field efforts (Figure 3C,D, Appendix I) and 9 during ESTCP field efforts (Figure 4C,D). These low sighting rates in 2016 may be related to the strong El Niño conditions which continued through early 2016. While there were few fin whale sightings during dedicated SCORE field efforts in 2017 (5 sightings, 8 individuals) (Figure 3C,D), ancillary efforts had an increased number of sightings (15 sightings, 22 individuals) (Figure 4C,D). Opportunistic contributions of fin whale sighting data and photographs by other researchers, whale watch organizations, etc. from 2016 dramatically improved the sample, however, adding 294 sightings and 244 identifications of fin whales to the study. While these data, which were received late in 2017, are still being processed into the catalog, they underscore the importance of networking with local whale watch operators and other research groups along the mainland coast to adequately collect data from this unpredictably distributed species. The MarEcoTel fin whale catalog currently contains 929 individual fin whales photographed at locations from Northern Baja California to Northern British Columbia, though the majority of these whales (546) were sighted exclusively in Southern California.

Tag deployments

Satellite tags are deployed as part of this project to help elucidate additional information on animal movement, habitat use, to document time spent on the SCORE range, and assess behavior and possible behavioral changes associated with training exercises. While Photo-ID and biopsy are the primary focus of this work, satellite telemetry provides an additional tool for understanding the populations which occur at SCORE. The tags deployed as part of this effort are being analyzed with tag data from additional projects (e.g. Schorr et al. 2014, Falcone et al. 2017, Scales et al. 2017), and therefore only basic summary information is provided here.

Four satellite tags purchased by this contract have been deployed, one each on a Cuvier's beaked whale and fin whale, and two on Risso's dolphins. Transmission durations ranged from 12-40 days (Table 3, Figure 6). Data was processed as described in Falcone and Schorr (2014). While uplinks were received from the fin whale for more than 23 days, no locations were ever generated using the traditional least-squared method of the Argos system. This was most likely due to surfacing behavior. Fin whales sometimes bring their dorsal fin clear of the water only on the final breath before a dive; this behavior mode does not allow for sufficient Argos transmissions during a single satellite overpass to successfully generate a location estimate. We will be exploring the Kalman filtering option for this individual to see if locations can be generated from the available uplinks using that method.

Table 5. Details on satellite tags deployed during this effort.

Tag ID	Species	Tag Type	Date	Trans. Dur. (days)
BpTag075	Fin Whale	Spot6	4/12/2016	23.3
GgTag015	Risso's Dolphin	Mk10-A	2/26/2016	11.7
ZcTag045	Cuvier's Beaked Whale	Mk10-A	1/11/2016	39.6
GgTag018	Risso's Dolphin	Mk10-A	4/4/2017	18.6

