Aerial Survey Marine Mammal Monitoring off Southern California in Conjunction with US Navy Major Training Events (MTE)

SOCAL Nov 18-23, 2009

Final Field Report

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Cover Photos: Killer whale (*Orcinus orca*), California sea lion *(Zalophus californianus),* Cuvier's beaked whale *(Ziphius cavirostris),* and short-beaked common dolphin *(Delphinus delphis)* photographed with a telephoto lens from the aircraft during the SOCAL November 09 aerial monitoring survey. Photos by Mark Deakos courtesy of Smultea Environmental Sciences.

Section 1 Introduction

In support of the U.S. Navy's (Navy) Marine Mammal Monitoring Plan (M3P) in the Southern California Range Complex (SOCAL) (DoN 2009), aerial surveys were conducted by Smultea Environmental Sciences (SES) to monitor marine mammals and sea turtles (MM/ST) during November 2009 in the SOCAL area. This was the fifth such aerial survey in SOCAL conducted by SES or SES/Marine Mammal Research Consultants (MMRC). Monitoring occurred in conjunction with several Navy Major Training Events (MTEs) involving mid-frequency-active sonar (MFAS). Portions of these MTEs occurred in offshore waters near San Clemente Island (SCI) off San Diego, California. Naval training has been conducted within SOCAL for over 40 years, and marine mammals are also known to be abundant there (e.g., summarized in Carretta et al. 2000, 2008; DoN 2008, 2009). As part of SOCAL, the Navy operates the Southern California Anti-submarine Warfare Range (SOAR) west of San Clemente Island (Figure 1).

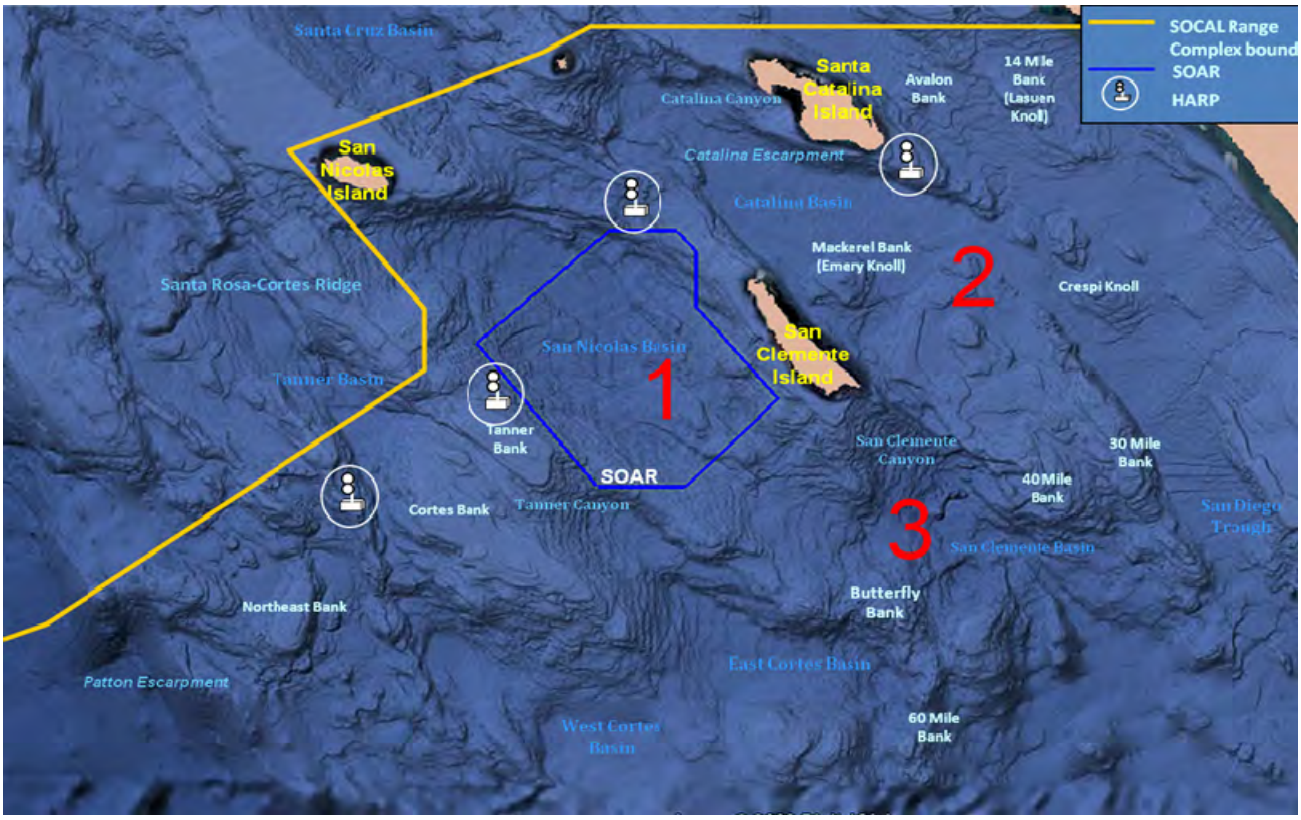


Figure 7. Location of the aerial survey monitoring area and underwater topographic features within the Navy's Southern California Range Complex (SOCAL). Numbers indicate survey areas of interest to the Navy in order of priority; orange line designates the SOCAL boundary; blue lines designate the Southern California Offshore Anti-submarine Warfare Range (SOAR); icons are approximate locations of Navy-funded bottom-mounted passive- acoustic high-frequency acoustic recording packages (HARPs).

The contracted work involved considerable pre-survey planning via email and telephone with the Navy Technical Representative (NTR) given the logistical complexity of the MTEs, as well as a pre-planning meeting in San Diego just prior to the survey (see below). In particular, coordinating multiple Navy activities on the SOCAL range was logistically challenging and time-consuming for Navy personnel given the high degree of safety planning. Protocol was similar to that implemented for aerial surveys in SOCAL in summer 2009 (see Smultea et al. 2009a,b).

Project Planning

Meetings and communications with Navy personnel identified the actual survey areas, periods, and communications protocols to be used. This was required to coordinate logistics and ensure safety and open communication between the Navy and the aerial monitoring team during the surveys, given the complexity of multiple naval aircraft and vessel operations involved with the MTEs and other missions. Clearance from various Navy commands was obtained by Navy environmental planners on behalf of SES prior to the research aircraft flying in the SOCAL.

In addition, pre-planning meetings were conducted. These communications were needed to coordinate survey efforts with others conducting marine mammal research in the same region and period including the Naval Undersea Warfare Center (NUWC), Scripps Institute of Oceanography (SIO), and Cascadia Research Collective (CRC). Other ongoing studies involved passive acoustics, tagging, photo-identification, and behavioral studies from small vessels (including a small CRC and two small SIO vessels), some of which were funded by the Office of Naval Research (ONR) and N45 funds (e.g., Falcone et al. 2009a,b). Communications identified ways the various research groups and platforms could collaborate and assist one another in obtaining complimentary data, thus maximizing the utility of simultaneously operating studies. Of particular focus was conducting simultaneous aerial and small vessel (CRC, SIO) tagging and photo-identification studies primarily west of SCI. The goal was to alert one another about the locations of unusual sightings such as beaked whales and killer whales.

Project Questions and Hypotheses

Project questions and hypotheses were developed by SES based on the five questions identified in the Navy's SOCAL M3P designed to assess potential effects of MFAS and underwater detonations on MM/ST during Navy MTEs (DoN 2009; see Smultea et al. 2009a,b). See the 2008 SOCAL aerial survey report (Smultea et al. 2009a,b) for more detailed related information.

An important factor limiting the ability to assess potential effects of MFAS in this report is that the Navy did not disclose MFAS transmission times and locations for national security reasons. Thus, it is not possible for us herein to compare data from specific operational MFAS "on" and "off" periods during MTEs, nor data on distance and relative location of MFAS sources vs. sightings.

Approach

The approach implemented to address SOCAL M3P requirements was to conduct surveys to monitor the occurrence and behavior of MM/ST from a small fixed-wing aircraft in the SOCAL relative to MFAS transmission periods. The primary survey areas were SOAR west of SCI and the Northern Air Operating Area (NAOPA) range between SCI and the mainland coast (Figure 1). The study approach involved implementing search, verify, and focal follow modes as described in Smultea et al. (2009a,b). Notably, sea turtles were considered unlikely to be seen in the MTE based on available data (reviewed in DoN 2008). See Smultea et al. (2009a) for a detailed list of primary monitoring goals of the aerial surveys.

As described in Smultea et al. (2009a), priority species were (1) MM/ST exhibiting unusual or distressed behavior, (2) near-stranded, stranded, or dead MM/ST, (3) MM/ST species listed as endangered or threatened under the ESA, (4) beaked whales, and (5) Risso's dolphins, dwarf/pygmy sperm whales (Kogia sp.), and other deep-diving odontocetes considered potential "surrogate" representatives for deep-diving beaked whales (see DoN 2009).

Section 2 Methods

Methods followed those outlined in the SOCAL aerial survey monitoring reports for the October/November 2008 surveys (Smultea et al. 2009a) and the June/July 2009 surveys (Smultea et al. 2009b). Thus, they are not repeated herein. See Smultea et al. (2009a) for the most detail on protocol and methodology. For the November 2009 SOCAL aerial survey, a Partenavia P68 was used as the observation aircraft for the entire survey (Figure 2a), as the glass-nosed Partenavia P68 Observer (Figure 2b) was not available for use (it was being used to conduct multiple weeks of pinniped surveys by the NMFS Southwest Fisheries Science Center). As in past surveys, we used an Apple iTouch for data collection.

As done during past surveys, a marine mammal species expert (Dr. Tom Jefferson, Clymene Enterprises, San Diego, CA) reviewed our photographs to verify or identify species. Additional experts were consulted as deemed appropriate, especially for large whale sightings, to differentiate as possible between sei, fin, and Bryde's whales.

Figure 2a. The Partenavia P68 Observer fixed-wing, twin-engine aircraft used during the November 2009 aerial survey monitoring.

Figure 2b. The Partenavia P68 Observer fixed-wing, twin-engine aircraft used during the October-November 2008 aerial survey monitorin (note the glass nose). This plane was not available during the November 2009 surveys but is preferred to conduct surveys when it is available given the glass nose and improved sighting effectiveness from the pilot and co-pilot seats.

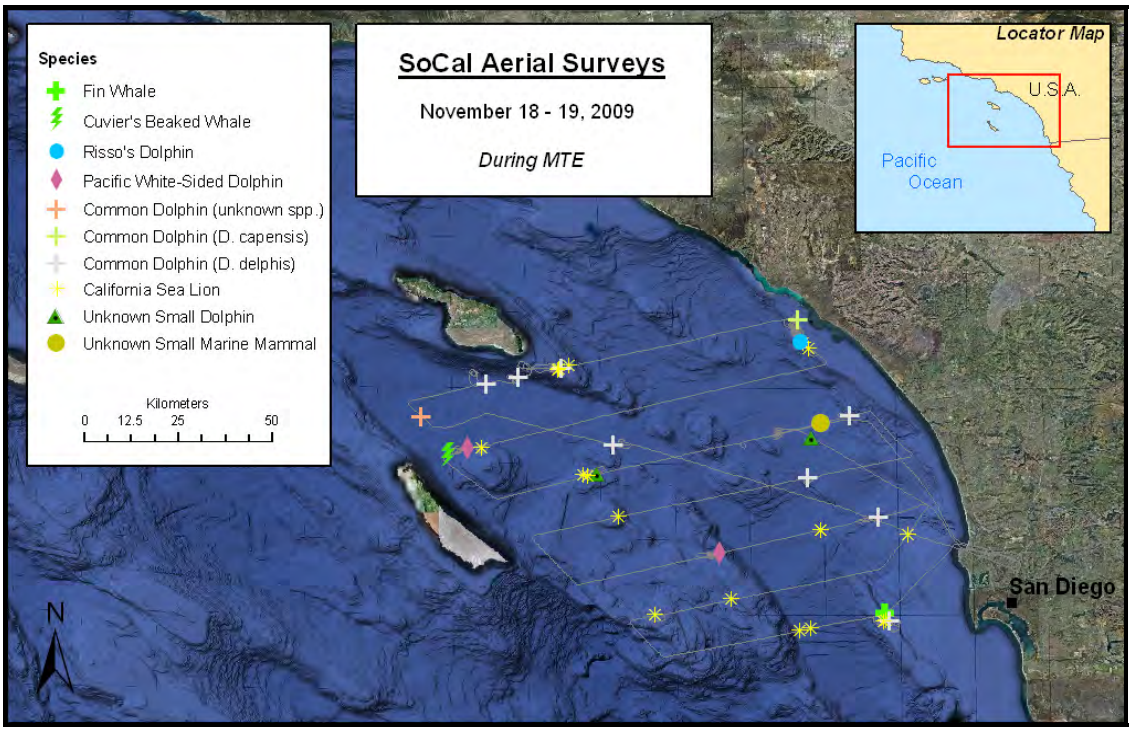


Figure 3. Aerial survey track lines and marine mammal sightings in the SOCAL during a Major Training Event (MTE) (November 18-19, 2009).

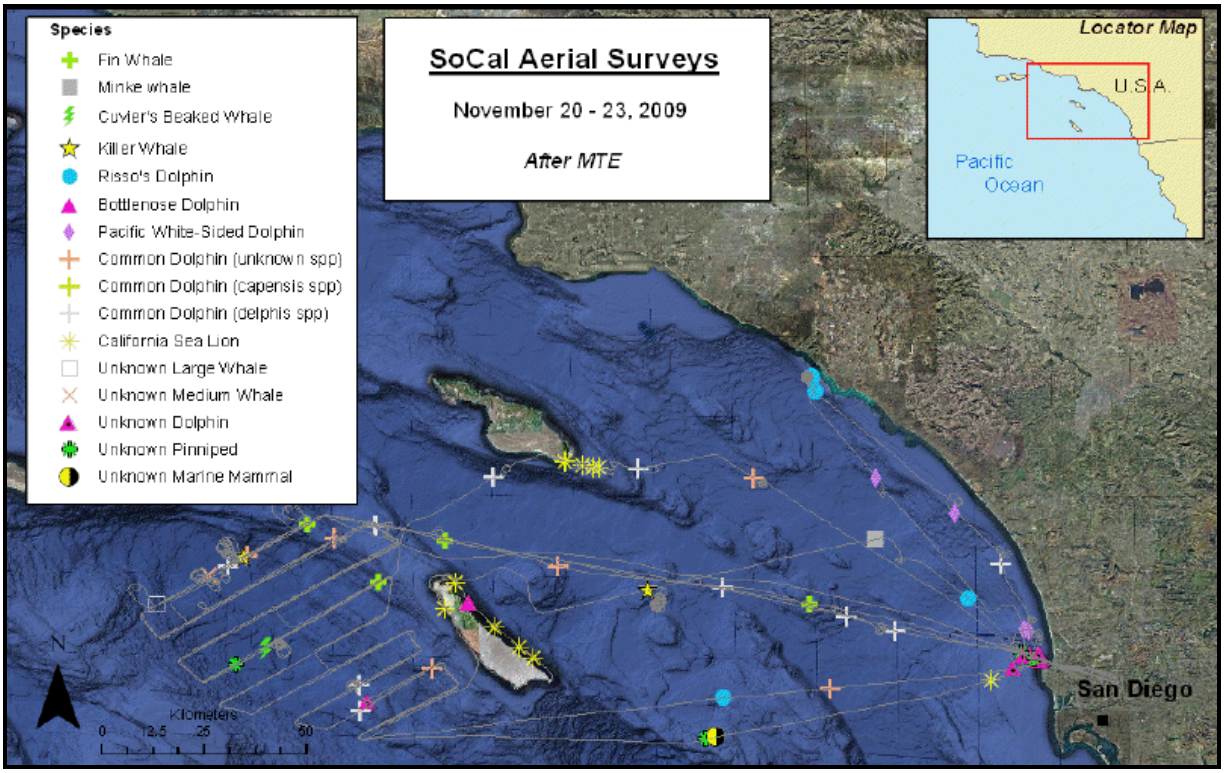


Figure 4. Aerial survey track lines and marine mammal sightings in the SOCAL after a Major Training Event (MTE) (November 20 - 23, 2009).

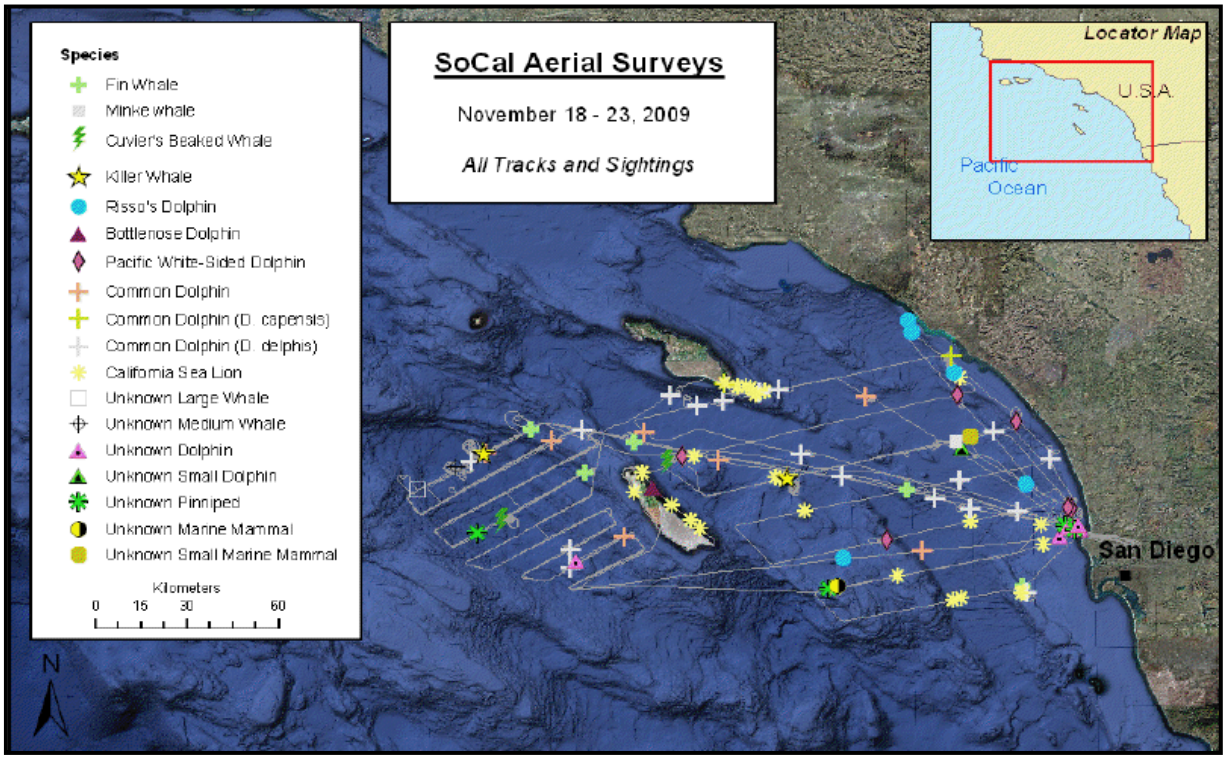


Figure 5. All track lines and sightings made during aerial monitoring surveys in SOCAL November 18 - 23, 2009.

Section 3 Results

This section closely follows the format of the summer 2009 SOCAL aerial survey monitoring report (Smultea et al. 2009b). Results are summarized in Tables 1-5, Figures 2-13, and Appendix A.

Effort

A total of 27.46 hr of flight and ~5233 km (2827 nm) of flight effort were conducted during the November 2009 SOCAL aerial survey between aircraft "wheels up" off the ground to "wheels down" when the plane landed (Tables 1 and Table 2). Surveys were flown on every day during November 18 – 23 for a total of 6 flight days. Overall, most (34%) of the total 5,233 km of observation effort in November consisted of systematic line-transect. This was followed by circling sightings for focal follows and/or species identification (26%), transit (19%), and random effort (13%) (Table 2). Random effort consisted primarily of transits to and from systematic survey lines but also included one circumnavigation of SCI totaling 120 km searching for potential stranded animals (Table 2). Overall, Bf (Beaufort sea state rating) ranged from 1-6 during November. Bf 3 predominated (43%) followed by Bf 2 (33%) (Figure 7).

Table 1. Aerial survey flight times, total hours, and nautical miles flown by date and survey period November SOCAL 2009 aerial survey.

Date	Time Engines On	Time Engines Off	Total Engine Time	Time Wheels Up	Time Wheels Down	Total Flight Time	Start Obs.	End Obs.	Total Obs. Time	Flight Area	General Weather	Comments
18 Nov	13:31	17:07	3:36	13:40	17:05	3:25	13:43	16:49	3:05	NAOPA South ½	Morning fog, clear by midday, light haze, Bf 2-3	Started late--morning fog. Too dark to observe on return transit, sunset @ 16:48. Large common dolphin grp (2000+) spread over 15 km. Not permitted on SOAR
19 Nov	10:03	14:33	4:30	10:13	14:31	4:18	10:17	14:25	4:08	NAOPA North ½	Morning fog, fog near San Clemente Isld (SCI) Winds 8-12 kt offshore. Bf 2-3, Bf 3-4 on return from SCI	Fuel truck 1hr late. Cuvier's beaked whale @11:14 on transit line. Large common dolphin grp (1200+) spread over 8 km. Not permitted on SOAR
20 Nov	10:28	15:08	4:40	10:47	15:03	4:16	10:50	14:57	4:06	SOAR (1 NAOPA line on return)	Fog in NAOPA during transect to SOAR. Bf 2-5	1 Unid. Med. whale NW SOAR. Saw Cascadia RHIB ~5 km away. RHIB 30 min later tracking beaked whale vocals. Spoke to them on VHF Ch 16 then 10
21 Nov	9:35	14:38	5:03	9:50	14:35	4:44	9:53	14:27	4:34	Circumnavigate SCI, ½ East SOAR	Light fog and haze in a.m., unable to fly some W ends of SOAR lines with high Bf >5 offshore. Bf 2-5 elsewhere	Killer whales with calves. Multiple-breaching minke whale.
22 Nov	8:45	13:40	4:55	9:02	13:36	4:33	9:06	13:25	4:19	SOAR then 1 NAOPA line on return	Light haze, predicted NW wind 20-25 kt. Bf 3-4 in SOAR, Bf 2-4 in NAOPA	Sunset 16:45pm, not enough light for second flight. Common dolphins seen in SOAR, 2 fin whale sightings.
23 Nov	7:38	12:18	4:40	7:54	12:13	4:19	7:57	12:06	4:08	½ North SOAR (1 NAOPA line on return)	Bf 2-3, clear, no fog or haze	Killer whales, 4 Cuvier's beaked whales. Not permitted on SOAR after 11:00
	13:55	16:22	2:27	14:06	16:15	2:08	14:09	16:08	1:58	Followed shelf N off coast	Bf 2-4, clear with no fog or haze	Sunset 16:43, ended flight due to limited light. Focal observ. of Risso's dolphins near Laguna coastline
		Total Engine Time	**29:51**		**Total Hours Flown**	**27:46**		**Total Obs Time**	**26:22**			

Table 2. Summary of aerial survey effort (km and nm) by leg type during the November SOCAL 2009 MTE aerial surveys.

Leg Type	Leg Type Definition	Total km Flown	*Total nm Flown*
Systematic	Pre-determined line transect legs located in SOAR and NAOPA	1790	*967*
Random	Short lines connecting longer systematic lines	669	*361*
Circling	Flying clockwise circles around sightings to verify species and group size via photography and/or to conduct focal behavioral sessions with videography as possible	1335	*721*
Circumnavigating Coast	Flying parallel to SCI coastline approximately 0.5 km offshore to search for potential strandings	120	*65*
Transiting	Flying between the airport and the survey grid locations	983	*531*
Fog Effort	Opportunistic observation effort conducted when fog or low clouds partially obscured view	83	*45*
Transiting Low Light	Transiting (see above) at dawn or dusk when low-light conditions compromised visibility	42	*23*
Navy-Directed Transiting	Flying off intended course as directed by Navy to avoid Navy activities	137	*74*
Sighting	Flying from the survey line to a sighting location before circling began	74	*40*
TOTAL		**5233**	***2827***

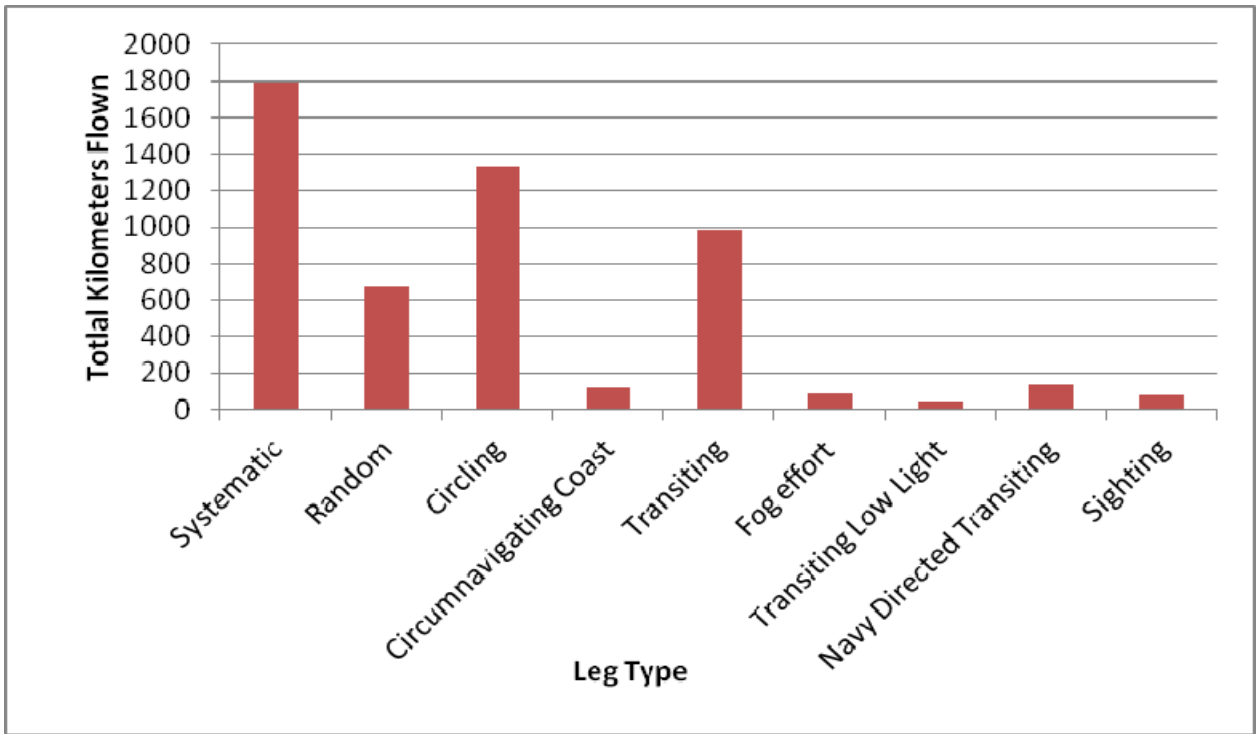


Figure 6. Summary of aerial survey effort (km) by leg type during the November SOCAL 2009 MTE aerial surveys.

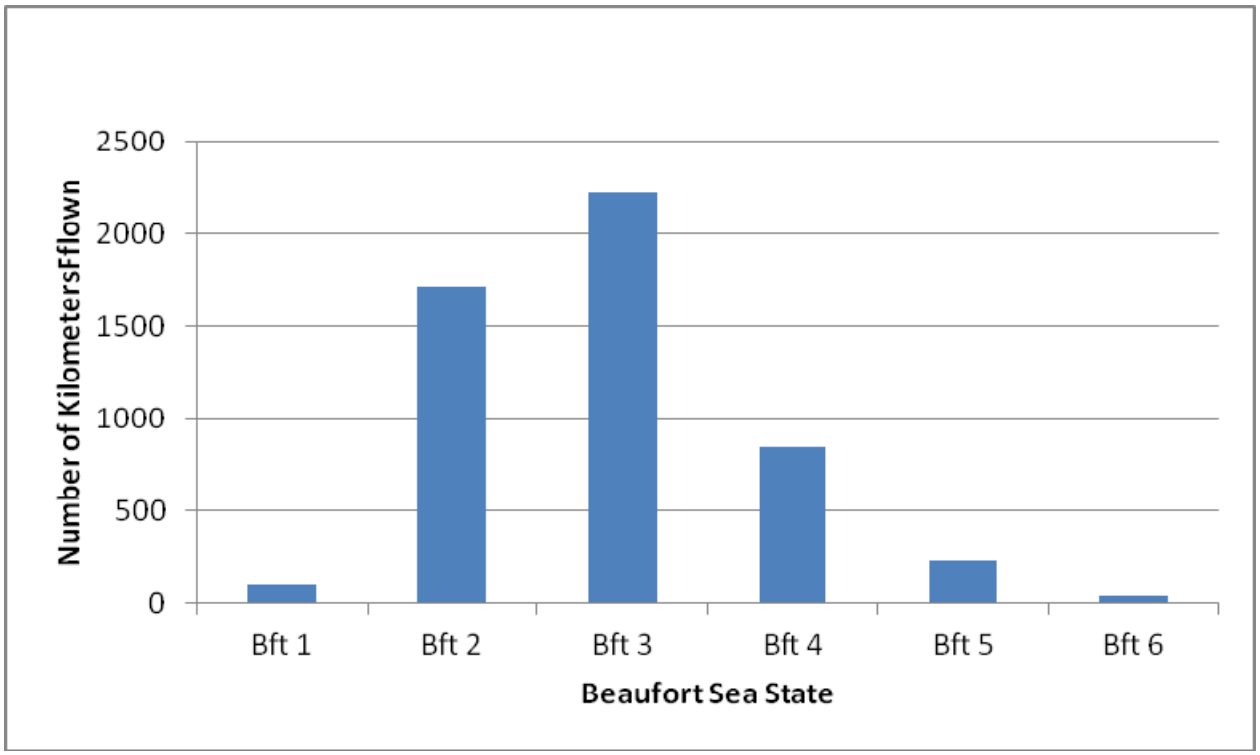


Figure 7. Summary of aerial survey effort (km) by Beaufort sea state during the November SOCAL 2009 MTE aerial surveys.

Sightings

A total of 94 sightings of ~12,829 individual marine mammals was observed (Table 3). Of the total 94 sightings, 79.8% were identified to species (n = 42) or genus (n = 75) (Table 3 and Appendix A). Not all sightings were identified to species because there was not always time to fly off course to identify and circle sightings. Rather, the priority was to reach and conduct a full survey in SOAR which required a full tank of fuel to complete, i.e., there was not enough fuel to circle species seen en route to or from the airport and the SOAR survey area.

At least 10 different marine mammal species were identified (Table 3); no sea turtles were seen similar to the previous five SOCAL aerial surveys (Smultea et al. 2009a,b). Sightings included two baleen whale species (fin and minke whales), Cuvier's beaked whale, killer whale, five dolphin species (bottlenose, short- and long-beaked common, Pacific white-sided, Risso's), and one pinniped species (California sea lion)(Table 3). Unidentified sightings usually occurred when there was no time to circle (see above). Overall, the California sea lion was the most frequently identified species group (30% or 28 of 94 total groups) followed by common dolphins of the genus Delphinus (19% or 18 groups) (Table 3). In terms of number of individuals seen, the common dolphin was the most abundant (n = ~11,944 or 93% of the total 12,829 individuals seen). California sea lions (n = 28 groups of 127 individuals) were the most commonly identified pinniped species.

Estimated mean group sizes were highest for short-beaked common dolphins (537) (Table 3). Mean group sizes for other delphinid species (n = 14 groups) were considerably smaller. For example, overall mean group size for five Risso's dolphin sightings was 33 individuals/group (Table 3). Baleen whales had the smallest observed group sizes (mean group size for fin = 2 whales/group, n = 5 groups and mean group size for minke = 1 whale/group, n = 1).

Table 3. Summary of marine mammal sightings by species during the November SOCAL 2009 MTE aerial surveys. Highlighted gray species have photos within the report as follows. Minke whale photos located in Appendix C. Cuvier's beaked whale photo located on the cover page. Killer whale photos located on the cover page and in Appendix D. Short-beaked common and California sea lion photos located on the cover page.

Species (Common Name)	Scientific Name	Total No. of Sightings	Total Estimated No. Individuals	Mean Group Size
Fin Whale	*Balaenoptera physalus*	5	9	2
Common Minke Whale	*Balaenoptera acutorostrata*	1	1	1
Cuvier's Beaked Whale	*Ziphius cavirostris*	2	6	3
Killer Whale	*Orcinus orca*	2	67	34
Pacific White-sided Dolphin	*Lagenorhynchus obliquidens*	6	274	46
Risso's Dolphin	*Grampus griseus*	5	167	33
Common Bottlenose Dolphin	*Tursiops truncatus*	1	4	4
Short-beaked Common Dolphin	*Delphinus delphis*	18	9666	537
Long-beaked Common Dolphin	*Delphinus capensis*	2	53	27
Common Dolphin sp.	*Delphinus* sp.	7	2225	318
California Sea Lion	*Zalophus californianus*	28	127	5
Unidentified Dolphin	Delphinidae sp.	7	177	25
Unidentified Small Dolphin	Delphinidae sp.	2	45	22.5
Unidentified Large Whale	Cetacea	1	1	1
Unidentified Medium Whale	Cetacea	1	1	1
Unidentified Pinniped	Pinnipedia	4	4	1
Unidentified Marine Mammal	Cetacea or Pinnipedia	1	1	1
Unidentified Small Marine Mammal	Cetacea or Pinnipedia	1	1	1
Totals:		**94**	**12,829**	

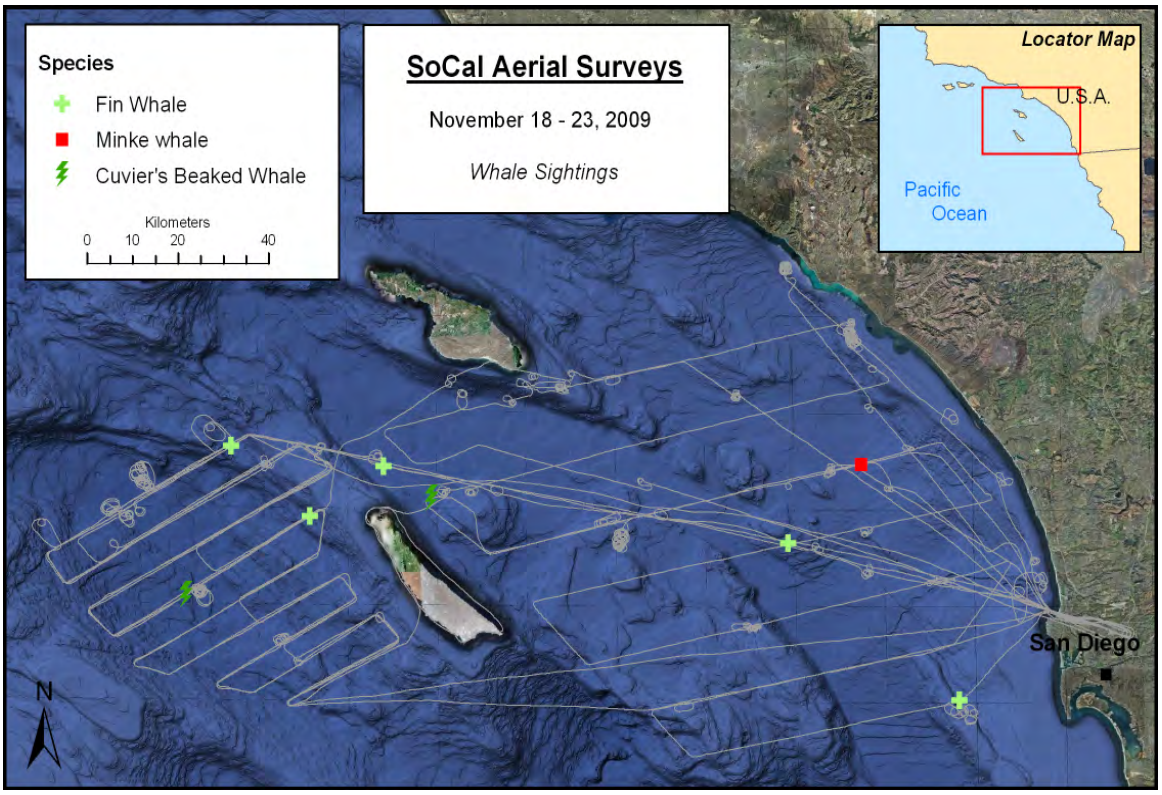


Figure 8. Whale sightings made during aerial survey monitoring in the SOCAL November 18 - 23, 2009.

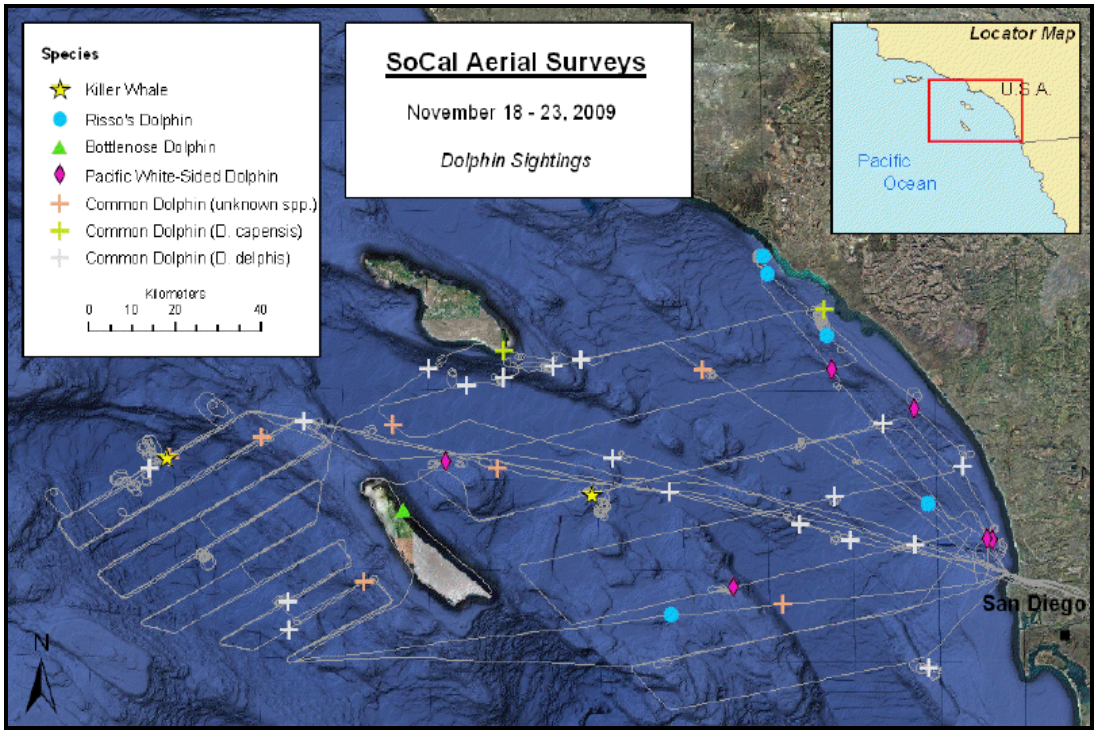


Figure 9. Dolphin sightings made during aerial survey monitoring in the SOCAL November 18 - 23, 2009.

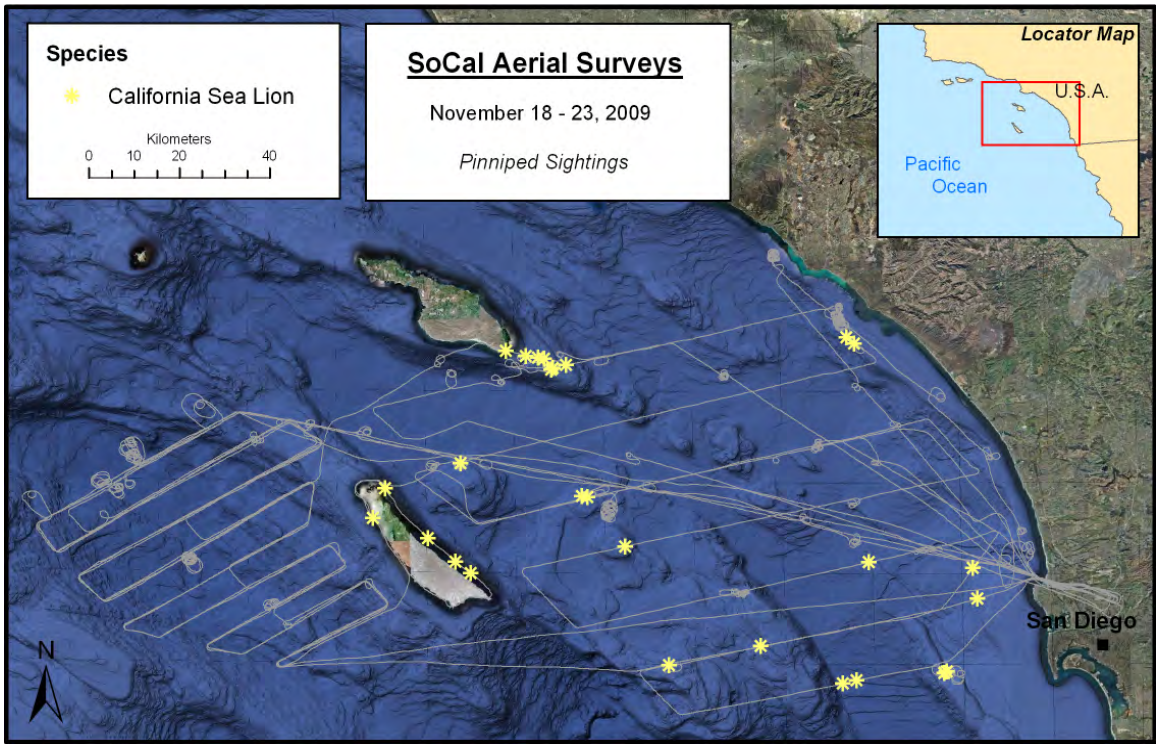


Figure 10. Pinniped sightings made during aerial survey monitoring in the SOCAL November 18 - 23, 2009.

