APPENDIX B. Southern California Aerial Survey Reports and Manuscripts

Sub-sections

27 July – 3 August 2010 (18.1 hours) and 24 – 28 September 2010 (28.6 hours)

23 -28 September 2010 (19.2 hours), 14 – 19 February 2011 (18 hours), 29 March – 3 April 2011 (9.5 hours), 12 – 20 April 2011 (46.1 hours), and 9 – 14 May 2011 (27 hours)

Navy-Funded Manuscripts contract issued to SES

Bryde's Whale (*Balaenoptera brydei/edeni*) Sightings in the Southern California Bight

Density and Abundance of Marine Mammals around San Clemente Island, San Diego County, California, in 2008-2010

Behavior and Group Characteristics of Marine Mammals in the Southern California Bight 2008-2010

Marine Mammal and Sea Turtle Monitoring Video during Navy Training Events

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

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Citation for this report is as follows:

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SECTION 1 INTRODUCTION

Per the Scope of Work (SOW), this report provides a combined summary of aerial surveys conducted in July and September 2010 in support of the U.S. Navy's (Navy) Marine Mammal Monitoring Plan (M3P) in the Southern California Range Complex (**Figure 1**) (SOCAL) (DoN 2009). These were the seventh and eighth such aerial surveys 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).

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 July 2010 survey, a helicopter (Bell 206) 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).

SECTION 2 METHODS

Methods followed those used in previous SOCAL aerial surveys as described in Smultea et al. (2009a,b; 2010a,b). Differences from previous methods are identified below.

Two aircraft were used for the July survey: (1) a fixed-wing, twin-engine Partenavia P-68 OBS Observer with a glass nose (the same one used on our previous SOCAL surveys), and (2) a Bell 206 helicopter (front cover)(both owned and operated by Aspen Helicopters, Oxnard, California). The helicopter was used evaluate its utility 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. During the September survey, the Partenavia Observer was the only aircraft used.

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. 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. In the helicopter, the pilot sat in the right front seat while the survey recorder/photographer sat in the left rear seat.

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).

Prior to the September 2010 survey, SES communicated with the Navy NTR and Dr. Brandon Southall of Southall Environmental Associates to identify ways in which the aircraft crew could assist the SOCAL Behavioral Response Study (BRS). Plans were made to contact the BRS group via email or cell phone each evening to learn the proposed location of the BRS survey vessels the following day, and to identify how efforts could be coordinated. Each morning, the survey aircraft would contact the BRS vessel when within range (~20 km or 10 nm) of the pre-communicated study area and identify how/if the aircraft crew could aid the BRS. The latter generally consisted of identifying and communicating the locations of cetaceans within their study area, and/or assisting them in relocating sightings.

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). The exception is that sighting encounter rates for the May, July and September SOCAL aerial surveys are included herein, per the SOWs. Results are summarized in **Tables 1 - 10**, **Figures 2-4**, and **Appendices A - E**. Unlike previous reports, **Tables 1 and 2** indicate aerial survey days when MTES-associated MFAS were operating in SOCAL. This activity occurred on five of the seven July 2010 survey days, including the first survey date of July 27. During the September survey, MTES-associated MFAS were operating on only two days.

Effort

27 July – 3 August 2010

A total of 18.1 hr of flight time and 3125 km (1688 nm) of effort occurred during the July 2010 SOCAL aerial survey between aircraft "wheels up" off the ground to "wheels down" when the plane landed (**Tables 1 and 3**). Surveys were flown on seven days from July 27 to August 3; no survey occurred on August 31 due to aircraft mechanical repair needs. Most (74% of 14.3 hr) 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 4**). Beaufort sea state rating (Bf) ranged from 2-6 during the July survey. Bf 3 predominated (16%) followed by Bf 2 (12%) (**Figure 2**). 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 (**Tables 1 and 4**). 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 times higher than the cost of the Partenavia fixed-wing plane.

24 – 28 September 2010

A total of 28.6 hr of flight time and 5314 km (2871 nm) of effort occurred during the September 2010 SOCAL aerial survey ("wheels up" to "wheels down") (**Tables 2 and 4**). Surveys were flown on six days from September 23 - 28. Overall, most (44%) of the total 5314 km of effort involved transiting between the airport and survey grid locations. This was followed by systematic line-transect (27%) and circling effort (26%) (**Table 4**). Beaufort sea state ranged from 1-5 during the September survey. Bf 2 predominated (53%) followed by Bf 3 (31%) (**Figure 3**).

Effort occurred in SOAR on four days with the remaining two days occurring in NAOPA (September 26 and 27). Effort was coordinated with the BRS study on 26-28 September and included conducting mini-transects on the NW corner of SOAR to help the BRS locate sightings (see **Table 2** for details).

Sightings

July 2010

A total of 86 sightings of ~11,090 individual marine mammals were observed in July 2010 (**Table 5**). 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).

September 2010

A total of 252 sightings of ~37, 874 individual marine mammals were observed in September 2010 (**Table 6**). Of the total 252 sightings, 35% were identified to species (n = 89) or genus (n = 124 common dolphin sp.). Not all sightings were identified to species as described above.

Nine different marine mammal species were identified. Sightings included three baleen whale species (Bryde's, minke and possibly sei whales), three dolphin species (long-beaked common, bottlenose and Risso's), and two pinniped species (California sea lion and northern elephant seal). Overall, the common dolphin was the most frequently identified species genus (49% or 124 of 252 total groups) followed by the California sea lion (28% or 71 groups). In terms of number of individuals seen, the common dolphin was also the most abundant (n = ~34,127 or 90% of the total ~37, 874 individuals seen).

SIGHTING ENCOUNTER RATES

Sighting encounter rates are tabulated in several tables, due to their large sizes. **Tables B-1 and B-2** compare sighting rates based on combined systematic, random and transit effort (i.e., point-to-point linear effort) 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 B-1**; the number of *individuals* sighted per unit effort is displayed in **Table B-2**. Sighting rates by survey effort type are provided in **Tables B-3 and B-4**, respectively. (See **Table 3** for definitions and total km and nm of effort types.) Sighting rates were similar across systematic effort for the three survey months, but differed for transit and random effort.

The overall numbers of sightings per unit effort were similar across November, May and July. However, the sighting rate based on number of individuals was about three times higher in November than May and twice as high in July as May. September was roughly 3 times higher than July and more than 7 times higher than May.

In July, overall 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.

In September, overall marine mammal sighting rates were about two to three times higher during transit vs. random and systematic effort. Systematic effort for September 2010 was much higher than those of the three other survey months. During random effort, individual sighting rates were five to seven times lower during May vs. November, July and September, most evidently for dolphins. For transit effort, individual sighting rates were at least five times higher during July and September 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 September 2010.

Distribution

July 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 **Table 3**). 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).

July 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 (~2 nm) west of La Jolla near a large buoy (**Figures 2 and 4**, **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 (8 nm) 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 (5 nm) 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 dolphins, 86% of 19 unidentified dolphin, and 100% of three common bottlenose dolphin groups were within 20 km (10 nm) 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).

September Effort Distribution

In September 2010, four (September 24, 26-28) of the six survey days were dedicated to opportunistic focal observations and did not entail systematic search effort. The remaining two days were line-transect survey effort: one day in NAOPA and one day in SOAR. NAOPA and SOAR transect lines were the same as those followed in November 2009, May 2010 and July 2010 (Smultea and Lomac-MacNair 2010, Smultea et al. 2010).

September Sighting Distribution

Relatively few whales were seen during September 2010 (n = 6 sightings), similar to the May 2010 survey. The two Cuvier's beaked whales, one Bryde's whale, and three minke whales were seen in the far northwestern corner of SOAR (**See Figure 3 in Appendix B in aerial report 01 August 2010 to 31 July 2011**); in comparison, during October 2008, November 2008 and May 2010, whales (mostly baleen whales) were seen relatively frequently in this small area, but appeared to concentrate between SW SCI and Tanner Bank to the west (see Smultea et al. 2009a, Smultea et al. 2010). In November 2008, another small concentration of whale sightings occurred ~20 km NW of San Diego directly W of Montgomery Field where the survey aircraft crossed nearly daily during transits to survey areas. This area encompassed the La Jolla and Scripps canyons; in contrast, only one whale was seen here in October 2008 and three whales in September 2010 (Smultea et al. 2009a). Blue whales were not seen during the September survey.