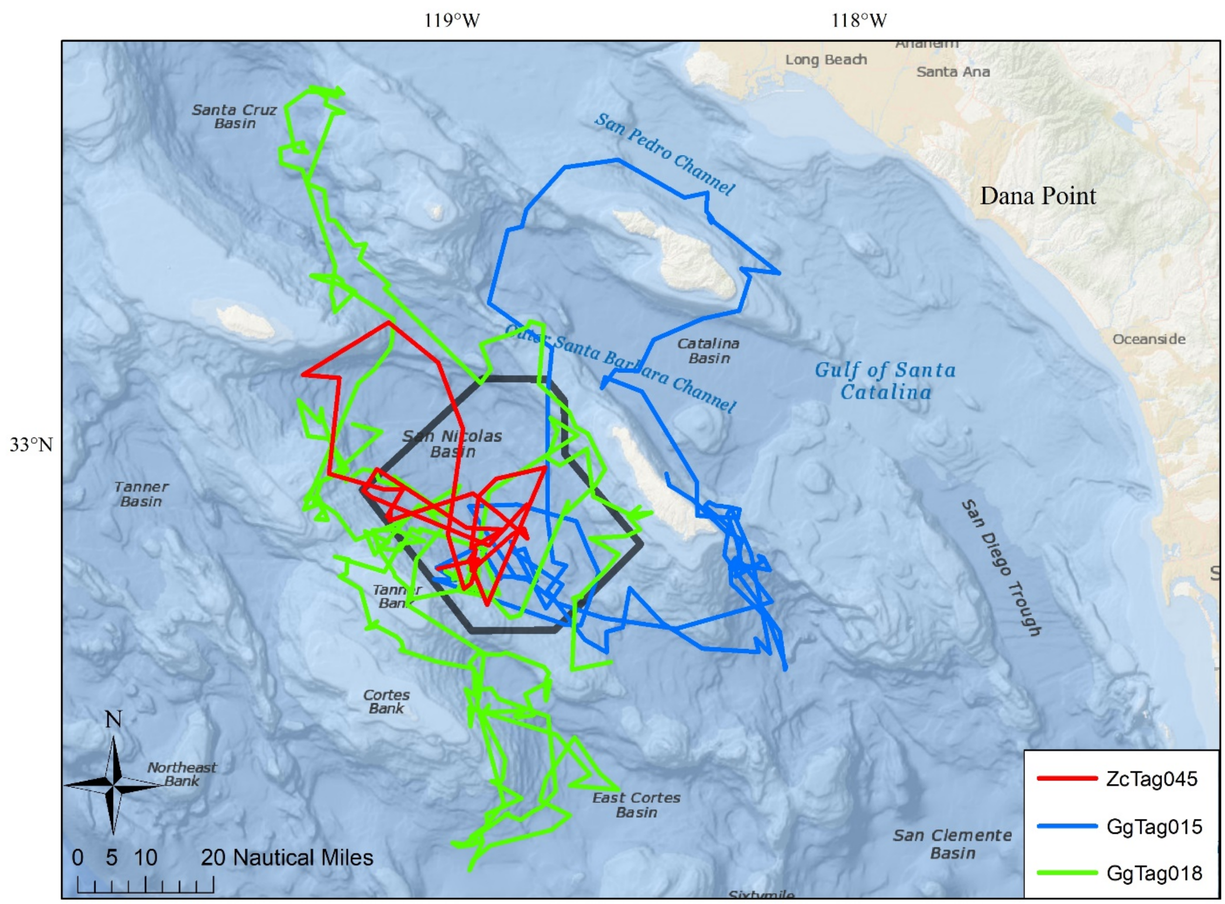

Figure 6. Filtered tracklines of a satellite tagged Cuvier's beaked whale (red) and two Risso's dolphins (blue, green) during the 2016 and 2017 monitoring effort.

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Appendix I. Sighting details from encounters during Fleet-supported effort in 2016 and 2017.