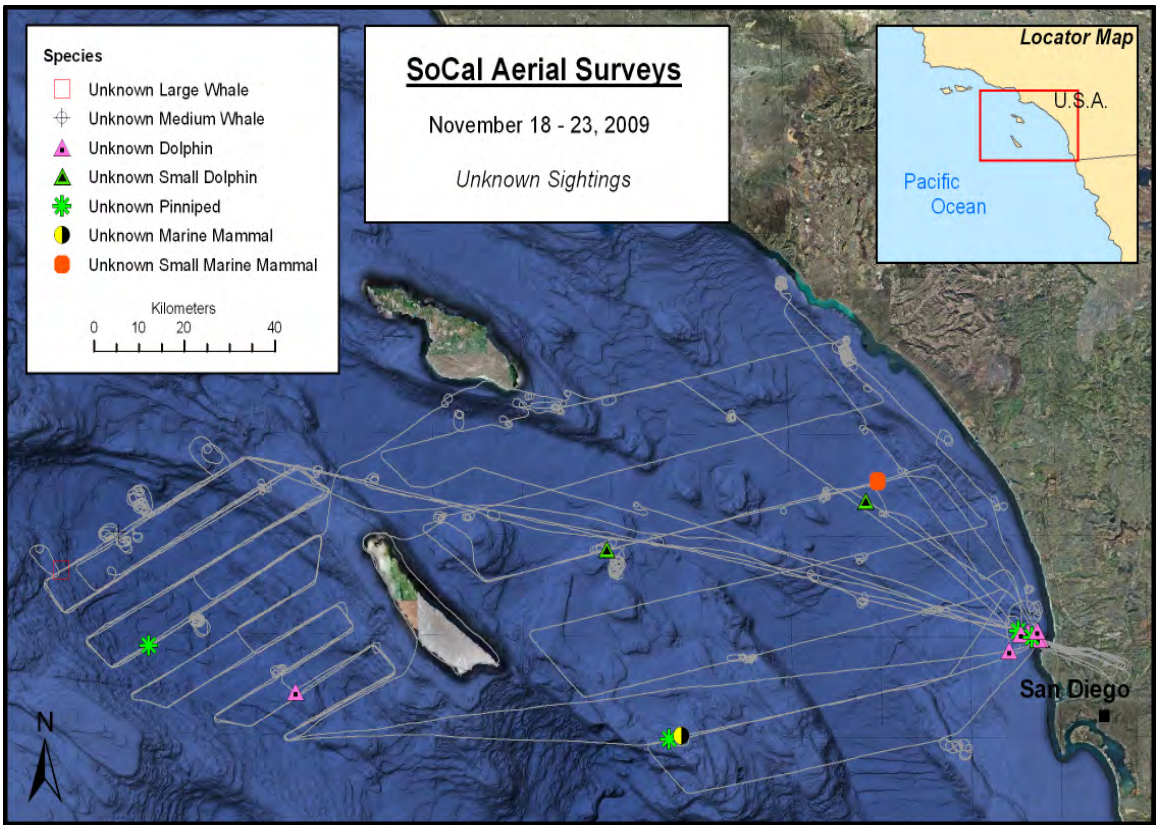


Figure 118. Unknown species sightings made during aerial survey monitoring in the SOCAL November 18 - 23, 2009.

Distribution

In November 2009, line-transect surveys were conducted only E and W of SCI (see Figures 3 and 4). Transect lines E of SCI in NAOPA were the same as those followed in October/November 2008 and June/July 2009 (see Smultea et al. 2009a,b). Survey lines W of SCI in SOAR in November 2009 were similar to those followed in June-July 2009 and October-November 2008, but extended further north and slightly farther apart in November 2009 vs. the earlier surveys to maximize coverage of the Navy-identified SOAR survey area within the ~4.5-5-hr limit of the aircraft's fuel tank.

Two Cuvier's beaked whale sightings were observed: one just E of the northern end of SCI at the edge of a steep topographic drop-off, the second one near the middle of SOAR in the San Nicholas Basin (Figure 8). All five fin whale sightings occurred along the edge of steep topographic drop-offs, including three sightings in or near SOAR, one off San Diego, and one in the middle of the NAOPA survey grid (Figure 8). Risso's dolphins, Pacific white-sided dolphins, and long-beaked common dolphins tended to be coastally distributed (Figure 9). In contrast, short-beaked common dolphins were distributed generally through much of the study area but particularly along steep underwater reliefs such as the south side of Santa Catalina Island. Two rare sightings of killer whales were made during the survey: one on the north end of SOAR and the second one in the NAOPA survey grid (Figure 9). Killer whales had never been seen during any of the five previous aerial surveys conducted in the same areas (Smultea et al. 2009a,b). The only pinnipeds identified to species were California sea lions. The highest concentration of this species occurred along the narrow bank extending off the southeast tip of Santa Catalina Island (Figure 10). Concentrations were also seen along the E side of San Clemente Island during the circumnavigation survey of the island. No pinnipeds were seen in SOAR. In addition, California sea lions were seen scattered throughout offshore waters between San Diego and SCI.

Behavior

Four species or genus had sample sizes considered large enough (n = 5) to warrant summarizing initially observed behavior state, heading, and estimated mean dispersal distance between individuals: fin whales (n = 5), common dolphins (n = 29), Risso's dolphins (n = 5), and Pacific white-sided dolphins (n = 6)(Figures 12-15). Common dolphins were frequently observed engaged in surface-active behavior states and travel (Figure 12). In contrast, Risso's dolphins were rarely seen engaged in surface-active behaviors (Figure 13); rather, they predominantly traveled and also exhibited rest and milling more frequently than common dolphins (Figures 12 and 13). The most frequently observed heading among common dolphins was to the WSW (Figure 12). Inter-individual spacing (i.e., dispersal) for both common and Risso's dolphins was usually 1-3 body lengths, though spacing was sometimes as much as 12-15 body lengths (Figures 12 and 13). Fin whales were always initially observed traveling either to the east-northeast or the northwest-north, spaced 1-3 body lengths apart (Figure 14). Although the sample size for Pacific white-sided dolphins was small, observations indicate that behavior state and heading varied (Figure 15). This species most frequently exhibited further maximum inter-individual spacing than the other species (Figures 12-15).

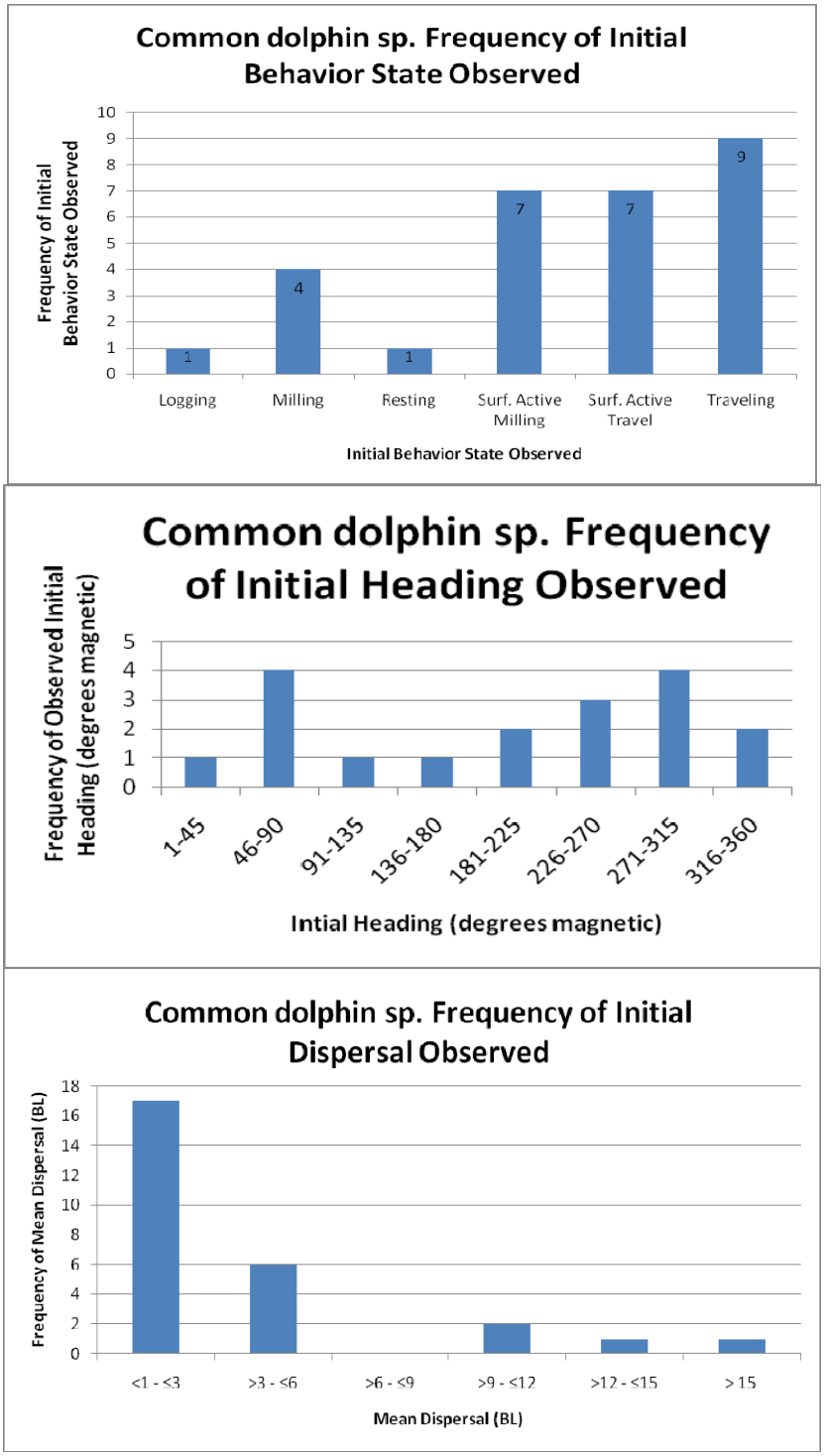
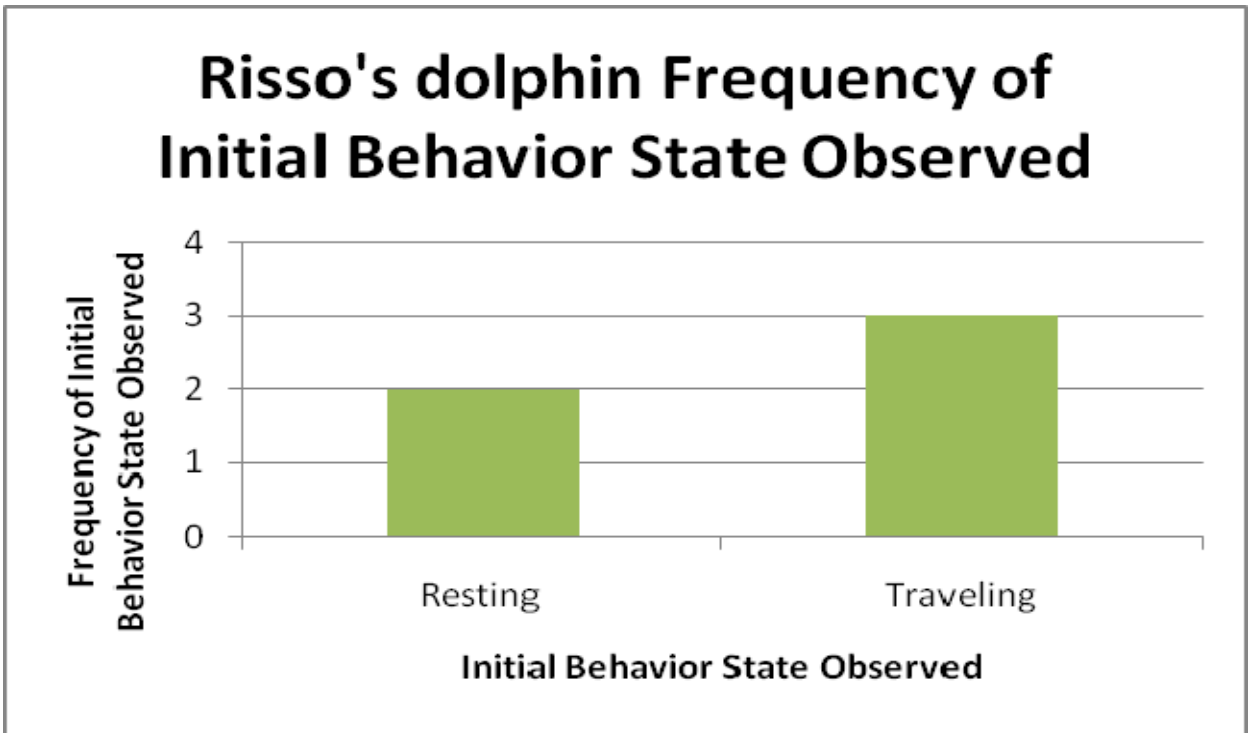


Figure 12. Common dolphins during the November SOCAL 2009 survey periods: Upper panel: frequency of initially observed behavioral states. Middle panel: frequency of initially observed headings (degrees magnetic). Bottom panel: frequency of mean dispersal distance between individuals (in estimated body lengths).



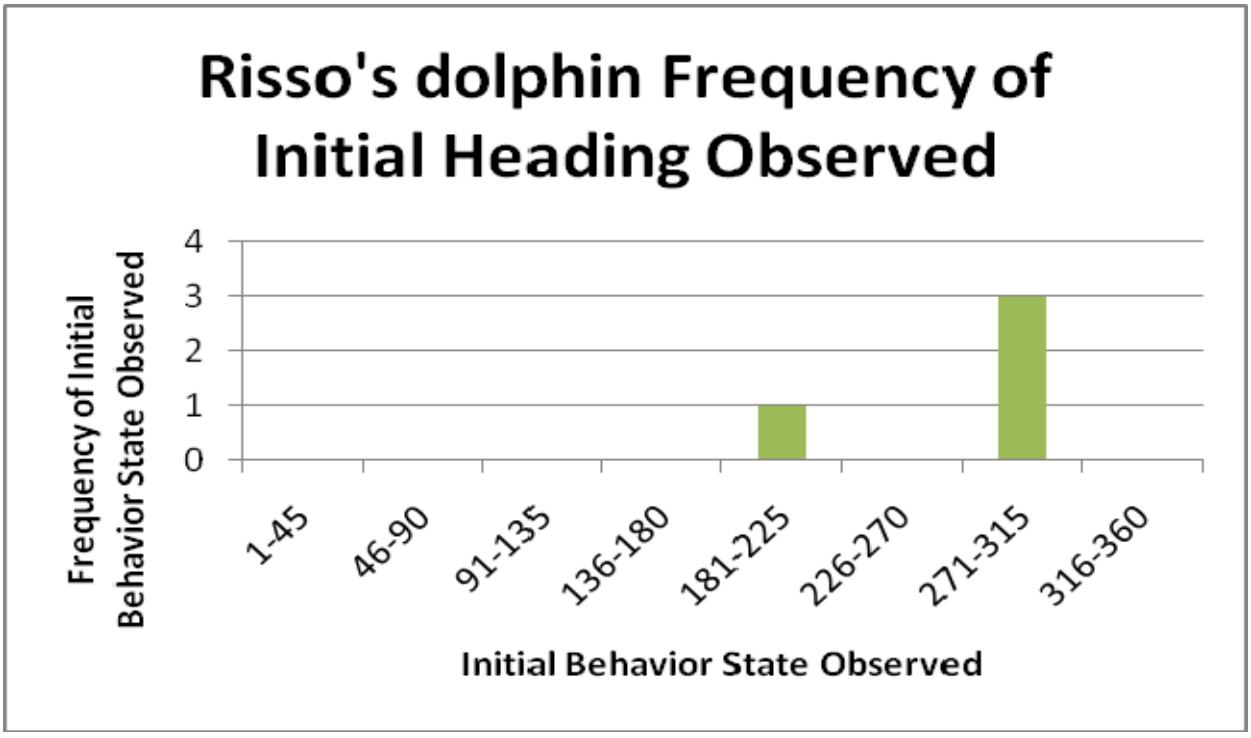


Figure 13. Risso's dolphins during the November SOCAL 2009 survey periods: Upper panel: frequency of initially observed behavioral states. Middle panel: frequency of initially observed headings (degrees magnetic). Bottom panel: frequency of mean dispersal distance between individuals (in estimated body lengths).

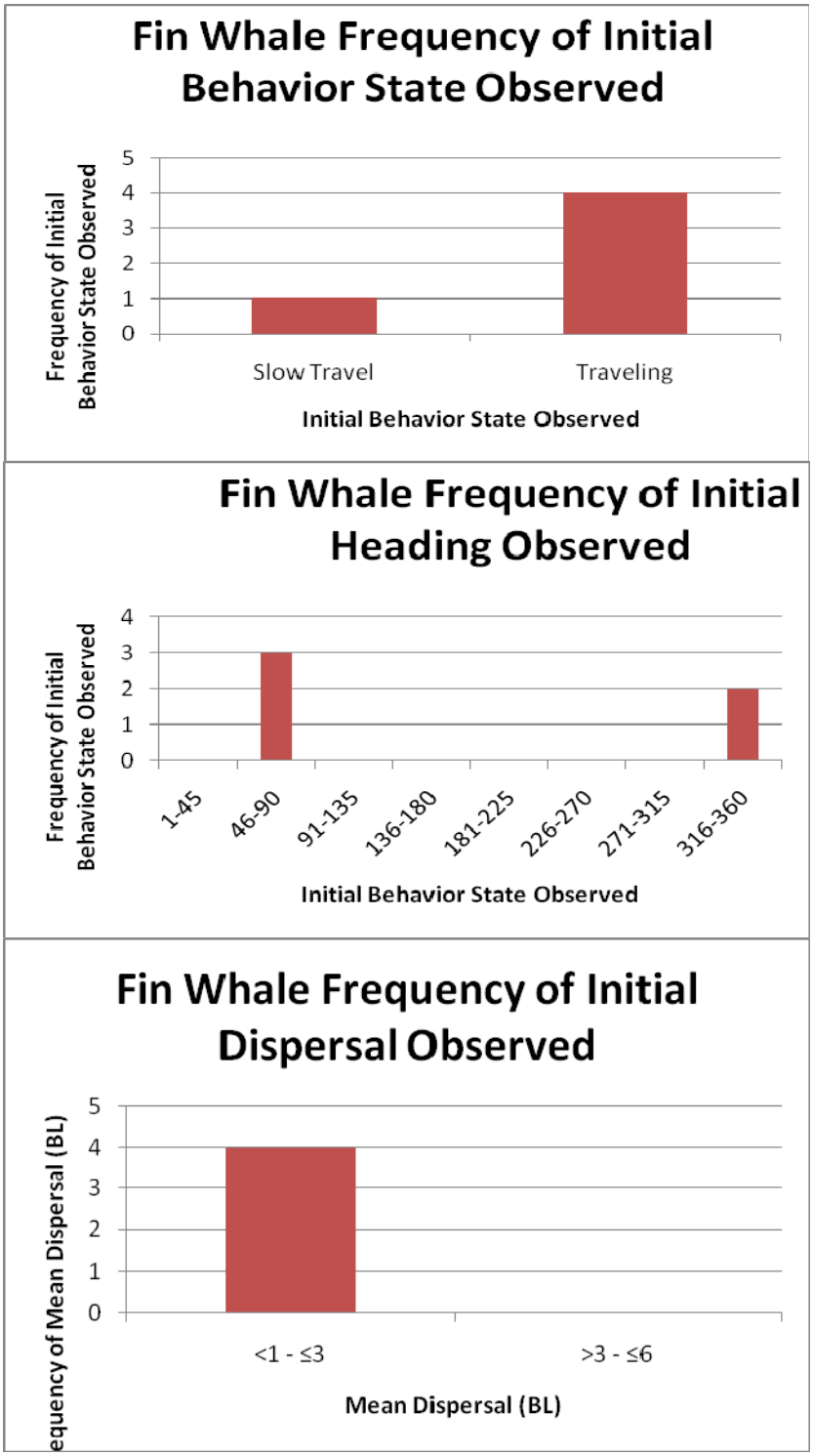


Figure 14. Fin whales during the November SOCAL 2009 survey periods: Upper panel: frequency of initially observed behavioral states. Middle panel: frequency of initially observed headings (degrees magnetic). Bottom panel: frequency of mean dispersal distance between individuals (in estimated body lengths).

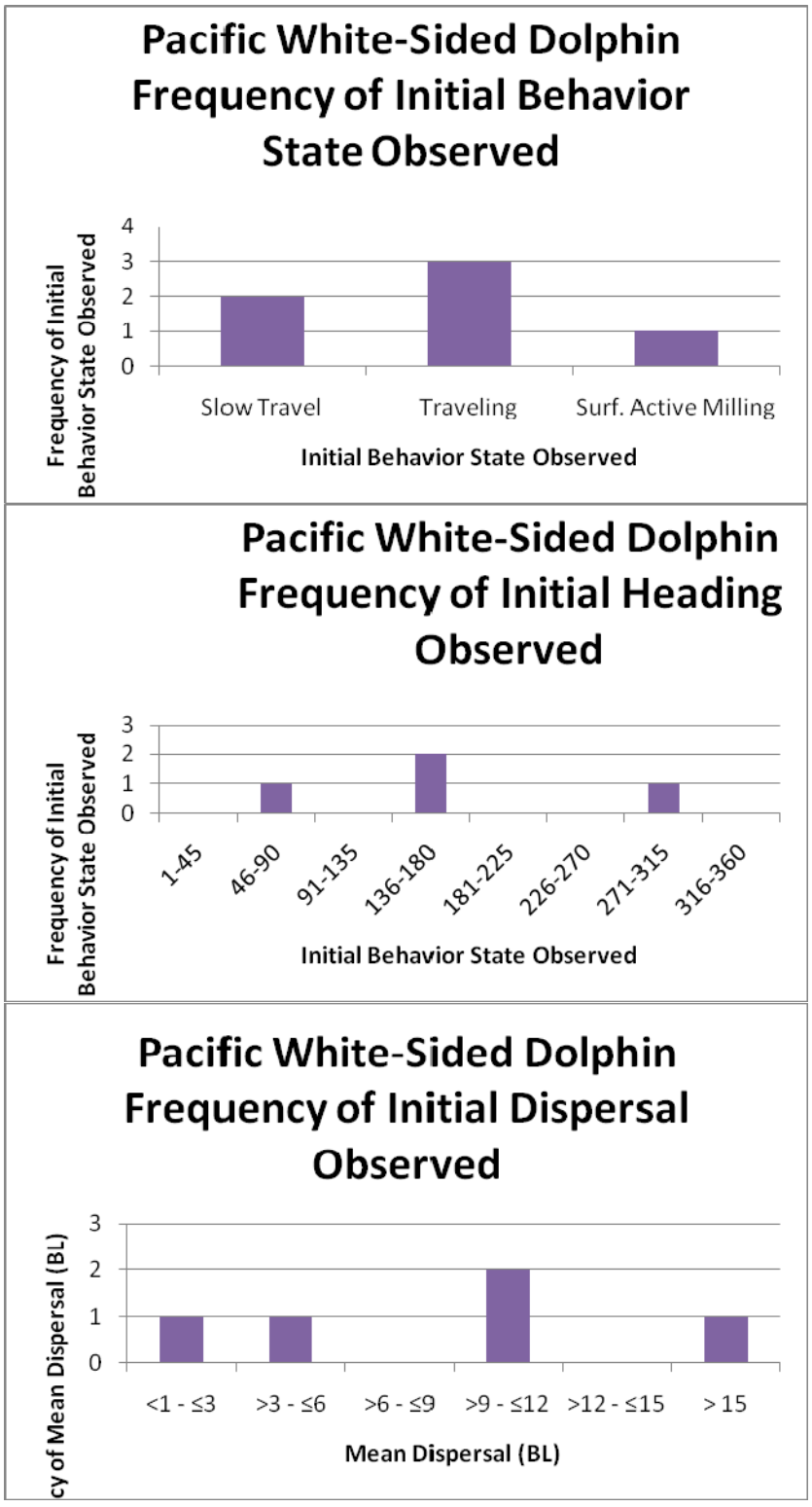


Figure 15. Pacific white-sided dolphins during the November SOCAL 2009 survey periods: Upper panel: frequency of initially observed behavioral states. Middle panel: frequency of initially observed headings (degrees magnetic). Bottom panel: frequency of mean dispersal distance between individuals (in estimated body lengths).

Focal Follows

Approximately 26 (28%) of the 94 sightings were circled for at least 5 min by the aircraft to photo-verify species and make group-size estimates as needed/feasible. Ten of these sightings were circled for 10 to 43 min to conduct "extended focal follows" (>10 min) (defined in Smultea et al. 2009a)(Appendix B). For extended follows altitude was increased to 1200-1500 ft and radial distance maintained as possible at 0.5-1.0 km. The total 10 extended focal follows most frequently involved short-beaked common dolphins (n = 11) or Pacific white-sided dolphins (n = 4). Detailed analyses of focal follow behavioral data (e.g., re-orientation and respiration rates, dive times, etc.) were not conducted given the inability to know MFAS transmission times, the small sample sizes, budget limitations, and goals of the SOW. Detailed analyses of this kind may be undertaken in the future and combined with results herein to provide a larger sample size.

Unusual Observations

Our observations based on aerial survey effort are necessarily limited only to those animals we saw and most of those observations were brief in duration, restricting the ability to make a more informed assessment. However, a few notable behavioral events were recorded.

A distinctly unusual behavior we observed was a minke whale seen on November 21 at 14:10 (Table 3). This single whale was first seen breaching (Appendix C) and continued breaching nearly entirely out of the water repeatedly at a fast travel pace throughout most of the observations as we circled it at an altitude of over 1000 ft and a radial distance of over approximately 0.5 km (well beyond the theoretical Snell's Cone distance and thus outside the estimated underwater hearing distance of the nearby circling plane). None of the experienced (over 50 years of combined observation experience) had seen this type of behavior exhibited by a minke before. Upon later talking with other colleagues, they agreed that this repetitive breaching behavior by a minke was indeed unusual for the SOCAL region. Notably, the minke was seen about 50 min after an unusually rare group of about 55 killer whales (Appendix D) was first seen at 13:58 on the same day, on the same NAOPA survey line; the minke whale was about 50 km east of the killer whale sighting (Figures 8 and 9). It is possible that the minke may have been responding to the killer whales (assuming the killer whales were vocalizing and could be heard at that distance by the minke), as killer whales are known to prey upon large whales.

Other rare/unusual observations occurred on November 21 among the large group of socializing killer whales described above (see Appendix B). Numerous photographs were taken of this group as we followed the whales from the aircraft above 1000 ft altitude from 13:18 until 13:58. Photographs were taken of a juvenile killer whale apparently nursing as the adjacent adult rolled on its side and back. In the same photograph, another juvenile is approaching the apparent nursing pair within less than one body length (see Appendix D). Also, at a different time within this group, an apparent subadult male killer whale swam on its side with an erect penis observable through the water (see Appendix D).

Photography/Videography

Over 2219 digital photos were taken during ~42 (45%) of the total 94 sightings (Table 4). No photos were taken during the remaining 52 sightings because the animals were too far away and/or the sighting was too brief because we did not have time to circle and photograph them due to the priority to complete the survey grid in SOAR relative to fuel limitations.

A total of ~1.3 hr of video was taken during focal follows that was considered useable for behavioral analyses (Table 5). Video included footage of systematic observations of the behavior

of Cuvier's beaked whales, Risso's dolphins, and killer whales, including systematically assessing the behavior of Risso's dolphins relative to the observation aircraft circling overhead for 5 min each at 2000, 1500 and 1000 feet altitude and approximately 1.0 km radial distance.

Aerial Survey Collaboration with Other Researchers

The pre-planning meeting held in San Diego by the Navy was critical in providing the opportunity for the various local researchers to communicate and assist one another. From the meeting, we were able to identify Navy activities and safety protocol, restricted areas during MTEs and other activities, communication protocols and types of communication available, and anticipated weather conditions. Other ongoing research coinciding with the aerial survey period described herein included small-vessel marine mammal research by Cascadia Research Collective and UC San Diego/SIO as well as passive acoustic studies conducted by Navy marine mammal researchers. The meeting provided a venue to meet face-to-face, exchange contact information for field and post-field purposes, and identify ways we could potentially communicate and assist one another in the field. In particular, radio and cell phone communications between the small-vessel researchers deploying from SCI and our aircraft crew allowed us to get on-site local weather conditions that were otherwise unattainable. This was critical in helping us effectively maximize and plan our limited aerial time. For example, when the vessel-based researchers alerted us that SOAR was fogged in, we would wait out the fog rather than waste time flying the approximately 45 min to SOAR to find out it could not be surveyed. We also assisted one another by sharing species sighting locations. For example, we alerted the small-vessel teams when we had priority species sightings including Cuvier's beaked whales and killer whales.

Table 4. Photo log of photographs taken during aerial survey monitoring in the SOCAL November 18 - 23, 2009.

Date	Time	Sighting ID	Species	Focal (Y/N)	Photo Frames
18-Nov	13:51	SOCAL SES_Nov09 001	Fin Whale	N	10-19
18-Nov	13:53	SOCAL SES_Nov09 003	Short-beaked Common Dolphin	N	20-70
18-Nov	14:57	SOCAL SES_Nov09 010	Short-beaked Common Dolphin	N	71-115
18-Nov	15:16	SOCAL SES_Nov09 013	Pacific White-Sided Dolphin	N	116-197
18-Nov	16:09	SOCAL SES_Nov09 015	Short-beaked Common Dolphin	N	198-253
18-Nov	16:27	SOCAL SES_Nov09 016	Short-beaked Common Dolphin	N	254-269
19-Nov	10:59	SOCAL SES_Nov09 021	California Sea Lion	N	271-289
19-Nov	11:12	SOCAL SES_Nov09 022	Cuvier's Beaked Whale	N	290-304
19-Nov	11:21	SOCAL SES_Nov09 023	Pacific White-Sided Dolphin	Y	306-350
19-Nov	12:46	SOCAL SES_Nov09 028	Long-beaked Common Dolphin	N	352-412
19-Nov	13:07	SOCAL SES_Nov09 030	Short-beaked Common Dolphin	Y	413-497, 531-544
19-Nov	13:13	SOCAL SES_Nov09 032	California Sea Lion	N	499-530
19-Nov	13:27	SOCAL SES_Nov09 033	Short-beaked Common Dolphin	Y	545-566
19-Nov	13:35	SOCAL SES_Nov09 034	Short-beaked Common Dolphin	Y	567-612
19-Nov	14:01	SOCAL SES_Nov09 036	Short-beaked Common Dolphin	N	613-656
20-Nov	12:32	SOCAL SES_Nov09 040	Short-beaked Common Dolphin	N	657-699
20-Nov	13:58	SOCAL SES_Nov09 041	Short-beaked Common Dolphin	N	700-744
21-Nov	10:02	SOCAL SES_Nov09 046	Short-beaked Common Dolphin	Y	745-789
21-Nov	10:11	SOCAL SES_Nov09 047	Short-beaked Common Dolphin	N	790-798
21-Nov	13:18	SOCAL SES_Nov09 054	Killer Whale	Y	799-1048
21-Nov	14:10	SOCAL SES_Nov09 055	Minke whale	Y	1049-1100
22-Nov	9:26	SOCAL SES_Nov09 059	Short-beaked Common Dolphin	Y	1102-1133
22-Nov	9:45	SOCAL SES_Nov09 060	Fin Whale	Y	1134-1175
22-Nov	9:59	SOCAL SES_Nov09 061	Fin Whale	Y	1176-1229
22-Nov	10:18	SOCAL SES_Nov09 063	Short-beaked Common Dolphin	Y	1230-1312
22-Nov	12:12	SOCAL SES_Nov09 065	Short-beaked Common Dolphin	Y	1314-1389
22-Nov	12:37	SOCAL SES_Nov09 066	Common Dolphin sp.	N	1391-1431
23-Nov	8:25	SOCAL SES_Nov09 072	Common Dolphin sp.	N	1432-1473
23-Nov	8:46	SOCAL SES_Nov09 073	Killer Whale	Y	1474-1641
23-Nov	10:15	SOCAL SES_Nov09 075	Cuvier's Beaked Whale	Y	1642-1751
23-Nov	11:08	SOCAL SES_Nov09 077	Short-beaked Common Dolphin	N	1752-1810
23-Nov	11:18	SOCAL SES_Nov09 080	California Sea Lion	N	1811-1868
23-Nov	11:21	SOCAL SES_Nov09 082	California Sea Lion	N	1869-1902
23-Nov	11:26	SOCAL SES_Nov09 083	Short-beaked Common Dolphin	N	1903-1938
23-Nov	11:37	SOCAL SES_Nov09 084	Common Dolphin sp.	Y	1939-1960
23-Nov	14:13	SOCAL SES_Nov09 087	Pacific White-Sided Dolphin	N	1961-1975
23-Nov	14:23	SOCAL SES_Nov09 088	Short-beaked Common Dolphin	Y	1976-1990
23-Nov	14:33	SOCAL SES_Nov09 089	Pacific White-Sided Dolphin	Y	1991-2048
23-Nov	14:52	SOCAL SES_Nov09 090	Risso's Dolphin	Y	2049-2140
23-Nov	14:53	SOCAL SES_Nov09 091	Risso's Dolphin	N	2141-2153
23-Nov	15:31	SOCAL SES_Nov09 092	Pacific White-Sided Dolphin	N	2154-2197
23-Nov	15:59	SOCAL SES_Nov09 093	Pacific White-Sided Dolphin	Y	2198-2219

Table 6. Video log of usable video taken during aerial survey monitoring in the SOCAL November 18 - 23, 2009.

Date	Start Time	End Time	Total Video (hr::min:sec)	Sighting ID	Species	Video Notes
19-Nov	11:14:15	11:15:40	0:01:25	SOCAL SES_Nov09 022	Cuvier's beaked whale	Limited usable video, animals not at surface during recording
19-Nov	11:59:33	12:21:44	0:22:11	SOCAL SES_Nov09 027	Risso's dolphin	Usable video, able to decipher body dispersal and basic behavior
19-Nov	12:22:21	12:43:20	0:20:59	SOCAL SES_Nov09 027	Risso's dolphin	Useable video, able to decipher body dispersal, sub groups and basic behavior
21-Nov	13:24:56	13:25:51	0:00:55	SOCAL SES_Nov09 054	Killer whale	Useable video, relative glare blocks view for a portion of the video, able to decipher body dispersal, sub groups and basic behavior
21-Nov	13:25:54	13:48:31	0:22:37	SOCAL SES_Nov09 054	Killer whale	Useable video, no glare, able to decipher body dispersal, sub groups and basic behavior, zoomed in and clear for much of the video.
21-Nov	13:25:54	13:35:04	0:09:10	SOCAL SES_Nov09 054	Killer whale	Useable video, limited glare, able to decipher body dispersal, sub groups and basic behavior and surface-active behavior, possible reaction.
			Total = 1.3 Hours			

Section 4 Discussion

Key Role of Aerial Surveys

Survey results provide further support of the key and unique roles that aerial surveys play in addressing Navy monitoring plan goals (see review in Smultea et al. 2009a,b). These include:

- providing the advantage of surveying key Navy areas of interest (e.g., areas W and E of SCI) within one day, providing a "snapshot" of marine mammal numbers, presence, distribution and behavior before, during and after MTEs,
- collecting quantifiable behavioral data known to be indices of stress/disturbance,
- conducting focal follows of priority cetacean species including video-documentation of underwater behavior,
- providing a platform from which the behavior and potential reactions of cetaceans to MTEs may be studied without confounding results (vs. from vessels), and
- locating and identifying dead floating and stranded animals.

Section 5 Recommendations

A comprehensive list of recommendations to improve data collection techniques, analyses, interpretations, and applications was provided in the SOCAL 2008 and 2009 aerial survey reports (Smultea et al. 2009a,b). Below are a few recommendations in addition to those.

1. Sighting data from 2008 and 2009 SOCAL aerial surveys should be preliminarily analyzed using free DISTANCE software (Buckland et al. 2001) to ascertain whether existing samples sizes are sufficiently large to calculate reasonable abundance and density estimates for some marine mammal species. This requires additional data analysis and preparation beyond the scope of this study. This is important to assess whether changes in abundance can be statistically linked to before, during and after MFAS activity periods. Additional DISTANCE analyses can be conducted if preliminary results are promising.
2. Preliminary and follow-up statistical analyses of behavioral indices successfully collected and summarized herein should be analyzed using a behavioral analysis program. These data could be analyzed in excel using summary and other statistics. This analysis was beyond the scope of our study. Such information is important to statistically identify minimum sample sizes required to identify statistically significant changes in attributes that could be related to MFAS activities, in consultation with a professional statistician.
3. Video of behavioral data collected during this study should be analyzed using Noldus video analysis software (www.noldus.com) or other video analysis software. Analysis of video data is typically a tedious and time-consuming process. However, Noldus has developed video data analysis software that increases analysis efficiency and helps to standardize the process. Such results provide the most detailed and accurate method for objectively quantifying measurable behavioral data (e.g., inter-animal dispersal distances, respiration rates, relative changes in orientation, frequency of behaviors, etc.) because videotape can be re-reviewed, etc. The most effective approach is to combine the video data with a recorded vocal narration of behavior, notes taken using a behavioral software program, e.g., BioSpectator Go, and/or handwritten notes on forms, all of which we did during the study. This approach has been successfully used to quantify and identify subtle and other significant changes in measurable behavioral variables of bowhead, gray and humpback whales, that in turn were statistically shown to be influenced by anthropogenic underwater sound and other stimuli (reviewed in Richardson et al. 1995). However, the above analyses were beyond the scope of the current study.
4. Formal Pre-Planning Meetings should continue to be conducted and attended by all key research and Navy representatives involved with the aerial surveys as well as other entities conducting research in the same areas. This allows coordinating and maximizing the ability of various simultaneously operating platforms to collect data useful to assess potential effects of Navy training activities on marine mammals. This helps to reduce data-collection costs through multi-use of platforms. It also increases efficiency and safety of field operations and provides the opportunity for team building, data sharing, and collaboration.

5. A formal post-field Information Transfer Meeting should be held ~2-3 months after the fiscal monitoring year has been completed. This allows the various researchers and Navy representatives to share data and techniques, to identify additional future collaborative efforts, and to build relationships between researchers and Navy representatives involved in the activities. This could include Navy personnel explaining the challenges faced when trying to coordinate and obtain approval for the monitoring research, and identifying ways in which researchers can assist in this process. It also gives both research and Navy representatives the opportunity to question one another about results and goals, and to identify ways to improve and smooth related endeavors, and to assist one another in data collection and meeting study goals.
6. Sighting rates for each species and leg type and overall sighting rates for marine mammals in general for aerial survey effort will be discussed in the May 2010 aerial survey report.

Section 6 Acknowledgements

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Appendix A List of All November 2009 Sightings

Appendix A. 18-23 November 2009: Summary of all individual marine mammal sightings, including location latitudes and longitudes, made during the SOCAL 2009 aerial monitoring surveys off San Diego, California.