Dolphin distribution was not concentrated in coastal areas like it was during the July 2010 survey. Common dolphins were concentrated in coastal areas but also seen on transect lines heading out to SOAR (**See Figure 5 in Appendix B in aerial report 01 August 2010 to 31 July 2011**). Forty-two percent of 125 common dolphins, 86% of 32 unidentified dolphin, and 50% of 4 common bottlenose dolphin groups were within 20 km (10 nm) of the mainland (**See Figure 5 in Appendix B in aerial report 01 August 2010 to 31 July 2011**). Only 11 (17%) of the total 167 dolphin groups were seen over 20 km from shore despite considerable line-transect effort farther offshore. Dolphin sightings during September were more evenly distributed throughout the SOCAL range compared to July. Only one group of Risso's dolphin was seen in July (n =9) compared to the six groups seen in September (n = 74) and these sightings mainly occurred within the SOAR range.

High numbers of California sea lions (n = 71 sightings) were seen during the September 2010 survey and occurred west of San Clemente Island within the SOAR range (**See Figure 7 in Appendix B in aerial report 01 August 2010 to 31 July 2011**). This was the highest number of pinniped sightings made during any of the eight SOCAL aerial surveys we have done (see Smultea et al. 2009a, b, Smultea and Lomac-MacNair 2010, Smultea et al. 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; 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.

Focal Follows

Focal follow effort was emphasized more during the July and September 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 occurred for 5-9 min.

A total of 19 focal follows at least 5 min long totaling 553 minutes (9 hr 13 min) occurred during the July 2010 survey Five (26%) of the 19 focals occurred 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.

During the July 2010 survey, all nine of the blue whale focals were over 10 min long and four were over 1 hour long. Video was taken on eight of the nine blue whale focal groups. In addition to common dolphin sp., focal follows occurred with Risso's dolphins, two minke whale groups, sei whales, large groups of California sea lions, and two unidentified baleen whales. Only eight of 17 common dolphin focals lasted over 10 min, six of which included video; the remaining seven common dolphin focals involved only circling of the group to verify species by taking photos. However, further preliminary detail on observed behaviors is provided in the Appendices and in the description below.

During the September 2010 survey, a total of 16 focal follows at least 5 min long totaling 274 minutes (4 hr 34 min) was conducted. Most (56%) of the total 16 focals were at least 10 min long. Over half (56% or 9) of the 17 focals were common dolphin sp. Focal sessions occurred more frequently with common dolphins than during previous surveys because they engaged in synchronized swimming and foraging behaviors in groups of twos and threes, and this behavior had not previously been seen; unusually high numbers of bait balls were also seen during the surveys.

Unusual Observations

Summarized below are unusual encounters and associated made during the July and September surveys. These encounters are included because they are considered rare based on previous efforts, and/or there are few if any available data or literature on such observations. Notably, the prolonged overhead 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.

Photographs and Video

Lists of photographs and video are presented **in Appendices D and E**. 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.

About 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.

A preliminary total of ~741 digital photographs and ~2.4 hours of HD video were taken during September 2010. The helicopter was not used during the September survey, 100% of the photos were taken from the fixed-wing Partenavia airplane.

SECTION 4 DISCUSSIONS

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 7** summarizes our comparison.

Aerial Survey Collaboration with Other Researchers

During July, 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 and September as part of the BRS led by Dr. Brandon Southall and funded by N45 and Office of Naval Research Funds. Our sighting data have been 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. In fall 2010, the BRS program began conducting playback sound studies to some of 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).

SECTION 5 CONCLUSIONS AND RECOMMENDATIONS

Survey Highlights

- Dr. Bernd Würsig of the Marine Mammal Research Program at Texas A&M University joined our field team in May, July and September 2010 to provide expert review and critique of our behavioral study approach and protocol, and to assist us in the field. Dr. Würsig 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 in July 2010 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 7** 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 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 **Appendix D-1** 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.

- The combined SOCAL aerial data from 2008-2010 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, September and previous six aerial surveys contribute to building recent 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 the light, white body coloration and scarring of Risso’s dolphins that 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.
- 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

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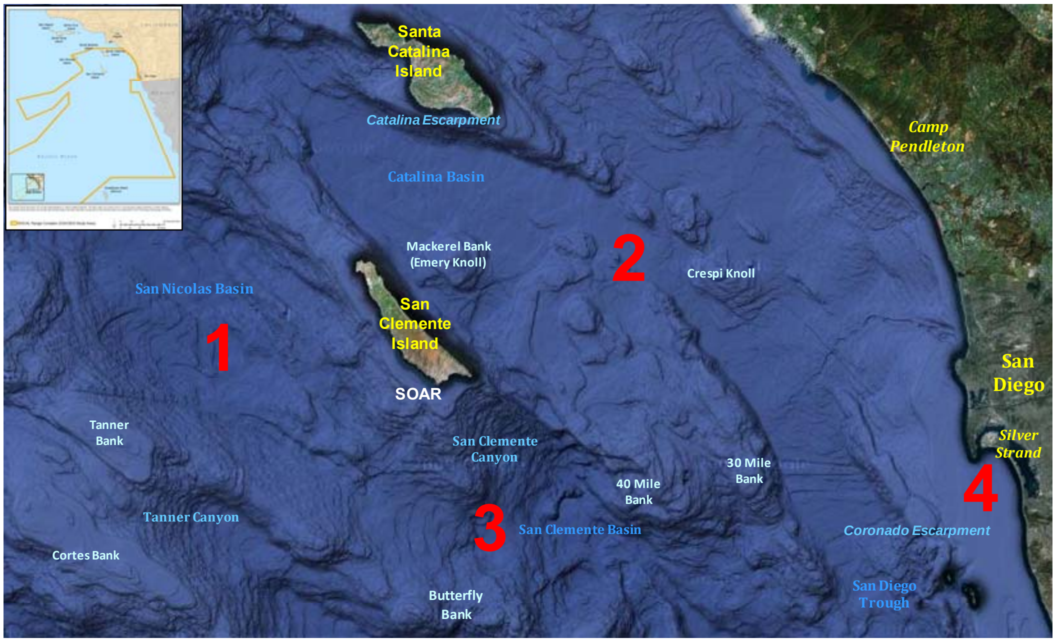

Figure 1. Location of the aerial survey monitoring area and underwater topographic features within the Navy's Southern California Range Complex (SOCAL).