Date	Species	Lat	Lon	Group size	Estimated ID's	# Samples collected	# Tags deployed
1/10/2016	Delphinus species	N33 01.85	W118 43.19	30			
1/11/2016	Cuvier's Beaked Whale	N32 57.98	W118 45.64	1	1		
1/11/2016	Cuvier's Beaked Whale	N32 50.94	W118 48.57	2	2		1
1/11/2016	Delphinus species	N32 57.69	W118 40.98	350			
1/12/2016	Bottlenose Dolphin	N33 04.31	W118 31.55	6			
1/12/2016	Gray Whale	N33 07.21	W118 36.68	1			
1/15/2016	Cuvier's Beaked Whale	N33 07.76	W118 25.86	2	2		
2/22/2016	Bottlenose Dolphin	N33 01.54	W118 33.34	32	20	1	
2/22/2016	Delphinus species	N33 04.47	W118 51.16	1			
2/22/2016	Gray Whale	N33 02.74	W118 35.48	2			
2/22/2016	Humpback Whale	N33 05.09	W118 33.75	1			
2/22/2016	Northern Right Whale Dolphin	N32 56.86	W118 50.50	17			
2/22/2016	Delphinus species	N33 05.41	W118 48.24	60			
2/23/2016	Cuvier's Beaked Whale	N33 01.56	W118 56.84	3	1		
2/23/2016	Dall's Porpoise	N33 04.18	W119 05.28	4		1	
2/23/2016	Fin Whale	N33 04.11	W119 03.12	2	1		
2/23/2016	Humpback Whale	N32 59.51	W118 47.39	1			
2/23/2016	Delphinus species	N33 00.87	W118 58.28	38			
2/24/2016	Bottlenose Dolphin	N32 48.96	W119 00.01	11	7	1	
2/24/2016	Bottlenose Dolphin	N32 53.70	W118 21.53	30	18	2	
2/24/2016	Cuvier's Beaked Whale	N32 45.11	W118 57.27	2	2	1	
2/24/2016	Fin Whale	N32 58.27	W118 29.62	1	1		
2/24/2016	Humpback Whale	N32 58.28	W118 29.60	1			
2/24/2016	Minke Whale	N32 58.28	W118 29.60	1	1		
2/24/2016	Northern Right Whale Dolphin	N32 33.28	W118 57.01	14			
2/24/2016	Risso's Dolphin	N32 54.25	W118 55.73	8	3		
2/24/2016	Risso's Dolphin	N32 48.71	W119 01.86	10			
2/24/2016	Risso's Dolphin	N32 55.42	W118 22.48	45	8	1	
2/25/2016	Fin Whale	N33 02.34	W118 48.01	1	1		
2/25/2016	Fin Whale	N33 01.70	W118 33.42	1			
2/25/2016	Fin Whale	N33 00.66	W118 31.87	1	1		
2/25/2016	Fin Whale	N33 01.90	W118 39.79	1	1		
2/25/2016	Gray Whale	N33 05.89	W118 34.73	4			
2/26/2016	Bottlenose Dolphin	N33 00.12	W118 30.53	18	10	1	
2/26/2016	Bottlenose Dolphin	N32 59.14	W118 30.02	18	8	1	
2/26/2016	Delphinus species	N33 01.14	W118 31.06	250			
2/26/2016	Risso's Dolphin	N32 58.58	W118 28.68	5	5		