Date 2009	Estim. Group Size	Species Common Name	Species Scientific Name	Initial time	Latitude °N	Longitude °W
18-Nov	2	Fin Whale	*Balaenoptera physalus*	13:51:04	32.68913	117.44074
18-Nov	1	California Sea Lion	*Zalophus californianus*	13:53:32	32.67002	117.44039
18-Nov	700	Short-beaked Common Dolphin	*Delphinus delphis*	13:53:50	32.66984	117.42958
18-Nov	2	California Sea Lion	*Zalophus californianus*	13:57:21	32.66727	117.44552
18-Nov	1	California Sea Lion	*Zalophus californianus*	14:10:54	32.65277	117.62013
18-Nov	1	California Sea Lion	*Zalophus californianus*	14:11:48	32.64681	117.64692
18-Nov	3	California Sea Lion	*Zalophus californianus*	14:27:28	32.68284	117.99215
18-Nov	1	California Sea Lion	*Zalophus californianus*	14:36:10	32.71965	117.80952
18-Nov	1	California Sea Lion	*Zalophus californianus*	14:50:27	32.87171	117.38854
18-Nov	2200	Short-beaked Common Dolphin	*Delphinus delphis*	14:57:13	32.91285	117.45735
18-Nov	1	California Sea Lion	*Zalophus californianus*	15:09:36	32.88289	117.59560
18-Nov	1	California Sea Lion	*Zalophus californianus*	15:09:36	32.88289	117.59560
18-Nov	4	Pacific White-Sided Dolphin	*Lagenorhynchus obliquidens*	15:16:58	32.82819	117.83760
18-Nov	1	California Sea Lion	*Zalophus californianus*	15:55:36	32.91363	118.07924
18-Nov	100	Short-beaked Common Dolphin	*Delphinus delphis*	16:09:28	33.00604	117.62626
18-Nov	15	Short-beaked Common Dolphin	*Delphinus delphis*	16:27:28	33.15057	117.52497
18-Nov	1	Unknown Small Marine Mammal	Cetacea or Pinnipedia	16:33:54	33.13287	117.59280
18-Nov	44	Unknown Small Dolphin	Delphinidae sp.	16:49:20	33.09864	117.61693
19-Nov	1	Unknown Small Dolphin	Delphinidae sp.	10:49:22	33.01333	118.13102
19-Nov	3	California Sea Lion	*Zalophus californianus*	10:50:37	33.01181	118.16543
19-Nov	3	California Sea Lion	*Zalophus californianus*	10:59:28	33.00926	118.15465
19-Nov	1	Cuvier's Beaked Whale	*Ziphius cavirostris*	11:12:05	33.05897	118.48570
19-Nov	9	Pacific White-Sided Dolphin	*Lagenorhynchus obliquidens*	11:21:12	33.07514	118.43829
19-Nov	1	California Sea Lion	*Zalophus californianus*	11:27:44	33.07574	118.40604
19-Nov	1	California Sea Lion	*Zalophus californianus*	11:56:06	33.30809	117.62477
19-Nov	1	California Sea Lion	*Zalophus californianus*	11:56:43	33.32059	117.63944
19-Nov	38	Risso's Dolphin	*Grampus griseus*	11:56:57	33.32366	117.64320
19-Nov	50	Long-beaked Common Dolphin	*Delphinus capensis*	12:46:19	33.37649	117.64842
19-Nov	3	California Sea Lion	*Zalophus californianus*	13:07:11	33.26698	118.19724
19-Nov	1250	Short-beaked Common Dolphin	*Delphinus delphis*	13:07:42	33.26326	118.21339
19-Nov	5	California Sea Lion	*Zalophus californianus*	13:09:49	33.25728	118.22596
19-Nov	48	California Sea Lion	*Zalophus californianus*	13:13:33	33.26036	118.22353

Date 2009	Estim. Group Size	Species Common Name	Species Scientific Name	Initial time	Latitude ˚N	Longitude ˚W
19-Nov	150	Short-beaked Common Dolphin	*Delphinus delphis*	13:27:51	33.24113	118.31784
19-Nov	225	Short-beaked Common Dolphin	*Delphinus delphis*	13:35:49	33.22538	118.39483
19-Nov	209	Common Dolphin sp.	*Delphinus* sp.	13:48:31	33.14809	118.54843
19-Nov	500	Short-beaked Common Dolphin	*Delphinus delphis*	14:01:42	33.08187	118.08963
20-Nov	2	Unknown Dolphin	Delphinidae sp.	10:51:47	32.85782	117.27065
20-Nov	1	Unknown Medium Whale	Cetacea	11:40:45	33.04281	119.10160
20-Nov	150	Common Dolphin sp.	*Delphinus* sp.	12:23:11	33.12370	118.82376
20-Nov	150	Short-beaked Common Dolphin	*Delphinus delphis*	12:32:17	33.15428	118.73392
20-Nov	75	Short-beaked Common Dolphin	*Delphinus delphis*	13:58:45	32.74472	118.76582
20-Nov	150	Unknown Dolphin	Delphinidae sp.	13:59:55	32.76465	118.74965
20-Nov	1	Unknown Pinniped	Pinnipedia	14:36:56	32.68159	118.00736
20-Nov	1	Unknown Marine Mammal	Cetacea or Pinnipedia	14:37:44	32.68712	117.98355
20-Nov	6	California Sea Lion	*Zalophus californianus*	14:55:12	32.81191	117.37985
21-Nov	800	Short-beaked Common Dolphin	*Delphinus delphis*	10:02:45	32.92006	117.59237
21-Nov	16	Short-beaked Common Dolphin	*Delphinus delphis*	10:11:46	32.95104	117.69774
21-Nov	1	California Sea Lion	*Zalophus californianus*	12:33:42	32.96914	118.58096
21-Nov	1	California Sea Lion	*Zalophus californianus*	12:38:30	33.02688	118.55594
21-Nov	4	Bottlenose Dolphin	*Tursiops truncatus*	12:40:23	32.98140	118.52742
21-Nov	4	California Sea Lion	*Zalophus californianus*	12:42:49	32.92923	118.47136
21-Nov	1	California Sea Lion	*Zalophus californianus*	12:44:50	32.88396	118.41644
21-Nov	1	California Sea Lion	*Zalophus californianus*	12:46:04	32.86141	118.38637
21-Nov	55	Killer Whale	*Orcinus orca*	13:18:29	33.01147	118.13367
21-Nov	1	Minke whale	*Balaenoptera acutorostrata*	14:10:48	33.12108	117.63501
21-Nov	45	Risso's Dolphin	*Grampus griseus*	14:21:55	32.99077	117.43195
21-Nov	15	Unknown Dolphin	Delphinidae sp.	14:28:14	32.85645	117.27518
22-Nov	2	Unknown Dolphin	Delphinidae sp.	9:07:57	32.86910	117.29496
22-Nov	1150	Short-beaked Common Dolphin	*Delphinus delphis*	9:26:13	33.01536	117.96945
22-Nov	2	Fin Whale	*Balaenoptera physalus*	9:45:14	33.11754	118.58091
22-Nov	2	Fin Whale	*Balaenoptera physalus*	9:59:51	33.15439	118.88303
22-Nov	900	Common Dolphin sp.	*Delphinus* sp.	10:17:20	33.08472	119.01415
22-Nov	1300	Short-beaked Common Dolphin	*Delphinus delphis*	10:18:53	33.06281	119.05640
22-Nov	1	Unknown Large Whale	Cetacea	10:29:09	32.97671	119.21522
22-Nov	175	Short-beaked Common Dolphin	*Delphinus delphis*	12:12:28	32.80048	118.76859
22-Nov	80	Common Dolphin sp.	*Delphinus* sp.	12:37:36	32.83863	118.60928
22-Nov	9	Risso's Dolphin	*Grampus griseus*	13:09:11	32.77275	117.96823
22-Nov	850	Common Dolphin sp.	*Delphinus* sp.	13:14:40	32.79440	117.73471

Date 2009	Estim. Group Size	Species Common Name	Species Scientific Name	Initial time	Latitude ˚N	Longitude ˚W
22-Nov	1	Unknown Dolphin	Delphinidae sp.	13:24:15	32.83645	117.33218
23-Nov	1	Unknown Pinniped	Pinnipedia	7:59:56	32.87120	117.31362
23-Nov	2	Fin Whale	*Balaenoptera physalus*	8:12:06	32.97615	117.78029
23-Nov	25	Common Dolphin sp.	*Delphinus* sp.	8:25:38	33.06319	118.33086
23-Nov	12	Killer Whale	*Orcinus orca*	8:46:32	33.08380	119.02205
23-Nov	1	Unknown Pinniped	Pinnipedia	10:13:14	32.84582	119.04101
23-Nov	5	Cuvier's Beaked Whale	*Ziphius cavirostris*	10:15:44	32.88215	118.97244
23-Nov	1	Fin Whale	*Balaenoptera physalus*	10:56:51	33.02622	118.72665
23-Nov	50	Short-beaked Common Dolphin	*Delphinus delphis*	11:08:21	33.25804	118.47327
23-Nov	3	Long-beaked Common Dolphin	*Delphinus capensis*	11:16:14	33.29372	118.31627
23-Nov	3	California Sea Lion	*Zalophus californianus*	11:16:14	33.29372	118.31627
23-Nov	5	California Sea Lion	*Zalophus californianus*	11:18:47	33.28388	118.27686
23-Nov	1	California Sea Lion	*Zalophus californianus*	11:20:38	33.28070	118.25271
23-Nov	26	California Sea Lion	*Zalophus californianus*	11:21:01	33.27875	118.24051
23-Nov	800	Short-beaked Common Dolphin	*Delphinus delphis*	11:26:51	33.27671	118.15614
23-Nov	11	Common Dolphin sp.	*Delphinus* sp.	11:37:01	33.25588	117.90258
23-Nov	6	Unknown Dolphin	Delphinidae sp.	12:05:18	32.86544	117.30841
23-Nov	1	Unknown Pinniped	Pinnipedia	12:05:59	32.85934	117.28662
23-Nov	20	Pacific White-Sided Dolphin	*Lagenorhynchus obliquidens*	14:13:03	32.92111	117.29726
23-Nov	10	Short-beaked Common Dolphin	*Delphinus delphis*	14:23:08	33.06743	117.35761
23-Nov	35	Pacific White-Sided Dolphin	*Lagenorhynchus obliquidens*	14:33:50	33.18030	117.45937
23-Nov	65	Risso's Dolphin	*Grampus griseus*	14:52:00	33.44473	117.76702
23-Nov	10	Risso's Dolphin	*Grampus griseus*	14:53:55	33.47875	117.77623
23-Nov	200	Pacific White-Sided Dolphin	*Lagenorhynchus obliquidens*	15:31:33	33.25700	117.63232
23-Nov	6	Pacific White-Sided Dolphin	*Lagenorhynchus obliquidens*	15:59:52	32.92333	117.30729
23-Nov	1	Unknown Dolphin	Delphinidae sp.	16:08:16	32.87046	117.27654

Appendix B List of All November 2009 Focal Observations

Appendix B. 18-23 November 2009: Summary of all focal observations (total observation time at least 5 min long), including location (latitude/ and longitude) made during the SOCAL 2009 aerial monitoring surveys off San Diego, California.

Date	Initial Time	Total Observation Time (hh:mm:ss)	Latitude°	Longitude°	Species	Estimated Group Size	Initial Behavior State	Sighting Notes
18-Nov	13:53:50	0:10:10	32.66984	117.4296	Short-beaked common dolphin	700	Surface-Active Milling	
18-Nov	15:16:58	0:18:40	32.82819	117.8376	Pacific white-sided dolphin	4	Travel	
18-Nov	16:09:28	0:05:25	33.00604	117.6263	Short-beaked common dolphin	100	Travel	
18-Nov	16:27:28	0:05:09	33.15057	117.525	Short-beaked common dolphin	15	Milling	possible feeding, bird associated
19-Nov	11:21:12	0:06:17	33.07514	118.4383	Pacific white-Sided dolphin	9	Travel	possible feeding
19-Nov	11:56:57	0:43:00	7:46:04	117.6432	Risso's dolphin	38	Resting	Conducted focal observation at1500 ft , boat approached, possible reaction, subgroups joined then separated after boat left
19-Nov	13:07:42	0:18:48	33.26326	118.2134	Short-beaked common dolphin	1250	Surface- Active Travel	
19-Nov	13:27:51	0:06:38	33.24113	118.3178	Short-beaked common dolphin	150	Milling	
19-Nov	13:35:49	0:05:16	33.22538	118.3948	Short-beaked common dolphin	225	Surface- Active Travel	
20-Nov	11:40:45	0:25:27	33.04281	119.1016	Unidentified medium whale	1	Resting	Logging at surface
21-Nov	10:02:45	0:07:46	32.92006	117.5924	Short-beaked common dolphin	800	Travel	
21-Nov	13:18:29	0:39:47	33.01147	118.1337	Killer whale	55	Travel	Closed saddles, likely transients, nursing, male with erect penis photographed (apparent subadult); no large adult males observed
21-Nov	14:10:48	0:05:38	33.12108	117.635	Minke whale	1	Surface-Active Travel	Breaching when first observed, continued repetitive breaching
22-Nov	9:26:13	0:07:25	33.01536	117.9695	Short-beaked common dolphin	1150	Surface- Active Milling	Bird association, group spread over 8 km, dolphins tight

Date	Initial Time	Total Observation Time (hh:mm:ss)	Latitude°	Longitude°	Species	Estimated Group Size	Initial Behavior State	Sighting Notes
								circling
22-Nov	9:45:14	0:08:02	33.11754	118.5809	Fin whale	2	Slow Travel	
22-Nov	9:59:51	0:11:46	33.15439	118.883	Fin whale	2	Travel	
22-Nov	10:18:53	0:05:34	33.06281	119.0564	Short-beaked common dolphin	1300	Travel	
22-Nov	10:29:09	0:07:00	32.97671	119.2152	Unidentified large whale	1	Other	Unable to observe in close range due to restricted airspace area
23-Nov	8:46:32	0:34:36	33.0838	119.0221	Killer whale	12	Traveling	
23-Nov	10:15:44	0:33:03	32.88215	118.9724	Cuvier's beaked whale	5	Logging	Long skinny, white bodies observed. Brought aircraft up to 1500 ft altitude for focal observation, body length approx. 15 to 20 ft
23-Nov	11:37:01	0:07:26	33.25588	117.9026	Common dolphin sp.	11	Milling	With birds and seaweed
23-Nov	14:23:08	0:05:49	33.06743	117.3576	Short-beaked common dolphin	10	Travel	Bird association, group stayed below surface
23-Nov	14:33:50	0:05:01	33.1803	117.4594	Pacific white-Sided dolphin	35	Surface-active Travel	Bird association, possible feeding
23-Nov	14:52:00	0:29:03	33.44473	117.767	Risso's dolphin	65	Travel	Two subgroups.
23-Nov	15:59:52	0:07:25	32.92333	117.3073	Pacific white-Sided dolphin	6	Travel	

Appendix C Minke Whale Photos

Minke whale (Balaenoptera acutorostrata) breach sequence as observed from the aircraft on November 21 using a telephoto lens during the November 2009 SOCAL marine mammal monitoring survey off San Diego, California, demonstrating the ability to observe cetaceans and behavior sub-surface during an aerial survey. Photos by Mark Deakos courtesy of Smultea Environmental Sciences.

Appendix D Killer Whale Photos

Below are photos from a rare (for southern California) sighting of killer whales (Orcinus orca) observed on November 21 from the aircraft during the November 2009 SOCAL marine mammal monitoring survey off San Diego, California (see Appendix B). Photographs were taken (with a telephoto lens) of a calf apparently nursing from an adjacent adult lying on its side underwater while another juvenile approached the pair (right photo below). A subadult male with an erect penis was also photographed as it approached another individual from the rear to within 0.25 body length (third photo below). Photos by Mark Deakos courtesy of Smultea Environmental Sciences.

Aerial Survey Marine Mammal Monitoring off Southern California in Conjunction with US Navy Major Training Events (MTE)

SOCAL May 13-18, 2010

Draft Report

Authors:

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SES SMULTEA ENVIRONMENTAL SCIENCES, LLC

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Cover Photos: Blue whale (Balaenoptera musculus), common dolphins (Delphinus sp.) and Pacific white-sided dolphins (Lagenorhynchus obliquidens) photographed with a telephoto lens from the Partenavia fixed-wing aircraft during the May 2010 SOCAL aerial monitoring survey. Photos by Mari A. Smultea/SES. Cover page design and layout by Kate Lomac-MacNair and Roxann Merizan.

Section 1 Introduction

In support of the U.S. Navy's (Navy) Marine Mammal Monitoring Plan (M3P) in the Southern California Range Complex (SOCAL) (DoN 2009), aerial surveys were conducted by Smultea Environmental Sciences (SES) to monitor marine mammals and sea turtles (MM/ST) during May 2010 in the SOCAL area off San Diego, California. This was the sixth such aerial survey in SOCAL conducted by SES or SES/Marine Mammal Research Consultants (MMRC). Monitoring occurred before, during, after and in conjunction with several Navy Major Training Events (MTEs) involving mid-frequency-active sonar (MFAS). Portions of these MTEs occurred in and near offshore waters of the Southern California Anti-submarine Warfare Range (SOAR) west of San Clemente Island (Figure 1). Naval training has been conducted within SOCAL for over 40 years, and marine mammals are also known to be abundant there (e.g., summarized in Carretta et al. 2000, 2008; DoN 2008, 2009).

The contracted work involved considerable planning and communications with and by the Navy Technical Representative (NTR) given the logistical complexity of the MTEs, the need to coordinate multiple Navy aircraft and vessel activities, and the high degree of safety planning. Clearance from various Navy commands was obtained by Navy environmental planners on behalf of SES prior to the research aircraft flying in the SOCAL. Aerial surveys were also coordinated with other marine mammal researchers conducting passive acoustics, tagging, photo-identification, and behavioral studies from small vessels in the SOCAL, some of which were funded by the Office of Naval Research (ONR) and N45 funds (e.g., the Naval Undersea Warfare Center [NUWC], Scripps Institute of Oceanography [SIO], and Cascadia Research Collective [CRC]) (e.g., see Falcone et al. 2009a,b). This served to identify ways researchers could collaborate and assist one another in obtaining complimentary data.

Project questions and hypotheses were developed by SES based on the five questions identified in the Navy's SOCAL M3P designed to assess potential effects of MFAS and underwater detonations on MM/ST during Navy MTEs (DoN 2009; see Smultea et al. 2009a,b). An important factor limiting the ability to assess potential effects of MFAS in this report is that the Navy did not disclose MFAS transmission times and locations for national security reasons. Thus, it is not possible for us herein to compare data from specific operational MFAS "on" and "off" periods during MTEs, nor data on distance and relative location of MFAS sources vs. sightings.

Protocol was similar to that implemented for aerial surveys in SOCAL in summer and fall 2009 designed to obtain baseline data and monitor for potential effects of MTEs on marine mammals (see Smultea et al. 2009a,b, Smultea and Lomac-MacNair 2010). However, to address growing interest by NMFS and the NTR the May 2010 survey effort focused more on collecting behavioral data using focal follow techniques by circling sightings for extended periods and obtaining video (see Methods below).

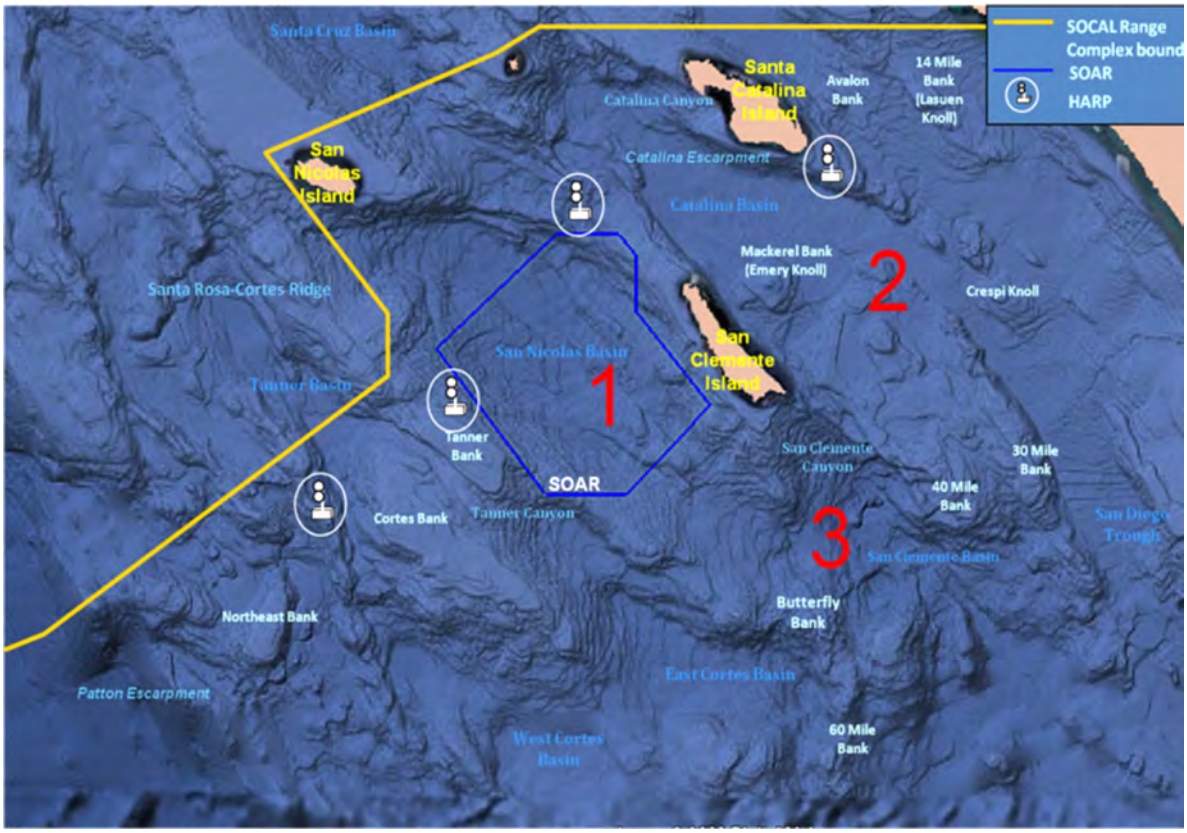


Figure 1. Location of the aerial survey monitoring area and underwater topographic features within the Navy's Southern California Range Complex (SOCAL). Numbers indicate survey areas of interest to the Navy in order of priority; orange line designates the SOCAL boundary; blue lines designate the Southern California Offshore Anti-submarine Warfare Range (SOAR); icons are approximate locations of Navy-funded bottom-mounted passive- acoustic high-frequency acoustic recording packages (HARPs).

Section 2 Methods

The approach implemented to address SOCAL M3P requirements was to conduct surveys to monitor the occurrence and behavior of MM/ST from a small fixed-wing aircraft in the SOCAL relative to MFAS transmission periods. The primary survey areas were SOAR west of San Clemente Island (SCI) and the Northern Air Operating Area (NAOPA) range between SCI and the mainland coast (Figure 1). This involved implementing "search", "verify", and "focal follow" modes as described in Smultea et al. (2009a,b). Notably, sea turtles were considered unlikely to be seen in the MTE based on available data and none have been seen during this or our past aerial surveys (reviewed in DoN 2008).

As described in Smultea et al. (2009a), priority species were (1) MM/ST exhibiting unusual or distressed behavior, (2) near-stranded, stranded, or dead MM/ST, (3) MM/ST species listed as endangered or threatened under the ESA, (4) beaked whales, and (5) Risso's dolphins, dwarf/pygmy sperm whales, and other deep-diving odontocetes considered potential "surrogate" representatives for deep-diving beaked whales (see DoN 2009).

A Partenavia P68, twin-engine, fixed-wing aircraft was used for the May 2010 survey. Line-transect "search" effort occurred at altitude 1000 ft and speed 100 kt; occasionally, we flew as low as 700 ft altitude (as permitted by a Letter of Confirmation and General Authorization for Scientific Research issued by NMFS to SES) over non-ESA-listed species to photo-verify species (i.e., "verify" mode), or when low clouds necessitated lower flight altitude. Altitudes of 1200-1500 ft were flown while circling sightings to obtain behavioral data in "focal follow" mode (see Smultea et al. 2009a,b). As in past surveys, we used two Apple iTouches for field data collection (one for line-transect and one for focal behavior data). The recently released Apple iPad was tried the first survey day; however, technical limitations related to software interfacing of this new system quickly became apparent. Expected software revisions are anticipated to allow future use of the iPad.

Section 3 Results

This section closely follows the format of the summer and fall 2009 SOCAL aerial survey monitoring reports (Smultea et al. 2009a,b). Results are summarized in Tables 1 through 5 and Figures 2 through 9. More detailed results are provided in Appendices A through D.

Effort

A total of 28.40 hr of flight time and 4,891 km (2641 nm) of flight effort were conducted during the May 2010 SOCAL aerial survey between aircraft "wheels up" off the ground to "wheels down" when the plane landed (Table 10 and Table 11). Surveys were flown every day from May 13 through May 18 for a total of five flight days. Most (43%) of the total 4,891 km of observation effort involved circling sightings for focal follows and/or species identification. This was followed by systematic line-transect (26%), transit (21%), random effort (8%), and island circumnavigation (2%) (Table 11). Beaufort sea state rating (Bf) ranged from 1-4 during the May survey. Bf 3 predominated (52%) followed by Bf 2 (36%) (Figure 11). Effort occurred in FLETA HOT only on May 15, as requested by the NTR; surveys in FLETA HOT had not been conducted since the November 2008 aerial survey monitoring (Smultea et al. 2009a). Effort occurred in SOAR west of SCI only on May 16 and was limited to the northern one-half of SOAR due to low clouds and to avoid airspace conflicts with Navy activities as directed by Navy personnel (Table 10, Figure 9). SCI was circumnavigated to search for potential strandings on May 17.

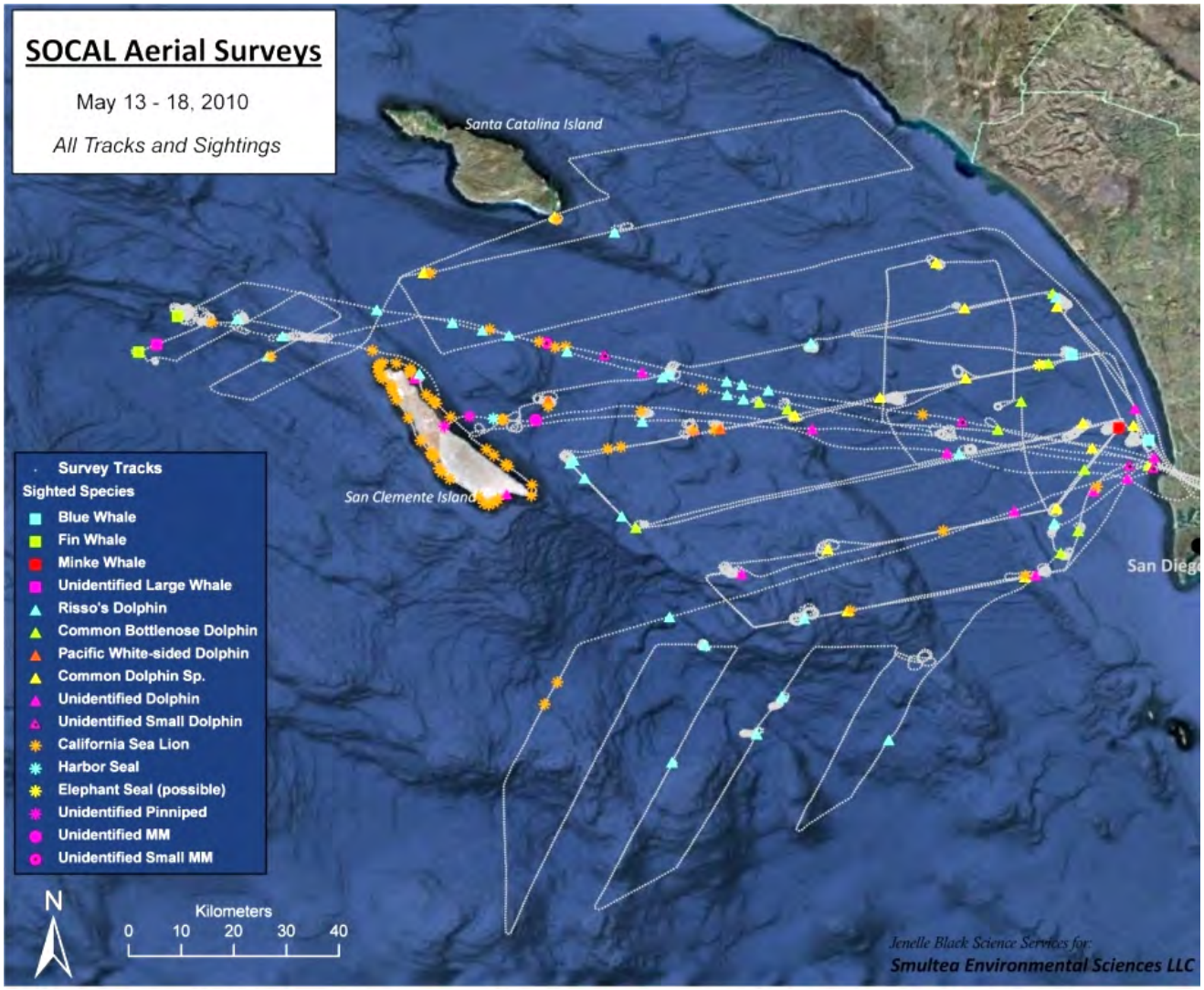


Figure 9. All track lines and sightings made during aerial monitoring surveys in SOCAL May 13 – 18, 2010.

Table 10. Aerial survey flight times, total hours (hh:mm) by date, and survey area during the May SOCAL 2010 aerial survey.

Date	Time Engines On	Time Engines Off	Total Engine Time	Time Wheels Up	Time Wheels Down	Total Flight Time	Flight Area	Comments
13-May	8:51	14:03	5:12	8:58	14:01	5:03:14	NAOPA	Bernd Wuersig flying, priority is focals. Mostly Beaufort 2 some 3.
14-May	14:05	10:31	3:34	10:37	14:04	3:26:12	N SOAR	Bernd Wuersig flying, priority is focals. Low marine cloud layer in morning delays start and limits our ability to fly high.
15-May	16:02	11:08	4:53	11:19	16:00	4:41:11	FLETA HOT	Completed survey grid at FLETA HOT.
16-May	13:01	17:41	4:40	13:07	17:39	4:31:54	SOAR	Overcast, heavy low marine layer in morning prevented us from flying until afternoon. Low clouds at SOAR closed in on us and had to leave SOAR.
17-May	9:37	13:35	3:58	9:42	13:35	3:52:39	NAOPA, San Clemente Island	Circumnavigated San Clemente Island, no strandings seen. Completed this first flight then refueled and made second flight this day.
17-May	14:57	17:56	2:59	15:03	17:54	2:50:37	Central NAOPA	Second flight, looking for Risso's and large whales for focal sessions.
18-May	9:07	13:33	4:26	9:15	13:32	4:16	SE corner of NAOPA	Low- lying clouds pushing from west and south.
		Total Engine Time	29:44		**Total Hours Flown**	28:42		

Table 11. Definitions and summary of aerial survey effort (km and nm) by leg type during the May SOCAL 2010 MTE aerial surveys.

Leg Type	Leg Type Definition	Total km Flown	Total nm Flown
Systematic	Pre-determined line-transect legs located in SOAR, NAOPA and FLETA HOT	1268	685
Random	Short lines connecting longer systematic lines	370	200
Transiting	Flying between the airport and the survey grid locations	956	516
Navy-Directed Transiting	Flying off intended course as directed by Navy during a survey to avoid Navy activities	91	49
Circling	Flying circles around sightings to verify species and group size via photography and/or to conduct focal behavioral sessions with videography as possible	2125	1147
Circumnavigating Coast	Flying parallel to San Clemente Island coastline approximately 0.5 km from shore to search for potential strandings	83	45
TOTAL		**4893**	**2641**

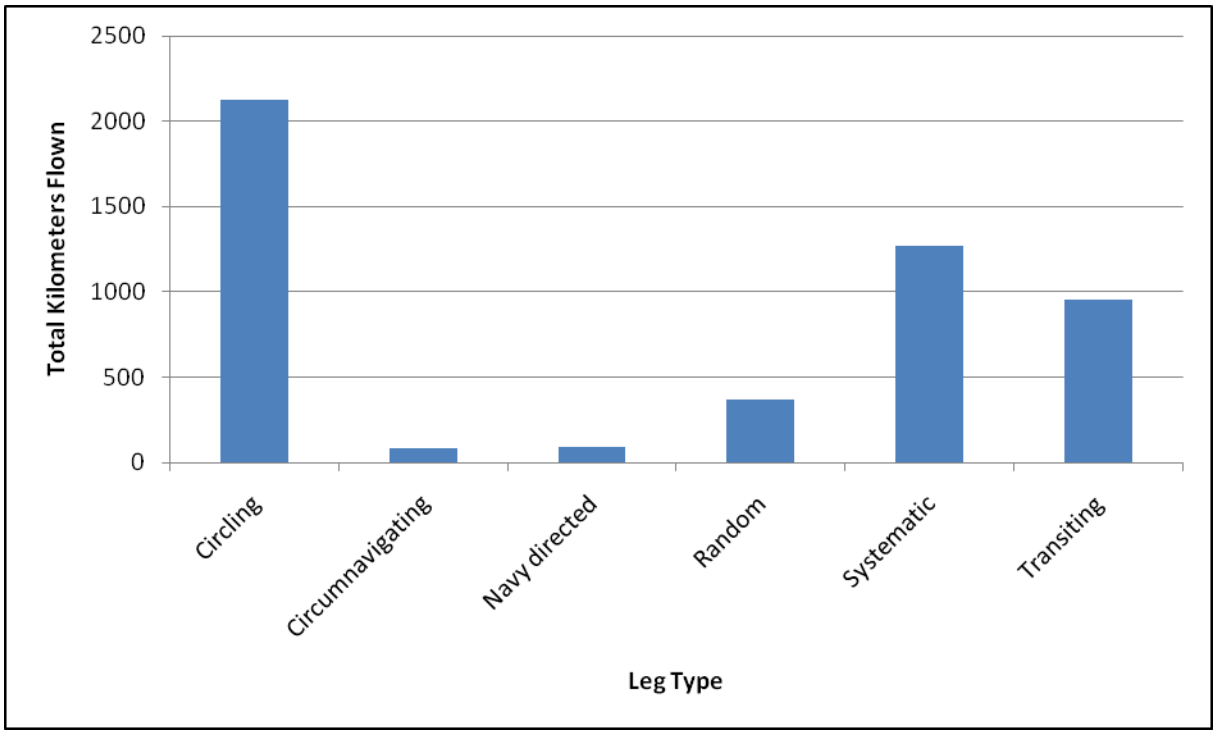


Figure 10. Summary of aerial survey effort (km) by leg type during the May SOCAL 2010 MTE aerial surveys.

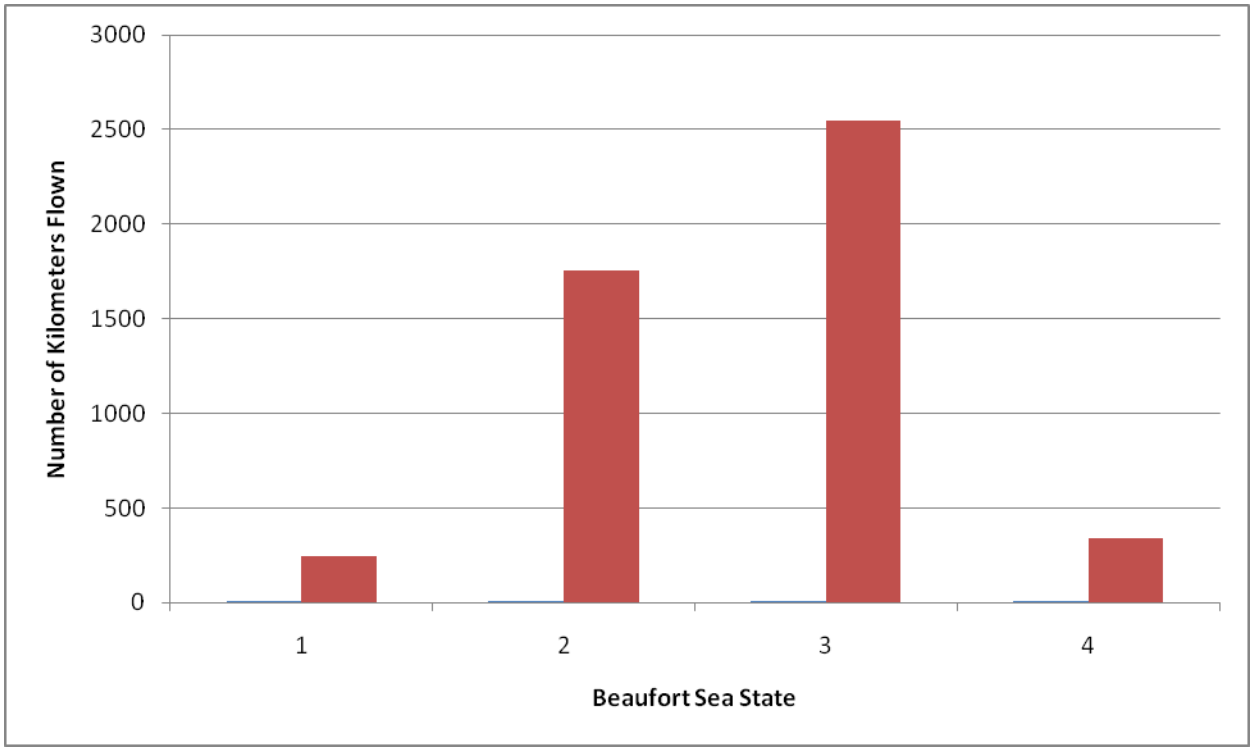


Figure 11. Summary of aerial survey effort (km) by Beaufort sea state during the May SOCAL 2010 MTE aerial survey.

Sightings

A total of 152 sightings of ~5,453 individual marine mammals was observed (Table 12 and Appendix A). Of the total 152 sightings 85% were identified to species (*n* = 129). Not all sightings were identified to species because there was not always time to fly off course to identify and circle sightings. Rather, the priorities were to conduct focal follows on priority species and/or to reach and conduct a full survey in SOAR which required a full tank of fuel to complete (i.e., there was not enough fuel to circle species seen en route to or from the airport and SOAR).

Ten different marine mammal species were identified. Sightings included three baleen whale species (blue, fin and minke whale), five dolphin species (bottlenose, short- and long-beaked common, Pacific white-sided, and Risso's dolphin), and two pinniped species (California sea lion and harbor seal). Overall, the California sea lion was the most frequently identified species (41% or 62 of 152 total groups) followed by the Risso's dolphin (22% or 33 groups). In terms of number of individuals seen, the common dolphin was the most abundant (*n* = ~3,000 or 55% of the total 5,453 individuals seen). Photographs are currently being reviewed by Dr. T.A. Jefferson to differentiate and verify short- and long-beaked common dolphins, as has been done for past surveys, and will be updated as relevant in the final report.

Table 12. Summary of marine mammal sightings by species during the May SOCAL 2010 MTE aerial surveys. Sightings organized in order of frequency observed starting with those seen most commonly.

Species (Common Name)	Scientific Name	Total No. of Sightings	Total Estimated No. Individuals
California Sea Lion	*Zalophus californianus*	62	159
Risso's Dolphin	*Grampus griseus*	33	432
Common Dolphin sp.	*Delphinus* sp.	14	3300
Unidentified Dolphin	Delphinidae sp.	13	736
Common Bottlenose Dolphin	*Tursiops truncatus*	12	292
Unidentified Small Dolphin	Delphinidae sp.	4	429
Blue Whale	*Balaenoptera musculus*	2	2
Fin Whale	*Balaenoptera physalus*	2	4
Pacific White-sided Dolphin	*Lagenorhynchus obliquidens*	2	81
Unidentified Marine Mammal	Cetacea or Pinnipedia	2	11
Unidentified Pinniped	Pinnipedia	2	2
Harbor Seal	*Phoca vitulina*	1	2
Minke whale`	*Balaenoptera acutorostrata*	1	1
Unidentified Large Whale	Cetacea	1	1
Unidentified Small Marine Mammal	Cetacea or Pinnipedia	1	1
Totals:		**152**	**5,453**

Sighting Rates

Table 4 compares sighting rates based on combined systematic, random and transit effort (i.e., point-to-point linear effort) for various species and species groups during November 2010 and May 2010 SOCAL aerial surveys. (See Smultea and Lomac-MacNair 2010 for other results of the November 2009 SOCAL aerial survey.) Overall, data show that sighting rates for all combined marine mammals based on number of *individuals* observed per km, per nm and per hour were higher in November than May. However, the number of *groups* sighted per unit of effort (i.e., number of sightings) was slightly higher in May vs. November. Among species, sighting rates of Risso's dolphins were approximately three times higher in May vs. November. In contrast, sighting rates of common dolphins and Pacific white-sided dolphins were approximately three times higher in November vs. May. Sighting rates of California sea lions were similar during November and May. Killer whales (n = 2 sightings) and Cuvier's beaked whales (n = 2 sightings) were seen only in November, while common bottlenose dolphins (n = 9) and harbor seals (n = 1) were observed only in May. Table 5 provides sighting rates by survey effort type based on number of groups observed (i.e., sightings made) per unit of effort (i.e., per km, nm, and hour). (See Table 2 for definitions and total km and nm of effort types.) The highest sighting rates for both November and May occurred while circumnavigating San Clemente Island due to high numbers of California sea lions in coastal waters. This was expected since effort was biased by paralleling the coastline where California sea lions concentrate to haul out. The sighting rate was twice as high in May vs. November during the circumnavigation effort, coinciding with known peaks of

Table 13. Sighting rates by species during the November 2009 and May 2010 SOCAL aerial surveys during systematic, random and transit effort.

Species (Common Name)	Nov-10				May-10			
	Total No. of Sightings (Total # Individuals)	Sightings/km (Indiv./km)	Sightings/nm (Indiv./nm)	Sightings/hr (Indiv./hr)	Total No. of Sightings (Total # Individuals)	Sightings/km (Indiv./km)	Sightings/nm (Indiv./nm)	Sightings/hr (Indiv./hr)
Whales								
Blue Whale	0 (0)	0 (0)	0 (0)	0 (0)	2 (2)	0.0007 (0.0007)	0.001 (0.001)	0.15 (0.15)
Fin Whale	5 (9)	0.001 (0.003)	0.003 (0.005)	0.36 (0.64)	2 (4)	0.0007 (0.002)	0.001 (0.003)	0.15 (0.30)
Minke whale`	1 (1)	0.0003 (0.0003)	0.0005 (0.0005)	0.07 (0.07)	1 (1)	0.0004 (0.0004)	0.0007 (0.0007)	0.08 (0.08)
Unidentified Large Whale	1 (1)	0.0003 (0.0003)	0.0005 (0.0005)	0.07 (0.07)	1 (1)	0.0004 (0.0004)	0.0007 (0.0007)	0.08 (0.08)
Unidentified Medium Whale	1 (1)	0.0003 (0.0003)	0.0005 (0.0005)	0.07 (0.07)	0 (0)	0 (0)	0 (0)	0 (0)
Dolphins								
Killer Whale	2 (67)	0.0006 (0.02)	0.001 (0.04)	0.14 (4.79)	0 (0)	0 (0)	0 (0)	0 (0)
Cuvier's Beaked Whale	2 (6)	0.0006 (0.002)	0.001 (0.003)	0.14 (0.43)	0 (0)	0 (0)	0 (0)	0 (0)
Risso's Dolphin	5 (167)	0.001 (0.05)	0.003 (0.09)	0.36 (11.93)	28 (373)	0.01 (0.14)	0.02 (0.27)	2.15 (28.69)
Common Dolphin sp.	25 (11891)	0.007 (3.45)	0.013 (6.4)	1.79 (849.36)	15 (3300)	0.006 (1.27)	0.01 (2.36)	1.15 (253.85)
Common Bottlenose Dolphin	0 (0)	0 (0)	0 (0)	0 (0)	9 (255)	0.003 (0.1)	0.006 (0.18)	0.69 (19.61)
Pacific White-sided Dolphin	6 (274)	0.002 (0.08)	0.003 (0.15)	0.43 (19.57)	2 (81)	0.0007 (0.03)	0.001 (0.06)	0.15 (6.23)
Unidentified Dolphin	6 (27)	0.002 (0.008)	0.003 (0.01)	0.43 (1.93)	10 (689)	0.004 (0.27)	0.007 (0.49)	0.77 (53)
Unidentified Small Dolphin	2 (45)	0.0006 (0.01)	0.001 (0.02)	0.14 (3.21)	4 (429)	0.002 (0.17)	0.003 (0.31)	0.31 (33)
Pinnipeds								
California Sea Lion	19 (83)	0.006 (0.02)	0.01 (0.04)	1.36 (5.93)	22 (58)	0.008 (0.02)	0.016 (0.04)	1.70 (4.46)
Harbor Seal	0 (0)	0 (0)	0 (0)	0 (0)	1 (2)	0.0004 (0.0008)	0.0007 (0.001)	0.08 (0.15)
Unidentified Pinniped	4 (4)	0.001 (0.001)	0.002 (0.002)	0.29 (0.29)	2 (2)	0.0008 (0.0008)	0.001 (0.001)	0.15 (0.15)
Unidentified Marine Mammal	1 (1)	0.0003 (0.0003)	0.0005 (0.0005)	0.07 (0.07)	1 (10)	0.0004 (0.004)	0.0007 (0.007)	0.08 (0.77)
Unidentified Small Marine Mammal	1 (1)	0.0003 (0.0003)	0.0005 (0.0005)	0.07 (0.07)	2 (2)	0.0007 (0.0007)	0.001 (0.001)	0.15 (0.15)
Overall Marine Mammal	81 (12578)	0.02 (3.65)	0.04 (6.77)	5.79 (898.43)	102 (5209)	0.04 (2.01)	0.073 (3.72)	7.85 (400.69)

Table 14. Sighting (Stg) rates of marine mammal (MM) groups by effort type during the November 2009 and May 2010 SOCAL aerial surveys.