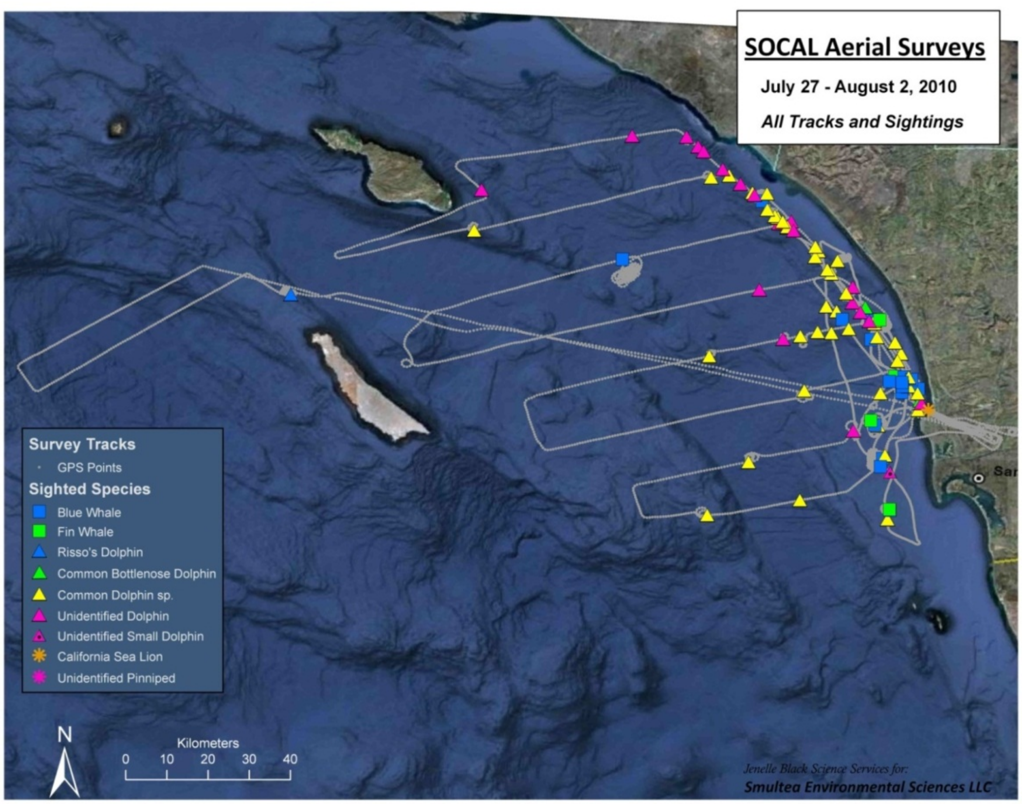

Figure 2. All track lines and sightings made during aerial monitoring surveys in SOCAL July 27 – August 3, 2010.

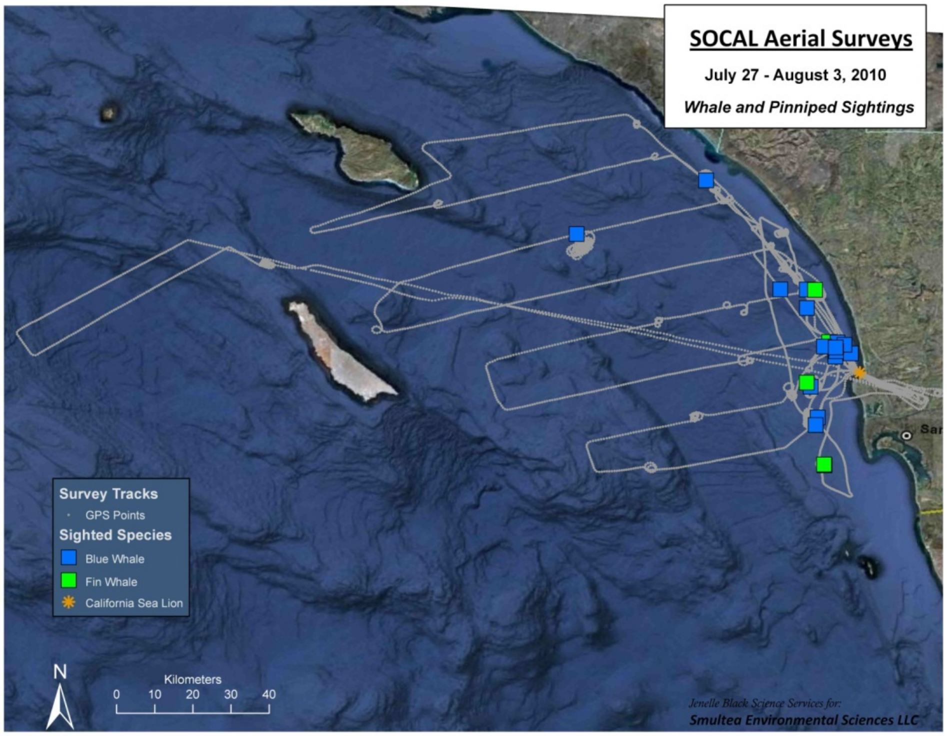

Figure 3. Whale sightings made during aerial survey monitoring in the SOCAL survey area July 27 – August 3, 2010.

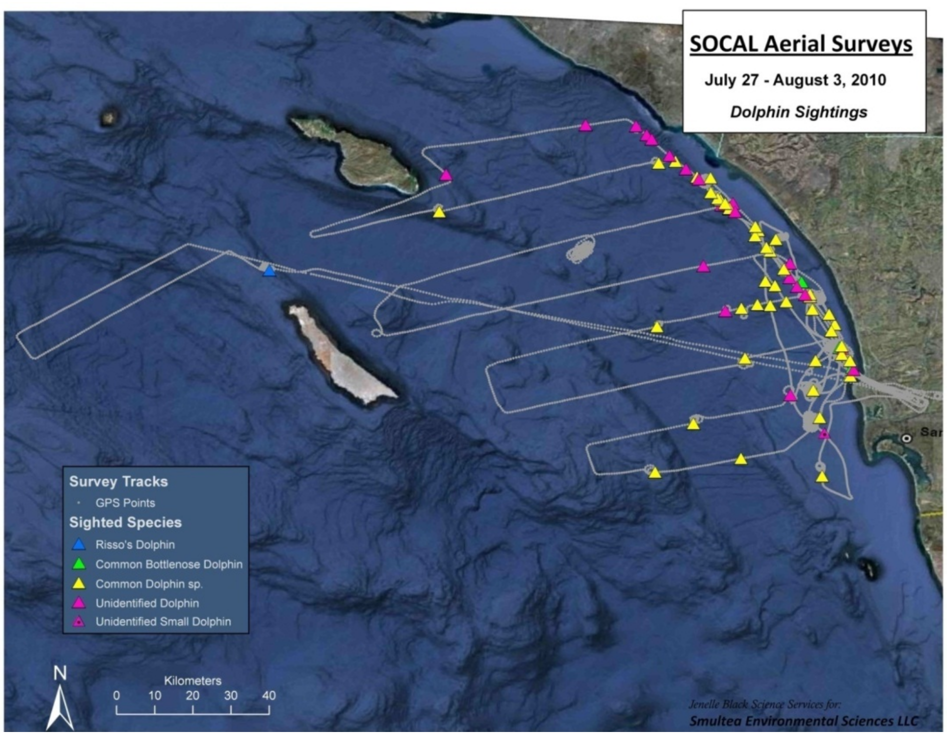

Figure 4. Dolphin sightings made during aerial survey monitoring in the SOCAL survey area July 27 – August 3, 2010.

Table 1. Aerial survey flight times, total hours (hh:mm) by date, and survey area during the July 2010 SOCAL aerial survey.

Date 2010	Flight	Platform	Location	Time Lift Off	Time Landed	Total Flight Time	Total "On Effort" Observ	MTE-assoc. MFAS?	Survey Notes
27-Jul	1	Helicopter Bell 206	Coastal NAOPA	14:01	16:35	2:34	1:20	Yes	Assessing effectiveness of helicopter as platform for focal behavioral observations with Bernd Würsig. Flew <3 nm from coast. Heavy morning fog/low clouds. Ceilings 1400-1600 ft, fog/heavy overcast. Conducted focal near San Diego on feeding blue and fin whales, observed frequent defecation.
28-Jul	1	Helicopter Bell 206	Coastal NAOPA	13:37	16:08	2:31	1:36	No	Assessing effectiveness of helicopter as platform for focal behavioral observations with Bernd Würsig. 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.
29-Jul	1	Partenavia OBS	NAOPA (SOAR fogged in)	14:29	16:39	2:11	0:30	Yes	Flew Partenavia Observer. Heavy fog/low clouds delayed departure until afternoon. Conducted focal on feeding blue and fin whales again in same area as yesterday.
30-Jul	1	Partenavia OBS	N SOAR	13:45	16:05	2:20	1:11	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.
31-Jul	1	Partenavia OBS	S NAOPA (SOAR fogged in)	14:27	18:27	4:00	3:22	Yes	Heavy fog/low clouds delayed departure until afternoon. Focal on blue whales in NAOPA; SOAR fogged in/ inaccessible.
1-Aug	1	n/a	n/a	n/a	n/a	n/a	n/a	n/a	No flight. Aircraft grounded due to mechanical issues
2-Aug	1	Partenavia OBS	Central NAOPA	14:45	17:52	3:07	2:37	Yes	Mechanic fixed plane by 1 pm. Flew N NAOPA lines. Focal on blue whales.
3-Aug	1	Partenavia OBS	N NAOPA	15:27	18:07	2:40	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 an effective focal.
Totals						**19:23**	**12:16**		

Table 2. Aerial survey flight times, total hours (hh:mm) by date, and survey area during the September 2010 SOCAL aerial survey.