2/26/2016	Risso's Dolphin	N32 59.84	W118 29.59	16	15		
2/26/2016	Risso's Dolphin	N32 59.15	W118 30.02	30	25	1	2
2/27/2016	Bottlenose Dolphin	N33 22.85	W118 16.99	7	7	1	
2/27/2016	Bottlenose Dolphin	N33 29.90	W118 07.88	11	2	1	
2/27/2016	Pacific White-sided Dolphin	N33 26.28	W117 41.74	5			
2/27/2016	Risso's Dolphin	N33 15.76	W118 19.81	6	1		
4/1/2016	Fin Whale	N33 04.86	W118 23.07	1	1		
4/1/2016	Fin Whale	N33 11.40	W118 09.76	1			
4/2/2016	Blue Whale	N32 51.03	W118 55.10	1			
4/2/2016	Bottlenose Dolphin	N33 02.57	W118 33.45	8			
4/2/2016	Delphinus species	N32 55.14	W118 54.58	3			
4/2/2016	Cuvier's Beaked Whale	N32 54.66	W119 05.57	1	1		
4/2/2016	Fin Whale	N32 56.93	W119 04.43	1	1	1	
4/2/2016	Northern Right Whale Dolphin	N32 56.84	W119 04.15	8			
4/3/2016	Risso's Dolphin	N33 05.41	W118 38.11	2			
4/4/2016	Bottlenose Dolphin	N33 01.27	W118 32.43	18	12	1	
4/4/2016	Bottlenose Dolphin	N32 56.72	W118 25.66	2	2		
4/4/2016	Fin Whale	N32 52.06	W118 19.18	1	1	1	
4/4/2016	Humpback Whale	N32 55.25	W118 24.47	2	1		
4/4/2016	Risso's Dolphin	N32 56.85	W118 26.44	7	3		
4/5/2016	Bottlenose Dolphin	N32 54.56	W118 43.60	28			
4/5/2016	Bottlenose Dolphin	N32 58.13	W118 52.65	7			
4/5/2016	Cuvier's Beaked Whale	N32 42.77	W118 45.50	5	3		
4/5/2016	Minke Whale	N32 56.51	W118 58.06	1	1		
4/5/2016	Northern Right Whale Dolphin	N32 56.48	W118 58.05	8			
4/6/2016	Cuvier's Beaked Whale	N32 51.32	W119 07.65	3	3		
4/6/2016	Fin Whale	N32 57.71	W118 51.74	1			
4/7/2016	Bottlenose Dolphin	N32 59.56	W118 51.83	30	7	1	
4/7/2016	Cuvier's Beaked Whale	N32 50.52	W119 02.86	1	1		
4/7/2016	Risso's Dolphin	N32 59.56	W118 51.83	11	5		
4/8/2016	Delphinus species	N33 04.90	W118 53.08	50			
4/8/2016	Delphinus species	N32 56.00	W118 57.75	1500			
4/8/2016	UnID Medium Cetacean	N33 03.08	W118 55.05	1			
4/10/2016	Bottlenose Dolphin	N32 57.37	W118 54.74	45	30	3	
4/10/2016	Bottlenose Dolphin	N32 57.37	W118 52.81	6			
4/10/2016	Risso's Dolphin	N32 57.37	W118 52.81	4	3	1	
4/10/2016	Risso's Dolphin	N32 57.33	W118 55.36	4	3	1	
8/20/2016	Blue Whale	N32 45.23	W118 43.87	1	1		
8/20/2016	Delphinus species	N32 44.36	W118 43.32	1			
8/20/2016	UnID Large Cetacean	N32 45.10	W118 43.41				

8/26/2016	Blue Whale	N33 21.29	W117 40.74	1	1		
8/26/2016	Delphinus species	N33 02.60	W118 17.67	170			
11/5/2016	Delphinus species	N32 59.82	W118 59.92	500	3		
11/10/2016	Delphinus species	N32 45.92	W119 03.32	400			
11/10/2016	Cuvier's Beaked Whale	N32 52.11	W118 58.15	5	4	2	
11/10/2016	Cuvier's Beaked Whale	N32 49.98	W118 55.91	5			
11/10/2016	Sei or Bryde's Whale	N32 47.43	W119 03.21	1			
11/10/2016	Delphinus species	N32 48.73	W119 01.87	20			
11/13/2016	Cuvier's Beaked Whale	N33 00.47	W118 59.34	2	1		
4/1/2017	Bottlenose Dolphin	N33 29.77	W118 33.58	48	25		
4/1/2017	Delphinus species	N33 26.19	W117 46.42	50			
4/1/2017	Delphinus species	N33 01.85	W118 31.57	15			
4/1/2017	Delphinus species	N33 15.72	W118 34.91	175			
4/2/2017	Delphinus species	N33 02.85	W118 46.73	500			
4/2/2017	Delphinus species	N33 01.67	W118 31.25	45			
4/2/2017	Fin Whale	N33 00.87	W118 31.93	2	2	1	1
4/2/2017	Gray Whale	N33 02.69	W118 37.76	1			
4/2/2017	Humpback Whale	N33 04.40	W118 46.55	1			
4/2/2017	UnID Large Cetacean	N33 05.53	W118 48.44	1			
4/2/2017	UnID Medium Cetacean	N33 02.24	W118 38.76	1			
4/3/2017	Delphinus species	N32 57.51	W118 47.87	15			
4/3/2017	Humpback Whale	N32 58.64	W119 06.72	2			
4/3/2017	Humpback Whale	N32 53.90	W119 08.30	1			
4/3/2017	Humpback Whale	N32 51.93	W119 05.22	2			
4/3/2017	Humpback Whale	N33 04.13	W119 03.50	1			
4/3/2017	Delphinus species	N32 56.68	W118 50.25	100			
4/3/2017	Northern Right Whale Dolphin	N32 46.59	W118 55.47	5		1	
4/3/2017	Pacific White-sided Dolphin	N32 58.64	W119 06.72	8	3	1	
4/3/2017	Pacific White-sided Dolphin	N33 02.94	W119 04.17	3	2		
4/3/2017	Pacific White-sided Dolphin	N32 59.89	W119 06.60	5	1	1	
4/4/2017	Bottlenose Dolphin	N33 04.16	W119 14.98	5	5		
4/4/2017	Bottlenose Dolphin	N33 09.60	W119 11.50	13	7	1	
4/4/2017	Bottlenose Dolphin	N33 04.32	W119 14.84	22	15	2	
4/4/2017	Bottlenose Dolphin	N33 03.11	W119 14.34	20			
4/4/2017	Delphinus species	N33 07.66	W119 14.37	125	3		
4/4/2017	Delphinus species	N33 08.02	W118 37.48	500			
4/4/2017	Delphinus species	N33 06.12	W118 35.21	40			
4/4/2017	Cuvier's Beaked Whale	N33 01.89	W119 14.29	4	4	1	
4/4/2017	Fin Whale	N33 01.87	W119 15.34	1			