Effort Type	Species Group	Nov 18-23, 2009							May 13-18, 2010						
		Total Stgs	Total km	Total nm	Total hr	Sighting/ km	Sighting/ nm	Sighting /hr	Total Stgs	Total km	Total nm	Total hr	Sighting /km	Sighting /nm	Sighting /hr
Systematic	Whales	6	1790	967	8	0.003	0.006	0.75	4	1268	685	7	0.003	0.006	0.57
	Dolphins	21				0.012	0.022	2.63	29				0.023	0.042	4.14
	Pinnipeds	17				0.009	0.018	2.13	13				0.010	0.019	1.86
	All MM	46				0.026	0.048	5.75	46				0.036	0.067	6.57
Random	Whales	0	669	361	2	0	0	0	1	370	200	2	0.003	0.005	0.5
	Dolphins	4				0.006	0.011	2	10				0.027	0.05	5
	Pinnipeds	3				0.004	0.008	1.5	1				0.003	0.005	0.5
	All MM	7				0.010	0.019	3.5	12				0.032	0.06	6
Transit	Whales	2	983	531	4	0.002	0.004	0.5	1	956	516	4	0.001	0.002	0.25
	Dolphins	23				0.023	0.043	5.75	29				0.030	0.056	7.25
	Pinnipeds	3				0.003	0.006	0.75	12				0.013	0.023	3
	All MM	28				0.028	0.053	7	42				0.044	0.081	10.5
Circling	Whales	0	1335	721	7	0	0	0	0	2125	1147	12.9	0.000	0.000	0
	Dolphins	1				0.001	0.001	0.143	0				0.000	0.000	0
	Pinnipeds	0				0.000	0	0	0				0.000	0.000	0
	All MM	1				0.001	0.001	0.143	0				0.000	0.000	0
Circumnavigating San Clemente Island	Whales	0	120	65	0.2	0	0	0	0	83	45	0.5	0.000	0.000	0
	Dolphins	2				0.017	0.031	10.000	3				0.036	0.067	6
	Pinnipeds	5				0.000	0	0	37				0.446	0.826	74
	All MM	7				0.058	0.108	35.000	40				0.482	0.893	80
Navy-directed Transiting	Whales	0	137	74	0.6	0	0	0	0	91	49	0.4	0.000	0.000	0
	Dolphins	1				0.007	0.014	1.667	7				0.077	0.142	17.5
	Pinnipeds	4				0.000	0	0	3				0.033	0.061	7.5
	All MM	5				0.036	0.068	8.333	10				0.110	0.204	25

California sea lion concentrations (Carretta et al. 2000). The second highest sighting rates for both November and May occurred during Navy-directed transiting effort (i.e., irregular re-routing to avoid conflict with Navy activities). This result was biased because the Navy-directed legs were short and occurred primarily near SCI where animals tend to concentrate near underwater ridges and drop offs (see Distribution section below). Sighting rates were generally similar for systematic, random, and transit effort in both November and May, ranging from 3.5 to 10.5 sightings per hour. However, sighting rates were slightly higher during transit and systematic effort than during random effort. Sighting rates were less than 0.2 sightings per hour during circling effort that occurred after the aircraft began circling a primary sighting made during other effort types. Thus, additional sightings were rarely made while circling a primary sighting. This was as expected because we were concentrating on the primary sighting rather than searching for additional animals, and because we repeatedly circled in the same small area around the primary sighting.

Distribution

Effort Distribution

In May 2010, line-transect surveys were conducted throughout NAOPA, northern SOAR, and in FLETA HOT to the south (see Figure 9 and Table 10). Transect lines east of SCI in NAOPA were the same as those followed in our previous five surveys (October and November 2008, June and July 2009, and November 2010 --- see Smultea et al. 2009a,b, Smultea and Lomac-MacNair 2010). Survey lines west of SCI in SOAR in May 2010 replicated those followed in June, July and November 2009. However, the SOAR transect lines extended further north and slightly farther apart than lines followed in June and July 2009 and October and November 2008. This line configuration maximized coverage of the Navy-identified SOAR survey area within the ~4.5-5-hr limit of the aircraft's fuel tank. Permission to survey SOAR was only granted by the Navy on May 14 and 16 from 10:00 to 15:00 to avoid potential airspace conflicts. However, low marine cloud layers on these days limited the time and vantage available to survey SOAR given associated cloud clearance requirements and permit restrictions. The FLETA HOT survey grid was flown on one day; this same area was surveyed previously by us in November 2008 on two days (Smultea et al. 2009a).

Sighting Distribution

Relatively few whales were seen during May 2010 (n = 6 sightings). The two fin whales and one unidentified large whale were seen in the far northwestern corner of SOAR (Figure 12); in comparison, during October and November 2008, fin whales were seen relatively frequently in this small area (see Smultea et al. 2009a). In contrast, the two blue whale groups in May 2010 were seen within 10 km of the mainland coast near San Diego, as was the one minke whale sighting. Concentrations of blue whales were also observed in this area during our June and July 2008 aerial surveys in SOCAL (see Smultea et al. 2009b).

Dolphin distribution generally appeared to be segregated between Risso's (n = 33) and common dolphins (n = 14), the two most commonly identified species (Figure 13). (At the time of this draft report, photographs had not yet been examined to differentiate short- and long-beaked common dolphins.) Risso's dolphins were seen primarily in the western one-half of NAOPA and west to SOAR, concentrated along underwater ridges and drop offs. However, 21 percent (n = 7) of Risso's groups occurred further south in FLETA HOT. Risso's dolphin was the only marine mammal species seen in FLETA HOT and the only dolphin species seen in SOAR (n = 5). In contrast, common dolphins occurred predominantly in the eastern one-half of NAOPA. They were fairly

evenly distributed throughout this area and did not appear to be strongly associated with any bathymetric features except the continental shelf. Of the 12 common bottlenose dolphin sightings, 92% occurred approximately 15-80 km offshore of the coast primarily within the San Diego Trough (refer to Figure 1). Many of the unidentified dolphins were spotted just outside San Diego in restricted busy airspace where it was unsafe and/or not allowed by air traffic control to circle dolphins to verify species. Based on relatively large group sizes, frequent surface-active behavior, and distribution, many of the unidentified dolphins are believed to have been common dolphins. No dolphins were seen along the two northernmost survey lines in NAOPA; dolphin sightings have tended to be relatively low in this area during our previous SOCAL aerial surveys as well (see Smultea et al. 2009a,b and Smultea and Lomac-MacNair 2010).

As expected, pinniped sightings (95% identified as California sea lions) were concentrated along the coast of SCI (Figure). This pattern was evident while circumnavigating SCI to search for potential strandings. (Notably, no stranded or dead marine mammals were observed). However, many pinnipeds (again, nearly exclusively California sea lions) were also recorded at sea primarily within approximately 30 km east of SCI. Small numbers were also scattered from SCI to the mainland coast. Very few pinnipeds were seen in SOAR or FLETA HOT, and only in the northwestern corner of FLETA HOT. Pinnipeds were also scarce in the northeast section of NAOPA where cetaceans were also scarce (see above). Overall, the at-sea distribution of California sea lions was associated with SCI and underwater ridges (similar to dolphins), with few, if any, occurring over flat underwater basins or shelves. The latter pattern is believed to reflect the generally higher concentrations of mesopelagic prey associated with underwater ridges and upwelling.

Behavior

Common and Risso's dolphins had sample sizes considered large enough (n = 14 and 33, respectively) to warrant summarizing initially observed behavior state, heading, and estimated mean dispersal distance between individuals (Figure and Figure 14). Both species were most frequently observed traveling slowly and milling. Similar behavior was observed for Risso's dolphins during our past five SOCAL aerial surveys. However, during past surveys, common dolphins were more surface-active than observed during the May survey (e.g., Smultea et al. 2009a,b, Smultea and Lomac-MacNair 2010). In contrast, Risso's dolphins have rarely been seen engaged in surface-active behaviors. For the May survey we added a modifier to the travel behavior state to indicate estimated slow (1-3 km/hr), medium (4-7 km/hr) and fast (>7 km/h) travel speed because we noted in earlier surveys that Risso's dolphins tended to swim slowly. Results supported this observation as 22 of 24 traveling Risso's groups traveled slowly as did 8 of 9 common dolphin groups.

The most frequently observed heading among common dolphins was from SE to SW; previous surveys recorded common dolphins headed mostly SW to W or to the NE. Similarly, Risso's dolphins were predominantly headed generally S to W or to the NE, again consistent with our earlier surveys. Mean inter-individual spacing (i.e., dispersal) among common dolphins was consistently tight (i.e., 1-3 body lengths between nearest neighbors). Most Risso's dolphins were also spaced 1-3 body lengths apart, although this spacing was less consistent than among common dolphins. The latter patterns of dispersal were also similar to results of our previous five SOCAL aerial surveys.

Unusual Observations

On May 16 from 13:54 to 14:17 at SOAR, an unusually behaving group of 14 Risso's dolphins was tracked from the airplane for a focal follow lasting approximately 23 minutes. The group consistently traveled fast and was surface-active with frequent porpoising and whitewater observed as the dolphins headed consistently to approximately 060 degrees magnetic. The observation was considered unusual because Risso's dolphins during our past surveys have most frequently been observed traveling slowly or milling with little to no surface-active behaviors (e.g., see Figure 14). Approximately 18 minutes of video was taken while following this group (see Appendix E).

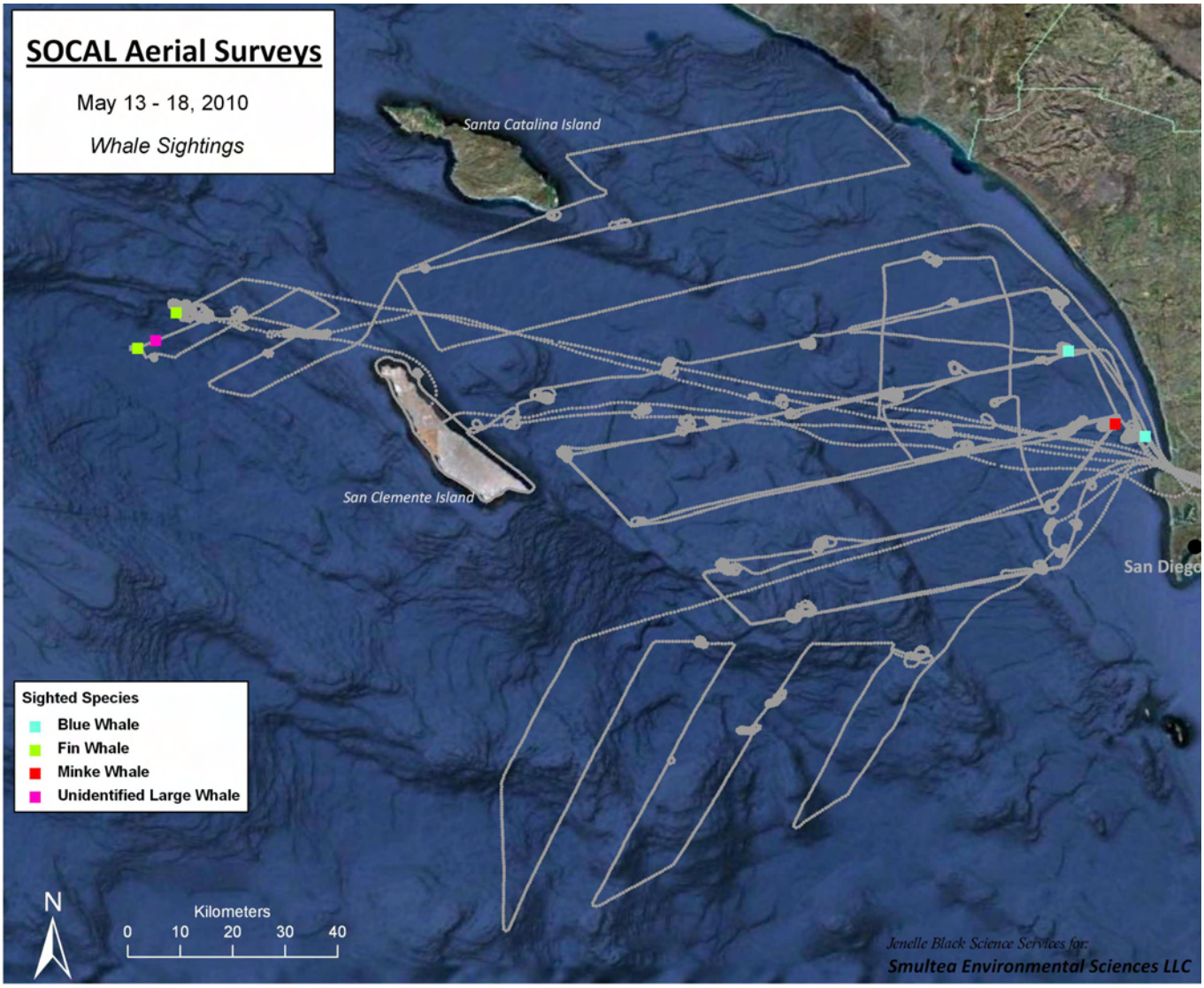


Figure 12. Whale sightings made during aerial survey monitoring in the SOCAL May 13-18, 2010.

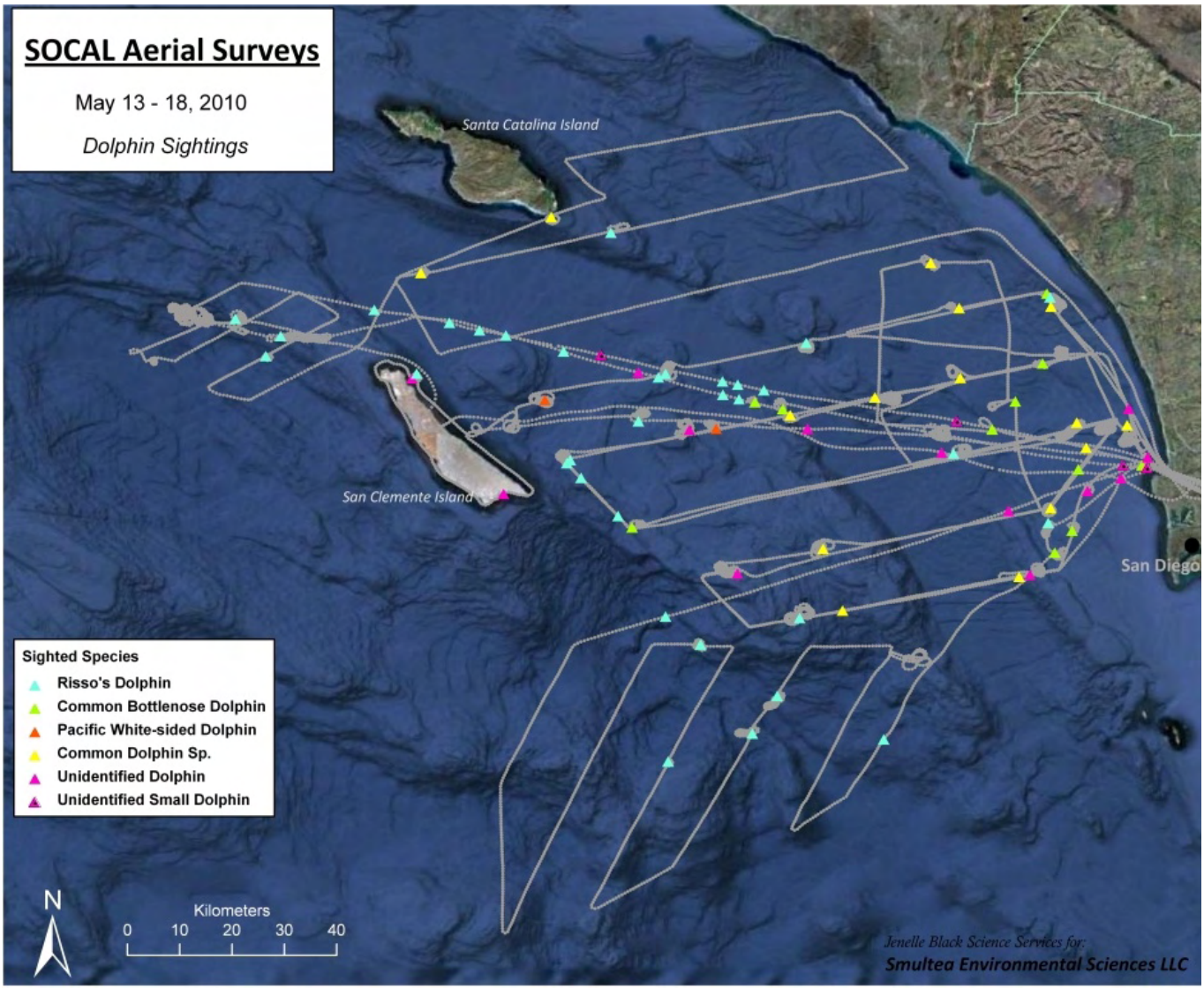


Figure 13. Dolphin sightings made during aerial survey monitoring in the SOCAL May 13-18, 2010.

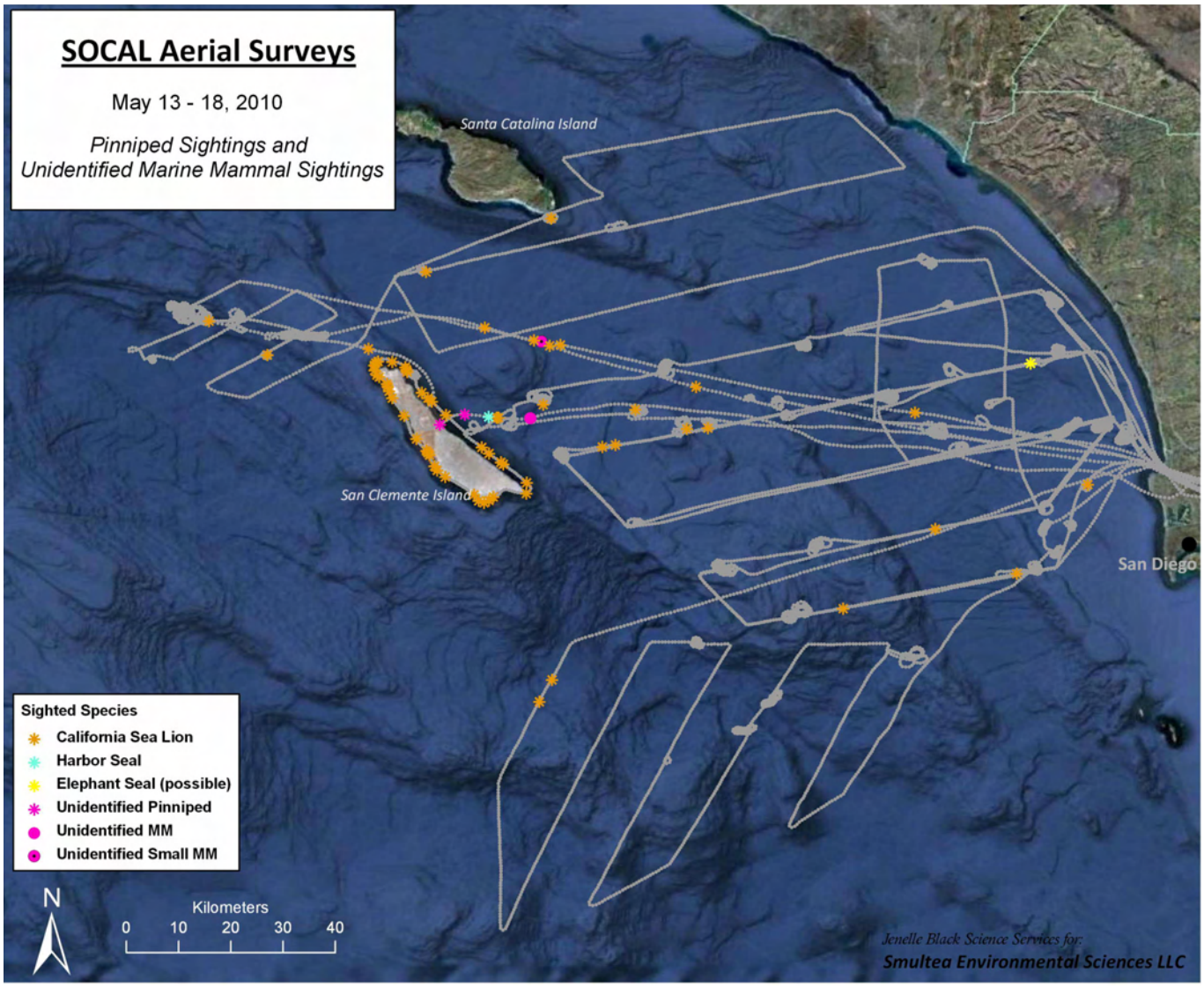


Figure 7. Pinniped sightings made during aerial survey monitoring in the SOCAL May 13-18, 2010.

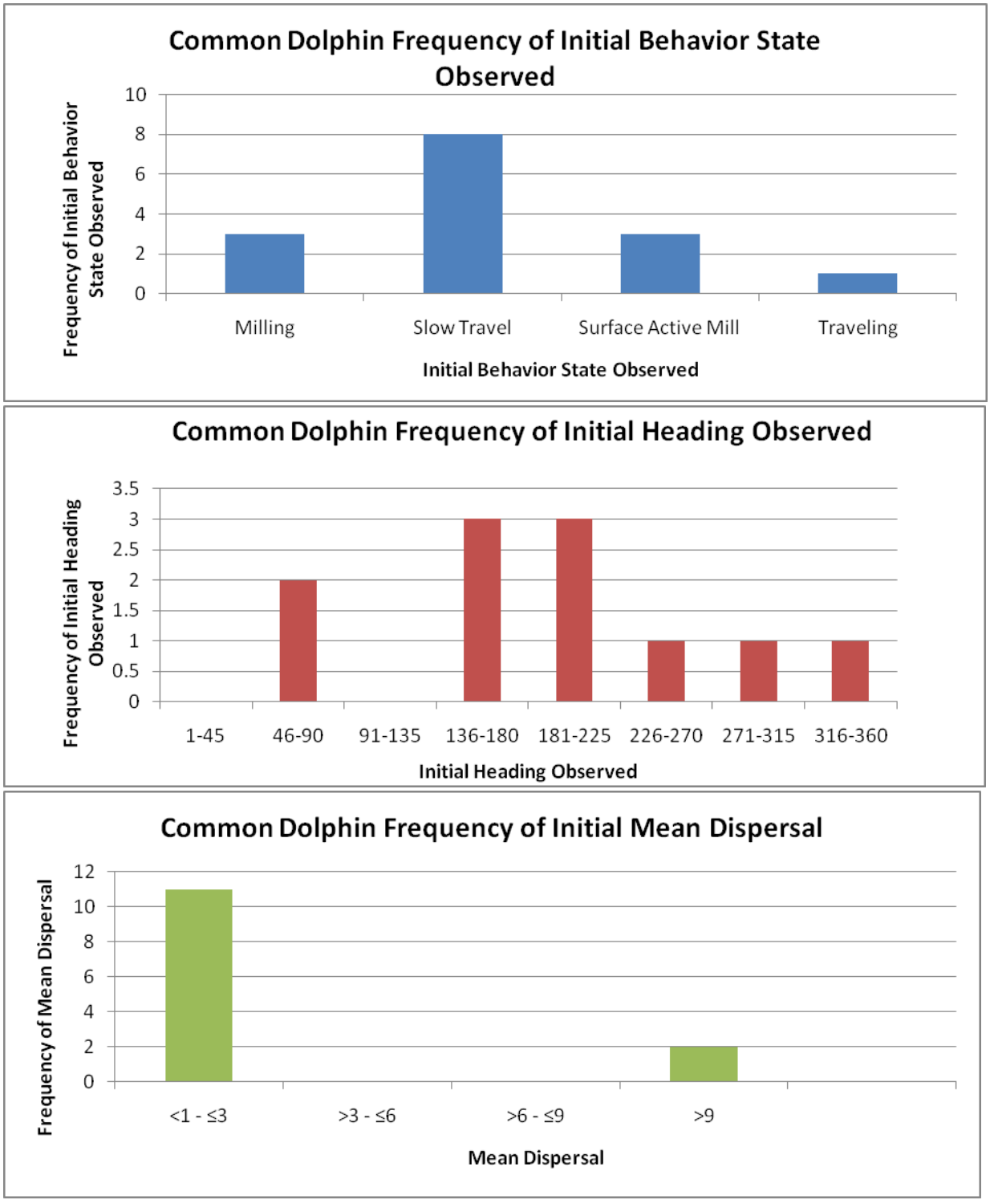
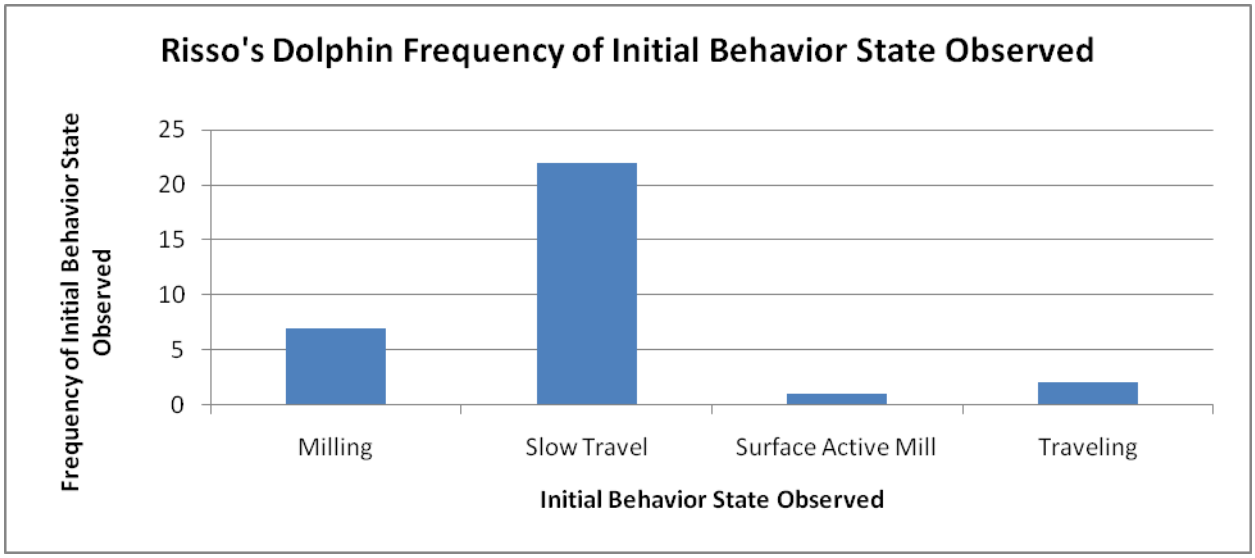
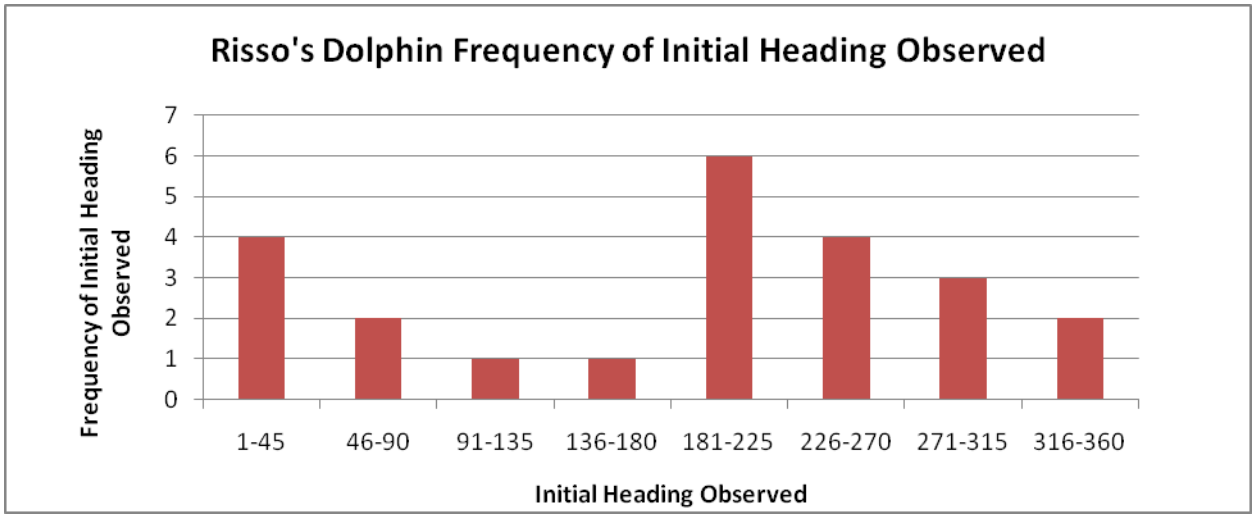


Figure 8. Common dolphins during the May SOCAL 2010 survey periods: Upper panel: frequency of initially observed behavioral states. Middle panel: frequency of initially observed headings (degrees magnetic). Bottom panel: frequency of mean dispersal distance between individuals (in estimated body lengths).





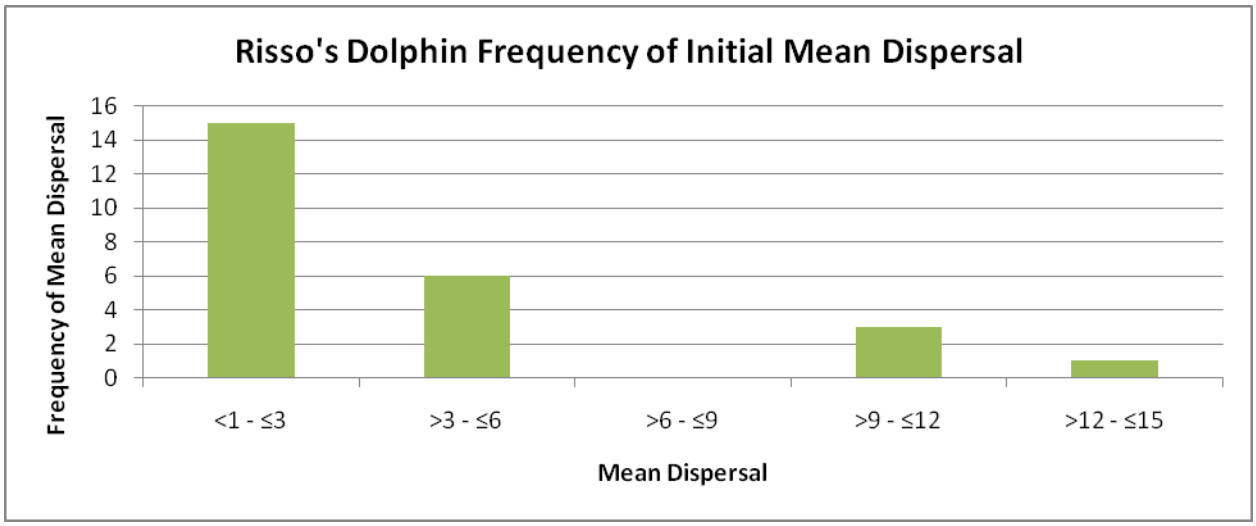


Figure 14. Risso's dolphins during the May SOCAL 2010 survey periods: Upper panel: frequency of initially observed behavioral states. Middle panel: frequency of initially observed headings (degrees magnetic). Bottom panel: frequency of mean dispersal distance between individuals (in estimated body lengths).

Photographs and Video

A total of ~1350 digital photographs and 5.5 hours of high-definition (HD) video were taken during May 2010. A preliminary list of photographs and video are presented in Appendix B and Appendix C. Note that the video is based on start and stop times and focal animals are not always in view and videotaped; the video was typically operating between surfacings to record ancillary information. The count of photographs is a raw count and has not been filtered in detail to identify usefulness of photographs for identifying species, calves, etc. The latter tasks are time-consuming and were outside the scope of this contract. As done for our previous surveys, Dr. T.A. Jefferson will review our photographs to confirm or speciate short-beaked vs. long-beaked common dolphins and other species as relevant.

Section 4 Discussion

Key Role of Aerial Surveys

The key and unique roles that aerial surveys play in addressing Navy monitoring plan goals have been discussed thoroughly in our previous reports (see review in Smultea et al. 2009a,b, Smultea and Lomac-MacNair 2010). Thus, they are not discussed again herein.

Survey Highlights

During the May 2010 aerial surveys, Dr. Bernd Wuersig of the Marine Mammal Research Program at Texas A&M University joined our field team to provide expert review and critique of our behavioral study approach and protocol, and to assist us in the field. Dr. Wuersig is one of the pioneer marine mammal behavioral experts who successfully developed and applied the use of small fixed-wing aircraft to study the behavior of focal groups of bowhead whales by circling animals for extended periods (e.g., Wuersig et al. 1989, Richardson et al. 1986, 1995). This research illustrated that at sufficient altitudes and radial distances, the animals exhibited no statistically detectable response to the observation platform. A similar protocol was applied to a study of the behavioral response of bottlenose dolphins to the *Mega Borg II* oil spill in the Gulf of Mexico in 1990 (Smultea and Wuersig 1995) and to humpback whales near Kauai in 1993 and 1994 (Bowles et al. 1995). Our SOCAL aerial surveys have taken these basic protocols and further developed, adapted, and applied them to multiple other species inhabiting the SOCAL as described in this and previous reports. From these observations, we have learned that Risso's dolphins and blue and fin whales are the most practical species upon which to focus our efforts. This is because they are relatively common, observable below the water surface, form groups of a size that are relatively easy to track, remain near the surface for extended periods, are of light color and/or large size facilitating tracking, and/or are of particular management interest (e.g., ESA status and/or a surrogate deep-diving species to the beaked whale [i.e., the Risso's dolphin]). Dr. Wuersig provided a positive review of our protocol and helped us further refine our techniques.

As summarized in Table 6 the May 2010 aerial survey contributed the highest number (n = 20) of focal behavioral observations at least 10 min long relative to our previous five SOCAL aerial surveys, largely because we had shifted our focus to focal follows. In addition, we also conducted the longest focal session during May 2010 (144 min with fin whales); our previous longest focal follow duration was 60 min with a fin whale in November 2009. The largest mean group size for all marine mammal combined was also recorded during May 2010 (137.9 individual marine mammals/group); the next highest mean group size of 109.4 individuals/group was recorded during October 2008.

Overall marine mammal sighting rates based on number of individuals sighted per hour and per km or nm were over twice as high in November 2009 vs. May 2010. However, there was some variation between species. These trends generally agree with results of other surveys in SOCAL. Based on effort type, combined marine mammal sighting rates were highest while circumnavigating SCI to search for potential strandings just offshore of the coastline. Nearly all such sightings were identified as California sea lions, and the effort was biased because it occurred where this species is known to concentrate. November sightings rates while circumnavigating were twice as high in May vs. November, consistent with other studies and known seasonal concentrations of California sea lions. Sighting rates were slightly higher during transit effort followed by systematic and random effort during both November and May.

Funding has not been available to analyze the detailed behavior of cetacean groups we have observed in the SOCAL. However, the Navy plans to further analyze these data through the IDIQ Marine Mammal Monitoring contract recently awarded to e2M/HDR. These data will also be analyzed relative to estimated received sound levels of MFAS, as applicable, and will provide baseline non-MFAS exposure data for comparison purposes for monitoring and other studies (e.g., the BRS study—see following subsection).

May survey results are unique in that they are the first data collected during May among our five previous aerial surveys. This contributes to building seasonal and year-round baseline data for the SOCAL marine mammals as directed under the SOCAL M3P.

Behavioral trends reported herein are generally consistent with the five previous aerial surveys for Risso's and common dolphins, by far the two most frequently observed cetacean species by us in the SOCAL. Results consistently show that Risso's dolphins spend the majority of their time slowly traveling at the surface in relatively tight cohesive groups of typically less than 50 individuals, and rarely engage in surface-active behaviors. They also remain within view of the aircraft observers at or below the surface for the longest periods compared to other SOCAL marine mammal species observed. In particular, the light, white body coloration and scarring of Risso's dolphins makes them relatively easy to track from the aircraft at and below the surface, even at altitudes of 1500 feet and radial distances of 1 km at which focal behavioral follows are typically conducted (see Appendix D).

Aerial Survey Collaboration with Other Researchers

No other marine mammal researchers were conducting field surveys in the SOCAL range simultaneously to our May survey to our knowledge. However, our data will be shared with researchers from the University of California San Diego/Scripps Institute of Oceanography, Cascadia Research Collective, the Navy's Marine Mammal Research Program (e.g., Dr. Dave Moretti), and other Office of Naval Research and N45-funded studies, including the 2010 Behavioral Response Study (BRS) led by Dr. Brandon Southall. Shared data of interest that we collected include locations of beaked, blue and fin whales, and bottlenose and Risso's dolphins. In particular, baseline behavioral and distribution data we have collected on these species is of relevance to the BRS program. Beginning in the SOCAL in late summer 2010, the BRS program plans to conduct playback sound with some of these species to assess potential behavioral responses. Thus, our baseline behavioral data provide a substantial database for comparison of typical behavior of these species. Very little published data are available on the behavior of any of the marine mammals species inhabiting the SOCAL with the exception of coastal bottlenose dolphins (e.g., Defran et al. 1999), gray whales (e.g., Punt and Wade 2010), and more recently, a few tagged individual Cuvier's whales (e.g., Falcone et al. 2009a).

Section 5 Recommendations

Recommendations to improve data collection techniques, analyses, interpretations, and applications are the same as those provided in the previous SOCAL 2008-2009 aerial survey reports (Smultea et al. 2009a,b, Smultea and Lomac-MacNair 2010).

Section 6 Acknowledgements

We are grateful to Navy personnel from US Pacific Fleet Environmental and Naval Facilities Engineering Command Pacific for their support, coordination and facilitation in the implementation of these surveys. We thank our excellent survey observer biologists Mark Deakos, Lori Mazzuca and Bernd Wuersig, our database and GIS manager and report editor Jenelle Black of Jenelle Black Sciences, and hard-working dedicated technical assistants Cathy Bacon and Roxann Merizan. We are grateful for our competent and safety-conscious pilot Barry Hanson of Aspen Helicopters, Oxnard, California.

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Appendix A List of All May 2010 Sightings

Appendix C. May 2010: Summary of all individual marine mammal sightings made during the May SOCAL 2010 aerial monitoring surveys off San Diego, California.