Date 2010	Flight	Platform	Location	Time Lift Off	Time Landed	Total Flight Time	Total "On Effort" Observ	MTE-assoc. MFAS?	Survey Notes
23-Sep	0	Partenavia OBS	n/a	14:10	14:12	0:02	n/a	n/a	Upon take-off pilot decided to land again to redistribute weight in plane.
23-Sep	1	Partenavia OBS	S NAOPA	14:20	17:33	3:13	3:06	Yes	Completed 4 southernmost NAOPA lines, relatively few sightings compared to previous surveys.
24-Sep	1	Partenavia OBS	N SOAR	11:42	14:57	3:15	3:10	No	First survey flight flew straight to N SOAR did 4 N legs at SOAR then flew back; fog nearshore on way in morning, no observing until partway through transit. Focal on blue whale and common dolphins. Saw many bait balls today and N elephant seal and common dolphins feeding on bait balls.
24-Sep	2	Partenavia OBS	Coastal NAOPA	16:05	17:41	1:36	1:46	No	Flew N about 10 nm from shore, hit Bf 5, then turned back and headed S about 5 nm offshore and went in. Saw many feeding common dolphins and bait balls.
25-Sep	1	Partenavia OBS	NE SOAR	10:19	13:37	3:18	3:13	No	Headed straight out to T2 in NE SOAR where BRS vessel was this morning; did not circle any groups on way out to save fuel for coordination with BRS and to maximize time on SOAR. Flew 4 northernmost SOAR transect lines. Bf 2 most of day. Unusually high number of common dolphins seen feeding, also bait balls seen.
26-Sep	1	Partenavia OBS	N SOAR	10:35	14:18	3:43	3:36	No	Flew straight to N SOAR since BRS vessel restricted to N SOAR. Communications with BRS requested that we help them relocate Cuvier's beaked whales. We circled at 1+ km from BRS' Cascadia tag boat looking for Cuvier's with them. Then we flew mini N-S transect lines in NW SOAR to look for other sightings that we reported to BRS vessel which was still busy with Cuvier's.
26-Sep	2	Partenavia OBS	Coastal NAOPA	15:24	17:25	2:01	1:54	No	Headed N parallel to shore by about 8 nm, did focals on unusual synchronized foraging behavior by common dolphins seen frequently only this survey period. Flew 2 NAOPA lines

Date 2010	Flight	Platform	Location	Time Lift Off	Time Landed	Total Flight Time	Total "On Effort" Observ	MTE-assoc. MFAS?	Survey Notes
27-Sep	1	Partenavia OBS	N SOAR	9:38	13:34	3:56	3:49	Yes	Flew straight over to N SOAR Line 1 flew this line E to W then talked to BRS and they asked us to help them find whales just N of SOAR Range in NW corner and to locate a beaked whale so we flew there and flew improvised systematic lines 1 nm apart paralleling SOAR lines and 3 nm long; saw 3 minkes and BRS had seen 2 minkes earlier this morning. Did focals on 2 groups of Risso's before and after seeing BRS vessel-- may have been same group check photos. VERY HOT in plane today, 95 degrees. Focal on Risso's dolphins and minke whales.
27-Sep	2	Partenavia OBS	W NAOPA	14:37	16:32	1:55	1:48	Yes	Headed W on NAOPA Line 4 to SCI then headed N along underwater drop off to try and locate sightings for BRS since they can't be on SOAR tomorrow. Focal on common dolphins.
28-Sep	1	Partenavia OBS	Coastal NAOPA	8:44	11:02	2:18	2:11	No	Headed N with goal to meet BRS in SC Basin and help them locate animals; however, airspace ended up being restricted so could not meet them to the W. Refueled at Oxnard.
28-Sep	2	Partenavia OBS	N NAOPA	11:55	15:14	3:19	3:12	No	Took off from Oxnard airport and did two lines in NAOPA; did focal on 3 sei/Bryde's whales lunge feeding (unusual sighting and behavior).
Totals						**28:34**	**27:45**		

Table 3. Definitions of leg types flown during the July and September 2010 aerial surveys.

Leg Type	Leg Type Definition
Systematic	Pre-determined line-transect legs located in SOAR, NAOPA and FLETA HOT
Random	Short lines connecting longer systematic lines
Transiting	Flying between the airport and the survey grid locations
Navy-Directed Transiting	Flying off intended course as directed by Navy during a survey to avoid Navy activities
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
Circumnavigating Coast	Flying parallel to SCI coastline approximately 0.5 km offshore to search for potential strandings
Fog Effort	Transiting above fog layer with limited or no visibility to water

Table 4. Summary of aerial survey effort (km and nm) by leg type during the July and September 2010 surveys.[1]/

Leg Type	July 2010			September 2010		
	Total km flown	Total nm Flown	Total hrs Flown	Total km Flown	Total nm Flown	Total hrs Flown
Systematic	592	320	3	1428	771	7.5
Random	111	60	0.5	164	89	1
Transiting	654	353	3.8	2345	1267	10.6
Navy-Directed Transiting	0	0	0	0	0	0
Circling	1549	836	10	1377	744	7.9
Circumnavigating Coast	0	0	0	0	0	0
Fog Effort	220	119	0.9	0	0	0
TOTAL	**3125**	**1688**	**18.1**	**5314**	**2871**	**27.0**

[1]/ Excludes flying over land to and from airport to water's edge.

Table 5. Summary of marine mammal sightings by species during the July SOCAL 2010 aerial surveys. Sightings organized in order of frequency observed starting with those seen most commonly.

Species Identification (Common Name)	Scientific Name	Total No. of Sightings	Total Estimated No. Individuals
Common Dolphin sp.	*Delphinus* sp.	40	9,354
Blue Whale	*Balaenoptera musculus*	18	44
Unidentified Dolphin	Delphinidae sp.	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**

Table 6. Summary of marine mammal sightings by species during the September SOCAL 2010 aerial surveys.

Species Identification (Common Name)	Scientific Name	Total No. of Sightings	Total Estimated No. Individuals
Common Dolphin sp.	*Delphinus* sp.	124	34,136
California Sea Lion	*Zalophus californianus*	71	194
Unidentified Dolphin	Delphinidae sp.	32	3,380
Risso's Dolphin	*Grampus griseus*	6	74
Common Bottlenose Dolphin	*Tursiops truncatus*	4	48
Northern Elephant Seal	*Mirounga angustirostris*	3	22
Unidentified Marine Mammal	Cetacea or Pinnipedia	2	9
Unidentified Baleen Whale	*Balaenoptera* sp.	2	2
Unidentified Medium Marine Mammal	Cetacea or Pinnipedia	2	1
Long-beaked Common Dolphin	*Delphinus capensis*	1	9
Minke Whale	*Balaenoptera acutorostrata*	1	3
Bryde’s/Sei Whale	*Balaenoptera borealis/edeni*	1	3
Cuvier's Beaked Whale	*Ziphius cavirostris*	1	2
Bryde's Whale	*Balaenoptera brydei/edeni*	1	1
Unidentified Small Marine Mammal	Cetacea or Pinnipedia	1	1
Totals		**252**	**37,874**

Table 7. Notable differences in the seasonal sighting encounter rates of marine mammal species during the May, July and September 2010 aerial surveys in SOCAL.