4/4/2017	Gray Whale	N33 02.02	W118 33.95	1			
4/4/2017	Humpback Whale	N33 08.73	W119 03.17	1			
4/4/2017	Humpback Whale	N33 07.66	W119 14.38	4			
4/4/2017	Humpback Whale	N33 09.96	W119 04.13	4			
4/4/2017	Humpback Whale	N33 09.80	W119 05.91	2			
4/4/2017	Humpback Whale	N33 07.19	W118 34.72	3			
4/4/2017	Humpback Whale	N33 07.72	W119 13.13	1			
4/4/2017	Delphinus species	N33 08.74	W119 03.20	700			
4/4/2017	Northern Right Whale Dolphin	N33 05.54	W119 15.50	50			
4/4/2017	Northern Right Whale Dolphin	N33 03.11	W119 14.34	12			
4/4/2017	Pacific White-sided Dolphin	N33 02.22	W119 15.07	13			
4/4/2017	Pacific White-sided Dolphin	N33 07.66	W119 14.37	14	2		
4/4/2017	Risso's Dolphin	N33 03.11	W119 14.35	25	15		1
4/4/2017	Risso's Dolphin	N33 09.66	W119 11.57	7	6	2	
4/4/2017	Risso's Dolphin	N33 05.53	W119 15.52	7			
4/4/2017	UnID Medium Cetacean	N33 09.28	W118 45.52	1			
4/5/2017	Delphinus species	N33 03.91	W119 09.02	2			
4/5/2017	Delphinus species	N33 12.56	W118 48.42	140			
4/5/2017	Humpback Whale	N33 07.12	W119 05.18	1			
4/5/2017	Humpback Whale	N33 12.46	W118 46.34	2			
4/5/2017	Humpback Whale	N33 12.30	W118 44.18	1			
4/5/2017	Humpback Whale	N33 10.13	W118 39.24	1			
4/5/2017	Delphinus species	N33 10.72	W118 39.59	75			
4/5/2017	Minke Whale	N33 02.70	W119 10.21	1	1		
4/5/2017	Minke Whale	N33 09.98	W118 38.68	1	1	1	
4/5/2017	Minke Whale	N33 02.18	W119 14.34	1	1		
4/5/2017	Risso's Dolphin	N33 12.30	W118 42.49	10			
4/6/2017	Bottlenose Dolphin	N32 59.88	W118 30.44	7			
4/6/2017	Delphinus species	N33 01.51	W118 38.69	400			
4/6/2017	Humpback Whale	N33 00.43	W118 30.59	1			
4/6/2017	Risso's Dolphin	N33 00.83	W118 31.78	22	5		
4/7/2017	Delphinus species	N32 59.33	W118 46.83	50			
4/7/2017	Delphinus species	N33 01.91	W118 40.91	18			
4/7/2017	Cuvier's Beaked Whale	N32 57.96	W119 03.53	3	2	3	
4/7/2017	Cuvier's Beaked Whale	N32 57.76	W118 59.12	4	4	6	
4/7/2017	Humpback Whale	N32 59.31	W118 46.87	1			
4/7/2017	Delphinus species	N32 56.96	W119 04.08	45			
4/7/2017	Minke Whale	N32 57.21	W119 02.43	1	1		
4/7/2017	Minke Whale	N32 58.99	W118 52.38	1	1		