Date	Initial time	Common Name	Species	Best Count	Latitude	Longitude
May 13	09:02:30	Common Bottlenose Dolphin	*Tursiops truncatus*	5	32.862850	-117.297050
May 13	09:03:42	Unidentified Dolphin	Delphinidae sp.	150	32.840867	-117.333133
May 13	09:11:06	Unidentified Dolphin	Delphinidae sp.	83	32.675650	-117.489533
May 13	09:11:39	Common Dolphin Sp.	undifferentiated *Delphinus*	15	32.671933	-117.507967
May 13	09:27:20	California Sea Lion	*Zalophus californianus*	1	32.673983	-117.507317
May 13	09:39:33	Risso's Dolphin	*Grampus griseus*	25	32.601167	-117.885567
May 13	10:13:00	Unidentified Dolphin	Delphinidae sp.	12	32.677633	-117.992183
May 13	10:40:18	Common Dolphin Sp.	undifferentiated *Delphinus*	150	32.719833	-117.845050
May 13	11:02:49	Common Dolphin Sp.	undifferentiated *Delphinus*	300	32.789750	-117.453933
May 13	11:16:56	Common Dolphin Sp.	undifferentiated *Delphinus*	300	32.936033	-117.409150
May 13	12:10:27	Risso's Dolphin	*Grampus griseus*	7	32.776283	-118.197683
May 13	12:13:19	Risso's Dolphin	*Grampus griseus*	3	32.841450	-118.260983
May 13	12:14:31	Risso's Dolphin	*Grampus griseus*	4	32.866683	-118.285500
May 13	12:21:59	Unidentified Dolphin	Delphinidae sp.	3	32.924117	-118.075050
May 13	12:31:28	California Sea Lion	*Zalophus californianus*	3	32.922383	-118.075467
May 13	12:44:00	Common Dolphin Sp.	undifferentiated *Delphinus*	350	32.979633	-117.756067
May 13	13:41:58	Common Bottlenose Dolphin	*Tursiops truncatus*	30	33.037617	-117.467883
May 14	10:50:56	Unidentified Small Dolphin	Delphinidae sp.	1	32.939267	-117.616217
May 14	10:52:35	California Sea Lion	*Zalophus californianus*	2	32.949650	-117.683067
May 14	10:59:11	Risso's Dolphin	*Grampus griseus*	16	32.991833	-117.947083
May 14	11:00:28	Risso's Dolphin	*Grampus griseus*	1	33.001500	-117.992117
May 14	11:01:04	Risso's Dolphin	*Grampus griseus*	2	33.006983	-118.018183
May 14	11:06:21	Unidentified Small Dolphin	Delphinidae sp.	23	33.052317	-118.227783
May 14	11:08:01	California Sea Lion	*Zalophus californianus*	1	33.066200	-118.293350
May 14	11:08:56	Unidentified Small Marine Mammal		1	33.071950	-118.325867
May 14	11:09:17	California Sea Lion	*Zalophus californianus*	3	33.074350	-118.338917
May 14	11:10:32	Risso's Dolphin	*Grampus griseus*	1	33.085683	-118.390300
May 14	11:11:45	Risso's Dolphin	*Grampus griseus*	10	33.094667	-118.435817
May 14	11:12:59	Risso's Dolphin	*Grampus griseus*	5	33.107350	-118.487333
May 14	11:16:19	Risso's Dolphin	*Grampus griseus*	1	33.129533	-118.616617
May 14	11:26:09	Fin Whale	*Balaenoptera physalus*	3	33.117933	-118.957217
May 14	13:22:45	California Sea Lion	*Zalophus californianus*	1	33.096083	-118.423217
May 14	13:25:29	California Sea Lion	*Zalophus californianus*	3	33.065117	-118.311900
May 14	13:26:02	Risso's Dolphin	*Grampus griseus*	3	33.058350	-118.291367
May 14	13:29:15	Unidentified Dolphin	Delphinidae sp.	1	33.022567	-118.162733
May 14	13:30:08	Risso's Dolphin	*Grampus griseus*	15	33.014017	-118.128200
May 14	13:31:46	California Sea Lion	*Zalophus californianus*	1	32.994150	-118.059433

Date	Initial time	Common Name	Species	Best Count	Latitude	Longitude
May 14	13:32:47	Risso's Dolphin	*Grampus griseus*	25	32.984050	-118.017317
May 14	13:33:24	Risso's Dolphin	*Grampus griseus*	9	32.976433	-117.989800
May 14	13:34:03	Common Bottlenose Dolphin	*Tursiops truncatus*	19	32.971267	-117.962317
May 14	13:38:22	Common Bottlenose Dolphin	*Tursiops truncatus*	18	32.959300	-117.914500
May 14	13:56:15	Unidentified Small Dolphin	Delphinidae sp.	350	32.863367	-117.330133
May 14	13:57:16	Unidentified Small Dolphin	Delphinidae sp.	55	32.859000	-117.289367
May 15	11:29:45	Unidentified Dolphin	Delphinidae sp.	30	32.785033	-117.526250
May 15	11:46:06	Risso's Dolphin	*Grampus griseus*	4	32.603917	-118.115883
May 15	11:52:56	California Sea Lion	*Zalophus californianus*	1	32.491717	-118.307833
May 15	11:54:29	California Sea Lion	*Zalophus californianus*	1	32.454000	-118.329517
May 15	12:30:17	Risso's Dolphin	*Grampus griseus*	17	32.555733	-118.055783
May 15	13:02:02	Risso's Dolphin	*Grampus griseus*	2	32.355300	-118.111833
May 15	13:27:23	Risso's Dolphin	*Grampus griseus*	33	32.402950	-117.966950
May 15	13:53:20	Risso's Dolphin	*Grampus griseus*	23	32.467483	-117.924117
May 15	14:58:34	Risso's Dolphin	*Grampus griseus*	12	32.393333	-117.740950
May 15	15:13:02	Common Bottlenose Dolphin	*Tursiops truncatus*	45	32.713133	-117.446917
May 15	15:26:52	Risso's Dolphin	*Grampus griseus*	15	32.764400	-117.458283
May 16	13:21:14	Unidentified Dolphin	Delphinidae sp.	100	32.884983	-117.641467
May 16	13:39:25	Unidentified Marine Mammal		10	32.940600	-118.344817
May 16	13:40:47	California Sea Lion	*Zalophus californianus*	1	32.941050	-118.402950
May 16	13:41:05	Harbor Seal	*Phoca vitulina*	2	32.942700	-118.417183
May 16	13:42:04	Unidentified Pinniped	Pinnipedia sp.	1	32.946617	-118.458217
May 16	13:43:31	Unidentified Pinniped	Pinnipedia sp.	1	32.929600	-118.500917
May 16	13:50:01	California Sea Lion	*Zalophus californianus*	1	33.059633	-118.623817
May 16	13:54:18	Risso's Dolphin	*Grampus griseus*	14	33.084583	-118.777583
May 16	14:21:59	Risso's Dolphin	*Grampus griseus*	30	33.114050	-118.855550
May 16	14:43:44	California Sea Lion	*Zalophus californianus*	1	33.107467	-118.898567
May 16	14:47:00	Unidentified Large Whale	Cetacea sp.	1	33.070033	-118.992567
May 16	14:48:00	Fin Whale	*Balaenoptera physalus*	1	33.057017	-119.023733
May 16	15:08:55	Risso's Dolphin	*Grampus griseus*	6	33.050217	-118.803250
May 16	15:10:53	California Sea Lion	*Zalophus californianus*	1	33.048833	-118.798017
May 16	15:39:30	Common Dolphin Sp.	undifferentiated *Delphinus*	300	33.288717	-118.312300
May 16	15:43:16	California Sea Lion	*Zalophus californianus*	25	33.284183	-118.309150
May 16	16:26:20	Risso's Dolphin	*Grampus griseus*	6	33.262017	-118.209917
May 16	16:40:50	Common Dolphin Sp.	undifferentiated *Delphinus*	30	33.192917	-118.536750
May 16	16:43:52	California Sea Lion	*Zalophus californianus*	1	33.191733	-118.524617
May 17	10:17:04	Unidentified Dolphin	Delphinidae sp.	90	32.925450	-117.871900
May 17	10:24:43	Risso's Dolphin	*Grampus griseus*	28	32.938500	-118.162717
May 17	10:28:26	California Sea Lion	*Zalophus californianus*	1	32.955467	-118.164283

Date	Initial time	Common Name	Species	Best Count	Latitude	Longitude
May 17	10:47:10	California Sea Lion	*Zalophus californianus*	2	32.890300	-118.428833
May 17	10:47:38	California Sea Lion	*Zalophus californianus*	2	32.880017	-118.416217
May 17	10:48:24	California Sea Lion	*Zalophus californianus*	1	32.864267	-118.395833
May 17	10:48:40	California Sea Lion	*Zalophus californianus*	1	32.861383	-118.392000
May 17	10:50:23	California Sea Lion	*Zalophus californianus*	5	32.829417	-118.351533
May 17	10:51:24	California Sea Lion	*Zalophus californianus*	1	32.811250	-118.352217
May 17	10:52:56	Unidentified Dolphin	Delphinidae sp.	1	32.814133	-118.394383
May 17	10:53:33	California Sea Lion	*Zalophus californianus*	1	32.804817	-118.409250
May 17	10:53:53	California Sea Lion	*Zalophus californianus*	4	32.799333	-118.416317
May 17	10:54:12	California Sea Lion	*Zalophus californianus*	1	32.795317	-118.424767
May 17	10:54:40	California Sea Lion	*Zalophus californianus*	2	32.798183	-118.433800
May 17	10:55:06	California Sea Lion	*Zalophus californianus*	4	32.809167	-118.442267
May 17	10:57:11	California Sea Lion	*Zalophus californianus*	3	32.839767	-118.491650
May 17	10:57:59	California Sea Lion	*Zalophus californianus*	2	32.850883	-118.505233
May 17	10:58:18	California Sea Lion	*Zalophus californianus*	3	32.857700	-118.510117
May 17	10:59:01	California Sea Lion	*Zalophus californianus*	3	32.876983	-118.518833
May 17	10:59:12	California Sea Lion	*Zalophus californianus*	2	32.880800	-118.521250
May 17	10:59:25	California Sea Lion	*Zalophus californianus*	2	32.884267	-118.524183
May 17	11:00:25	California Sea Lion	*Zalophus californianus*	2	32.905033	-118.541500
May 17	11:02:01	California Sea Lion	*Zalophus californianus*	1	32.944550	-118.562367
May 17	11:03:28	California Sea Lion	*Zalophus californianus*	1	32.974867	-118.582683
May 17	11:03:51	California Sea Lion	*Zalophus californianus*	3	32.987083	-118.588217
May 17	11:04:13	California Sea Lion	*Zalophus californianus*	1	32.995717	-118.590733
May 17	11:04:30	California Sea Lion	*Zalophus californianus*	4	32.999833	-118.592383
May 17	11:05:04	California Sea Lion	*Zalophus californianus*	2	33.011733	-118.605717
May 17	11:05:16	California Sea Lion	*Zalophus californianus*	2	33.014583	-118.609300
May 17	11:05:32	California Sea Lion	*Zalophus californianus*	3	33.022667	-118.613183
May 17	11:05:52	California Sea Lion	*Zalophus californianus*	4	33.031400	-118.614333
May 17	11:06:05	California Sea Lion	*Zalophus californianus*	2	33.035200	-118.611300
May 17	11:06:17	California Sea Lion	*Zalophus californianus*	1	33.038050	-118.607083
May 17	11:07:06	California Sea Lion	*Zalophus californianus*	1	33.037283	-118.583083
May 17	11:08:00	California Sea Lion	*Zalophus californianus*	6	33.028000	-118.560250
May 17	11:08:10	California Sea Lion	*Zalophus californianus*	4	33.024017	-118.558483
May 17	11:08:20	California Sea Lion	*Zalophus californianus*	3	33.019900	-118.557033
May 17	11:08:45	Unidentified Dolphin	Delphinidae sp.	45	33.012133	-118.551983
May 17	11:10:08	Risso's Dolphin	*Grampus griseus*	7	33.020083	-118.543783
May 17	11:13:09	California Sea Lion	*Zalophus californianus*	7	32.983983	-118.531867
May 17	11:13:33	California Sea Lion	*Zalophus californianus*	1	32.975133	-118.521633
May 17	11:13:55	California Sea Lion	*Zalophus californianus*	6	32.968917	-118.514700

Date	Initial time	Common Name	Species	Best Count	Latitude	Longitude
May 17	11:15:07	California Sea Lion	*Zalophus californianus*	3	32.945733	-118.490467
May 17	11:20:30	California Sea Lion	*Zalophus californianus*	3	32.941450	-118.399800
May 17	11:29:06	Pacific White-sided Dolphin	*Lagenorhyncus obliquidens*	45	32.975050	-118.323333
May 17	11:31:38	California Sea Lion	*Zalophus californianus*	1	32.963833	-118.323267
May 17	11:50:51	Risso's Dolphin	*Grampus griseus*	11	33.019750	-118.115933
May 17	12:16:03	Risso's Dolphin	*Grampus griseus*	12	33.072933	-117.874150
May 17	12:49:00	Common Bottlenose Dolphin	*Tursiops truncatus*	12	33.157517	-117.460367
May 17	12:49:19	Risso's Dolphin	*Grampus griseus*	35	33.151100	-117.455133
May 17	15:08:01	Unidentified Dolphin	Delphinidae sp.	40	32.876950	-117.287317
May 17	15:09:05	Blue Whale	*Balaenoptera musculus*	1	32.906017	-117.295767
May 17	15:37:43	Common Dolphin Sp.	undifferentiated *Delphinus*	120	32.931883	-117.322500
May 17	15:51:42	Risso's Dolphin	*Grampus griseus*	6	32.883367	-117.620767
May 17	16:27:34	Common Bottlenose Dolphin	*Tursiops truncatus*	22	32.756717	-118.173633
May 17	16:40:26	Risso's Dolphin	*Grampus griseus*	44	32.872117	-118.279533
May 17	17:00:20	California Sea Lion	*Zalophus californianus*	1	32.891150	-118.221350
May 17	17:01:00	California Sea Lion	*Zalophus californianus*	2	32.894617	-118.198833
May 17	17:06:00	California Sea Lion	*Zalophus californianus*	4	32.923517	-118.039067
May 17	17:06:14	Pacific White-sided Dolphin	*Lagenorhyncus obliquidens*	36	32.925900	-118.029100
May 17	17:18:36	Common Dolphin Sp.	undifferentiated *Delphinus*	500	32.949200	-117.901683
May 17	17:37:24	Unidentified Small Marine Mammal possible elephant seal	Pinnipedia sp.(?)	1	33.034400	-117.483783
May 17	17:44:42	Unidentified Dolphin	Delphinidae sp.	180	32.960183	-117.319983
May 18	09:23:12	Unidentified Dolphin	Delphinidae sp.	1	32.819017	-117.390683
May 18	09:23:53	California Sea Lion	*Zalophus californianus*	1	32.826283	-117.384833
May 18	09:28:22	Common Bottlenose Dolphin	*Tursiops truncatus*	50	32.751117	-117.417150
May 18	09:46:39	California Sea Lion	*Zalophus californianus*	**1**	32.613917	-117.806667
May 18	10:08:03	California Sea Lion	*Zalophus californianus*	2	32.751150	-117.647850
May 18	10:20:29	Minke Whale	*Balaenoptera acutorostrata*	1	32.927417	-117.347533
May 18	11:12:36	Blue Whale	*Balaenoptera musculus*	1	33.052383	-117.427600
May 18	11:36:21	Common Dolphin Sp.	undifferentiated *Delphinus*	120	33.135383	-117.453700
May 18	11:47:08	Common Dolphin Sp.	undifferentiated *Delphinus*	45	33.132650	-117.611417
May 18	12:18:10	Common Bottlenose Dolphin	*Tursiops truncatus*	40	32.856050	-117.406717
May 18	12:28:53	Common Bottlenose Dolphin	*Tursiops truncatus*	28	32.972500	-117.514850
May 18	12:47:44	Common Dolphin Sp.	undifferentiated *Delphinus*	1000	33.209883	-117.660100
May 18	13:15:20	Common Bottlenose Dolphin	*Tursiops truncatus*	23	32.924650	-117.554567
May 18	13:22:15	Common Dolphin Sp.	undifferentiated *Delphinus*	70	32.893300	-117.393183

Appendix B May 2010 Focal Follows

Appendix D. List of all focal behavioral follows longer than 5 min conducted during the May SOCAL 2010 aerial monitoring surveys off San Diego, California. Video was taken on some of these groups as indicated in Appendix C. This summary is based on a preliminary "quick look" and should not be considered a detailed analysis or summary of useable video.

Date	Focal Start Time	Focal End Time	Duration of Focal (hr:min:sec)	Video Segment Lengths (hr:min:sec)	Total Minutes of Video (hr:min:sec)	Latitude (Degrees N)	Longitude (Degrees W)	Species	Group Size	Preliminary Focal Notes
13-May	9:39:33	10:05:32	0:25:59	0:11:35 + 0:10:22	0:21:57	32.3607	117.53134	Risso's Dolphin	4	
13-May	10:13:00	10:38:03	0:25:03	0:11:37 + 0:06:24	0:18:01	32.40658	117.59531	Unid. Dolphin	12	
13-May	10:40:18	10:54:10	0:13:52			32.4319	117.50703	Common Dolphin sp.	150	
13-May	11:02:49	11:08:43	0:05:54			32.47385	117.27236	Common Dolphin sp.	300	
13-May	12:44:00	13:38:07	0:54:07	0:01:26	0:01:26	32.58778	117.45364	Common Dolphin sp.	350	
14-May	11:26:09	13:09:49	1:43:40	0:11:33 + 0:02:45 + 0:11:38 + 0:11:32 + 0:11:35 + 0:05:45	0:54:48	33.07076	118.57433	Fin Whale	3	Long focal, 3 fins, possible calf
15-May	12:30:17	12:54:00	0:23:43	0:11:44 + 0:08:12	0:19:56	32.33344	118.03347	Risso's Dolphin	17	
15-May	13:27:23	13:51:40	0:24:17	0:11:43 + 0:08:19	0:20:02	32.24435	117.57964	Risso's Dolphin	33	
15-May	13:53:20	14:18:53	0:25:33	0:11:43	0:11:43	32.28049	117.55447	Risso's Dolphin	23	
15-May	15:26:52	15:49:51	0:22:59	0:11:44	0:11:44	32.45864	117.27497	Risso's Dolphin	15	
16-May	13:54:18	14:17:40	0:23:22	0:11:47 + 0:06:29	0:18:16	33.0512	118.47029	Risso's Dolphin	14	
16-May	14:21:59	14:43:04	0:21:05	0:10:01	0:10:01	33.06788	118.50972	Risso's Dolphin	30	
16-May	14:47:00	14:53:32	0:06:32			33.04202	118.59554	Unid. Large Whale	1	
16-May	15:08:55	15:14:48	0:05:53	0:01:53	0:01:53	33.03013	118.48195	Risso's Dolphin	6	
16-May	15:39:30	15:44:51	0:05:21			33.1743	118.18404	Common Dolphin sp.	300	
17-May	12:16:03	12:36:03	0:20:00			33.04376	117.52449	Risso's Dolphin	12	
17-May	12:49:00	13:18:42	0:29:42			33.09451	117.27622	Common Bottlenose Dolphin	12	
17-May	12:49:19	13:18:36	0:29:17			33.09066	117.27308	Risso's Dolphin	35	Mixed with Tursiops

Date	Focal Start Time	Focal End Time	Duration of Focal (hr:min:sec)	Video Segment Lengths (hr:min:sec)	Total Minutes of Video (hr:min:sec)	Latitude (Degrees N)	Longitude (Degrees W)	Species	Group Size	Preliminary Focal Notes
17-May	15:09:05	15:38:30	0:29:25			32.54361	117.17746	Blue Whale	1	Did focals for over 20 min w video small vessel was passing blue approx 0.5 nm at fast pace when we first saw blue then another small vessel passed later at approx 1 mile
17-May	15:51:42	16:10:09	0:18:27	0:04:48	0:04:48	32.52897	117.3698	Risso's Dolphin	6	Video was on Risso's almost entire 15 min focal while above and below surface
17-May	16:27:34	16:34:35	0:07:01			32.45403	118.10418	Common Bottlenose Dolphin	22	
17-May	16:40:26	16:58:30	0:18:04	0:00:29 + 0:02:09 + 0:11:28 + 0:01:43	0:15:49	32 52.327	118 16.772	Risso's Dolphin	44	
17-May	17:06:00	17:15:00	0:09:00			32.5548	118.02044	California Sea Lion	4	
17-May	17:06:14	17:14:44	0:08:30			32.55554	118.01746	Pacific White-sided Dolphin	36	
17-May	17:18:36	17:25:42	0:07:06			32.56952	117.54101	Common Dolphin sp.	500	
18-May	10:20:29	10:47:42	0:27:13	0:11:38 + 0:03:20	0:14:58	32.55645	117.20852	Minke Whale	1	
18-May	11:12:36	11:31:23	0:18:47	0:01:28 + 0:01:30 + 0:01:30	0:04:28	33.03143	117.25656	Blue Whale	1	
18-May	11:36:21	11:41:28	0:05:07			33.08123	117.27222	Common Dolphin sp.	120	
18-May	12:28:53	12:34:57	0:06:04			32.5835	117.30891	Common Bottlenose Dolphin	28	
18-May	12:47:44	12:58:41	0:10:57			33.12593	117.39606	Common Dolphin sp.	1000	

TOTALS: >5 min focals for May= 10

>10 min focals for May= 20

Appendix C List of May 2010 Video

Appendix E. Video recorded during May SOCAL 2010 aerial monitoring surveys off San Diego, California based on preliminary "quick look" review.

Video Name (Draft)	Date 2010	Video Start Time	Video End Time	Total Video (min)	Preliminary Species Identification	Preliminary Video Notes
SOCAL May 2010_Video_13 May_094125_IDXX_Rissos	May-10	9:41:25	9:53:00	0:11:35	Risso's Dolphin	spread out, all different orientations,0.5 to 30 body lengths apart, milling, multiple breaches, split into subgroups
SOCAL May 2010_Video_13 May_095238_IDXX_Rissos	May-10	9:52:38	10:03:00	0:10:22	Risso's Dolphin	3-8 body lengths apart, 2 subgroups, slow travel, oriented at 240, one animal approx. 40 body lengths away from other groups, milling, low level social, shift in position to slow travel
SOCAL May 2010_Video_13 May_101623_IDXX_UnIdDolphin	May-10	10:16:23	10:28:00	0:11:37	Unidentified Dolphin, probable Common Dolphin sp.	spread out, slow travel, milling, oriented at 290, potential reaction to aircraft, 1000 ft., 1-6 body lengths apart, 4 animals, 2 subgroups
SOCAL May 2010_Video_13 May_102736_IDXX_UnIdDolphin	May-10	10:27:36	10:34:00	0:06:24	Unidentified Dolphin	orientation at 270, spyhop ?, 3 animals,0 .5- 4 body lengths apart, 2 subgroups, subsurface, slow travel
SOCAL May 2010_Video_13 May_112121_IDXX_commonsp.	May-10	11:21:21	11:33:00	0:11:39	Common Dolphin sp.	300-500 indiv., surface active travel, milling, oriented at 220, dispersal is less than 1 throughout, no change in behavior, heading S, no calves seen, many seagulls traveling with the dolphin, slight zigzagging, the stragglers are approx. 40 body lengths away from main group
SOCAL May 2010_Video_13 May_113227_IDXX_commomsp.	May-10	11:32:27	11:44:00	0:11:33	Common Dolphin sp.	15 body lengths apart, oriented at 220, group size remains the same
SOCAL May 2010_Video_13 May_114434_IDXX_commonsp.	May-10	11:44:34	11:46:00	0:01:26	Common Dolphin sp.	oriented at 230, birds above dolphins at surface
SOCAL May 2010_Video_13 May_121923_IDXX_UnIdDolphin	May-10	12:19:23	12:31:00	0:11:37	Unidentified Dolphin	mill/travel, oriented 240, dispersal 1-4 and 1-1, milling all directions, angle 22, oblong egg group shape, wider than long, 3 gulls above them, surface-active, angle 21, 1500 ft. after 10 minutes went to 1000 ft.
SOCAL May 2010_Video_13 May_122534_IDXX_UnIdDolphin	May-10	12:25:34	12:29:00	0:03:26	Unidentified Dolphin	
SOCAL May 2010_Video_13 May_122818_IDXX_Casealion	May-10	12:28:18	12:29:00	0:00:42	California Sea lion	3 individuals seen
SOCAL May 2010_Video_13 May_124728_IDXX_Commonsp.	May-10	12:47:28	12:59:00	0:11:32	Common Dolphin sp.	slow travel, leaping, very rapid movement of one animal in middle of others, long line, oriented at 200 and 210, poss. reaction to aircraft, shift between a blob and one that was milling in a long line, medium travel with some white water, disperal of 1-10, medium travel, now wider than long

Video Name (Draft)	Date 2010	Video Start Time	Video End Time	Total Video (min)	Preliminary Species Identification	Preliminary Video Notes
SOCAL May 2010_Video_13 May_125928_IDXX_Commonsp.	May-10	12:59:28	13:11:00	0:11:32	Common Dolphin sp.	slow travel, 1 and 1-3 body lengths, oriented at 220, wing formation, split into subgroups, overall movement from group to group, leap, breach, egg shape, wider than long, very surface active
SOCAL May 2010_Video_13 May_131740_IDXX_Commonsp.	May-10	13:17:40	13:22:00	0:04:20	Common Dolphin sp.	ragged line, wider than long, oriented towards the north, medium travel, now longer than wide, dispersal 1-4, close to them presumably within cone, oriented at 020, milling, moving towards 300, no obvious reaction to airplane, evenly spaced 1-2, oriented now at 330
SOCAL May 2010_Video_14 May_112927_IDXX_Fin	May-10	11:29:27	11:41:00	0:11:33	Fin whale	huge mola mola seen, been down for 4 minutes, blow, whale scat seen, just below surface, 1 adult, oriented 090, poss calf
SOCAL May 2010_Video_14 May_114115_IDXX_Fin	May-10	11:41:15	11:44:00	0:02:45	Fin whale	Logging at surface, full size adult, subsurface,
SOCAL May 2010_Video_14 May_114422_IDXX_Fin	May-10	11:44:22	11:56:00	0:11:38	Fin whale	blow, oriented 090, slow travel, subsurface, 1 animal, angle 8 degrees, visibility decreasing, whale just below surface
SOCAL May 2010_Video_14 May_115528_IDXX_Fin	May-10	11:55:28	12:07:00	0:11:32	Fin whale	fin whale, slow travel, resting at times, subsurface, occasionally blowing
SOCAL May 2010_Video_14 May_120725_IDXX_Fin	May-10	12:07:25	12:19:00	0:11:35	Fin whale	blow, oriented 210, not quite sure if it is same animal as before, laying just below surface motionless, occasionally blowing,0 .5- 6 body lengths apart, slow travel, now oriented at 250, poss. 2 pairs, 3 animals, one rolled up under the kelp, defecation seen on video, 2 mola molas
SOCAL May 2010_Video_14 May_121815_IDXX_Fin	May-10	12:18:15	12:24:00	0:05:45	Fin whale	occasional blows, oriented at 200, 3 animals, defecation, dispersal is over 10 body lengths, one whale moving away from other 2, oriented at 360
SOCAL May 2010_Video_15 May_123217_IDXX_Rissos	May-10	12:32:16	12:44:00	0:11:44	Risso's Dolphin	dispersal 1-8, 16 animals, slow travel to 060, angle 14 degrees, milling, different heading, 800 ft. cloud cover not allowing to go higher, line abreast formation, no calves seen, 2 subgroups, dorsals breaking the surface
SOCAL May 2010_Video_15 May_124348_IDXX_Rissos	May-10	12:43:48	12:52:00	0:08:12	Risso's Dolphin	dispersal less than 1 to 6 body lengths, in oval formation, below surface, animals spread out to 1 to 8 body lengths, mostly below surface, oriented 300, spread out longer then wider, couple still clumped, staggered line abreast, now in u shape with small clumps, 2 in lead, rest behind line abreast, whales move close together, angle 19, less than 900 ft.

Video Name (Draft)	Date 2010	Video Start Time	Video End Time	Total Video (min)	Preliminary Species Identification	Preliminary Video Notes
SOCAL May 2010_Video_15 May_133017_IDXX_Rissos	May-10	13:30:17	13:42:00	0:11:43	Risso's Dolphin	just below surface, oriented 310, line abreast, slow travel, dispersal 1-3 and 1-4, 3 groups, one with 10 animals, other with 8 animals, always visible at or below the surface, groups are less than 100 meters apart, 2 groups coming together, third group still behind, 2 groups have formed as one with 23 indiv., bird flock formation, second group behind with 9 animals.
SOCAL May 2010_Video_15 May_134141_IDXX_Rissos	May-10	13:41:41	13:50:00	0:08:19	Risso's Dolphin	dispersal 1-3 and 1-4, subgroup is line abreast, and 70 body lengths from large group, oreinted at 240, inverted triangle formation, 25 in main group, 2 tail slaps, dispersal now 1-6, subgroup now 30 body lengths behind main group and to the left, other group now 15 body lengths away, subgroup is milling, main group line abreast in a letter C formation, angle is 18 degrees, unident. splash,
SOCAL May 2010_Video_15 May_140217_IDXX_Rissos	May-10	14:02:17	14:14:00	0:11:43	Risso's Dolphin	brief social, disperal is 1-7, oriented at 240, one mother-calf group, line abreast, angle is 21 degrees, dispersal now 1-5, now oriented 210, staggered line abreast over a large area, dispersal now 1-10,
SOCAL May 2010_Video_15 May_141356_IDXX_Rissos	May-10	14:13:56	14:18:00	0:04:04	Risso's Dolphin	maternal group staying to the side of main group, dispersal is less than 1 to 6, animals seem to stay headed the same direction all day, dispersal now less than 1 to 5, milling, spread out, longer than wider, oriented at 240 and 210, angle is 16 degrees
SOCAL May 2010_Video_15 May_153016_IDXX_Rissos	May-10	15:30:16	15:42:00	0:11:44	Risso's Dolphin	disperal 1-4, oriented to 8 o'clock, clumped line abreast, longer line than wide, oriented 180, subsurface
SOCAL May 2010_Video_16 May_155829_IDXX_Risso's	May-10	15:58:29	16:10:16	0:11:47	Risso's Dolphin	Surface- active travel with rooster tails, group in an inverted triangle, 14 individ., oriented at 030 and 060, dispersal 1-15, single animal in back 100 body lengths, 600 ft, spread out in an elongated line, line abreast towards end of video
SOCAL May 2010_Video_16 May_161015_IDXX_Risso's	May-10	16:10:15	16:16:44	0:06:29	Risso's Dolphin	Surface-active travel, group still oblong than wide, oriented at 060, dispersal 1-15, rooster tailing, no calves seen, white water seen when dolphin come to surface, angle is 11 degrees, 700 ft
SOCAL May 2010_Video_16 May_163157_IDXX_Risso's	May-10	16:31:57	16:41:58	0:10:01	Risso's Dolphin	Surface-active, dispersal 1-20 and 1-10, 30 indiv., slow travel, oriented to 120, group in broad oval
SOCAL May 2010_Video_16 May_171207_IDXX_Risso's	May-10	17:12:07	17:14:00	0:01:53	Risso's Dolphin	dispersal is 1-20, shallow dive

Video Name (Draft)	Date 2010	Video Start Time	Video End Time	Total Video (min)	Preliminary Species Identification	Preliminary Video Notes
SOCAL May 2010_Video_17 May_102724_Casealion	May-10	10:27:24	10:38:50	0:11:26	California Sea Lion	16 CA sea lion
SOCAL May 2010_Video_17 May_104902_IDXX_UnidPinnCAsea lion	May-10	10:49:02	11:00:28	0:11:26	Unidentified Pinniped_CA sea lion	1 unidentified pinniped, 24 CA sea lion, voice only no video
SOCAL May 2010_Video_17 May_110029_IDXX_Casealion_Unid Dolp_Risso's	May-10	11:00:29	11:11:54	0:11:25	California Sea Lion_Unid Dolphin_Risso's	37 Cal. Sea lion, voices only, no video, unidentified dolphin, vocals hard to understand, poss 30-45 dolphin, 5 Rissos's
SOCAL May 2010_Video_17 May_160452_IDXX_Risso's	May-10	16:04:52	16:09:40	0:04:48	Risso's Dolphin	6 animals, slow travel, dispersal 1-2, in tight ball, shallow dive, oriented at 270, subsurface, angle 16
SOCAL May 2010_Video_17 May_160452_IDXX_Risso's	May-10	16:42:31	16:43:00	0:00:29	Risso's Dolphin	Dispersal is 1-2, a big group, on line 4 of NAOPA, at 3 o'clock
SOCAL May 2010_Video_17 May_164231_IDXX_Risso's	May-10	16:43:01	16:45:10	0:02:09	Risso's Dolphin_CA sea lion	oval longer than wider group shape, oriented at 270, dispersal 1-2, approx. 34 indiv., 1700 ft., 1 CA Sea Lion
SOCAL May 2010_Video_17 May_164301_IDXX_Risso's_Casealio n	May-10	16:45:12	16:56:40	0:11:28	Risso's Dolphin	24 angle for CA Sea Lion, 54 angle for Risso's, slow travel, 1-2 and 1-3 and 1-4 dispersal, oval longer then wider group size, oriented at 270 and 300, no calves seen, 44 animals, line abreast, 1500 ft.
SOCAL May 2010_Video_17 May_164512_IDXX_Risso's	May-10	16:56:39	16:58:22	0:01:43	Risso's Dolphin	wider than longer group size, slow travel, oriented at 300, dispersal 1-4, two lines, no vessels in view, angle is 44, 1500 ft.
SOCAL May 2010_Video_18 May_103224_IDXX_Minke	May-10	10:32:24	10:44:02	0:11:38	Minke Whale	multiple blows, oriented at 1 o'clock, subsurface, variable dive times
SOCAL May 2010_Video_18 May_104422_IDXX_Minke	May-10	10:44:22	10:47:42	0:03:20	Minke Whale	blow, surfaced very briefly
SOCAL May 2010_Video_18 May_111452_IDXX_Blue	May-10	11:14:52	11:16:20	0:01:28	Blue Whale	Blue whale, boat went next to whale and whale defecated, multiple blows, oriented at 220, slow travel,
SOCAL May 2010_Video_18 May_112720_IDXX_Blue	May-10	11:27:20	11:28:50	0:01:30	Blue Whale	blow, flukes
SOCAL May 2010_Video_18 May_112852_IDXX_Blue	May-10	11:28:52	11:30:22	0:01:30	Blue Whale	whale not visible

Appendix D Selected Photographs of Sightings

All photos by Mari A. Smultea courtesy of Smultea Environmental Sciences.

Blue whale (Balaenoptera musculus) traveling at the surface (below left) and diving (below right) on May 17th in NAOPA. The relatively light body coloration of blue whales allows observers to track them underwater for longer periods of time and at deeper water depths than darker whale species.

Common dolphins (Delphinus sp.) (below left) surface-active fast traveling (porpoising) and common dolphins (Delphinus sp.) (below right) with sea gulls, surface-active fast traveling/possible feeding, on 17 May 2010 in NAOPA. Photos by Mari Smultea courtesy of Smultea Environmental Sciences.

Common dolphin (Delphinus sp.) (below left) mother and calf surface-active traveling in a group of commons on 17 May 2010 in NAOPA. Common dolphins (Delphinus sp.) (below right) (including a calf on bottom right) surface-active fast traveling on 17 May 2010 in NAOPA. Photos by Mari Smultea courtesy of Smultea Environmental Sciences.

Pacific white-sided dolphins (Lagenorhynchus obliquidens) (below bottom) surface-active fast traveling on 17 May 2010 in NAOPA. Common bottlenose dolphins (Tursiops truncates) (below top) traveling on 17 May 2010 in NAOPA. Photos by Mari Smultea courtesy of Smultea Environmental Sciences.

Risso's dolphin (Grampus griseus) (below) slow traveling on 17 May 2010 in NAOPA. Note how the dolphins are readily visible below the water surface due to their light body coloration. This enables observers to track them for longer periods of time underwater than darker cetacean species. Photos by of Mari Smultea courtesy of Smultea Environmental Sciences.

Aerial Survey Marine Mammal Monitoring off Southern California in Conjunction with US Navy Major Training Events (MTE)

SOCAL July, 2010

Surveys July 27 – August 3

Draft Report

SES
SMULTEA ENVIRONMENTAL SCIENCES, LLC

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Cover Photos: Blue whale (Balaenoptera musculus), photographed with a telephoto lens from the Partenavia in the SOCAL 2010, and the Bell 206 helicopter and Partenavia Observer fixed-wing airplane used during the July 2010 SOCAL aerial survey monitoring . Photos of blue whale and helicopter by Mari A. Smultea/SES; photographer of Partenavia unknown. Cover page design and layout by Kate Lomac-MacNair and Roxann Merizan.

Section 1 Introduction

In support of the U.S. Navy's (Navy) Marine Mammal Monitoring Plan (M3P) in the Southern California Range Complex (SOCAL) (DoN 2009), aerial surveys were conducted by Smultea Environmental Sciences (SES) to monitor marine mammals and sea turtles (MM/ST) during July 2010 in the SOCAL area off San Diego, California. This was the seventh such aerial survey in SOCAL conducted by SES or SES/Marine Mammal Research Consultants (MMRC). Monitoring occurred before, during, after and in conjunction with several Navy Major Training Events (MTEs) involving mid-frequency-active sonar (MFAS). Portions of these MTEs occurred in and near offshore waters of the Southern California Anti-submarine Warfare Range (SOAR) west of San Clemente Island (Figure 1). Naval training has been conducted within SOCAL for over 40 years, and marine mammals are also known to be abundant there (e.g., summarized in Carretta et al. 2000, 2008; DoN 2008, 2009).

The contracted work involved considerable planning, communications and clearances with and by the Navy Technical Representative (NTR) given the logistical complexity and high degree of safety planning associated with the MTEs.

Project questions and hypotheses were developed by SES based on the five questions identified in the Navy's SOCAL M3P designed to assess potential effects of MFAS and underwater detonations on MM/ST during Navy MTEs (DoN 2009; see Smultea et al. 2009a,b). An important factor limiting the ability to assess potential effects of MFAS in this report is that the Navy did not disclose MFAS transmission times and locations for national security reasons. Thus, it is not possible for us herein to compare data from specific operational MFAS "on" and "off" periods during MTEs, nor data on distance and relative location of MFAS sources vs. sightings.

Protocol was the same as that implemented for aerial surveys in SOCAL in November 2009 (Smultea and Lomac-MacNair 2010) and May 2010 (Smultea et al. 2010). The survey purpose was to obtain baseline data and monitor for potential effects of MTEs on marine mammals (see Smultea et al. 2009a,b, Smultea and Lomac-MacNair 2010). However, for the first time during the total seven surveys, a helicopter (Bell XXX) was used for part of the survey to assess the feasibility and utility of this platform to address survey goals, particularly collecting behavioral data using focal follow techniques by circling sightings for extended periods and obtaining video (see Methods below).

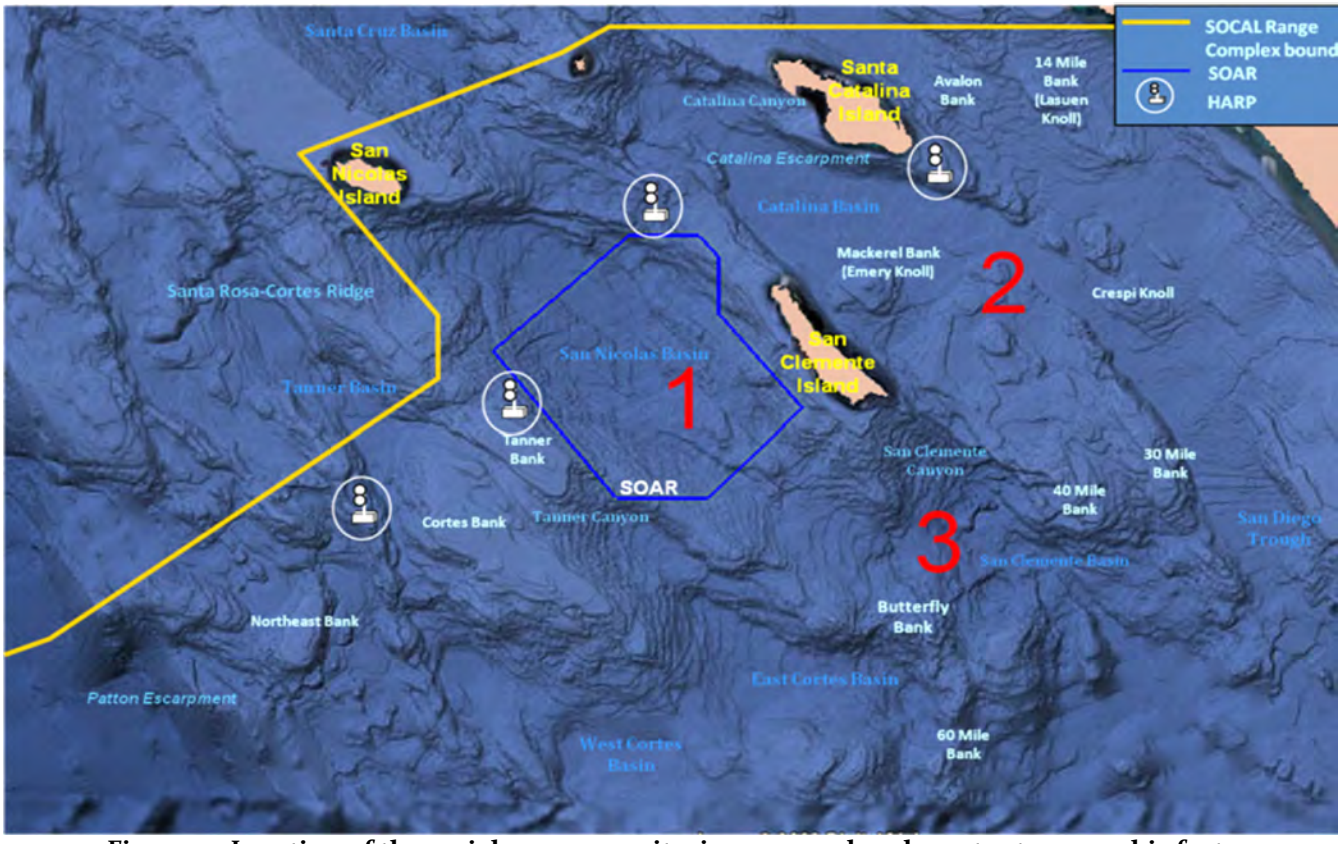

Figure 15. Location of the aerial survey monitoring area and underwater topographic features within the Navy's Southern California Range Complex (SOCAL). Numbers indicate survey areas of interest to the Navy in order of priority; orange line designates the SOCAL boundary; blue lines designate the Southern California Offshore Anti-submarine Warfare Range (SOAR); icons are approximate locations of Navy-funded bottom-mounted passive- acoustic high-frequency acoustic recording packages (HARPs).

Section 2 Methods

Two aircraft were used for the survey: (1) a fixed-wing, twin-engine Partenavia Observer with a glass nose (the same one used on our previous SOCAL surveys), and (2) a Bell 206 helicopter (front cover). Both aircrafts were owned and operated by Aspen Helicopters, Oxnard, California. This was the first time a helicopter had been used for a survey; the goal was to evaluate the feasibility of this platform for conducting focal observations given its advantages of larger and multiple-opening windows and the ability to circle at a slower speed around focal groups. The only opening window in the Partenavia was a small (approximately 4-inch diameter) flip-up circular window in the right front seat where the recorder/videographer/photographer sat (Figure 3). Two observers sat in the two middle seats of the plane and looked through bubble windows (that did not open). In the helicopter, 12 by 12 inch sliding windows opened in the rear two seats where two observers sat, and an approximately 6 by 12 inch sliding window opened in the front left seat where the recorder/photographer sat (Figure 4). In the helicopter, the pilot sat in the right front seat while the survey recorder/photographer sat in the left

The primary survey areas were the SOAR west of San Clemente Island (SCI) (as permitted given Navy exercise activities) and the Northern Air Operating Area (NAOPA) range between SCI and the mainland coast (Figure 1). "Search", "verify", and "focal follow" modes were implemented as described in Smultea et al. (2009a,b, 2010a,b). Notably, sea turtles were considered unlikely to be seen in the MTE based on available data and none have been seen during this or our past aerial surveys (reviewed in DoN 2008).

As described in Smultea et al. (2009a), priority species were (1) MM/ST exhibiting unusual or distressed behavior, (2) near-stranded, stranded, or dead MM/ST, (3) MM/ST species listed as endangered or threatened under the ESA, (4) beaked whales, and (5) Risso's dolphins considered potential "surrogate" representatives for deep-diving beaked whales (see DoN 2009). Past surveys have shown that Risso's dolphins are the easiest small cetacean to track during focal follows given their light body coloration that increases ability to track them underwater, their tendency to travel slowly at and near the water surface often for extended periods, and their apparent tolerance of close vessels and small aircraft (Smultea et al. 2010b, SES unpublished data).

Line-transect "search" effort was flown at altitude 1000 ft and speed 100 kts; occasionally, we flew as low as 700 ft altitude (as permitted by a Letter of Confirmation [LoC] for a General Authorization [GA] issued by NMFS to SES) over non-ESA-listed species to photo-verify species (i.e., "verify" mode), or when low clouds necessitated lower flight altitude. If an ESA-listed species was seen, the aircraft immediately moved above 1000 ft altitude and 1 km radial distance, as applicable, as specified in the GA. During focal follows, aircraft were flown in at altitudes of 1200-1500 ft and radial distances of approximately 1 km to remain outside the expected 13-degree-radial "Snell's sound cone" produced by the aircraft (i.e., beyond where the animals could hear the aircraft below the water). Clockwise circles were flown in the Partenavia since the only opening window for observers was in the front right seat; video and photographs were taken through this window. Counter-clockwise circles were flown by the helicopter since two observers were on the left hand side. As in past surveys, we used two Apple iTouches for field data collection (one for line-transect and one for focal behavior data).

A Sony HD HDR-XR550 12.0 megapixels video camera with a 10x zoom lens, internal image stabilization, and a 1.4 power converter lens were used to video focal follow groups. The video camera was mounted on a 30-cm telescoping chest pod to improve stabilization. (A Canon HD video camera was used during the five aerial surveys prior to May 2010).

Section 3 Results

This section follows the format of the Nov 2009 and May 2010 SOCAL aerial survey monitoring reports (Smultea et al. 2010a,b). Results are summarized in Tables 1 - 3, Figures 2 - 7, and Appendices A - G. However, unlike previous reports, **Error! Reference source not found.** indicates aerial survey days when MTES-associated MFAS was operating in SOCAL. This activity occurred on five of the seven July 2010 survey days, including the first survey date of July 27.

Effort

A total of 18.1 hr of flight time and 3125 km (1688 nm) of effort were conducted during the May 2010 SOCAL aerial survey between aircraft "wheels up" off the ground to "wheels down" when the plane landed (Table 1 and Table 2). Surveys were flown on seven days from July 27 to August 3 (0); no survey occurred on August 31 due to aircraft mechanical repair needs. Most (74% of 14.3 hrs) effort occurred with the fixed-wing aircraft on four days (July 29-31, August 2-3). The remaining 26% (5.1 hr) occurred from the helicopter on the first two survey days (July 27-28). Overall, most (50%) of the total 3125 km of effort involved circling sightings for focal follows and/or species identification. This was followed by transit (21%) and systematic line-transect (19%) (Table 11). Beaufort sea state rating (Bf) ranged from 1-5 during the July survey. Bf 3 predominated (16%) followed by Bf 2 (12%) (Figure 11). July and August 2010 had an unusually high number of days with a heavy low marine fog layer over the SOCAL. During the survey period, heavy fog typically persisted through the morning until early afternoon and returned in early evening. Even in the middle of the day, when the marine layer sometimes lifted, the ceiling was low (approximately 1000-2000 ft). Effort occurred in SOAR west of San Clemente Island only on July 30 and was limited to the two northernmost survey lines due to low clouds and to avoid airspace conflicts with Navy activities as directed by Navy personnel (Table 1, Table 2, 0). Remaining effort occurred in NAOPA. Helicopter effort occurred in coastal areas usually within ~15 km of the coastline and ~60 km from San Diego. Helicopter effort was focused there because the range of this aircraft with four personnel onboard was about 2.7 hr and the hourly cost to operate it was about 2.5 time higher than the cost of the Partenavia fixed-wing plane.