Species and Description
During July 2010 only, sighting rates were highest for common dolphins and blue whales based on both number of groups and individuals per km and hr. Other species were seen at considerably lower sighting rates due to fewer sightings per unit effort.
Sighting rates of Risso's dolphins were remarkably higher in May than in November and July, with May being the highest (n=432).
Sighting rates for individual common dolphins were roughly three times higher in July and November vs. May. In September, sighting rates for common dolphins were almost four times higher than July.
Blue whale sighting rates were also highest in July, were considerably lower for May and were absent during the September survey.
Pacific white-sided dolphins and California sea lions were absent or virtually absent in July as expected (Carretta et al. 2000).
Bottlenose dolphins were not seen in November.
Fin whale sighting rates were similar across May and July but none were seen in September survey.
Minke whales were last sighted in July 2009 and November, each with one sighting. Sightings for September were three individuals.
Bryde's whales were only seen during two of the eight surveys, October 2008 and September, each with one individual sighting. A sei/Bryde's whale sighting (n=3 individuals in one group) only occurred in September; two other surveys, November 2008 and July 2009, had possible fin or sei sightings.
Sightings rates for California sea lions in September were roughly 100 times higher than July due to the fact that they were absent or virtually absent in July.
Northern elephant seals were absent in all surveys except one individual sighting in November 2008 and September. Sighting rates for individual Northern elephant seals for September were roughly 20 times greater than the single sighting in November 2008.

1 *Table 8. Unusual and relatively rare observations made during the July and September 2010 SOCAL*
2 *aerial surveys.*

Date in 2010	Species	Description
27 July	Blue Whale Mother and Calf #1	A mother and calf (young-of-the-year) blue whale pair was circled form 15:24-16:24. We have rarely seen blue whale calves during our seven SOCAL aerial surveys. Video was taken on this part from 15:51-16:24. The interesting aspect of this encounter was that the calf appeared to be nursing from the mother based on review of the video. After a series of surfacing and blows, the calf dove below the mother who was at the time visible below the water surface. The pair appears 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 o her side.
28 July	Blue-Fin Whale Interaction	We circled a loose grouping of blue and fin whales, and gathered 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 thus the 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. 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 seconds. We linked 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 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.
2 August	Blue Whale Mother and Calf #2	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 par 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.

Date in 2010	Species	Description
24 September	Bryde's Whale	At 13:56:15, a single Bryde's whale was seen. Initially, this whale was not identified to species; however, subsequent examination of photographs showed three prominent rostral ridges and species was confirmed by Dr. Tom Jefferson. The Bryde's whale had only been seen once before during the October 2008 SOCAL aerial monitoring survey.
25 September	Northern Elephant Seal	We circled a group of five northern elephant seals at 11:55:00 for ~3 minutes. The seals stayed near or at the surface through the entire sighting. Northern elephant seals had not been identified during any other of the previous seven SOCAL Marine Species Monitoring Plan (SMSPM) aerial surveys, except in November 2008 (1 group, 1 individual).
26 September	Cuvier's Beaked Whale	At 12:00 a group of two Cuvier's beaked whales was seen blowing at the surface and traveling slowly in the opposite direction from the Cascadia Research Collective rigid-hulled inflatable research boat that was ~25 m away. We circled them at 1 to 1.5 km (0.5 to 0.8 nm) radius to not interfere with the whales (well outside Snell's cone, at 304 m (1000 ft) altitude). Dr. Brandon Southall had asked us to aid in sighting cetaceans for their ongoing SOCAL Behavioral Response Study (BRS), in particular helping to resight the Cuvier's beaked whales. Other sightings of Cuvier's beaked whale occurred during the July 09 (1 group, 4 individuals) and November 09 (2 groups, 6 individuals) SOCAL aerial monitoring surveys.
28 September	Sei/Bryde's Whale	Initially seen mostly underwater as it fluked up, a sei or Bryde's whale was seen at 9:41:30. We circled the sighting and subsequently saw three whales in the group. We watched for ~30 minutes while the whales sporadically lunge fed including on their sides (see report cover photograph). Photographs of this sighting were taken and were reviewed by Dr. Tom Jefferson who confirmed the whales were either sei or Bryde's whales, based primarily on the lack of white on the right jaw, body length, head shape, body coloration, and the possibility of three rostral ridges on the head. Additional photograph angles may have allowed species differentiation based on dorsal shape and size and the rostral ridges

Table 9. 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;

Aircraft Type	Partenavia P68-C	Partenavia P68-OBS ("Observer")	Helicopter
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 08, Jul 10	Jul 10

Table 10. Summary of SOCAL Marine Mammal Aerial Surveys.

	Survey								
	October	**November**	**June**	**July**	**November**	**May**	**July**	**September**	**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	23-28 Sept 2010	**8 surveys: May, June, July, Oct, Nov**
No. Days Flown	5	4	6	9	6	6	7	6	**49**
Major Training Exercise (MTE) Before, During or After Survey?	Before/During	After	After	After	During/After	During	During/After	During/After	**During, Before or After**
Total Flight Hr (Wheels up/down)	28	21	30	34	28	29	18	28	**216**
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)	3918 km (2116 nm)	**37,798 (20,410)**
No. Navy-directed Survey Changes (appox)	9	7	12	10	3	1	0	0	**42**
No. Coastline Surveys for Strandings (San Clemente Isld)	0	2	1	0	1	1	0	0	**5**
No. Groups Seen	115	185	161	240	93	152	86	252	**1,284**
Estim. No. Individuals	12,587	5732	9489	22,719	12,826	5,453	11,090	37,874	**117,770**
Mean Group Size	109.4	31	58.9	94.7	137.9	35.9	131.3	150.3	**91.7**
No. Dead Sightings	0	3 (2 CA sea lions, 1 blue whale)	0	2 (2 prob. CA sea lions)	0	0	0	0	**5**
No. Species	9	9	11	10	10	9	5	9	**16 total species seen**

	Survey								
	October	**November**	**June**	**July**	**November**	**May**	**July**	**September**	**Total**
No. Focal Groups Circled 5-9 min	22	20	24	37	14	10	6	6	**139**
No. Extended Focal Groups Circled >10 min	5	7	7	8	10	20	13	10	**80**
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)	45 min (Bryde's Whale)	**144 min. (longest focal from all surveys)**
No. Photos Taken	1050	1280	1099	2301	2203	1350	2900	741	**12,924**
Estimated Usable Video (min)	53	41	83	50	90	334	373	142	**1166**

Appendix A. List of Sightings

Table A-1. Sightings during SOCAL 2010 July aerial monitoring surveys off San Diego, California.