4/7/2017	Pacific White-sided Dolphin	N32 58.23	W119 03.46	80			
4/8/2017	Delphinus species	N33 02.52	W118 30.55	45			
7/22/2017	Delphinus species	N33 26.84	W118 38.69	45			
7/22/2017	Delphinus species	N33 26.45	W117 45.25	5			
7/22/2017	Delphinus species	N33 25.91	W118 07.40	25			
7/22/2017	Cuvier's Beaked Whale	N33 20.72	W118 42.67	3	3		
7/22/2017	Humpback Whale	N33 25.79	W118 06.52	1			
7/22/2017	Delphinus species	N33 11.81	W118 38.12	90			
7/22/2017	Delphinus species	N33 07.07	W118 31.08	190			
7/23/2017	Delphinus species	N33 02.27	W118 34.17	80			
7/23/2017	Delphinus species	N32 49.15	W119 00.36	500			
7/23/2017	Delphinus species	N32 43.25	W118 49.16	45			
7/23/2017	Delphinus species	N33 05.57	W118 35.64	30			
7/24/2017	Bottlenose Dolphin	N33 00.22	W118 40.17	43	20		
7/24/2017	Bottlenose Dolphin	N33 04.74	W118 36.55	18	13		
7/24/2017	Delphinus species	N32 43.94	W118 45.01	60			
7/24/2017	Delphinus species	N32 56.81	W118 43.09	80			
7/24/2017	Delphinus species	N32 50.16	W118 45.96	25			
7/24/2017	Cuvier's Beaked Whale	N32 42.78	W118 46.15	2	2		
7/25/2017	Bryde's Whale	N32 43.87	W118 54.81	1	1		
7/25/2017	Cuvier's Beaked Whale	N32 41.29	W118 54.24	2	2		
7/25/2017	Cuvier's Beaked Whale	N32 41.92	W118 54.36	3	3		1
7/25/2017	Fin Whale	N32 41.50	W118 55.25	1	1		
7/25/2017	Fin Whale	N32 41.73	W118 55.76	2	2		
7/26/2017	Fin Whale	N32 51.12	W119 04.13	2			
7/29/2017	Delphinus species	N33 04.83	W118 38.53	1			
7/29/2017	Delphinus species	N33 02.22	W118 42.34	60			
7/29/2017	Delphinus species	N32 51.11	W118 47.14	12	1		
7/29/2017	Cuvier's Beaked Whale	N32 43.94	W118 55.96	3	3		
7/29/2017	Delphinus species	N32 54.26	W118 45.66	750	10	2	
7/29/2017	Delphinus species	N33 02.50	W118 42.00	18			
7/30/2017	Delphinus species	N33 25.65	W117 46.33	55			
7/30/2017	Delphinus species	N33 08.12	W118 34.29	150			
7/30/2017	Delphinus species	N33 03.56	W118 30.76	100			
7/30/2017	Delphinus species	N33 21.14	W118 07.59	23			
7/30/2017	Delphinus species	N33 22.82	W117 57.54	200			