Sightings

A total of 86 sightings of ~11,090 individual marine mammals was observed (Table 12 and 0). Of the total 86 sightings, 78% were identified to species (n = 27) or genus (n = 40 common dolphin sp.). Not all sightings were identified to species because there was not always time to fly off course to identify and circle sightings. Rather, the priorities were to conduct focal follows on priority species and/or to reach and conduct a full survey in SOAR which required a full tank of fuel to complete (i.e., there was not enough fuel to circle species seen en route to or from the airport and SOAR). Seven different marine mammal species were identified. Sightings included two baleen whale species (blue and fin whales), four dolphin species (bottlenose, short- and long-beaked common, Risso's), and one pinniped species (California sea lion). Overall, the common dolphin was the most frequently identified species genus (47% or 40 of 86 total groups) followed by the blue whale (21% or 18 groups). In terms of number of individuals seen, the common dolphin was also the most abundant (n = ~9354 or 84% of the total ~11,090 individuals seen). Photographs are currently being reviewed by Dr. T.A. Jefferson to differentiate and verify short- and long-beaked common dolphins, as has been done for past surveys.

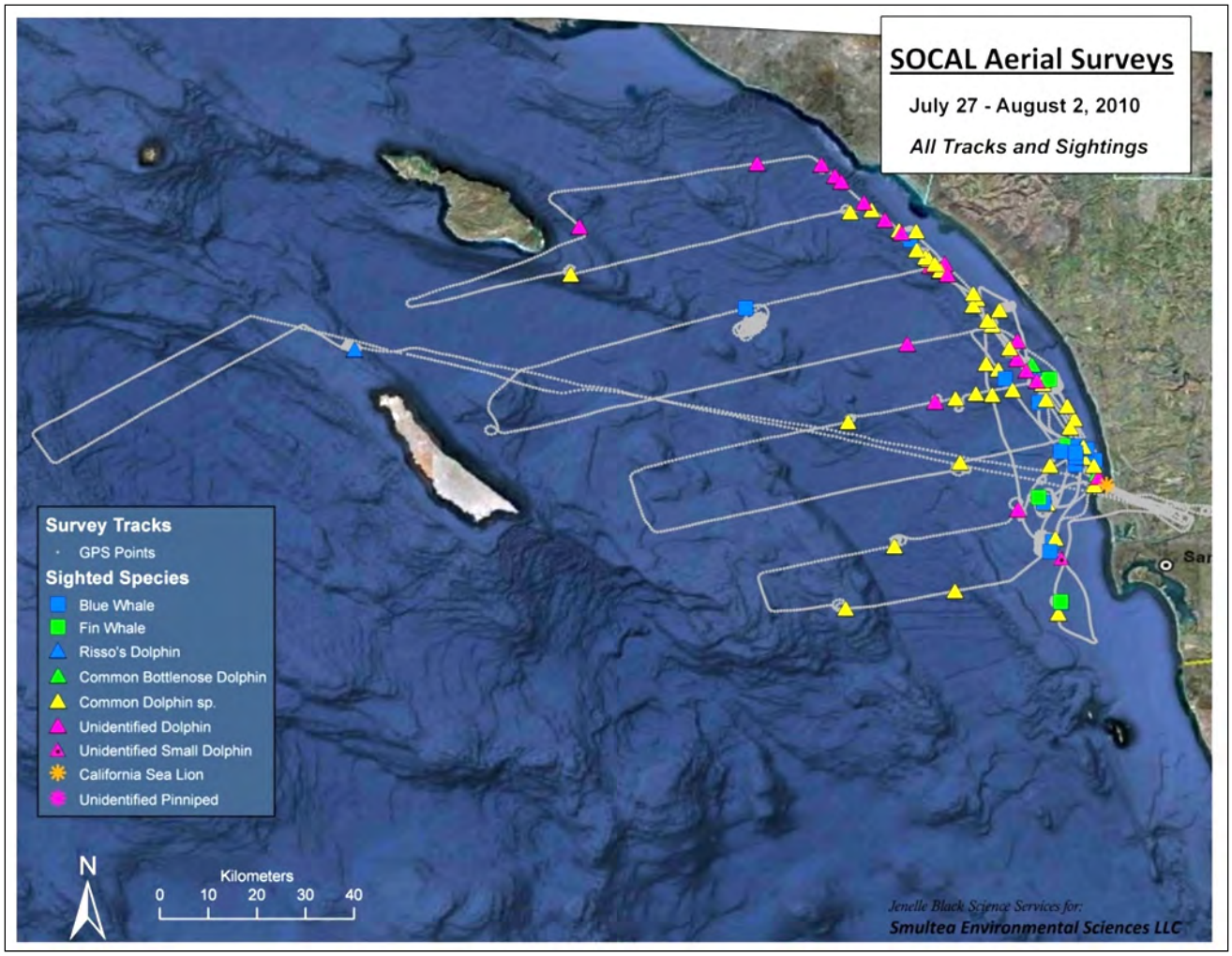

Figure 16. All track lines and sightings made during aerial monitoring surveys in SOCAL July 27 – August 3, 2010

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Table 15. Aerial survey flight times, total hours (hh:mm) by date, and survey area during the July 2010 SOCAL aerial survey

Date 2010	Platform	Location	Time Lift Off	Time Landed	Total Flight Time	Total Engine Time	Start Observ	End Observ	Total "On Effort" Observ	MTE-assoc. MFAS?	Survey Notes
July 27	Helicopter Bell 206	Coastal NAOPA	14:01	16:35	02:34	02:41	14:06	16:29	01:20	Yes	Assessing effectiveness of helicopter as platform for focal behavioral observations with Bernd Wuersig. Flew <5 km from coast. Heavy morning fog/low clouds. Ceilings 1400-1600 ft, fog/heavy overcast. Conducted focals near San Diego on feeding blue and fin whales, observed frequent defecation.
July 28	Helicopter Bell 206	Coastal NAOPA	13:37	16:08	02:31	02:40	13:42	16:03	01:36	No	Assessing effectiveness of helicopter as platform for focal behavioral observations with Bernd Wuersig. Flew <15 km from coast south to Mexican border. Heavy fog/low clouds in morning delayed departure to afternoon when ceiling was 1400-1500 ft/heavy overcast. Conducted focal on feeding blue and fin whales again in same area as yesterday.
July 29	Partenavia OBS	NAOPA (SOAR fogged in)	14:29	16:39	02:11	02:34	14:33	16:19	00:30	Yes	Flying Partenavia Observer. Heavy fog/low clouds delayed departure until afternoon. Conducted focals on feeding blue and fin whales again in same area as yesterday.
July 27	Helicopter Bell 206	Coastal NAOPA	14:01	16:35	02:34	02:41	14:06	16:29	01:20	Yes	Assessing effectiveness of helicopter as platform for focal behavioral observations with Bernd Wuersig. Flew <5 km from coast. Heavy morning fog/low clouds. Ceilings 1400-1600 ft, fog/heavy overcast. Conducted focals near San Diego on feeding blue and fin whales, observed frequent defecation.
July 28	Helicopter Bell 206	Coastal NAOPA	13:37	16:08	02:31	02:40	13:42	16:03	01:36	No	Assessing effectiveness of helicopter as platform for focal behavioral observations with Bernd Wuersig. Flew <15 km from coast south to Mexican border. Heavy fog/low clouds in morning delayed departure to afternoon when ceiling was 1400-1500 ft/heavy overcast. Conducted focal on feeding blue and fin whales again in same area as yesterday.
July 30	Partenavia OBS	N SOAR	13:45	16:05	02:20	02:38	14:18	15:29	01:11	No	N SOAR range open, flew over cloud cover to San Clemente then dropped and flew two N SOAR lines, flew over cloud cover return trip.
July 31	Partenavia OBS	S NAOPA (SOAR fogged in)	14:27	18:27	04:00	04:18	14:31	18:21	03:22	Yes	Heavy fog/low clouds delayed departure until afternoon. Focals on blue whales in NAOPA; SOAR fogged in/ inaccessible.
August 1	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	No flight. Aircraft grounded due to mechanical issues
August 2	Partenavia OBS	Central NAOPA	14:45	17:52	03:07	03:24	14:49	17:46	02:37	Yes	Mechanic fixed plane by 1 pm. Flew N NAOPA lines. Focal on blue whales.
August 3	Partenavia OBS	N NAOPA	15:27	18:07	02:40	02:52	15:31	18:00	1:40	Yes	Extra unscheduled survey day in NAOPA. Heavy fog/low clouds delayed departure until afternoon. Low clouds all day limited ability to do effective focals.
			Total Flight Time		19:23	21:07	**Total Observ.Time**		12:17		

Table 16. Definitions and summary of aerial survey effort (km and nm) by leg type during the July 2010 SOCAL MTE aerial surveys.

Leg Type	Leg Type Definition	Total km Flown	Total nm Flown	Total hrs Flown
Systematic	Pre-determined line-transect legs located in SOAR, NAOPA and FLETA HOT	592	320	3.0
Random	Short lines connecting longer systematic lines	111	60	0.5
Transiting	Flying between the airport and the survey grid locations	654	353	3.8
Navy-Directed Transiting	Flying off intended course as directed by Navy during a survey to avoid Navy activities	0	0	0
Circling	Flying clockwise circles around sightings to verify species and group size via photography and/or to conduct focal behavioral sessions with videography as possible	1549	836	10.0
Circumnavigating Coast	Flying parallel to SCI coastline approximately 0.5 km offshore to search for potential strandings	0	0	0
Fog Effort	Transiting above fog layer with limited or no visibility to water	220	119	0.9
TOTAL		3125	1688	18.1

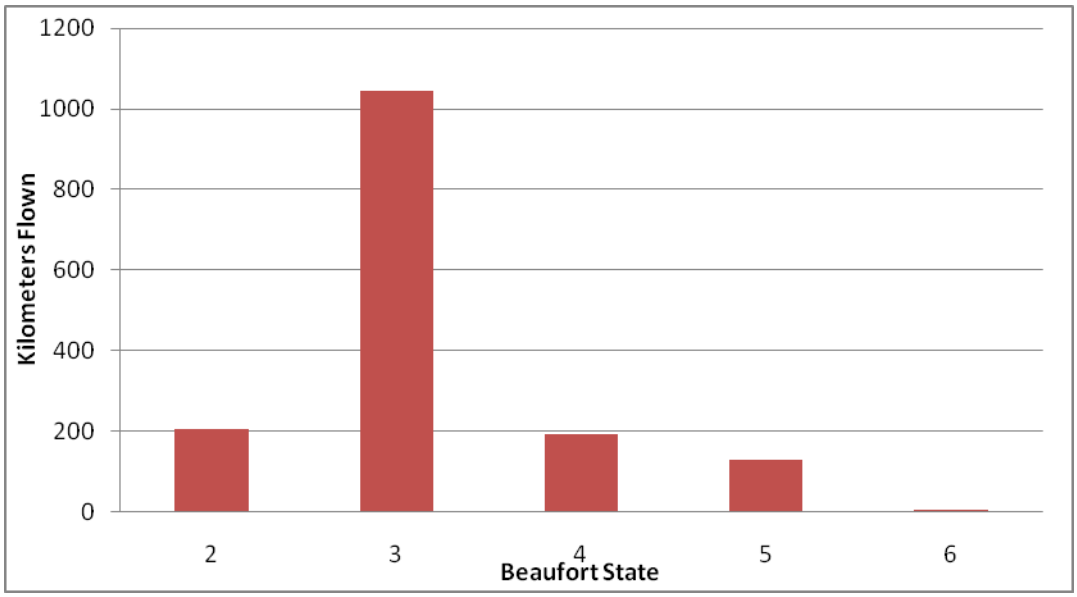


Figure 17. Summary of aerial survey effort (km) by Beaufort sea state during the July 2010 SOCAL MTE aerial survey. Includes only Random, Systematic, and Transiting survey effort.

Table 17. Summary of marine mammal sightings by species during the July SOCAL 2010 MTE aerial surveys. Sightings organized in order of frequency observed starting with those seen most commonly.

Species (Common Name)	Scientific Name	Total No. of Sightings	Total Estimated No. Individuals
Common Dolphin sp.	*Delphinus* spp.	40	9,354
Blue Whale	*Balaenoptera musculus*	18	44
Unidentified Dolphin	Delphinidae spp.	17	1,392
Fin Whale	*Balaenoptera physalus*	4	7
Common Bottlenose Dolphin	*Tursiops truncatus*	3	62
Unidentified Small Dolphin	Delphinidae sp.	2	220
California Sea Lion	*Zalophus californianus*	1	2
Risso's Dolphin	*Grampus griseus*	1	9
Totals:		86	11,090

Sighting Rates

Sighting Rates are tabulated in several 0 tables, due to their large sizes. Tables C-1 and C-2 compare sighting rates based on combined systematic, random and transit effort (i.e., point-to-point linear effort) for various species and species groups during the November 2009 and May and July 2010 SOCAL aerial surveys. (See Smultea and Lomac-MacNair 2010 for other results of the November 2009 SOCAL aerial survey.) Sighting rates based on the number of *groups* sighted per km, per nm and per hour (i.e., number of sightings) are shown separately in Table C-1; the number of *individuals* sighted per unit effort is displayed in Table C-2. During July 2010 only, sighting rates were highest for common dolphins and blue whales based on both numbers groups and individuals per km and hr. Other species were seen at considerably lower sighting rates due to fewer sightings per unit effort. Differences were evident in the seasonal sighting rates of a number of marine mammal species. Sighting rates of Risso's dolphins were remarkably higher in May than in November and July. In contrast, sighting rates for individual common dolphins were roughly three times higher in July and November vs. May. Blue whale sighting rates were also highest in July, and were considerably lower for May and November. Pacific white-sided dolphins and California sea lions were absent or virtually absent in July; reduced densities of these two species are expected during summer based on past surveys in SOCAL (Carretta et al. 2000?). Bottlenose dolphins were not seen in November. However, fin whale sighting rates were similar across all three survey months. The overall number of marine mammal sightings per unit effort were also similar across November, May and July. However, the sighting rate based on number of individual marine mammals seen per hour was about three times higher in November than May and twice as high in July as May. Sighting rates by survey effort type based on number of groups and number of individuals per unit of effort (i.e., per km, nm, and hour) are provided in Tables C-3 and C-4, respectively. (See Table 2 for definitions and total km and nm of effort types.) In July, overall marine mammal sighting rates were about two to four times higher during transit vs. random and systematic effort. This was believed to have been an artifact of flying over a known area of marine mammal concentration near San Diego and La Jolla every day en route to and from Montgomery Airport. In contrast, systematic and random effort included large areas where we have found marine mammal densities to be relatively low. Sighting rates were similar across

systematic effort for the three survey months, but differed for transit and random effort. During random effort, individual sighting rates were five to seven times higher during May vs. November and July, most evidently for dolphins. For transit effort, individual sighting rates were at least five times higher during July vs. May and November. There was less difference across survey months for group sighting rates. See Smultea et al. (2010) for further discussion of sighting rates during SCI circumnavigation effort, this effort type did not occur in July 2010.

Distribution

Effort Distribution

In July 2010, three (July 27-29) of the seven survey days were dedicated to opportunistic focal observations and did not entail systematic search effort (see **Error! Reference source not found.**, Table 10, and 0). The remaining four days were line-transect survey effort: three days in NAOPA and one day in SOAR. Although access to SOAR was permitted by the Navy on two days from 10:00-15:00, fog precluded this effort except for the afternoon of July 30th on the two northernmost lines of SOAR. NAOPA and SOAR transect lines were the same as those followed in November 2009 and May 2010 (Smultea and Lomac-MacNair 2010, Smultea et al. 2010).

Sighting Distribution

Relatively high numbers of blue whales (n = 18 sightings) were seen during July 2010, similar to the July 2009 survey (see Smultea et al. 2009b). On five of seven survey days 3-6 blue whales were consistently seen in the same small area ~5 km west of La Jolla near a large buoy (Figure 2 and Figure 3, Appendix A). This apparent concentration may be partially biased because we flew over this area every day en route to and from Montgomery Airport. However, 92% of all blue whale groups were seen within 15 km of the mainland coast, despite considerable effort further offshore, indicating that blue whales prefer coastal SOCAL waters. All four fin whale sightings were within 10 km of the mainland near San Diego. Blue and fin whales were also observed in this coastal area during previous surveys (see Smultea et al. 2009a,b, Smultea and Lomac-MacNair 2010, Smultea et al. 2010). The location coincides with the drop-off of the coastal underwater shelf topography. Dolphin distribution was concentrated in coastal areas: 80% of 40 common dolphin, 86% of 19 unidentified dolphin, and 100% of 3 common bottlenose dolphin groups were within 20 km of the mainland (Figure 4). (Notably, most of the unidentified dolphins are believed to have been common dolphins based on relatively large group sizes and frequent surface-active behavior we have found to be characteristic of this species per other surveys). However, this observed distribution was partially biased by concentrated effort near San Diego while en route to and from the airport and during opportunistic focal follows on blue and fin whales. Only 11 (17%) of the total 63 dolphin groups were seen over 20 km from shore despite considerable line-transect effort farther offshore. Although only one Risso's dolphin group was seen (just north of SCI), it was the farthest offshore sighting. Similarly, an apparent inshore-common-dolphin and offshore-Risso's-dolphin distributional segregation was seen during May 2010 (see Smultea et al. 2010). In general, similar to May 2010 (Smultea et al. 2010), common and unidentified dolphins were fairly evenly distributed along the mainland coastline and did not appear to be strongly associated with any bathymetric features except the continental shelf. Further examination of photos may allow differentiation of short- and long-beaked dolphins and potential associated differences in distribution. No dolphins were seen along the two northernmost survey lines in SOAR. Only one pinniped sighting, a California sea lion, was seen during the July 2010 survey and occurred close to the San Diego coast (Figure 3). This was the fewest pinniped sightings made during any of the

total seven SOCAL aerial surveys we have done (see Smultea et al. 2009a,b, Smultea and Lomac-MacNair 2010, Smultea et al. 2010). This is attributed to very little effort near SCI where they are known to concentrate, and to the late summer season when their numbers in SOCAL are reduced as many individuals have migrated farther north to feed (Jefferson et al. 2008, DoN 2009).

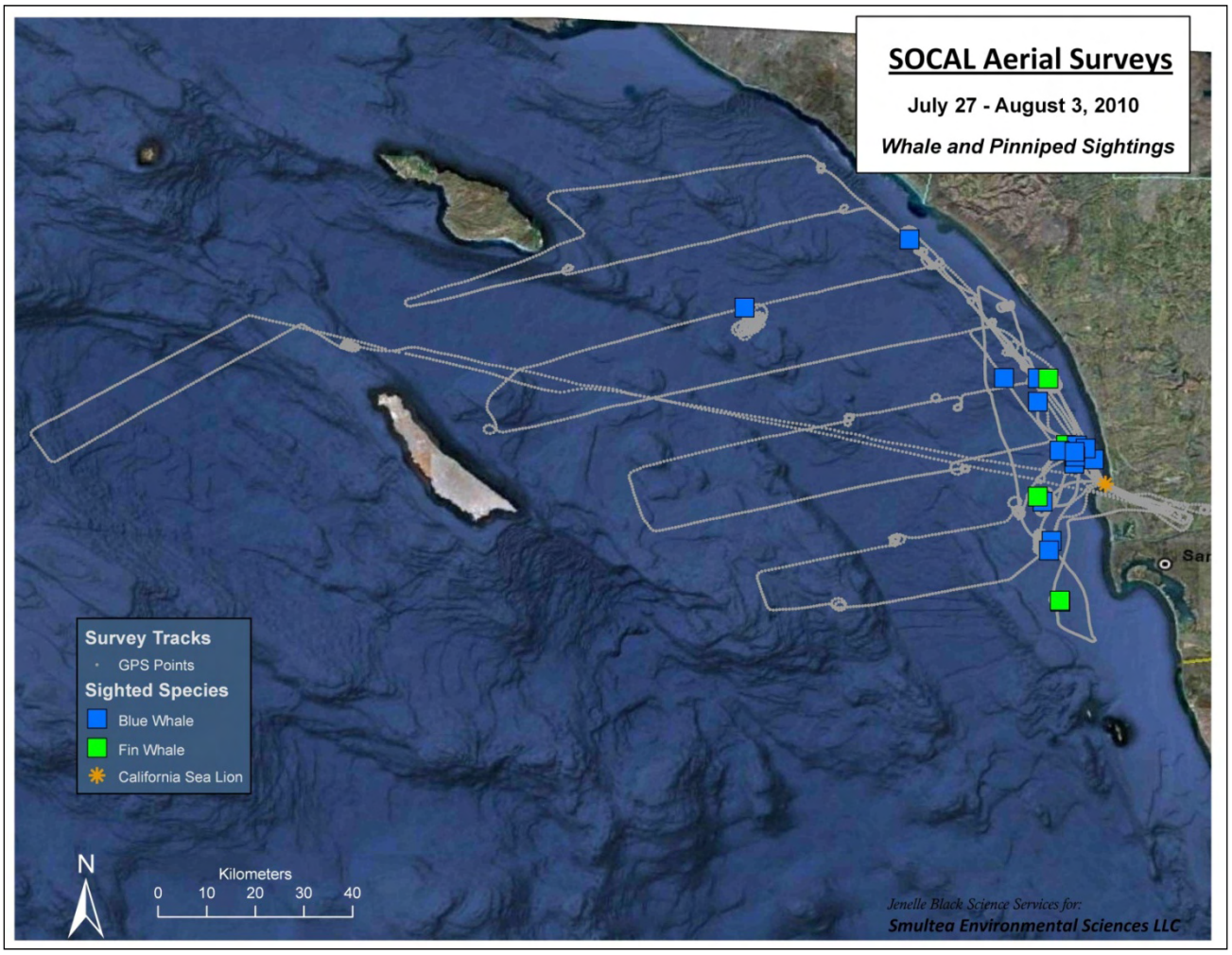


Figure 18. Whale sightings made during aerial survey monitoring in the SOCAL survey area July 27 – August 3, 2010.

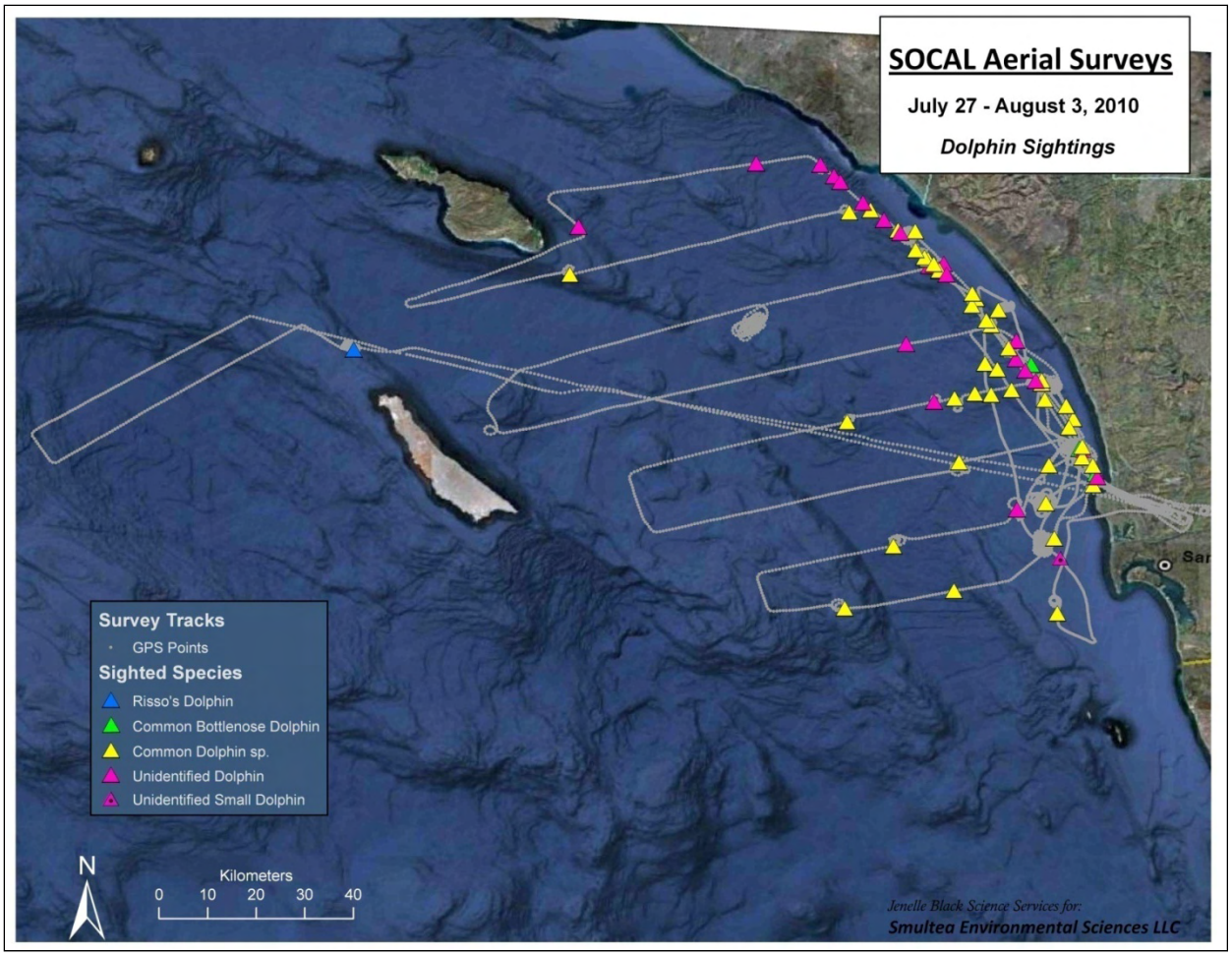


Figure 19. Dolphin sightings made during aerial survey monitoring in the SOCAL survey area July 27 – August 3, 2010.

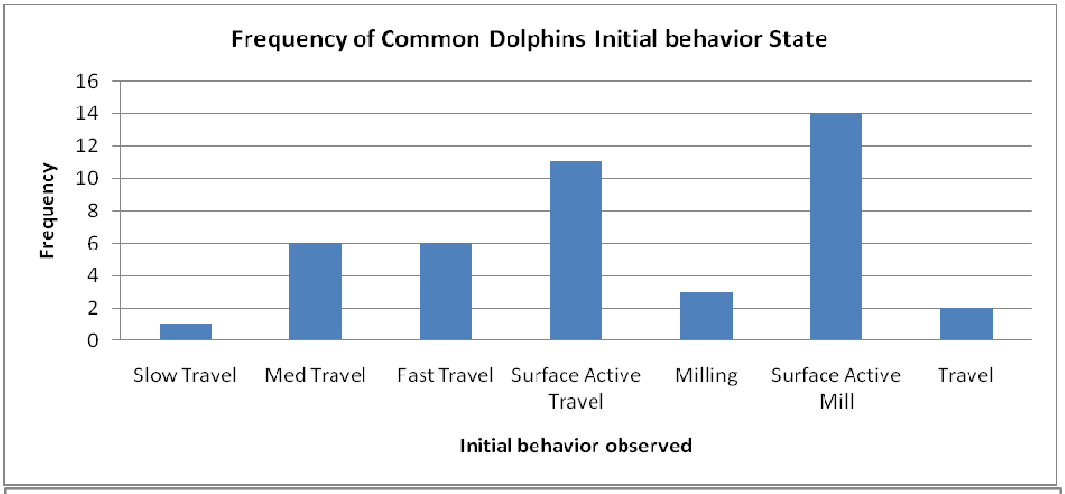
General Behavior

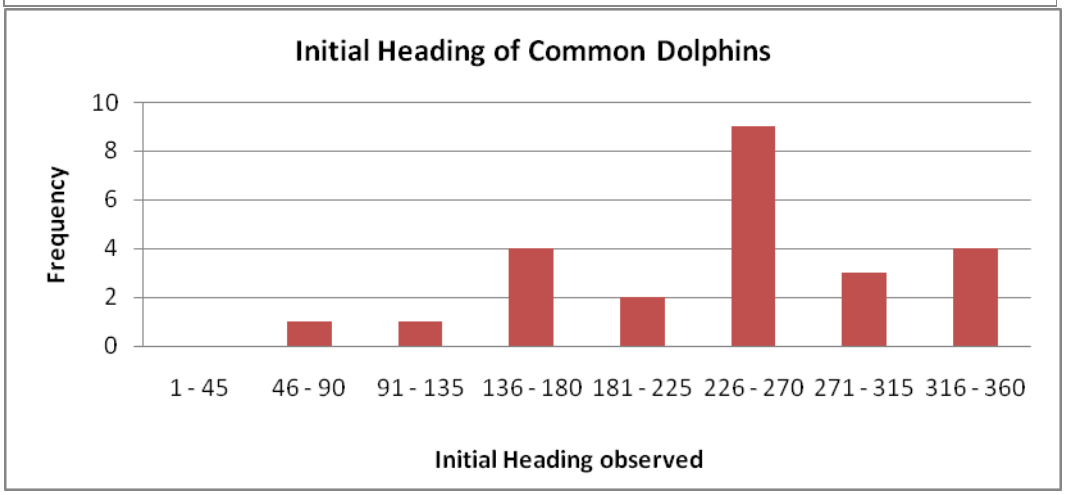
Common dolphins and blue whales had sample sizes considered large enough (*n* = 40 and 18, respectively) to warrant summarizing initially observed behavior state, heading, and estimated mean dispersal distance between individuals. Common dolphins were most frequently observed in surface-active behavior states and travel (6, top panel). This behavior is consistent with that observed during our past six aerial surveys (Smultea et al. 2009a,b, Smultea and Lomac-MacNair 2010, Smultea et al. 2010). Travel speed was predominantly medium to fast. Common dolphins were most frequently observed headed southwest to west (Figure 6, middle panel);this was the same predominant heading observed for common dolphins during June and July 2009 (Smultea et al. 2009). Inter-individual spacing (i.e., dispersal) for common dolphins was nearly always 1-3 body lengths (97% of 38 groups), consistent with our past six aerial surveys (Figure 6, bottom panel).

Blue whales predominantly traveled at a slow to medium speed, consistent with previous surveys (Figure 7, top panel). Feeding behavior was frequently observed during focal follows of both blue and fin whales as evidenced by inflated lunges, lunging on prey balls, and frequent reddish defecations (0 and 0). Blue whale headings were more variable than those of common dolphins, with some tendency to head southerly and northerly (Figure 7, center panel). Mean dispersal between closest neighbors among blue whales was variable and ranged from 1 to 24 body lengths dispersal (Figure 14, bottom panel).

Focal Follows

Focal follow effort was emphasized more during this July and the May 2010 aerial surveys compared to previous aerial surveys which more equally distributed line-transect and focal-follow effort. This shift in study focus resulted from a shift in the Navy's Statement of Work to concentrate on collecting baseline behavioral data relative to the need per the M3P to assess potential effects of MFAS exposure on marine mammals and sea turtles (DoN 2009). The shift was also related to increased interest by NMFS in the latter topic. As during previous surveys since summer 2009, the goal was to conduct focal follows with video for at least 10 min with Risso's dolphins and up to 60 min with ESA-listed whales such as blue and fin whales. Shorter focal follows involving circling of animals to photo-verify species were conducted for 5-9 min. A preliminary total of 19 focal follows at least 5 min long totaling 553 minutes (9 hr 13 min) was conducted during the July 2010 survey (0). Five (26%) of the 19 focals were conducted from the helicopter and totaled 194 min (3 hr 14 min). The remaining 74% (*n* = 14) occurred from the airplane and totaled 359 minutes (5 hr 59 min). Most (68%) of the total 19 focals were at least 10 min long. About one-half (47% or 9) of the 19 focals occurred with blue whales or blue whales with fin whales (*n* = 1). All nine of the blue whale focals were over 10 min long and four were over 1 hour long (0). Video was taken on eight of the nine blue whale focal groups. In addition to blue whales, focal follows occurred with the one Risso's dolphin sighting for a total of ~20 min with 12 min of video. Only three of eight common dolphin focals lasted over 10 min, two of which included video; the remaining five common dolphin focals involved only circling of the group to verify species by taking photos. Based on our first SOCAL surveys in October and November 2008, we decided it was not effective to conduct extended focal follows on common dolphins as they tended to occur in large (typically over 100 dolphins) spread-out groups that were too difficult to consistently track with the video and for behavioral monitoring. In addition, common dolphins were not considered priority species per the M3P as they are not ESA-listed and are not considered a logical deep-diving surrogate for beaked whales. Further preliminary detail on observed behaviors is provided in the Appendices and in the description below.





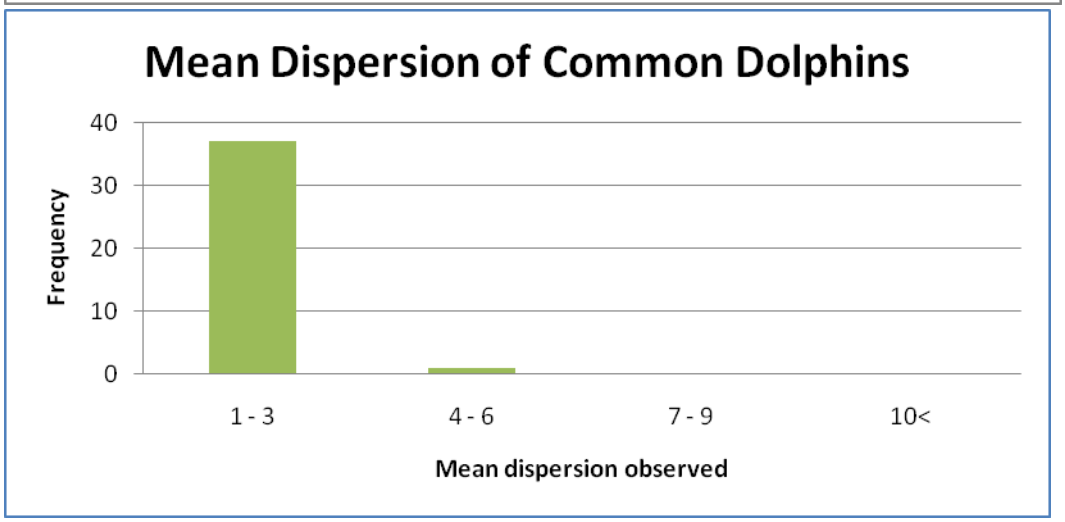


Figure 20. Common dolphins during the July 2010 SOCAL survey periods: Upper panel: frequency of initially observed behavioral states. Middle panel: frequency of initially observed headings (degrees magnetic). Bottom panel: frequency of mean dispersal distance between individuals (in estimated body lengths)

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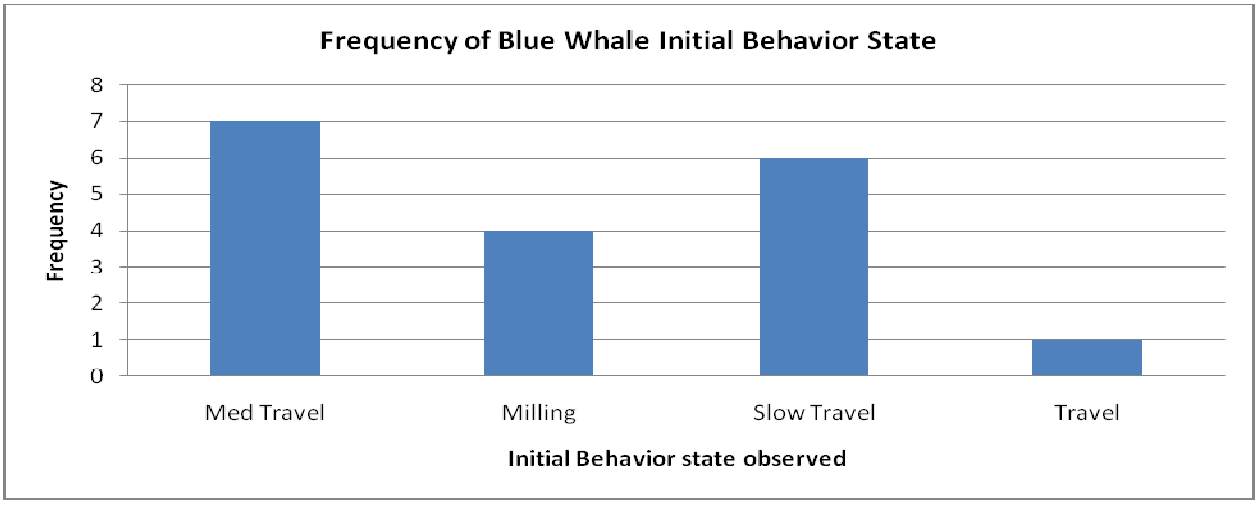

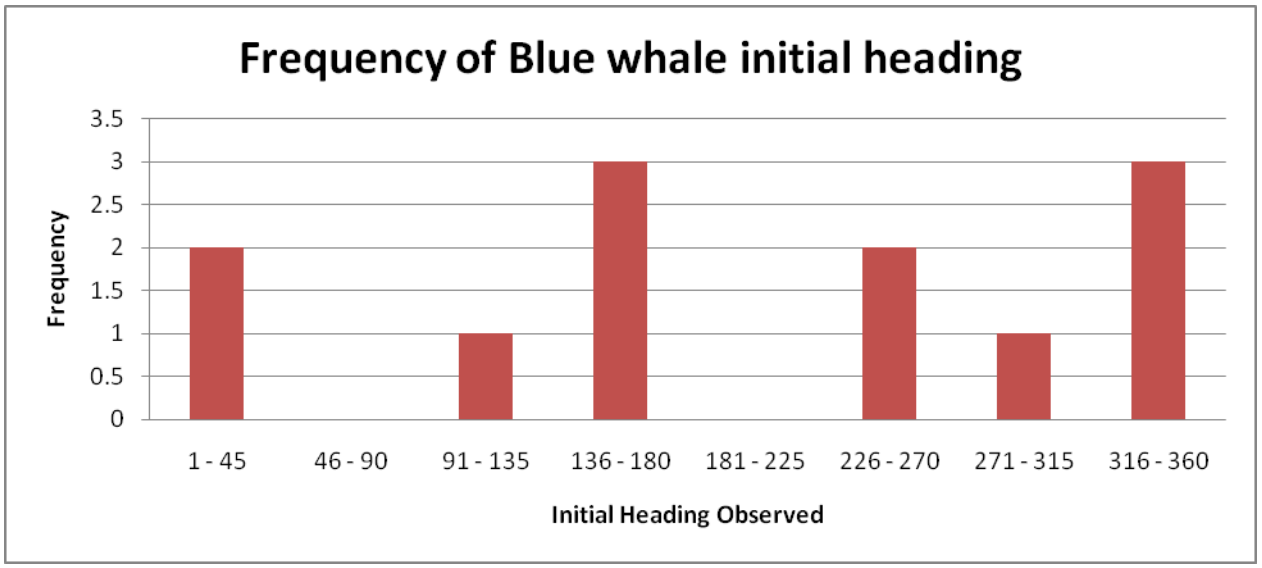

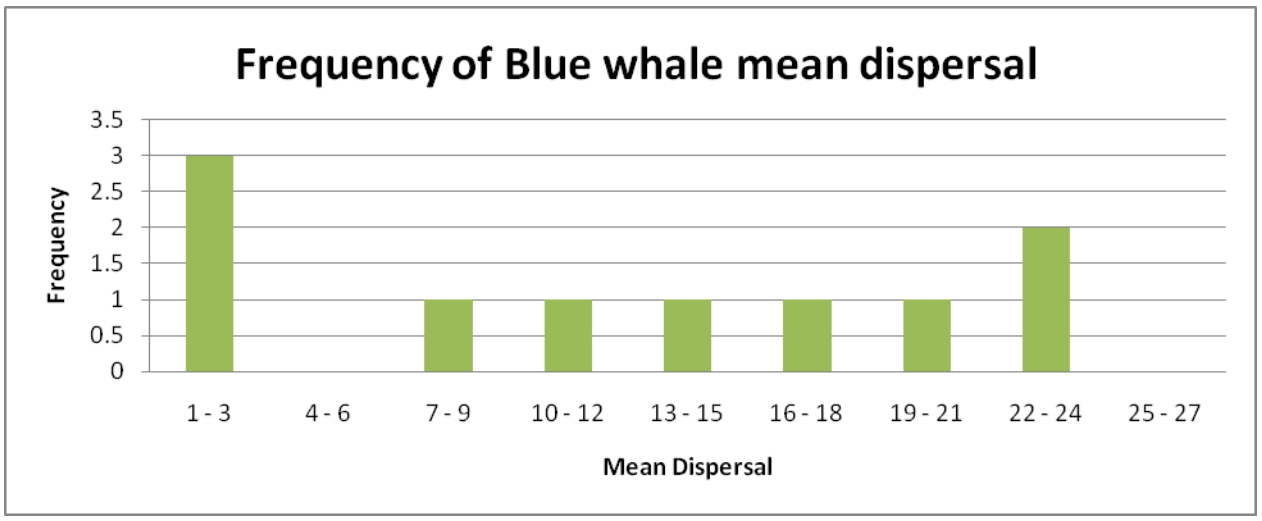

Figure 21. Blue whale behavior during the July 2010 SOCAL survey periods: Upper panel: frequency of initially observed behavioral states. Middle panel: frequency of initially observed headings (degrees magnetic). Bottom panel: frequency of mean dispersal distance between individuals (in estimated body lengths).

Unusual Observations

Summarized preliminarily below are three unusual encounters and associated observations with blue and fin whales in the SOCAL. Two encounters were observed from the helicopter and one from the airplane. These encounters are included because they have not been previously seen during our past SOCAL surveys. In addition, there are few if any available data or literature on such observations.

The overhead and prolonged view from the helicopter circling overhead outside the predicted Snell's Cone sound radius of the aircraft allowed a "bird's eye view" of the animals both above and below the surface without affecting their behavior in a noticeable manner. In particular, videotaping from the helicopter allowed us to keep the animals within view for longer periods than from the airplane given that the helicopter can circle safely at slower speeds. The animals were circled at a radial distance of approximately 1 km and an altitude of 1200-1500 ft.

Blue Whale Mother and Calf #1

On 27 July 2010, a focal follow was conducted on a mother and calf (young-of-the-year) blue whale pair from 15:24-16:24 and included video (Appendix E). We have rarely seen blue whale calves during our seven SOCAL aerial surveys. Video was taken on this pair from 15:51-16:24. The interesting aspect of this encounter was that the calf may have been nursing from the mother based on review of the video. After a series of surfacings and blows, the calf dove below the mother who was at the time visible below the water surface. The pair appeared to rest/float just below the water surface for a short period with the calf oriented towards the mother's ventral surface as the mother appeared to roll on her side in what we believe was likely nursing behavior. See Appendix E for further detail on this group based on a preliminary "first look" at the video.