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

Sighting Date	Sighting Time	Common Name	Species	Best Count	Latitude	Longitude
07/31/2010	15:50:33	Common Dolphin sp.	undifferentiated *Delphinus*	200	32.63283	-117.74500
07/31/2010	16:07:24	Common Dolphin sp.	undifferentiated *Delphinus*	60	32.74817	-117.65483
07/31/2010	16:21:53	Unidentified Dolphin	unidentified Delphinidae	25	32.81583	-117.42633
07/31/2010	16:32:32	Common Dolphin sp.	undifferentiated *Delphinus*	12	32.89733	-117.36683
07/31/2010	16:46:05	Common Dolphin sp.	undifferentiated *Delphinus*	110	32.90317	-117.53317
07/31/2010	17:22:26	Common Dolphin sp.	undifferentiated *Delphinus*	15	32.97783	-117.74033
07/31/2010	17:30:45	Unidentified Dolphin	unidentified Delphinidae	1	33.01517	-117.57950
07/31/2010	17:33:13	Common Dolphin sp.	undifferentiated *Delphinus*	125	33.02150	-117.54183
07/31/2010	17:37:33	Common Dolphin sp.	undifferentiated *Delphinus*	40	33.03033	-117.50417
07/31/2010	17:41:12	Common Dolphin sp.	undifferentiated *Delphinus*	450	33.05467	-117.38017
07/31/2010	17:41:32	Blue Whale	*Balaenoptera musculus*	1	33.05667	-117.36817
07/31/2010	17:41:32	Fin Whale	*Balaenoptera physalus*	1	33.05667	-117.36817
07/31/2010	18:20:41	Unidentified Dolphin	unidentified Delphinidae	90	32.87600	-117.27733
08/02/2010	14:49:42	California Sea Lion	*Zalophus californianus*	2	32.86100	-117.26233
08/02/2010	14:51:25	Blue Whale	*Balaenoptera musculus*	2	32.90717	-117.28417
08/02/2010	14:53:04	Blue Whale	*Balaenoptera musculus*	1	32.91217	-117.30517
08/02/2010	14:53:04	Common Dolphin sp.	undifferentiated *Delphinus*	300	32.91217	-117.30517
08/02/2010	15:02:45	Common Dolphin sp.	undifferentiated *Delphinus*	40	32.98350	-117.32167
08/02/2010	15:03:33	Common Dolphin sp.	undifferentiated *Delphinus*	35	33.00733	-117.33500
08/02/2010	15:09:36	Unidentified Dolphin	unidentified Delphinidae	75	33.12800	-117.42733
08/02/2010	15:15:32	Unidentified Dolphin	unidentified Delphinidae	120	33.12217	-117.63100
08/02/2010	15:55:32	Blue Whale	*Balaenoptera musculus*	2	33.18833	-117.92983
08/02/2010	16:47:54	Unidentified Dolphin	unidentified Delphinidae	200	33.26650	-117.58817
08/02/2010	16:48:19	Common Dolphin sp.	undifferentiated *Delphinus*	55	33.27883	-117.59067
08/02/2010	16:53:12	Common Dolphin sp.	undifferentiated *Delphinus*	175	33.28233	-117.59717
08/02/2010	16:56:05	Blue Whale	*Balaenoptera musculus*	2	33.31483	-117.62500
08/02/2010	17:19:09	Common Dolphin sp.	undifferentiated *Delphinus*	75	33.33083	-117.61433
08/02/2010	17:29:49	Unidentified Dolphin	unidentified Delphinidae	50	33.27050	-117.56150
08/02/2010	17:32:21	Common Dolphin sp.	undifferentiated *Delphinus*	250	33.20567	-117.50200
08/02/2010	17:33:57	Common Dolphin sp.	undifferentiated *Delphinus*	70	33.16583	-117.48283
08/02/2010	17:36:39	Unidentified Dolphin	unidentified Delphinidae	125	33.09400	-117.42833
08/02/2010	17:37:31	Unidentified Dolphin	unidentified Delphinidae	50	33.07317	-117.41050
08/03/2010	15:32:41	Common Dolphin sp.	undifferentiated *Delphinus*	*	32.89717	-117.28583
08/03/2010	15:33:39	Blue Whale	*Balaenoptera musculus*	1	32.92717	-117.29900
08/03/2010	15:35:22	Common Dolphin sp.	undifferentiated *Delphinus*	25	32.93200	-117.30533
08/03/2010	15:36:42	Common Dolphin sp.	undifferentiated *Delphinus*	40	32.96767	-117.33000
08/03/2010	15:42:06	Common Dolphin sp.	undifferentiated *Delphinus*	1000	33.11417	-117.44150
08/03/2010	15:52:18	Common Dolphin sp.	undifferentiated *Delphinus*	*	33.19333	-117.50950
08/03/2010	15:55:05	Common Dolphin sp.	undifferentiated *Delphinus*	600	33.21533	-117.50883

Sighting Date	Sighting Time	Common Name	Species	Best Count	Latitude	Longitude
08/03/2010	15:57:43	Common Dolphin sp.	undifferentiated *Delphinus*	100	33.25683	-117.57017
08/03/2010	15:59:00	Common Dolphin sp.	undifferentiated *Delphinus*	*	33.25833	-117.56967
08/03/2010	16:02:29	Common Dolphin sp.	undifferentiated *Delphinus*	1100	33.29600	-117.61367
08/03/2010	16:04:07	Common Dolphin sp.	undifferentiated *Delphinus*	350	33.33267	-117.64617
08/03/2010	16:06:11	Common Dolphin sp.	undifferentiated *Delphinus*	400	33.37000	-117.69683
08/03/2010	16:07:32	Common Dolphin sp.	undifferentiated *Delphinus*	250	33.36600	-117.73617
08/03/2010	16:23:44	Common Dolphin sp.	undifferentiated *Delphinus*	300	33.25083	-118.25333
08/03/2010	16:47:03	Unidentified Dolphin	unidentified Delphinidae	125	33.33900	-118.23733
08/03/2010	16:59:54	Unidentified Dolphin	unidentified Delphinidae	70	33.45633	-117.90867
08/03/2010	17:03:26	Unidentified Dolphin	unidentified Delphinidae	140	33.45400	-117.78983
08/03/2010	17:07:10	Unidentified Dolphin	unidentified Delphinidae	50	33.43317	-117.76483
08/03/2010	17:07:38	Unidentified Dolphin	unidentified Delphinidae	200	33.42233	-117.75267
08/03/2010	17:09:21	Unidentified Dolphin	unidentified Delphinidae	*	33.38367	-117.71100
08/03/2010	17:10:52	Unidentified Dolphin	unidentified Delphinidae	25	33.35183	-117.67233
08/03/2010	17:12:01	Unidentified Dolphin	unidentified Delphinidae	35	33.32767	-117.64167
08/03/2010	17:14:31	Common Dolphin sp.	undifferentiated *Delphinus*	7	33.26983	-117.58017
08/03/2010	17:18:17	Unidentified Dolphin	unidentified Delphinidae	11	33.25067	-117.55650
08/03/2010	17:26:16	Unidentified Dolphin	unidentified Delphinidae	*	33.05417	-117.39117
08/03/2010	17:27:28	Common Dolphin sp.	undifferentiated *Delphinus*	120	33.01917	-117.37450
08/03/2010	17:31:06	Blue Whale	*Balaenoptera musculus*	1	32.91200	-117.31867
08/03/2010	17:34:51	Blue Whale	*Balaenoptera musculus*	2	32.92117	-117.31967

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

Table A-2. Sightings during SOCAL 2010 September aerial monitoring surveys off San Diego, California.