Blue Whale Mother and Calf #2

On 2 August 2010, a blue whale mother and calf and another adult were circled from the airplane from 16:56 to 17:28. A total of 38 min of video was taken. The calf was more active at the surface than we have previously seen among blue whales in SOCAL. All three whales breached, and the calf breached and rolled at the surface on multiple occasions as recorded on video. In one episode, the mother lunged and breached followed by the calf breaching and lunging five times and then the pair dove. A third adult then lunged twice and breached. The calf resurfaced and continued breaching numerous times as the mother was observed traveling below the water surface nearby.

Blue-Fin Whale Interaction

On 28 July 2010, we did behavioral circles around a loose grouping of blue and fin whales, and took particularly valuable data on surfacing/respiration and inter-individual spacing (i.e., dispersal) parameters of traveling blue whales, yet to be analyzed. Our last behavioral description/video sequence of the day was for a scene of 8 min 24 sec in the afternoon from 15:45:54 – 15:54:18. Observations were hampered a bit by glare and the videographer's inability to stay with focal animals in parts of the circles around them. There were three blue and three fin whales. At least five of them, probably all six with one underwater, were as close as one whale body length (BL) from each other during part of one circling by the plane. All the whales were traveling, but brief social interactions were noted among the three fin whales. We are presently acquiring frame-by-frame analysis capability, and will report on details of interactions at some other time.

It is possible but not presently demonstrated, that there were at least brief social interactions among the fin and blue whales, i.e., between species. One particularly interesting observation stands out. It lasted for only 24 sec. In 0, we link descriptions of the behaviors with 8 still shots pulled off video, in order as AA29, then A39 through G53. These numbers refer to arbitrary seconds into the 6th minute of the scene as described below. The encounter described chronologically in 0 involved feeding blue and fin whales focused around a bait ball of presumably euphausiid prey. This encounter appeared to involve inter-specific social interactions and/or potential competition for food.

Photographs and Video

A preliminary total of ~2900 digital photographs and ~4.3 hours of HD video were taken during July 2010. Approximately 17% of the photos were taken from the helicopter with the remaining 83% taken from the fixed-wing Partenavia airplane. Approximately 41% of the video was made from the helicopter on two days vs. 59% from the airplane in five days. Preliminary lists of photographs and video are presented in 0 and 0. Note that the video is based on start and stop times, and focal animals are not always in view and videotaped; the video was typically kept on between surfacings to record ancillary information. The count of photographs is a raw count and has not been filtered in detail to identify usefulness of photographs to identify species, calves, etc. The latter tasks are time consuming and were outside the scope of this contract. As done for our previous surveys, Dr. T.A. Jefferson will review our photographs to confirm or speciate short-beaked vs. long-beaked common dolphins and other species as relevant.

Section 4 Discussion

Key Role of Aerial Surveys

The key and unique roles that aerial surveys play in addressing Navy monitoring plan goals have been discussed thoroughly in our previous reports (see review in Smultea et al. 2009a,b, Smultea and Lomac-MacNair 2010). Thus, they are not discussed again herein.

Comparison of Airplane vs. Helicopter Platforms

For the first time during our seven SOCAL aerial surveys, for the July 2010 survey we used a Bell 206 helicopter as a platform from which to conduct behavioral observations. We did this to ascertain the relative utility of this platform vs. the fixed-wing Partenavia we have used for previous surveys. Table 18 summarizes our comparison.

Aerial Survey Collaboration with Other Researchers

It was not logistically feasible to collaborate in real-time with other marine mammal researchers in the SOCAL range during our July survey to our knowledge, as they were not conducting field studies in the same area simultaneously. However, upon request, we provided a list of our blue whale sightings to J. Calambokidis (JC) of Cascadia Research Collective (CRC) that included the dates, times, numbers, and locations of our blue whale sightings. During our survey, JC was simultaneously conducting small-vessel surveys for blue whales in the Santa Barbara Channel area. He requested our data because he was scheduled to conduct small-vessel surveys in the SOCAL in early August as part of the Behavioral Response Study (BRS) led by Dr. Brandon Southall and funded by N45 and Office of Naval Research Funds. In addition, our (other) data will be shared with researchers from UC San Diego/Scripps Institute of Oceanography, CRC, the Navy's Marine Mammal Research Program (e.g., Dr. Dave Morretti), and other Office of Naval Research and N45-funded studies, including the BRS.

Shared data of interest that we have collected include locations and photographs of blue and fin whales and Risso's dolphins. In particular, baseline behavioral and distribution data we have collected on these and other species is of relevance to the BRS program. Beginning in the SOCAL in fall 2010, the BRS program will be conducting playback sound studies to some of these species to assess potential behavioral responses. Thus, our baseline behavioral data provide a substantial source for comparison of typical behavior of these species. Few published data are available on the behavior of any of the marine mammals species inhabiting the SOCAL with the exception of coastal bottlenose dolphins (e.g., Defran et al. 1999), gray whales (e.g., Punt and Wade 2010), and more recently, a few tagged individual Cuvier's whales (e.g., Falcone et al. 2009a, b).

Table 18. Comparison of Aircraft Platforms to Collect Behavioral Data on Marine Mammals.

Aircraft Type	Partenavia P68-C	Partenavia P68-OBS ("Observer")	Helicopter
Plane Tail Numbers/Models	300LK and 32K (P68c)--no glass nose	6602L ("Observer" with glass nose)	Bell 206 LIII
Maximum Range	4.5 hr (if remove 100 lbs. of cargo/person would have 5.5 hours--e.g., equipmt? Smaller observers?)	4.0 hr (if remove 100 lbs. of cargo/person would have 5.0 hours--e.g., equipmt? Smaller observers?)	2.6 hr
Approx Cost per Hr	$550	$550	$1450/hr
Slowest Safe Apprx. Circling Speed	80 kt	80 kt	~45 -50 kt
Windows	small porthole (~5 inches diameter) in co-pilot seat but difficult to use/requires some contortion; middle seats have bubble windows (bad for photo/video /binocs due to distortion); during future IDIQ surveys 2 pilots will be required and thus co-pilot seat will not be available for biological observers; rear 3rd bench windows have small opening but exhaust fumes distort this view that is easily blocked by cowling/wing when plane turns; has belly window	same as for P68-C; glass nose increases visibility in front seats; has belly window	large (12 x 12 inch) sliding windows in co-pilot and two rear seats; large concave windows provide better view than Partenavias in rear of aircraft
Advantages	300 LK is best range aircraft of Partenavias big tires allow more weight to be carried can drop sonobuoy from belly window	Easier for pilot to spot and circle sightings than other Partenavias due to glass nose can drop sonobuoy from belly window	Floats allow offshore surveys; Large open windows allow good view and excellent photo/video conditions; slower circle speed allows longer/better view of whales to video/photo; easier for pilot to keep animals in view;
Disadvantages	no glass nose; only co-pilot seat small porthole opens; cost and time (FAA approval) to remove/replace window); bubble windows distort image; cowlings partially block view especially in rear 3rd seat; rear 3rd seat view distorted by exhaust fumes	shorter range than other Partenavia; bubble windows distort image; only small porthole opens in front and rear seats; bubble windows distort image; cowlings partially block view especially in rear 3rd seat; rear 3rd seat view distorted by exhaust fumes; cost and time (FAA approval) to remove/replace windows	Expense is nearly 3x that of Partenavia; Short range (about half that of Partenavias) SOAR SOCAL range is too far to survey unless helicopter & crew/observers stationed and fueled on San Clemente Isld; requires more maintenance than fixed wings
Potential Improvements/ Mitigation?	Could remove bubble center seat windows and replace with opening windows or no window(s)	same as other Partenavia	if use helo on standby on SCI could potentially share/cut costs; Aspen flies both this helo and the partenavias
When Used for Navy Surveys	SOCAL Nov 08, June/July 09, Nov 09, May 10	Oct 2008, July 2010	July 2010

Table 19. Summary of SOCAL Marine Mammal Aerial Surveys

	Survey							
	October	**November**	**June**	**July**	**November**	**May**	**July**	**Total**
Survey Dates	17-21 Oct 2008	15-18 Nov 2008	5-11 June 2009	20-29 July 2009	18-23 Nov 2009	13-18 May	27 July-3 Aug	7 surveys: May, June, July, Oct, Nov
No. Days Flown	5	4	6	9	6	6	7	36
Major Training Exercise (MTE) Before, During or After Survey?	Before/During	After	After	After	During/After	During	During/After	During, before or after
Total Flight Hr (Wheels up/down)	28	21	30	34	28	29	19	189
Total Observation Effort (km) *(excl. poor weather, over land)*	4563 km (2464 nm)	3838 km (2072 nm)	6140 km (3315 nm)	6500 km (3510 nm)	4823 km (2604 nm)	4891 km (2641 nm)	3125 km (1688 nm)	33,880 km 18,294 nm
No. Navy-directed Survey Changes (appox)	9	7	12	10	3	1	0	42
No. Coastline Surveys for Strandings (San Clemente Isld)	0	2	1	0	1	1	0	5
No. Groups Seen	115	185	161	240	93	152	86	1,032
Estim. No. Individuals	12,587	5732	9489	22,719	12,826	5,453	11,090	79,896
Mean Group Size	109.4	31	58.9	94.7	137.9	35.9	131.3	85.6
No. Dead Sightings	0	3 *(2 CA sea lions, 1 blue whale)*	0	2 *(2 prob. CA sea lions)*	0	0	0	5
No. Species	9	9	11	10	10	9	5	16
No. Focal Groups Circled 5-9 min	22	20	24	37	14	10	6	139
No. Extended Focal Groups Circled >10 min	5	7	7	8	10	20	13	83
Longest Focal Follow Duration	29 min (*Fin whale*)	60 min (*Fin whale*)	48 min (*Fin whale*)	38 min (*Long-beaked common dolphin*)	40 min (*Killer whale*)	144 min (*Fin whale*)	59 min (Blue whale)	144 min.
No. Photos Taken	1050	1280	1099	2301	2203	1350	2900	12,183
Estimated Usable Video (min)	53	41	83	50	90	334	373	1024

Section 5 Conclusions and Recommendations

Survey Highlights

Dr. Bernd Wuersig of the Marine Mammal Research Program at Texas A&M University joined our field team for the second time (also in May 2010) to provide expert review and critique of our behavioral study approach and protocol, and to assist us in the field. Dr. Wuersig again provided a positive review of our protocol and helped us further refine our field and post-field analysis and summary techniques. He also provided the write-up and photos for the blue-fin whale focal follow as summarized above under *Unusual Observations*. He also was critical in providing an expert opinion on the utility of the helicopter as a platform for conducting extended focal follows with video.

We successfully used the Bell 206 helicopter to conduct behavioral focal follow observations of Priority cetacean species. We concluded that this platform is advantageous over the Partenavia for taking video and obtaining detailed behavioral data, while the Partenavia is better suited for conducting line-transect surveys (see Table 18 and subsection that follows). This is because the helicopter can fly slower circles (45 -50 kts) that allows for a better, longer view, with less interruption by glare (on sunny days) within the focal circle view. Especially important is that the helicopter can circle in a manner that keeps it approximately equal distance from the focal animal(s) throughout the circle, unlike the strong oblong pattern necessitated by the circling of a fixed wing (i.e., the Partenavia's slowest safe circling speed is approximately 80 kt). The helicopter we used also has larger photo-capable windows and less cramped space than the Partenavia, facilitating inherently better photos, both still and video. The disadvantage of the helicopter we used is its reduced range (2.6 hr vs 4.5 hr for Partenavia) and its increased expense (almost three times the hourly cost of the Partenavia).

We concluded and recommend that that (the Partenavia) fixed-wing plane is best when the primary goal is to collect line-transect data, and the (Bell 206) helicopter is better when detailed behavioral work is warranted. Given the higher cost of the latter, we recommend judicious occasional but then dedicated use of a helicopter for behavioral focal follows. Given that behavioral data is currently a primary focus of the SOCAL monitoring per Navy input, we recommend that the helicopter be used to the maximum extent practicable during these surveys. Using both platforms during one survey as we did during July 2010 is one feasible approach. Another possible approach is to use the helicopter separately for focal sessions and the Partenavia separately for line transects. Perhaps the ideal approach would be to use both simultaneously to gather both types of data on a survey. The latter approach should be attempted to assess the utility of collecting simultaneous density/abundance/distribution data from the Partenavia while at the same time collecting extended focal follows including video from the helicopter.

As summarized in Table 19 the July 2010 aerial survey contributed the second highest number (n = 13) of focal behavioral observations at least 10 min long relative to our previous six SOCAL aerial surveys, with only the May 2010 such sample size being larger (n = 20). This again was because we had shifted our primary focus to extended focal follows.

The July 2010 survey contributed the highest number of blue whale focal follow sessions of any of the previous six SOCAL surveys as summarized in the text. This is important in providing critical baseline behavioral data on this ESA-listed, "Priority" species of special concern with respect to the Navy's SOCAL monitoring plan.

As the seventh aerial survey we have conducted for Navy monitoring in the SOCAL, the combined data represent the largest and most recent concentrated such survey effort within the SOCAL

(Table 10). Our surveys also are the first behavioral-focused aircraft-based studies conducted in the SOCAL, and are the first such studies conducted on numerous species (e.g., Risso's dolphin, common dolphin, blue whale, Pacific white-sided dolphin, etc.). Given the current and increasing focus by NMFS and the Navy on assessing behavioral responses of marine mammals to MFAS activities, our data fill a unique niche and currently represent considerable sample sizes that are essential to provide adequate and relevant comparative baseline data to assess such effects.

Funding has not been available to analyze the detailed behavior of cetacean groups we have observed in the SOCAL. It is critical that these data be further analyzed to assess and evaluate their results and utility relative to the goals of the Navy's SOCAL and other marine mammal monitoring plans. It is also critical that these data will also be analyzed relative to estimated received sound levels of MFAS, as applicable, and will provide baseline non-MFAS exposure data for comparison purposes for monitoring and other studies (e.g., the BRS study—see following subsection).

The July and previous six aerial surveys contributes to building seasonal and year-round baseline data for the SOCAL marine mammals as directed under the SOCAL M3P.

Behavioral trends reported herein are generally consistent with the six previous aerial surveys for common, Risso's and bottlenose dolphins as well as blue and fin whales.

Results consistently show that blue whales and Risso's dolphins tend to remain within view of the aircraft observers at or below the surface for the longest periods compared to other SOCAL marine mammal species observed. This is in part related to their light, white body coloration and scarring of Risso's dolphins making them relatively easy to track from the aircraft at and below the surface, even at altitudes of 1500 feet and radial distances of 1 km at which focal behavioral follows are typically conducted (see 0).

Other recommendations to improve data collection techniques, analyses, interpretations, and applications are the same as those provided in the previous SOCAL 2008-2009 aerial survey reports (Smultea et al. 2009a,b, Smultea and Lomac-MacNair 2010).

Section 6 Acknowledgements

We are grateful to Navy personnel from US Pacific Fleet Environmental and Naval Facilities Engineering Command Pacific and UCSD/SIO personnel Dr. John Hildebrand, Paula Hodgkiss and Linda Sawyer for their support, coordination and facilitation in the implementation of these surveys. We thank our excellent survey observer biologists Mark Deakos, Kate Lomac-MacNair, and Lori Mazzuca. We are grateful for our competent and safety-conscious pilots Kathleen Veatch and Michael Estomo of Aspen Helicopters, Oxnard, California.

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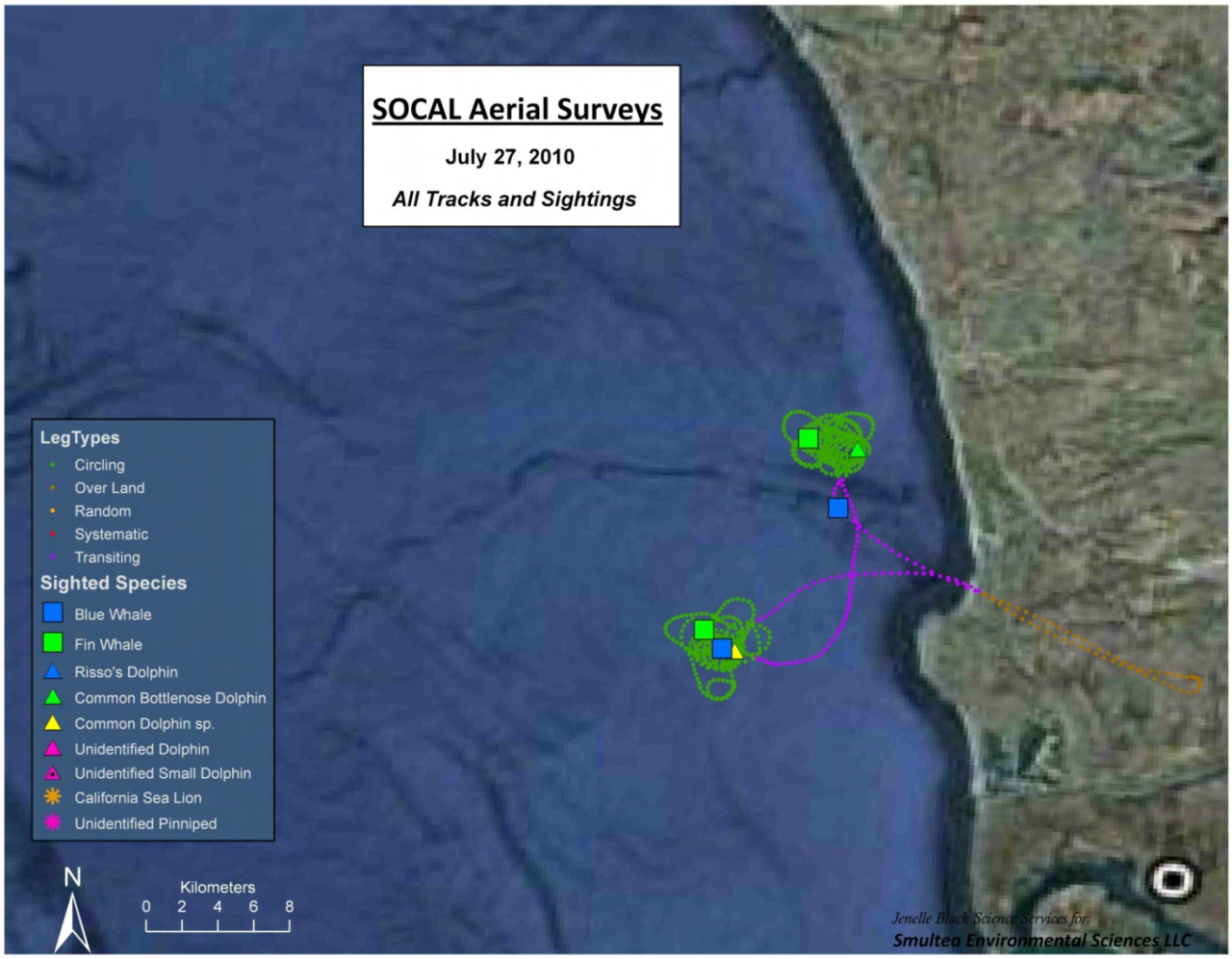
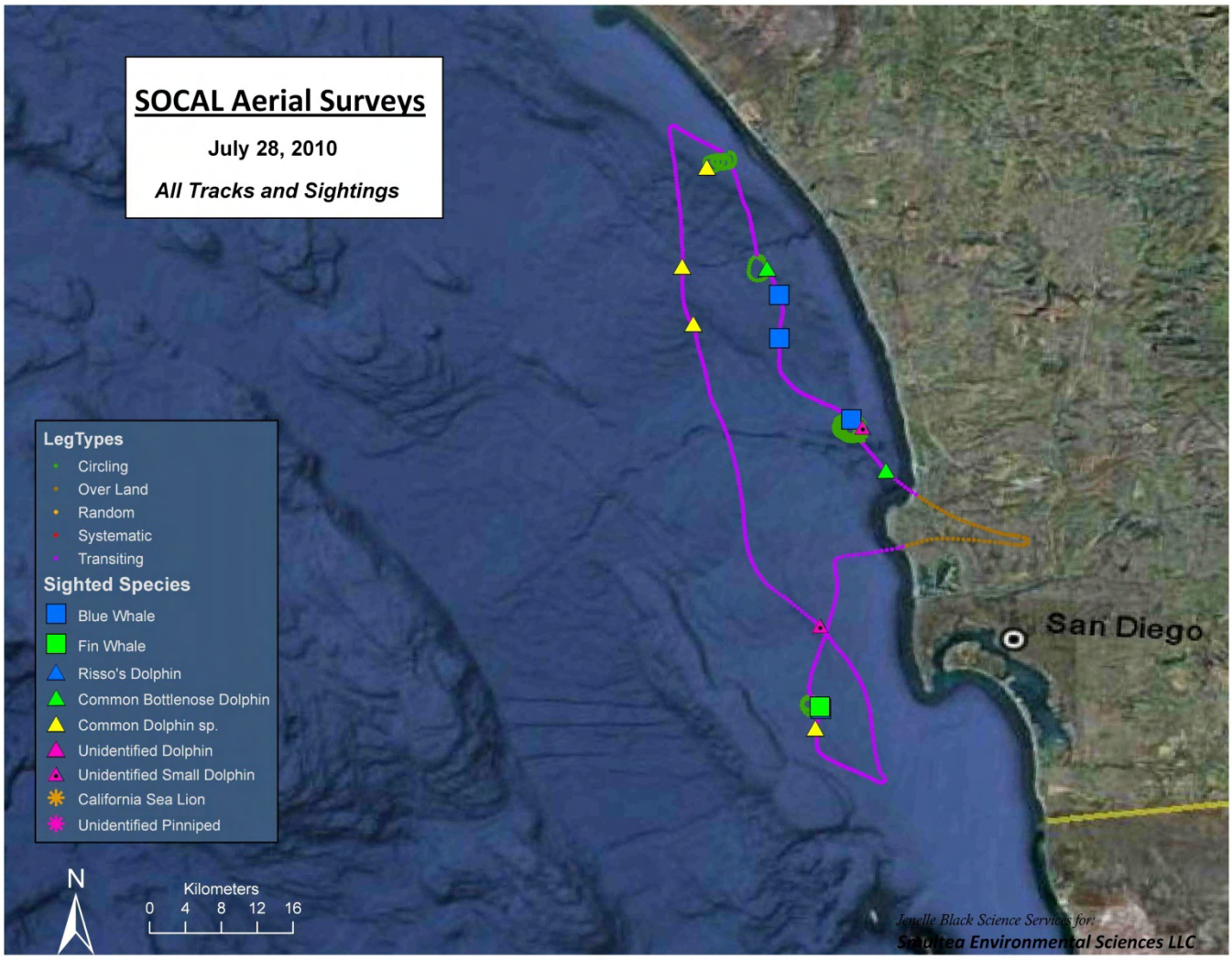
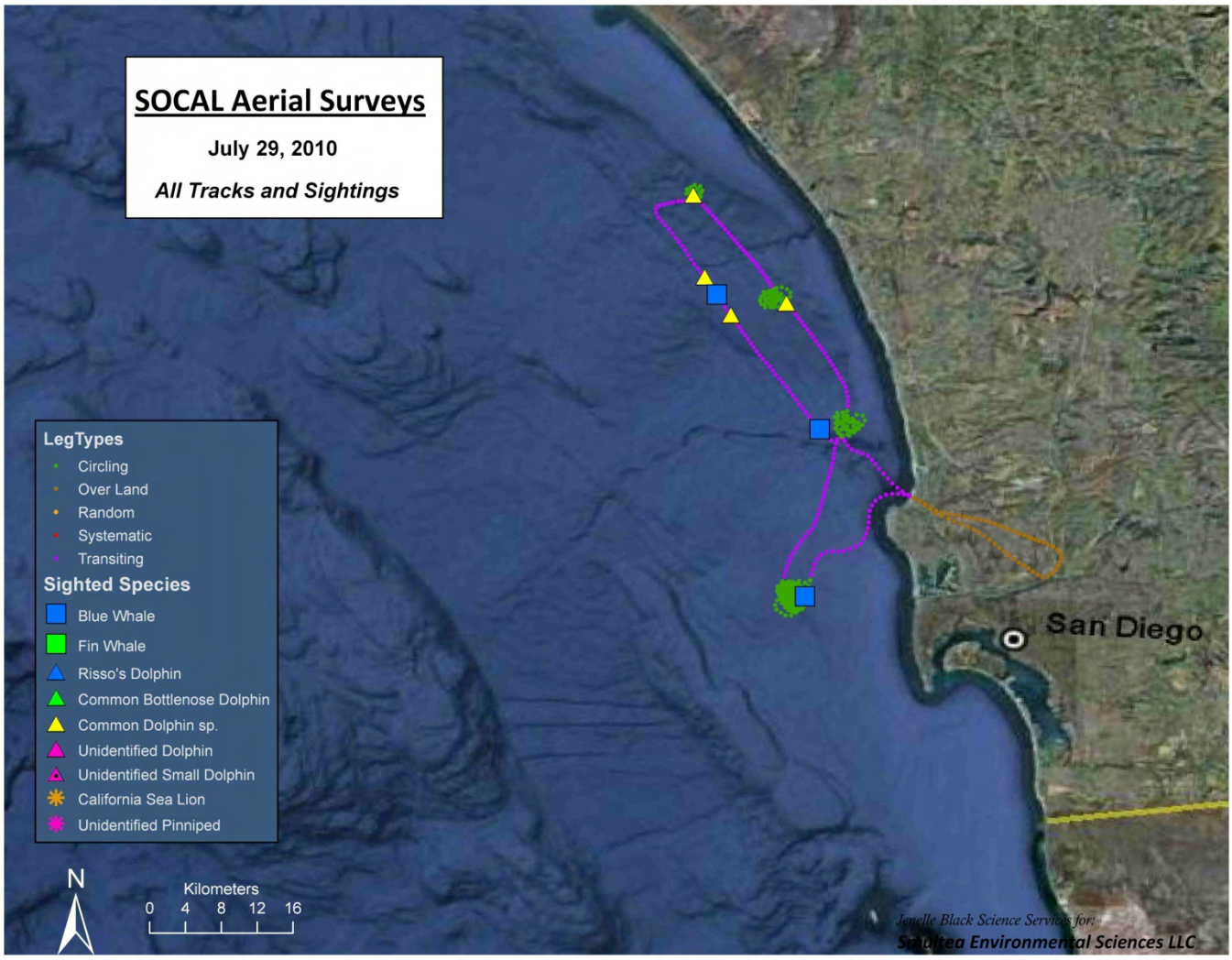
Appendix A Maps of Daily Surveys and Sightings




SOCAL Aerial Surveys
July 28, 2010
All Tracks and Sightings
LegTypes
Circling
Over Land
Random
Systematic
Transiting
Sighted Species
Blue Whale
Fin Whale
Risso's Dolphin
Common Bottlenose Dolphin
Common Dolphin sp.
Unidentified Dolphin
Unidentified Small Dolphin
California Sea Lion
Unidentified Pinniped
N
Kilometers
0 4 8 12 16
San Diego
Jewelle Black Science Services for:
Southtea Environmental Sciences LLC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July 29, 2010
All Tracks and Sightings
LegTypes
Circling
Over Land
Random
Systematic
Transiting
Sighted Species
Blue Whale
Fin Whale
Risso's Dolphin
Common Bottlenose Dolphin
Common Dolphin sp.
Unidentified Dolphin
Unidentified Small Dolphin
California Sea Lion
Unidentified Pinniped
N
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San Diego
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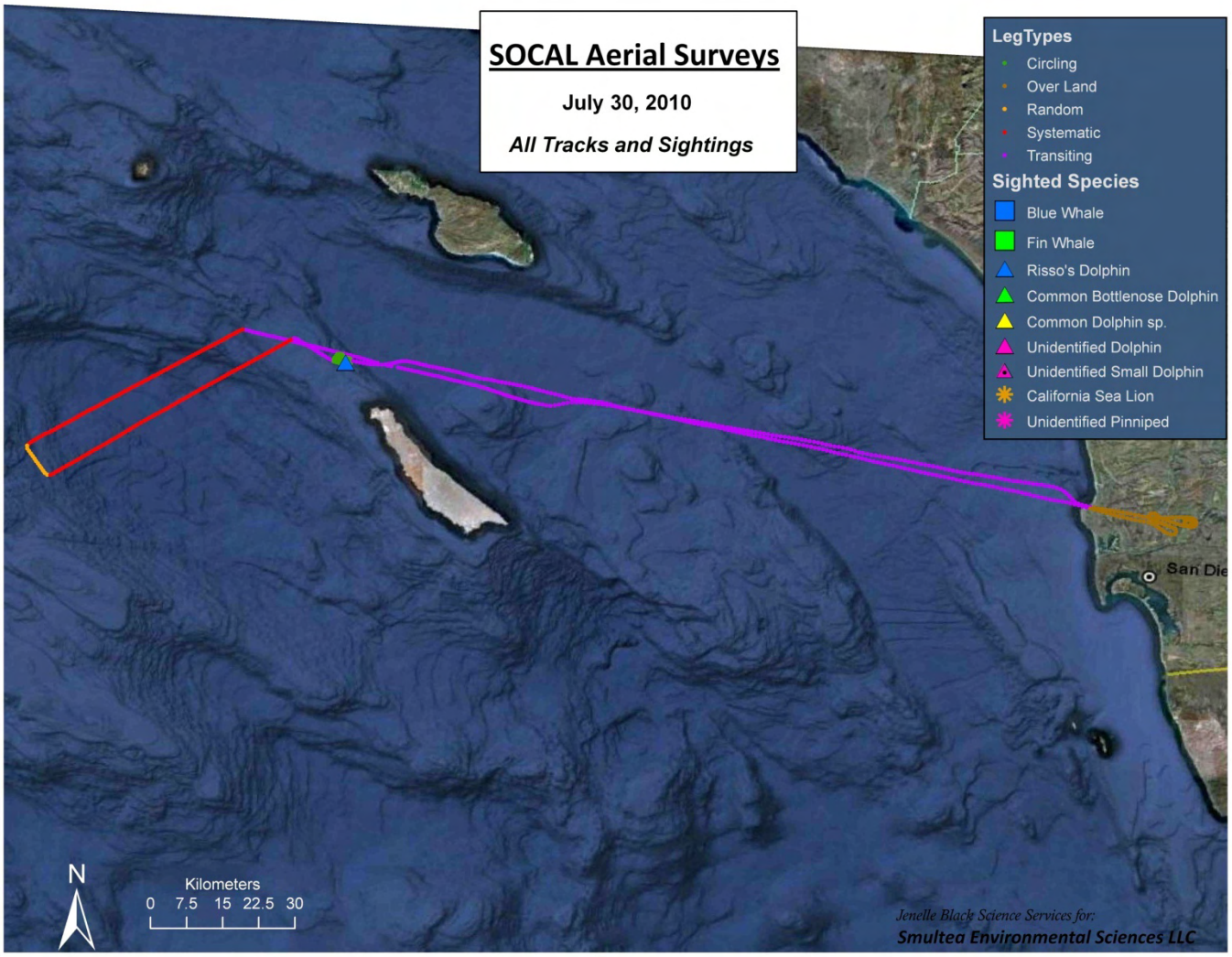
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July 30, 2010
All Tracks and Sightings
LegTypes
Circling
Over Land
Random
Systematic
Transiting
Sighted Species
Blue Whale
Fin Whale
Risso's Dolphin
Common Bottlenose Dolphin
Common Dolphin sp.
Unidentified Dolphin
Unidentified Small Dolphin
California Sea Lion
Unidentified Pinniped
San Die
N
Kilometers
0 7.5 15 22.5 30
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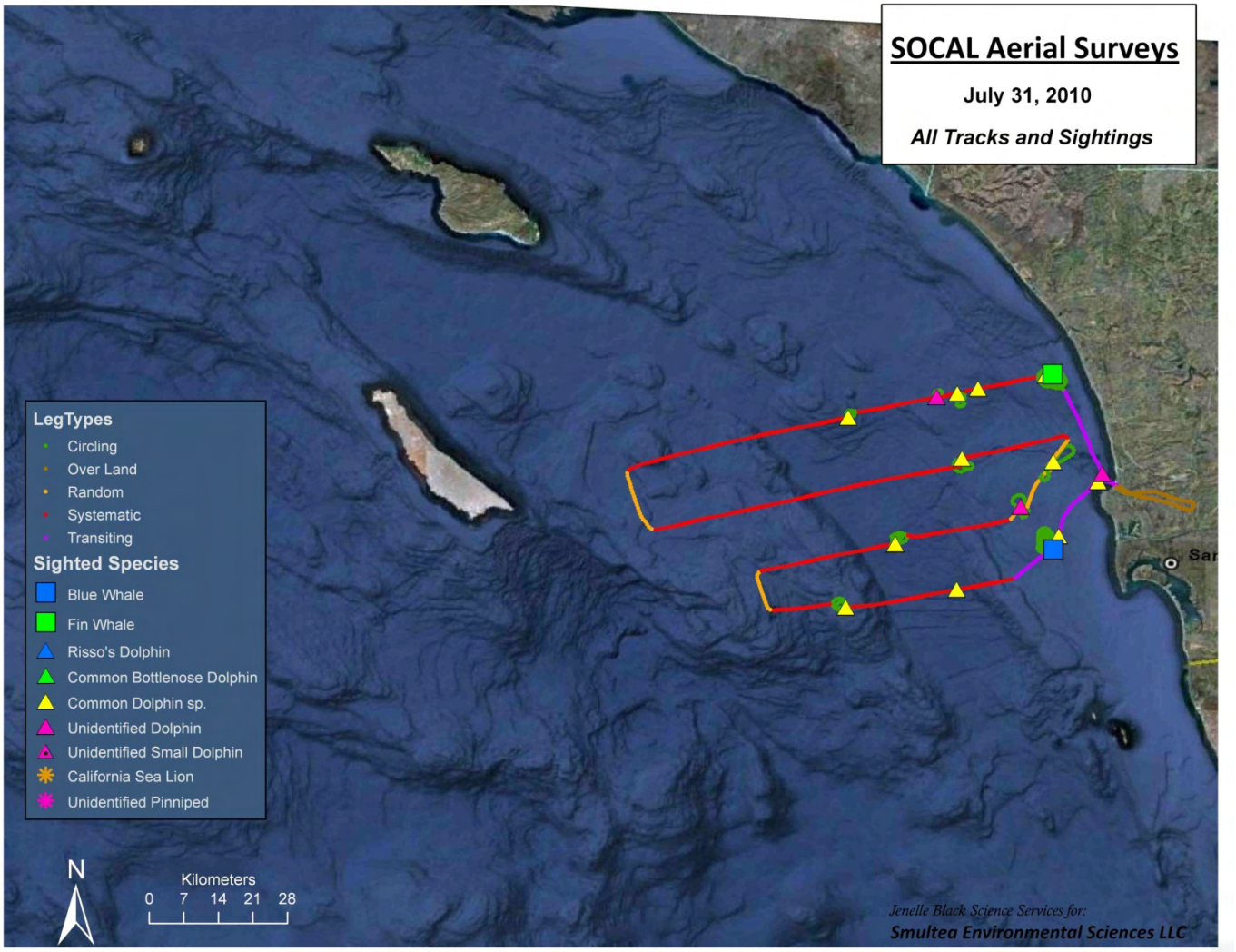
Smultea Environmental Sciences LLC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July 31, 2010
All Tracks and Sightings
LegTypes
Circling
Over Land
Random
Systematic
Transiting
Sighted Species
Blue Whale
Fin Whale
Risso's Dolphin
Common Bottlenose Dolphin
Common Dolphin sp.
Unidentified Dolphin
Unidentified Small Dolphin
California Sea Lion
Unidentified Pinniped
N
Kilometers
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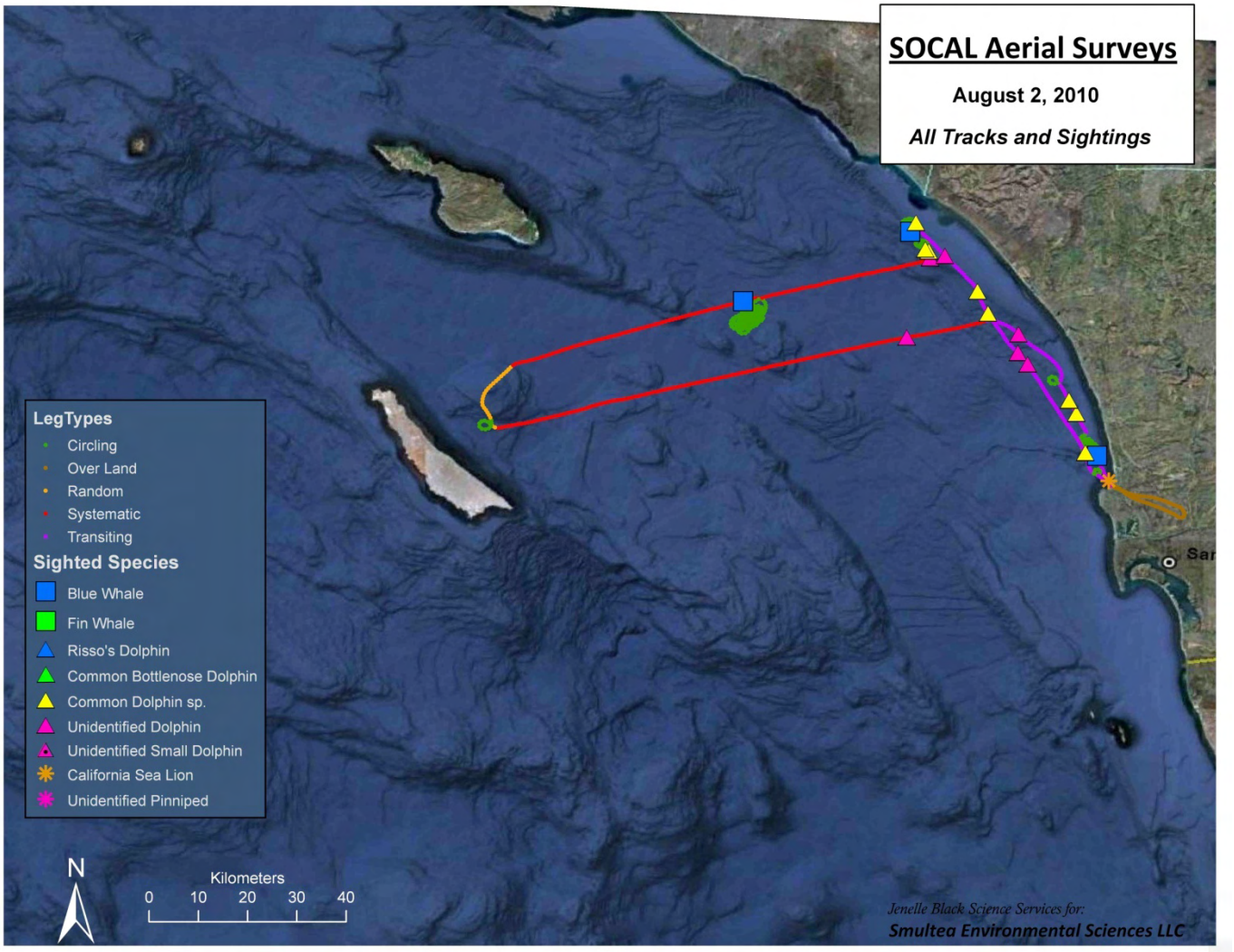
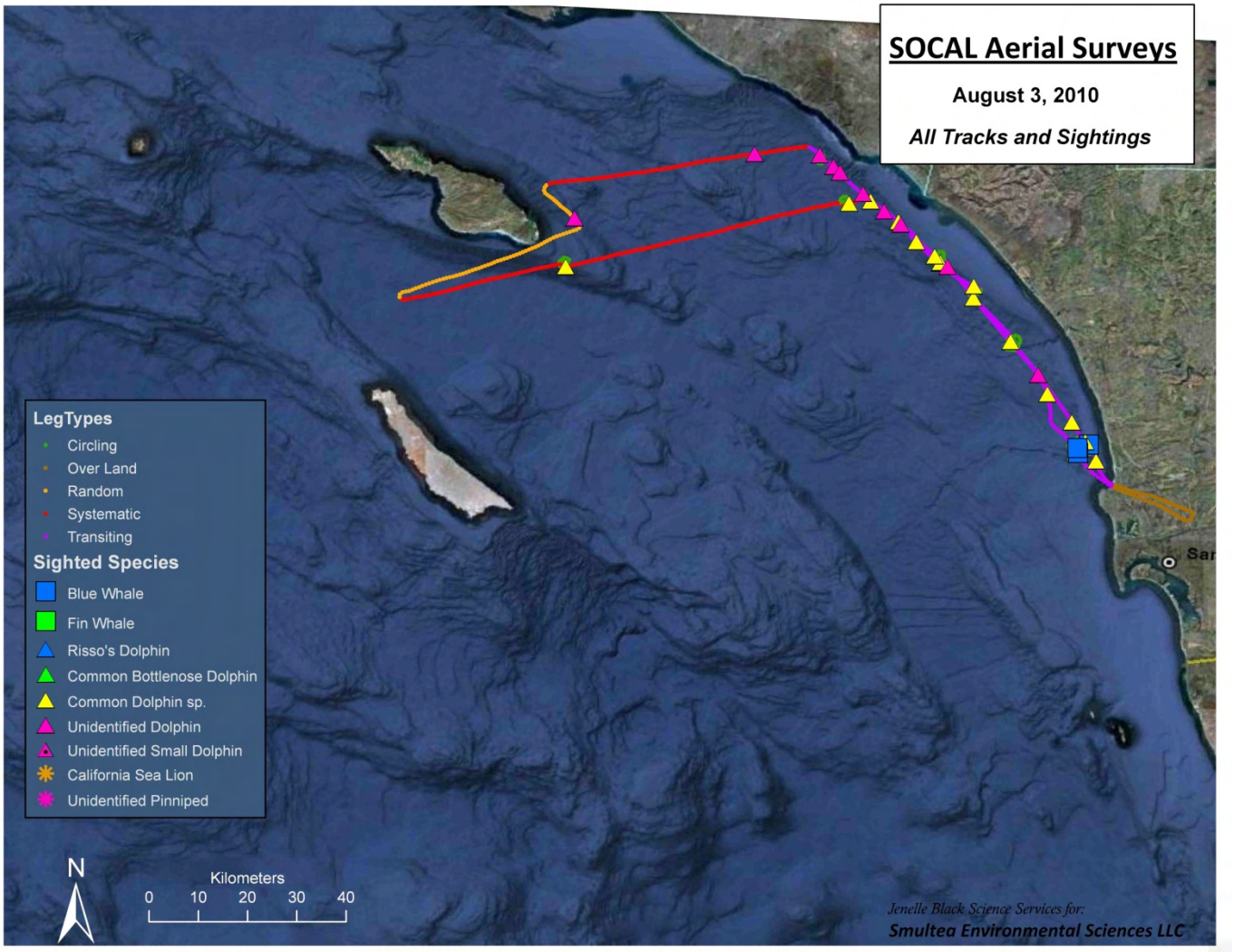
Smultea Environmental Sciences LLC