Sighting Date	Sighting Time	Common Name	Species	Best Count	Latitude	Longitude
9/23/2010	15:11:00	Common Dolphin sp.	undifferentiated *delphinus*	25	32.768	-117.575333
9/23/2010	15:29:00	Common Dolphin sp.	undifferentiated *delphinus*	6	32.92483333	-117.405500
9/23/2010	15:54:10	Unidentified Medium Marine Mammal	unidentified marine mammal	1	32.7905	-118.012000
9/23/2010	16:07:25	Common Dolphin sp.	undifferentiated *delphinus*	15	32.81333333	-118.231500
9/23/2010	16:08:30	California Sea Lion	*Zalophus californianus*	1	32.81683333	-118.217000
9/23/2010	16:16:17	Common Dolphin sp.	undifferentiated *delphinus*	60	32.87733333	-118.247333
9/23/2010	16:30:00	Common Dolphin sp.	undifferentiated *delphinus*	700	32.90483333	-118.113667
9/23/2010	16:54:22	Common Dolphin sp.	undifferentiated *delphinus*	600	33.017	-117.326500
9/23/2010	16:57:00	Bottlenose Dolphin	*Tursiops truncatus*	2	32.9515	-117.309500
9/23/2010	16:59:08	Common Dolphin sp.	undifferentiated *delphinus*	80	32.89966667	-117.316000
9/23/2010	17:09:16	Common Dolphin sp.	undifferentiated *delphinus*	200	32.65516667	-117.303833
9/23/2010	17:09:55	Common Dolphin sp.	undifferentiated *delphinus*	300	32.64183333	-117.291333
9/23/2010	17:15:00	Bottlenose Dolphin	*Tursiops truncatus*	3	32.5535	-117.253833
9/23/2010	17:21:23	Common Dolphin sp.	undifferentiated *delphinus*	315	32.70166667	-117.341333
9/23/2010	17:24:33	Common Dolphin sp.	undifferentiated *delphinus*	40	32.787	-117.363667
9/24/2010	12:02:47	Unidentified Medium Marine Mammal	unidentified marine mammal	1	33.00333333	-117.995667
9/24/2010	12:08:00	Unidentified Dolphin	unidentified Delphinidae	250	33.04516667	-118.207667
9/24/2010	12:09:26	Common Dolphin sp.	undifferentiated *delphinus*	100	33.05783333	-118.271333
9/24/2010	12:09:55	Unidentified Dolphin	unidentified Delphinidae	1000	33.06233333	-118.297167
9/24/2010	12:17:40	Bottlenose Dolphin	*Tursiops truncatus*	25	33.12833333	-118.622000
9/24/2010	12:21:08	California Sea Lion	*Zalophus californianus*	1	33.167	-118.804500
9/24/2010	12:28:21	Common Dolphin sp.	undifferentiated *delphinus*	375	33.08733333	-119.006167
9/24/2010	12:36:32	Unidentified Marine Mammal	unidentified marine mammal	4	33.03216667	-119.110167
9/24/2010	12:36:47	California Sea Lion	*Zalophus californianus*	2	33.02883333	-119.118000
9/24/2010	12:38:15	Common Dolphin sp.	undifferentiated *delphinus*	75	33.018	-119.135667
9/24/2010	12:39:06	Common Dolphin sp.	undifferentiated *delphinus*	70	32.999	-119.169500
9/24/2010	12:39:50	Common Dolphin sp.	undifferentiated *delphinus*	125	32.9915	-119.183000
9/24/2010	12:40:17	California Sea Lion	*Zalophus californianus*	30	32.9785	-119.206333
9/24/2010	12:40:27	Unidentified Dolphin	unidentified Delphinidae	4	32.9785	-119.206333
9/24/2010	12:42:19	California Sea Lion	*Zalophus californianus*	4	32.94633333	-119.247167
9/24/2010	12:42:56	California Sea Lion	*Zalophus californianus*	*	32.93216667	-119.235667
9/24/2010	12:43:02	California Sea Lion	*Zalophus californianus*	3	32.93216667	-119.235667
9/24/2010	12:43:34	California Sea Lion	*Zalophus californianus*	1	32.93216667	-119.235667
9/24/2010	12:43:57	California Sea Lion	*Zalophus californianus*	1	32.91366667	-119.220167
9/24/2010	12:44:16	Common Dolphin sp.	undifferentiated *delphinus*	*	32.902	-119.210500
9/24/2010	12:49:01	California Sea Lion	*Zalophus californianus*	1	32.916	-119.183167

Sighting Date	Sighting Time	Common Name	Species	Best Count	Latitude	Longitude
9/24/2010	12:50:01	California Sea Lion	*Zalophus californianus*	2	32.93133333	-119.158667
9/24/2010	12:50:10	California Sea Lion	*Zalophus californianus*	*	32.93133333	-119.158667
9/24/2010	12:51:18	Unidentified Marine Mammal	unidentified marine mammal	5	32.952	-119.123667
9/24/2010	12:57:07	Northern Elephant Seal	*Mirounga angustirostris*	5	32.96733333	-119.124333
9/24/2010	13:06:27	California Sea Lion	*Zalophus californianus*	*	33.0025	-119.034333
9/24/2010	13:08:27	California Sea Lion	*Zalophus californianus*	1	33.02966667	-118.983667
9/24/2010	13:12:26	California Sea Lion	*Zalophus californianus*	1	33.09316667	-118.866500
9/24/2010	13:14:21	California Sea Lion	*Zalophus californianus*	2	33.12266667	-118.814667
9/24/2010	13:22:00	California Sea Lion	*Zalophus californianus*	1	33.08183333	-118.740500
9/24/2010	13:23:18	California Sea Lion	*Zalophus californianus*	2	33.06066667	-118.781167
9/24/2010	13:25:22	Common Dolphin sp.	undifferentiated *delphinus*	2	33.02566667	-118.845833
9/24/2010	13:31:24	California Sea Lion	*Zalophus californianus*	25	33.00816667	-118.887667
9/24/2010	13:34:44	California Sea Lion	*Zalophus californianus*	4	32.956	-118.984167
9/24/2010	13:42:13	Unidentified Baleen Whale	unidentified balaenopterid	1	32.8385	-119.149000
9/24/2010	13:48:48	California Sea Lion	*Zalophus californianus*	1	32.806	-119.116000
9/24/2010	13:48:51	California Sea Lion	*Zalophus californianus*	1	32.806	-119.116000
9/24/2010	13:51:48	California Sea Lion	*Zalophus californianus*	2	32.84883333	-119.044000
9/24/2010	13:51:58	California Sea Lion	*Zalophus californianus*	1	32.85666667	-119.030667
9/24/2010	13:52:10	California Sea Lion	*Zalophus californianus*	1	32.85666667	-119.030667
9/24/2010	13:52:39	California Sea Lion	*Zalophus californianus*	1	32.86683333	-119.013167
9/24/2010	13:52:42	California Sea Lion	*Zalophus californianus*	1	32.86683333	-119.013167
9/24/2010	13:53:17	California Sea Lion	*Zalophus californianus*	2	32.86683333	-119.013167
9/24/2010	13:53:54	California Sea Lion	*Zalophus californianus*	2	32.88083333	-118.988000
9/24/2010	13:54:54	California Sea Lion	*Zalophus californianus*	1	32.90366667	-118.948500
9/24/2010	13:55:04	California Sea Lion	*Zalophus californianus*	2	32.90366667	-118.948500
9/24/2010	13:55:43	California Sea Lion	*Zalophus californianus*	4	32.917	-118.925000
9/24/2010	13:56:13	Bryde's Whale	*Balaenoptera brydei/edeni*	1	32.917	-118.925000
9/24/2010	14:03:00	California Sea Lion	*Zalophus californianus*	1	33.00466667	-118.768500
9/24/2010	14:03:36	California Sea Lion	*Zalophus californianus*	1	33.01616667	-118.749000
9/24/2010	14:03:46	California Sea Lion	*Zalophus californianus*	1	33.01616667	-118.749000
9/24/2010	14:05:24	California Sea Lion	*Zalophus californianus*	*	33.0445	-118.695500
9/24/2010	14:05:54	California Sea Lion	*Zalophus californianus*	*	33.04416667	-118.687333
9/24/2010	14:07:31	California Sea Lion	*Zalophus californianus*	*	33.03616667	-118.622000
9/24/2010	14:07:56	California Sea Lion	*Zalophus californianus*	*	33.03616667	-118.622000
9/24/2010	14:16:30	Common Dolphin sp.	undifferentiated *delphinus*	250	32.99216667	-118.317833
9/24/2010	14:22:43	Risso's Dolphin	*Grampus griseus*	2	32.99466667	-118.277833
9/24/2010	14:22:44	Unidentified Dolphin	unidentified Delphinidae	15	32.99466667	-118.277833
9/24/2010	14:27:21	Common Dolphin sp.	undifferentiated *delphinus*	300	32.97266667	-118.192000
9/24/2010	14:30:22	Unidentified Dolphin	unidentified Delphinidae	5	32.95833333	-118.087000