SOCAL Aerial Surveys
August 2, 2010
All Tracks and Sightings
LegTypes
Circling
Over Land
Random
Systematic
Transiting
Sighted Species
Blue Whale
Fin Whale
Risso's Dolphin
Common Bottlenose Dolphin
Common Dolphin sp.
Unidentified Dolphin
Unidentified Small Dolphin
California Sea Lion
Unidentified Pinniped
N
Kilometers
0 10 20 30 40
Jenelle Black Science Services for:
Smultea Environmental Sciences LLC


SOCAL Aerial Surveys
August 3, 2010
All Tracks and Sightings
LegTypes
Circling
Over Land
Random
Systematic
Transiting
Sighted Species
Blue Whale
Fin Whale
Risso's Dolphin
Common Bottlenose Dolphin
Common Dolphin sp.
Unidentified Dolphin
Unidentified Small Dolphin
California Sea Lion
Unidentified Pinniped
N
Kilometers
0 10 20 30 40
Jenelle Black Science Services for:
Smultea Environmental Sciences LLC

Appendix B List of All July 2010 Survey Sightings

Sighting Date	Sighting Time	Common Name	Species	Best Count	Longitude	Latitude
07/27/2010	14:09:01	Blue Whale	*Balaenoptera musculus*	4	-117.32050	32.89900
07/27/2010	14:16:15	Common Bottlenose Dolphin	*Tursiops truncatus*	50	-117.31067	32.92833
07/27/2010	14:47:30	Fin Whale	*Balaenoptera physalus*	1	-117.33550	32.93383
07/27/2010	15:23:46	Common Dolphin sp.	undifferentiated *Delphinus*	400	-117.37233	32.82733
07/27/2010	15:24:19	Blue Whale	*Balaenoptera musculus*	6	-117.37883	32.82867
07/27/2010	16:21:15	Fin Whale	*Balaenoptera physalus*	2	-117.38783	32.83817
07/28/2010	13:43:11	Common Bottlenose Dolphin	*Tursiops truncatus*	6	-117.28067	32.88150
07/28/2010	13:46:21	Blue Whale	*Balaenoptera musculus*	3	-117.31550	32.93283
07/28/2010	14:06:22	Unidentified Small Dolphin	unidentified Delphinidae	20	-117.30483	32.92500
07/28/2010	14:40:04	Blue Whale	*Balaenoptera musculus*	1	-117.38767	33.01400
07/28/2010	14:42:26	Blue Whale	*Balaenoptera musculus*	1	-117.38783	33.05750
07/28/2010	14:44:00	Common Bottlenose Dolphin	*Tursiops truncatus*	6	-117.40000	33.08383
07/28/2010	14:56:06	Common Dolphin sp.	undifferentiated *Delphinus*	400	-117.46033	33.18500
07/28/2010	15:13:48	Common Dolphin sp.	undifferentiated *Delphinus*	60	-117.48517	33.08583
07/28/2010	15:16:50	Common Dolphin sp.	undifferentiated *Delphinus*	600	-117.47383	33.02833
07/28/2010	15:31:50	Unidentified Small Dolphin	unidentified Delphinidae	200	-117.34750	32.72617
07/28/2010	15:44:38	Common Dolphin sp.	undifferentiated *Delphinus*	200	-117.35150	32.62367
07/28/2010	15:45:58	Blue Whale	*Balaenoptera musculus*	5	-117.34600	32.64333
07/28/2010	15:45:58	Fin Whale	*Balaenoptera physalus*	3	-117.34717	32.64533
07/29/2010	14:37:26	Blue Whale	*Balaenoptera musculus*	2	-117.36200	32.75583
07/29/2010	15:50:41	Common Dolphin sp.	undifferentiated *Delphinus*	380	-117.38033	33.04883
07/29/2010	16:05:57	Common Dolphin sp.	undifferentiated *Delphinus*	110	-117.47383	33.15700
07/29/2010	16:13:49	Common Dolphin sp.	undifferentiated *Delphinus*	40	-117.46250	33.07517
07/29/2010	16:14:22	Blue Whale	*Balaenoptera musculus*	1	-117.45033	33.05783
07/29/2010	16:15:16	Common Dolphin sp.	undifferentiated *Delphinus*	60	-117.43617	33.03717
07/29/2010	16:19:58	Blue Whale	*Balaenoptera musculus*	3	-117.34733	32.92300
07/30/2010	15:08:36	Risso's Dolphin	*Grampus griseus*	9	-118.65333	33.11183
07/31/2010	14:31:55	Common Dolphin sp.	undifferentiated *Delphinus*	600	-117.28500	32.86100
07/31/2010	14:35:46	Common Dolphin sp.	undifferentiated *Delphinus*	100	-117.35683	32.76233
07/31/2010	14:36:31	Blue Whale	*Balaenoptera musculus*	6	-117.36700	32.73800
07/31/2010	15:44:29	Common Dolphin sp.	undifferentiated *Delphinus*	100	-117.54267	32.66533
07/31/2010	15:50:33	Common Dolphin sp.	undifferentiated *Delphinus*	200	-117.74500	32.63283
07/31/2010	16:07:24	Common Dolphin sp.	undifferentiated *Delphinus*	60	-117.65483	32.74817
07/31/2010	16:21:53	Unidentified Dolphin	unidentified Delphinidae	25	-117.42633	32.81583
07/31/2010	16:32:32	Common Dolphin sp.	undifferentiated *Delphinus*	12	-117.36683	32.89733
07/31/2010	16:46:05	Common Dolphin sp.	undifferentiated *Delphinus*	110	-117.53317	32.90317
07/31/2010	17:22:26	Common Dolphin sp.	undifferentiated *Delphinus*	15	-117.74033	32.97783
07/31/2010	17:30:45	Unidentified Dolphin	unidentified Delphinidae	1	-117.57950	33.01517
07/31/2010	17:33:13	Common Dolphin sp.	undifferentiated *Delphinus*	125	-117.54183	33.02150
07/31/2010	17:37:33	Common Dolphin sp.	undifferentiated *Delphinus*	40	-117.50417	33.03033
07/31/2010	17:41:12	Common Dolphin sp.	undifferentiated *Delphinus*	450	-117.38017	33.05467
07/31/2010	17:41:32	Blue Whale	*Balaenoptera musculus*	1	-117.36817	33.05667
07/31/2010	17:41:32	Fin Whale	*Balaenoptera physalus*	1	-117.36817	33.05667

Sighting Date	Sighting Time	Common Name	Species	Best Count	Longitude	Latitude
07/31/2010	18:20:41	Unidentified Dolphin	unidentified Delphinidae	90	-117.27733	32.87600
08/02/2010	14:49:42	California Sea Lion	*Zalophus californianus*	2	-117.26233	32.86100
08/02/2010	14:51:25	Blue Whale	*Balaenoptera musculus*	2	-117.28417	32.90717
08/02/2010	14:53:04	Blue Whale	*Balaenoptera musculus*	1	-117.30517	32.91217
08/02/2010	14:53:04	Common Dolphin sp.	undifferentiated *Delphinus*	300	-117.30517	32.91217
08/02/2010	15:02:45	Common Dolphin sp.	undifferentiated *Delphinus*	40	-117.32167	32.98350
08/02/2010	15:03:33	Common Dolphin sp.	undifferentiated *Delphinus*	35	-117.33500	33.00733
08/02/2010	15:09:36	Unidentified Dolphin	unidentified Delphinidae	75	-117.42733	33.12800
08/02/2010	15:15:32	Unidentified Dolphin	unidentified Delphinidae	120	-117.63100	33.12217
08/02/2010	15:55:32	Blue Whale	*Balaenoptera musculus*	2	-117.92983	33.18833
08/02/2010	16:47:54	Unidentified Dolphin	unidentified Delphinidae	200	-117.58817	33.26650
08/02/2010	16:48:19	Common Dolphin sp.	undifferentiated *Delphinus*	55	-117.59067	33.27883
08/02/2010	16:53:12	Common Dolphin sp.	undifferentiated *Delphinus*	175	-117.59717	33.28233
08/02/2010	16:56:05	Blue Whale	*Balaenoptera musculus*	2	-117.62500	33.31483
08/02/2010	17:19:09	Common Dolphin sp.	undifferentiated *Delphinus*	75	-117.61433	33.33083
08/02/2010	17:29:49	Unidentified Dolphin	unidentified Delphinidae	50	-117.56150	33.27050
08/02/2010	17:32:21	Common Dolphin sp.	undifferentiated *Delphinus*	250	-117.50200	33.20567
08/02/2010	17:33:57	Common Dolphin sp.	undifferentiated *Delphinus*	70	-117.48283	33.16583
08/02/2010	17:36:39	Unidentified Dolphin	unidentified Delphinidae	125	-117.42833	33.09400
08/02/2010	17:37:31	Unidentified Dolphin	unidentified Delphinidae	50	-117.41050	33.07317
08/03/2010	15:32:41	Common Dolphin sp.	undifferentiated *Delphinus*	*	-117.28583	32.89717
08/03/2010	15:33:39	Blue Whale	*Balaenoptera musculus*	1	-117.29900	32.92717
08/03/2010	15:35:22	Common Dolphin sp.	undifferentiated *Delphinus*	25	-117.30533	32.93200
08/03/2010	15:36:42	Common Dolphin sp.	undifferentiated *Delphinus*	40	-117.33000	32.96767
08/03/2010	15:42:06	Common Dolphin sp.	undifferentiated *Delphinus*	1000	-117.44150	33.11417
08/03/2010	15:52:18	Common Dolphin sp.	undifferentiated *Delphinus*	*	-117.50950	33.19333
08/03/2010	15:55:05	Common Dolphin sp.	undifferentiated *Delphinus*	600	-117.50883	33.21533
08/03/2010	15:57:43	Common Dolphin sp.	undifferentiated *Delphinus*	100	-117.57017	33.25683
08/03/2010	15:59:00	Common Dolphin sp.	undifferentiated *Delphinus*	*	-117.56967	33.25833
08/03/2010	16:02:29	Common Dolphin sp.	undifferentiated *Delphinus*	1100	-117.61367	33.29600
08/03/2010	16:04:07	Common Dolphin sp.	undifferentiated *Delphinus*	350	-117.64617	33.33267
08/03/2010	16:06:11	Common Dolphin sp.	undifferentiated *Delphinus*	400	-117.69683	33.37000
08/03/2010	16:07:32	Common Dolphin sp.	undifferentiated *Delphinus*	250	-117.73617	33.36600
08/03/2010	16:23:44	Common Dolphin sp.	undifferentiated *Delphinus*	300	-118.25333	33.25083
08/03/2010	16:47:03	Unidentified Dolphin	unidentified Delphinidae	125	-118.23733	33.33900
08/03/2010	16:59:54	Unidentified Dolphin	unidentified Delphinidae	70	-117.90867	33.45633
08/03/2010	17:03:26	Unidentified Dolphin	unidentified Delphinidae	140	-117.78983	33.45400
08/03/2010	17:07:10	Unidentified Dolphin	unidentified Delphinidae	50	-117.76483	33.43317
08/03/2010	17:07:38	Unidentified Dolphin	unidentified Delphinidae	200	-117.75267	33.42233
08/03/2010	17:09:21	Unidentified Dolphin	unidentified Delphinidae	*	-117.71100	33.38367
08/03/2010	17:10:52	Unidentified Dolphin	unidentified Delphinidae	25	-117.67233	33.35183
08/03/2010	17:12:01	Unidentified Dolphin	unidentified Delphinidae	35	-117.64167	33.32767
08/03/2010	17:14:31	Common Dolphin sp.	undifferentiated *Delphinus*	7	-117.58017	33.26983
08/03/2010	17:18:17	Unidentified Dolphin	unidentified Delphinidae	11	-117.55650	33.25067
08/03/2010	17:26:16	Unidentified Dolphin	unidentified Delphinidae	*	-117.39117	33.05417
08/03/2010	17:27:28	Common Dolphin sp.	undifferentiated *Delphinus*	120	-117.37450	33.01917
08/03/2010	17:31:06	Blue Whale	*Balaenoptera musculus*	1	-117.31867	32.91200
08/03/2010	17:34:51	Blue Whale	*Balaenoptera musculus*	2	-117.31967	32.92117

* Individual animal counts for these sightings are pending further survey data analysis.

Appendix C Sighting Rate Tables

Appendix Table C- 1. Sighting rates of marine mammal groups by species during the November 2009, May, and July 2010 SOCAL aerial surveys during systematic, random and transit effort.

Species (Common Name)	Nov 2009				May 2010				July 2010			
	Total No. of Sightings	Sightings /km	Sightings /nm	Sightings /hr	Total No. of Sightings	Sightings/km	Sightings /nm	Sightings/hr	Total No. of Sightings	Sightings/km	Sightings/nm	Sightings/hr
Whales												
Blue Whale	0	0	0	0	2	0.0007	0.001	0.072	18	0.0058	0.026	0.99
Fin Whale	5	0.001	0.003	0.19	2	0.0007	0.001	0.072	4	0.0013	0.0024	0.22
Minke Whale`	1	0.0003	0.0005	0.037	1	0.0004	0.0007	0.036	0	0	0	0
Unidentified Large Whale	1	0.0003	0.0005	0.037	1	0.0004	0.0007	0.036	0	0	0	0
Unidentified Medium Whale	1	0.0003	0.0005	0.037	0	0	0	0	0	0	0	0
Dolphins												
Killer Whale	2	0.0006	0.001	0.075	0	0	0	0	0	0	0	0
Cuvier's Beaked Whale	2	0.0006	0.001	0.075	0	0	0	0	0	0	0	0
Risso's Dolphin	5	0.001	0.003	0.19	28	0.14	0.02	1.011	1	0.00032	0.00059	0.06
Common Dolphin sp.	25	0.007	0.013	0.94	15	1.27	0.01	0.54	40	0.013	0.024	2.21
Common Bottlenose Dolphin	0	0	0	0	9	0.98	0.006	0.32	3	0.00096	0.0018	0.17
Pacific White-sided Dolphin	6	0.002	0.003	0.22	2	0.03	0.001	0.072	0	0	0	0
Unidentified Dolphin	6	0.002	0.003	0.22	10	0.27	0.007	0.361	17	0.0054	0.01	0.94
Unidentified Small Dolphin	2	0.0006	0.001	0.075	4	0.17	0.003	0.14	2	0.00064	0.0012	0.11
Pinnipeds												
California Sea Lion	19	0.006	0.01	0.71	22	0.02	0.016	0.79	1	0.00032	0.00059	0.06
Harbor Seal	0	0	0	0	1	0.0007	0.0007	0.036	0	0	0	0
Unidentified Pinniped	4	0.001	0.002	0.15	2	0.0007	0.001	0.072	0	0	0	0
Unidentified Marine Mammal	1	0.0003	0.0005	0.037	1	0.0004	0.0007	0.036	0	0	0	0
Unidentified Small Marine Mammal	1	0.0003	0.0005	0.037	2	0.0007	0.001	0.072	0	0	0	0
Overall Marine Mammal	81	0.02	0.04	3.034	102	0.04	0.073	3.68	86	0.028	0.051	4.75

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Appendix Table C- 2. Sighting rates of individual marine mammals by species during the November 2009, May, and July 2010 SOCAL aerial surveys during systematic, random and transit effort.

Species (Common Name)	Nov 2009				May 2010				July 2010			
	Total # Individuals	Individuals/km	Individuals/nm	Individuals/hr	Total # Individuals	indiv./km	indiv./nm	indiv./hr	Total # Individuals	indiv./km	indiv./nm	indiv./hr
Whales												
Blue Whale	0	0	0	0	2	0.0007	0.001	0.14	44	0.014	0.026	2.43
Fin Whale	9	0.003	0.005	0.64	4	0.002	0.003	0.29	7	0.0022	0.0041	0.39
Minke whale`	1	0.003	0.0005	0.07	1	0.0004	0.0007	0.71	0	0	0	0.00
Unidentified Large Whale	1	0.003	0.0005	0.07	1	0.0004	0.0007	0.71	0	0	0	0.00
Unidentified Medium Whale	1	0.003	0.0005	0.07	0	0	0	0	0	0	0	0.00
Dolphins												
Killer Whale	67	0	0.04	4.79	0	0	0	0	0	0	0	0.00
Cuvier's Beaked Whale	6	0.002	0.003	0.43	0	0	0	0	0	0	0	0.00
Risso's Dolphin	167	0.05	0.09	11.93	373	0.14	0.27	26.64	9	0.0029	0.0053	0.50
Common Dolphin sp.	11891	3.45	6.4	849.36	3300	1.27	2.36	235.71	9154	2.99	5.54	505.75
Common Bottlenose Dolphin	0	0	0	0	255	0.98	0.18	18.21	62	0.02	0.037	3.43
Pacific White-sided Dolphin	274	0.08	0.15	19.57	81	0.03	0.06	5.79	0	0	0	0.00
Unidentified Dolphin	27	0.08	0.01	1.93	689	0.27	0.49	49.21	1392	0.45	0.82	76.91
Unidentified Small Dolphin	45	0.01	0.02	3.21	429	0.17	0.31	30.64	220	0.07	0.13	12.15
Pinnipeds												
California Sea Lion	83	0.02	0.04	5.93	58	0.02	0.04	4.14	2	0.00064	0.0012	0.11
Harbor Seal	0	0	0	0	2	0.0007	0.001	0.14	0	0	0	0.00
Unidentified Pinniped	4	0.001	0.002	0.29	2	0.0007	0.001	0.14	0	0	0	0.00
Unidentified Marine Mammal	1	0.0003	0.0005	0.07	10	0.004	0.007	0.71	0	0	0	0.00
Unidentified Small Marine Mammal	1	0.0003	0.0005	0.07	2	0.0007	0.001	0.14	0	0	0	0.00
Overall Marine Mammal	12578	3.65	6.77	898.43	5209	2.01	3.72	372.07	11090	3.55	6.57	612.71

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Appendix Table C- 3. Sighting rates of marine mammal (MM) groups by effort type during the November 2009, May 2010, and July 2010 SOCAL aerial surveys.

		Nov 18-23, 2009							May 13-18, 2010							July 27- August 3, 2010						
Effort Type	Species Group	Total Stgs	Total km	Total nm	Total hr	Sighting/ km	Sighting/ nm	Sighting/ hr	Total Stgs	Total km	Total nm	Total hr	Sighting/ km	Sighting/ nm	Sighting/ hr	Total Stgs	Total km	Total nm	Total hr	Sighting/ km	Sighting/ nm	Sighting/ hr
	Whales	6				0.003	0.006	0.73	4				0.003	0.006	0.5509	1				0.0017	0.0031	0.3333
	Dolphins	21				0.012	0.022	2.55	29				0.023	0.042	3.9939	10				0.0169	0.0313	3.333
	Pinnipeds	17				0.009	0.018	2.06	13				0.01	0.019	1.7904	0				0	0	0
Systematic	All MM	46	1790	967	8.25	0.026	0.048	5.58	46	1268	685	7.26	0.036	0.067	6.3351	11	592	319.68	3	0.0186	0.0344	3.6667
	Whales	0				0	0	0.00	1				0.003	0.005	0.4768	0				0	0	0
	Dolphins	4				0.006	0.011	2.33	10				0.027	0.05	4.76821	3				0.0270	0.0501	6
	Pinnipeds	3				0.004	0.008	1.75	1				0.003	0.005	0.4768	0				0	0	0
Random	All MM	7	669	361	1.72	0.01	0.019	4.08	12	370	200	2.10	0.032	0.06	5.7219	3	111	59.94	0.5	0.027	0.0501	6
	Whales	2				0.002	0.004	0.54	1				0.001	0.002	0.2206	16				0.0183	0.0339	4.2105
	Dolphins	23				0.023	0.043	6.17	29				0.03	0.056	6.3971	1				0.0011442	0.0021188	0.2632
	Pinnipeds	3				0.003	0.006	0.81	12				0.013	0.023	2.6471	42				0.0480549	0.0889906	11.052632
Transit	All MM	28	983	531	3.73	0.028	0.053	7.51	42	956	516	4.53	0.044	0.081	9.2647	59	874	471.96	3.8	0.0675057	0.1250106	15.526316
	Whales	0				0	0	0.00	0				0	0	0	5				0.0032279	0.0059776	0.5
	Dolphins	1				0.001	0.001	0.14	0				0	0	0	5				0.0032279	0.0059776	0.5
	Pinnipeds	0				0	0	0.00	0				0	0	0	0				0	0	0
Circling	All MM	1	1335	721	7.20	0.001	0.001	0.14	0	2125	1147	12.91	0	0	0	10	1549	836.46	10	0.0064558	0.0119551	1
	Whales	0				0	0	0.00	0				0	0	0	0				0	0	0
	Dolphins	2				0.017	0.031	9.33	3				0.036	0.067	6.2791	0				0	0	0
Circumnavigating San Clemente Island	Pinnipeds	5				0	0	23.32	37				0.446	0.826	77.4419	0				0	0	0
	All MM	7	120	65	0.21	0.058	0.108	32.64	40	83	45	0.48	0.482	0.893	83.7209	0	0	0	0	0	0	0
	Whales	0				0	0	0.00	0				0	0	0	0				0	0	0
	Dolphins	1				0.007	0.014	1.58	7				0.077	0.142	17.7465	0				0	0	0
	Pinnipeds	4				0	0	6.34	3				0.033	0.061	7.6056	0				0	0	0
Navy-directed Transiting	All MM	5	137	74	0.63	0.036	0.068	7.92	10	91	49	0.39	0.11	0.204	25.3521	0	0	0	0	0	0	0

Appendix Table C- 4. Sighting rates of individual marine mammals (MM) by effort type during the November 2009, May 2010, and July 2010 SOCAL aerial surveys.

		Nov 18-23, 2009							May 13-18, 2010							July 27- August 3, 2010						
Effort Type	Species Group	Total Animals	Total km	Total nm	Total hr	Individual/ km	Individual/ nm	Individual/hr	Total Animals	Total km	Total nm	Total hr	Individual/km	Individual/nm	Individual/ hr	Total Animals	Total km	Total nm	Total hr	Individual/km	Individual/nm	Individual/hr
	Whales	4				0.0022	0.0041	0.48	6				0.0047	0.0088	0.83	1				0.0017	0.0031	0.33
	Dolphins	3823				2.14	3.95	463.5	3080				2.43	4.5	424.18	10				0.017	0.031	3.33
	Pinnipeds	8				0.0045	0.0083	0.97	20				0.016	0.029	2.75	0				0	0	0
Systematic	All MM	3835	1790	967	8.25	2.14	3.97	464.96	3106	1268	685	7.26	2.45	4.53	427.76	11	592	319.68	3	0.019	0.034	3.67
	Whales	8				0.012	0.022	4.66	1				0.0027	0.005	0.477	0				0	0	0
	Dolphins	8207				12.27	22.73	4785.42	582				1.57	2.91	277.51	3				0.027	0.05	6
	Pinnipeds	77				0.12	0.21	44.9	25				0.068	0.125	11.92	0				0	0	0
Random	All MM	8292	669	361	1.72	12.39	22.97	4834.99	608	370	200	2.1	1.64	3.04	289.91	3	111	59.94	0.5	0.027	0.05	6
	Whales	2				0.002	0.0038	0.54	1				0.001	0.0019	0.22	16				0.018	0.034	4.21
	Dolphins	3835				3.9	7.22	1029.22	1465				1.53	2.84	323.16	1				0.0011	0.0021	0.26
	Pinnipeds	3				0.0031	0.0056	0.81	18				0.019	0.035	3.97	42				0.048	0.089	11.053
Transit	All MM	28	983	531	3.73	0.028	0.0527	7.51	1495	956	516	4.53	1.56	2.9	329.78	59	874	471.96	3.8	0.068	0.13	15.53
	Whales	0				0	0	0	0				0	0	0	5				0.0032	0.006	0.5
	Dolphins	150				0.11	0.2	20.84	0				0	0	0	5				0.0032	0.006	0.5
	Pinnipeds	0				0	0	0	0				0	0	0	0				0	0	0
Circling	All MM	150	1335	721	7.2	0.11	0.2	20.84	0	2125	1147	12.91	0	0	0	10	1549	836.46	10	0.0065	0.012	1
	Whales	0				0	0	0	0				0	0	0	0				0	0	0
	Dolphins	50				0.42	0.77	233.16	53				0.64	1.18	110.93	0				0	0	0
	Pinnipeds	35				0.29	0.54	163.21	96				1.16	2.13	200.93	0				0	0	0
Circumnavigating San Clemente Island	All MM	85	120	65	0.21	0.71	1.31	396.37	149	83	45	0.48	1.8	3.31	311.86	0	0	0	0	0	0	0
	Whales	0				0	0	0	0				0	0	0	0				0	0	0
	Dolphins	447				3.26	6.041	707.96	90				0.99	1.84	228.17	0				0	0	0
	Pinnipeds	2				0.015	0.027	3.17	5				0.055	0.1	12.68	0				0	0	0
Navy-directed Transiting	All MM	449	137	74	0.63	3.28	6.068	711.13	95	91	49	0.39	1.044	1.94	240.85	0	0	0	0	0	0	0

May 2010 Focal Follows

Preliminary list of focal behavioral follows longer than 5 min conducted during the July SOCAL 2010 aerial monitoring surveys off San Diego, California. Video was taken on some of these groups as indicated in Appendix D.

Date	Start Time	End Time	Duration of Focal (hr:min:sec)	Latitude	Longitude	Species	Group Size	Notes
27-Jul	14:09:01	15:16:00	1:06:59	32.54065	117.19325	Blue Whale	4	
27-Jul	15:24:19	16:24:00	0:59:41	32.49768	117.22878	Blue Whale	6	One possible young-of-the year, 2 fins joined after period of time, 6 blues and 2 fins at the surface at one time in large 800-m circle
28-Jul	13:46:21	14:32:00	0:45:39	32.5597	117.18939	Blue Whale	3	
28-Jul	14:56:06	15:05:00	0:08:54	33.10959	117.27519	Common Dolphin sp.	400	
28-Jul	15:45:58	15:59:00	0:13:02	32.38722	117.20831	Blue Whale/Fin Whale	6/2	3 fin whales travel together with 3 blue whales, 2 other blue whales on the outskirts about 10 and 50 body lengths away
29-Jul	14:37:26	15:39:50	1:02:24	32.45351	117.21725	Blue Whale	2	
29-Jul	15:50:41	16:02:27	0:11:46	33.03163	117.23013	Common Dolphin sp.	380	
29-Jul	16:19:58	16:31:03	0:11:05	32.55137	117.2063	Blue Whale	3	
30-Jul	15:08:36	15:28:27	0:19:51	33.06714	118.39205	Risso's Dolphin	9	
31-Jul	14:35:36	15:40:07	1:04:31	32.45747	117.21411	Common Dolphin sp.	100	
31-Jul	14:36:31	15:40:21	1:03:50	32.44289	117.22023	Blue Whale	6	
31-Jul	15:50:33	15:56:10	0:05:37	32.37979	117.44703	Common Dolphin sp.	200	
31-Jul	16:07:24	16:16:01	0:08:37	32.44972	117.38886	Common Dolphin sp.	60	
31-Jul	16:21:53	16:30:29	0:08:36	32.48956	117.25582	Unid. Dolphin	25	
31-Jul	16:46:05	16:52:28	0:06:23	32.5412	117.32314	Common Dolphin sp.	110	

Date	Start Time	End Time	Duration of Focal (hr:min:sec)	Latitude	Longitude	Species	Group Size	Notes
31-Jul	17:41:12	18:15:06	0:33:54	33.03289	117.22819	Common Dolphin sp.	450	Fin whale in vicinity of single blue
2-Aug	16:56:05	17:28:36	0:32:31	33.19146	117.37712	Blue Whale	2	
3-Aug	15:42:06	15:49:00	0:06:54	33.07479	117.26426	Common Dolphin sp.	1000	
3-Aug	17:34:51	17:57:45	0:22:54	32.55495	117.19366	Blue Whale	2	Seen while circling the single blue whale seen earlier thus no angle; circled these 2 blues for focal session but clouds did not allow us to go any higher than 800 ft so we circled outside 1 km radial distance for short period but then determined that observations were not effective because too difficult to follow and resight whales at that low altitude due to wing getting in way and short period whales in view; seen near buoy

5 min focals for July= 6
10min focals for July= 13

List of July 2010 Video

Video recorded during July SOCAL 2010 aerial monitoring surveys off San Diego, California based on preliminary review of video. This summary is based on a preliminary "quick look" and should not be considered a detailed analysis or summary of useable video.

Video Name (Draft)	Date 2010	Video Start Time	Video End Time	Total Video (min)	Sighting ID	Preliminary Species Identification	Video Notes
SOCAL July 2010_Video_27 July_141025_IDXX_Blue	7/27/2010	14:10:25	14:14:38	0:04:13	XX	Blue Whale	multiple blows, no vocals due to noise of helicopter, subsurface, 1 indiv.,
SOCAL July 2010_Video_27 July_141538_IDXX_Boat	7/27/2010	14:15:38	14:15:41	0:00:03	XX	Boat	Private Sail Boat near blue whale
	7/27/2010	14:16:10	14:17:58	0:01:48	XX		Fast travel, oriented at 350,
	7/27/2010	14:18:28	14:19:38	0:01:10	XX		
SOCAL July 2010_Video_27 July_142206_IDXX_Blue	7/27/2010	14:22:06	14:26:58	0:04:52	XX	Blue Whale	1 indiv., below surface, multiple blows, slow travel, blew and dove,
SOCAL July 2010_Video_27 July_143839_IDXX_Blue	7/27/2010	14:38:39	14:41:09	0:02:30	XX	Blue Whale	below surface, 1 indiv., slow travel, blew and shallow dive
SOCAL July 2010_Video_27 July_144431_IDXX_Blue	7/27/2010	14:44:31	14:45:20	0:00:49	XX	Blue Whale	1 indiv., below surface, blew and dove
SOCAL July 2010_Video_27 July_144703_IDXX_Fin	7/27/2010	14:47:03	14:48:15	0:01:12	XX	Fin Whale	1 indiv, below surface, surfaces blows, and dives again and seen below surface
SOCAL July 2010_Video_27 July_145232_IDXX_Blue	7/27/2010	14:52:32	14:52:53	0:00:21	XX	Blue Whale	Flukes up and dove
SOCAL July 2010_Video_27 July_145601_IDXX_Blue	7/27/2010	14:56:01	14:58:25	0:02:24	XX	Blue Whale	1 indiv., below surface, multiple blows, slow travel,
SOCAL July 2010_Video_27 July_150525_IDXX_Blue	7/27/2010	15:05:25	15:06:54	0:01:29	XX	Blue Whale	1 indiv., resting below surface, multiple blows
SOCAL July 2010_Video_27 July_150939_IDXX_Blue	7/27/2010	15:09:39	15:12:42	0:03:03	XX	Blue Whale	multiple blows, 1 indiv., shallow dive, slow travel,
SOCAL July 2010_Video_27 July_152454_IDXX_Blue	7/27/2010	15:24:54	15:25:16	0:00:22	XX	Blue Whale	1 indiv, subsurface blows, arched back then flukes up and dives
SOCAL July 2010_Video_27 July_152550_IDXX_Blue	7/27/2010	15:25:50	15:28:32	0:02:42	XX	Blue Whale	whale scat, 1 indiv., slow travel

Video Name (Draft)	Date 2010	Video Start Time	Video End Time	Total Video (min)	Sighting ID	Preliminary Species Identification	Video Notes
SOCAL July 2010_Video_27 July_153626_IDXX_Blue	7/27/2010	15:36:26	15:44:27	0:08:01	XX	Blue Whale	2 indiv., swimming towards helicopter, whale #2 reorientes to the right of whale #1, whale #2 is .5 body lengths behind #1, multiple blows, dispersal is now 2 body lengths, some white water when whales submerge, slow travel, whale #1 dove, whale #2 at surface then dives, both shallow dives, whale #2 now to the left of #1, poss #2 a calf, whales side by side .5 body lengths
SOCAL July 2010_Viedo_27 July_155012_IDXX_Blue	7/27/2010	15:50:12	15:50:27	0:00:15	XX	Blue Whale	Flukes and dove
SOCAL July 2010_Video_27 July_155104_IDXX_Blue	7/27/2010	15:51:04	16:01:13	0:10:09	XX	Blue Whale	2 indiv., second 2 body lengths behind to the right, slow travel, multiple blows, traveling away from helicopter, first whale circled around and 2nd whale dove, whale #2 up, swimming behind other whale 1.5 body lengths apart, whale #1 dove, whale #2 dove, whales surface together .5 body lengths apart side by side and it is a mother-calf pair, calf dove, mother subsurface, calf just below mother both under the surface, looks like they are floating just below surface, possible nursing, looks as if mother rolled to side,
SOCAL July 2010_Video_27 July_160446_IDXX_Blue	7/27/2010	16:04:46	16:08:32	0:03:46	XX	Blue Whale	1 indiv. , 3 spots of scat, multiple blows, slow travel, arched back, flukes up and dove
SOCAL July 2010_Video_27 July_161013_IDXX_Blue	7/27/2010	16:10:13	16:12:17	0:02:04	XX	Blue Whale	2 indiv., multiple blows, slow travel, front animal 4 body lengths apart, not 2 body lengths apart, the 2nd is behind to the left,
SOCAL July 2010_Video_27 July_161740_IDXX_Blue	7/27/2010	16:17:40	16:21:07	0:03:27	XX	Blue Whale	1 indiv. subsurface, looks as if it is floating just below surface, milling, whale turns slightly on its side, arched back and dove
SOCAL July 2010_Video_27 July_162117_IDXX_Unid	7/27/2010	16:21:17	16:21:27	0:00:10	XX	Unidentified Whale Scat	Whale scat
SOCAL July 2010_Video_27 July_162141_IDXX_Unid	7/27/2010	16:21:41	16:21:47	0:00:06	XX	Unidentified Whale Scat	Big blob of whale scat

Video Name (Draft)	Date 2010	Video Start Time	Video End Time	Total Video (min)	Sighting ID	Preliminary Species Identification	Video Notes
SOCAL July 2010_Video_28 July_134711_IDXX_Blue	7/28/2010	13:47:11	13:50:24	0:03:13	XX	Blue Whale	cannot hear vocals, multiple blows, arched back and dove,
SOCAL July 2010_Video_28 July_135623_IDXX_Blue	7/28/2010	13:56:23	14:30:50	0:34:27	XX	Blue Whale	Cannot hear vocals, 1 indiv. Subsurface, multiple blows, looks like it is logging, very slow travel, arched back and a fluke, dove, arched back and shallow dive, arched back and dove, flukes, seems to be floating at surface at times, arched back, flukes and dove
SOCAL July 2010_Video_28 July_145741_IDXX_Common sp.	7/28/2010	14:57:41	15:03:56	0:06:15	XX	Common Dolphin sp.	Surface active milling, dispersal 1-8, 1400 ft, angle 26, well over 100 animals, 2 groups, 1st group scattered
SOCAL July 2010_Video_28 July_152622_IDXX_Boat	7/28/2010	15:26:22	15:26:28	0:00:06	XX	Boat	Private Boat Only
SOCAL July 2010_Video_28 July_154558_IDXX_Blue_Fin	7/28/2010	15:45:58	15:54:22	0:08:24	XX	Blue Whale_Fin Whale	oriented to 320, multiple blows, 3 indiv., slow travel, 3 fins, 2 blues, subsurface, blues oriented at 330, 3 animals are 1 body length apart, 3 fins and 3 blues, the fins are swimming towards a bait ball, one fin with mouth open
SOCAL July 2010_Video_29 July_143809_IDXX_Blue	7/29/2010	14:38:09	15:19:36	0:41:27	XX	Blue Whale	2 indiv., slow travel, subsurface, multiple blows, lots of white water, vocals hard to understand; oriented at 180, angle 30 degrees, flukes, 2nd whale defecated, reoriented about 15 degrees to 210, about 1.5 body lengths apart
SOCAL July 2010_Video_29 July_155244_IDXX_Commo nsp.	7/29/2010	15:52:44	15:55:45	0:03:01	XX	Common Dolphin sp.	800 ft., looking at subgroup, orientation 270, unidentified splash, 2 gulls over dolphin
SOCAL July 2010_Video_29 July_155549_IDXX_Commo nsp.	7/29/2010	15:55:49	15:57:44	0:01:55	XX	Common Dolphin sp.	
SOCAL July 2010_Video_29 July_160820_IDXX_Commo nsp.	7/29/2010	16:08:20	16:09:05	0:00:45	XX	Common Dolphin sp.	
SOCAL July 2010_Video_30 July_131258_IDXX_Risso's	7/30/2010	15:12:58	15:13:32	0:00:34	XX	Risso's Dolphin	Oriented at 2 o'clock
SOCAL July 2010_Video_30 July_151558_IDXX_Risso's	7/30/2010	15:15:58	15:27:32	0:11:34	XX	Risso's Dolphin	line abreast, dispersal 1-2, oriented at 330, dispersal now 1-5

Video Name (Draft)	Date 2010	Video Start Time	Video End Time	Total Video (min)	Sighting ID	Preliminary Species Identification	Video Notes
SOCAL July 2010_Video_31 July_143756_IDXX_Blue	7/31/2010	14:37:56	14:59:20	0:21:24	XX	Blue whale	.5 body lengths apart, 2 indiv
SOCAL July 2010_Video_31 July_145923_IDXX_Blue	7/31/2010	14:59:23	15:29:16	0:29:53	XX	Blue Whale	2 indiv.
SOCAL July 2010_Video_31 July_153608_IDXX_Blue	7/31/2010	15:36:08	15:37:32	0:01:24	XX	Blue Whale	oriented at 300, 2 ind.,one whale fluked and the second one sounded, angle is 26
SOCAL July 2010_Video_31 July_174437_IDXX_Blue	7/31/2010	17:44:37	17:55:48	0:11:11	XX	Blue Whale	
SOCAL July 2010_Video_31 July_175549_IDXX_Blue	7/31/2010	17:55:49	18:19:39	0:23:50	XX	Blue Whale	oriented at 150
SOCAL July 2010_Video_2 August_155827_IDXX_Blue	8/2/2010	15:58:27	16:36:41	0:38:14	XX	Blue Whale	mother-calf pair, oriented at 210, calf rolled over, another adult blue whale 30 body lengths away, breaching, mother-calf .5 body lengths apart, calf now 5 body lengths apart from mother, calf breached, mother lunged and breached then sounded, calf breached and lunged 5 times, now mother-calf pair dove, 3 rd whale lunged twice, breached and blew, and fast travel, orientation now 300, calf lunged, angle from calf is 33 degrees, calf keeps lunging while mom underwater swimming
SOCAL July 2010_Video_2 August_165955_IDXX_Blue	8/2/2010	16:59:55	17:59:30	0:59:35	XX	Blue Whale	2 indiv., multiple blows, speed boat in picture but not close to whales, whale #2 defecated, #2 whale fluked then dove, 50 body lengths apart, oriented at 130, first whale angle 29 degrees, 2nd whale 37 degrees,

Photo Log

Preliminary List of Photographs Taken During the 27 July - 3 August 2010 Navy SOCAL Aerial Survey off San Diego, California.

Date 2010	Daily Sighting ID No.	Species Common Name	Best Group Size Estim.	Start Frame #	End Frame #	Total Photos	First Frame Time	Last Frame Time
3-Aug	1	Common dolphin sp.		1657	1734		3:46:18	3:47:58
3-Aug	2	Common dolphin sp.		1736	1798		3:52:54	3:53:38
3-Aug	3	Common dolphin sp.		1800	1833		3:58:16	3:58:46
3-Aug	4	Common dolphin sp.		1835	1900		3:59:02	4:08:14
3-Aug	5	Common dolphin sp.		1902	1976		4:24:52	4:26:26
3-Aug	6	Common dolphin sp.		2003	2042		5:04:20	5:05:42
3-Aug	7	Common dolphin sp.		2044	2069		5:14:52	5:16:30
3-Aug	8	Blue whale	1	2076	2078		5:33:52	5:34:06
3-Aug	9	Blue whale	2	2080	2107		5:34:16	5:34:46
3-Aug	10	Common dolphin sp.		2109	2132		5:39:42	5:41:08
3-Aug	11	Blue whale	1	2125	2170		5:42:08	5:43:20
3-Aug	12	Common dolphin sp.		2171	2189		5:44:08	5:47:42
3-Aug	13	Blue whale	1	2190	2228		5:48:06	5:51:58
3-Aug	14	Blue whale	1	2230	2249		5:54:18	5:54:56
3-Aug	15	Blue whale	2	2251	2262		5:55:46	5:56:00

Photos of Fin and Blue Whales Feeding

Below is a chronological description of eight consecutive photographs gleaned from HD video taken from the helicopter on 28 July 2010 of a loose aggregation of three blue (*Balaenoptera musculus*) and three fin whales (*B. physalus*) in SOCAL off San Diego. Photographs are taken from a video scene duration of 24 seconds at the end of a focal follow in the afternoon from 15:45:54 – 15:54:18. The caption numbers for each photo refer to arbitrary seconds into the 6th minute of the scene as described below. The photos are listed in order as AA29, then A39 through G53. The numbers refer to arbitrary seconds into the 6th minute of the scene as described below.

AA29 (photo on above left): shows three fin whales traveling side by side, whale 1 (#1) about one body length (BL) from whale 2 (#2), and whale 2 about one-half BL from whale 3 (#3). #3 is about 2 BL from an orange "bait ball' (on bottom left of photo, probably euphausiid crustaceans). There is a blue whale in the video frame as well, but this has been cropped out to concentrate on the fin whale action.

A39 (photo on above right): ten seconds later, shows #1 turning to its right by about 30 degrees. This was at first interpreted as a turn towards the bait ball, but a slight shimmer underwater (and clearer in subsequent frames) shows that a blue whale (labeled here as (bw)) is about to surface. It is likely that #1 is reacting to the blue whale in front of it, to avoid it.

B41 (photo on left above): two seconds later, has #1 diving and #2 also turning to its right. Subsequent action indicates that #2 is indeed cueing onto the baitball, at a distance of approximately 2 BL. The surfacing blue whale is becoming more visible.

C44 (photo on right above): three seconds later, has #3 also reacting to the baitball, by turning to the right, and twisting its body with whitewater at the surface. Whales #2 and #3 are about one-third BL apart.

D48 (above left photo): 4 seconds later (and also just before then), #3 markedly speeds up and it seems that it is using its closer track to the baitball to "outrace" #2. The blue whale has surfaced, blown, and is rotating through its surfacing sequence.

E51 (above right photo): 3 seconds later, #3 is lunging while turning to the right and on its axis. The baitball is in the open mouth of #3. Whale #2 is submerged but visible, and glides past at about one-third BL from #3. Another blue whale surfaces at bottom right, one-half BL from the first blue whale.

F52: 1 second later, the lunge continues, and it is likely that fin whale #1 is seen just below the surface, one-half BL from #2

G53: 1 second later, the fin whale's lunge continues, #3 has rotated through almost 180 degrees and is closing its mouth.