Sighting Date	Sighting Time	Common Name	Species	Best Count	Latitude	Longitude
9/24/2010	14:31:15	California Sea Lion	*Zalophus californianus*	1	32.95366667	-118.054667
9/24/2010	14:31:42	California Sea Lion	*Zalophus californianus*	1	32.95366667	-118.054667
9/24/2010	14:33:05	Common Dolphin sp.	undifferentiated *delphinus*	400	32.9475	-118.002833
9/24/2010	14:33:11	Common Dolphin sp.	undifferentiated *delphinus*	400	32.9435	-117.977833
9/24/2010	14:37:26	Common Dolphin sp.	undifferentiated *delphinus*	50	32.9225	-117.834000
9/24/2010	14:38:13	Common Dolphin sp.	undifferentiated *delphinus*	200	32.91816667	-117.808167
9/24/2010	14:39:09	Common Dolphin sp.	undifferentiated *delphinus*	6	32.91383333	-117.777833
9/24/2010	14:42:26	California Sea Lion	*Zalophus californianus*	1	32.89666667	-117.658167
9/24/2010	16:11:00	Common Dolphin sp.	undifferentiated *delphinus*	400	32.912	-117.347500
9/24/2010	16:16:00	Common Dolphin sp.	undifferentiated *delphinus*	100	33.02083333	-117.489333
9/24/2010	16:18:00	Common Dolphin sp.	undifferentiated *delphinus*	*	33.03483333	-117.494333
9/24/2010	16:21:00	Common Dolphin sp.	undifferentiated *delphinus*	30	33.06866667	-117.542167
9/24/2010	16:22:00	Common Dolphin sp.	undifferentiated *delphinus*	200	33.084	-117.567500
9/24/2010	16:37:00	Common Dolphin sp.	undifferentiated *delphinus*	300	33.35766667	-117.915333
9/24/2010	16:59:00	Common Dolphin sp.	undifferentiated *delphinus*	40	33.41233333	-117.861000
9/24/2010	17:05:00	Unidentified Dolphin	unidentified Delphinidae	150	33.38366667	-117.807167
9/24/2010	17:09:00	Common Dolphin sp.	undifferentiated *delphinus*	300	33.3095	-117.683000
9/24/2010	17:12:00	Common Dolphin sp.	undifferentiated *delphinus*	300	33.30233333	-117.659000
9/24/2010	17:13:00	Long-Beaked Common Dolphin	*Delphinus capensis*	9	33.28483333	-117.628167
9/24/2010	17:18:00	Common Dolphin sp.	undifferentiated *delphinus*	300	33.24483333	-117.577500
9/24/2010	17:21:00	Common Dolphin sp.	undifferentiated *delphinus*	75	33.18416667	-117.490833
9/24/2010	17:25:00	Common Dolphin sp.	undifferentiated *delphinus*	70	33.13866667	-117.452667
9/25/2010	10:33:00	Common Dolphin sp.	undifferentiated *delphinus*	700	32.945	-117.678500
9/25/2010	10:33:01	Risso's Dolphin	*Grampus griseus*	10	32.945	-117.678500
9/25/2010	10:39:01	Unidentified Dolphin	unidentified Delphinidae	19	32.98733333	-117.890833
9/25/2010	10:44:50	Common Dolphin sp.	undifferentiated *delphinus*	20	33.02883333	-118.097167
9/25/2010	10:54:00	Unidentified Dolphin	unidentified Delphinidae	75	33.0935	-118.425667
9/25/2010	11:01:00	Common Dolphin sp.	undifferentiated *delphinus*	350	33.14233333	-118.676333
9/25/2010	11:07:00	California Sea Lion	*Zalophus californianus*	1	33.15266667	-118.887333
9/25/2010	11:07:10	Common Dolphin sp.	undifferentiated *delphinus*	1100	33.15266667	-118.887333
9/25/2010	11:09:00	Unidentified Dolphin	unidentified Delphinidae	400	33.14433333	-118.938667
9/25/2010	11:18:00	Common Dolphin sp.	undifferentiated *delphinus*	15	33.05016667	-119.078167
9/25/2010	11:38:00	California Sea Lion	*Zalophus californianus*	1	33.095	-118.865000
9/25/2010	11:40:00	Common Dolphin sp.	undifferentiated *delphinus*	100	33.12666667	-118.807667
9/25/2010	11:47:00	Common Dolphin sp.	undifferentiated *delphinus*	400	33.126	-118.697500
9/25/2010	11:55:00	Northern Elephant Seal	*Mirounga angustirostris*	11	33.02966667	-118.848333
9/25/2010	12:03:00	Northern Elephant Seal	*Mirounga angustirostris*	6	32.96183333	-118.973000
9/25/2010	12:17:00	California Sea Lion	*Zalophus californianus*	35	32.85616667	-119.038167
9/25/2010	12:30:00	California Sea Lion	*Zalophus californianus*	2	33.0245	-118.735000

Sighting Date	Sighting Time	Common Name	Species	Best Count	Latitude	Longitude
9/25/2010	12:33:00	Common Dolphin sp.	undifferentiated *delphinus*	1200	33.05166667	-118.628667
9/25/2010	12:41:00	Common Dolphin sp.	undifferentiated *delphinus*	1600	33.09733333	-118.330667
9/25/2010	12:52:00	Common Dolphin sp.	undifferentiated *delphinus*	150	33.155	-118.082333
9/25/2010	13:02:00	Common Dolphin sp.	undifferentiated *delphinus*	110	33.19183333	-117.921333
9/25/2010	13:02:10	Unidentified Dolphin	unidentified Delphinidae	50	33.19183333	-117.921333
9/25/2010	13:06:00	Common Dolphin sp.	undifferentiated *delphinus*	100	33.201	-117.882333
9/25/2010	13:22:00	Common Dolphin sp.	undifferentiated *delphinus*	75	33.06433333	-117.384000
9/25/2010	13:24:00	Common Dolphin sp.	undifferentiated *delphinus*	200	33.0615	-117.360000
9/25/2010	13:28:00	Unidentified Dolphin	unidentified Delphinidae	40	32.966	-117.311500
9/25/2010	13:29:00	Unidentified Dolphin	unidentified Delphinidae	8	32.93416667	-117.306167
9/26/2010	10:46:19	Unidentified Dolphin	unidentified Delphinidae	1	32.945	-117.550333
9/26/2010	10:50:32	Unidentified Dolphin	unidentified Delphinidae	30	32.97	-117.728667
9/26/2010	10:52:21	Common Dolphin sp.	undifferentiated *delphinus*	20	32.98166667	-117.803000
9/26/2010	10:53:36	Common Dolphin sp.	undifferentiated *delphinus*	40	32.9915	-117.849333
9/26/2010	10:55:25	Common Dolphin sp.	undifferentiated *delphinus*	125	33.0055	-117.923333
9/26/2010	11:02:57	Common Dolphin sp.	undifferentiated *delphinus*	200	33.06416667	-118.220667
9/26/2010	11:04:57	Unidentified Dolphin	unidentified Delphinidae	20	33.078	-118.301000
9/26/2010	11:09:15	Unidentified Dolphin	unidentified Delphinidae	2	33.10983333	-118.475833
9/26/2010	11:11:08	Common Dolphin sp.	undifferentiated *delphinus*	200	33.12466667	-118.549667
9/26/2010	11:11:30	Common Dolphin sp.	undifferentiated *delphinus*	60	33.12683333	-118.563333
9/26/2010	11:12:56	Common Dolphin sp.	undifferentiated *delphinus*	400	33.138	-118.625000
9/26/2010	12:00:00	Cuvier's Beaked Whale	*Ziphius cavirostris*	2	32.84183333	-119.150333
9/26/2010	12:43:14	California Sea Lion	*Zalophus californianus*	1	32.9795	-119.189667
9/26/2010	12:58:16	Unidentified Dolphin	unidentified Delphinidae	15	32.94583333	-119.254167
9/26/2010	13:13:30	Common Dolphin sp.	undifferentiated *delphinus*	1000	33.175	-118.846500
9/26/2010	13:43:17	California Sea Lion	*Zalophus californianus*	2	33.1685	-118.685333
9/26/2010	13:47:47	Common Dolphin sp.	undifferentiated *delphinus*	75	33.11733333	-118.487500
9/26/2010	13:59:01	Unidentified Dolphin	unidentified Delphinidae	24	33.01716667	-117.969500
9/26/2010	14:01:53	Unidentified Dolphin	unidentified Delphinidae	150	32.9765	-117.842167
9/26/2010	14:02:34	Common Dolphin sp.	undifferentiated *delphinus*	50	32.96666667	-117.812167
9/26/2010	14:09:11	Common Dolphin sp.	undifferentiated *delphinus*	250	32.88683333	-117.504333
9/26/2010	14:10:10	Common Dolphin sp.	undifferentiated *delphinus*	550	32.87683333	-117.458167
9/26/2010	15:35:00	Unidentified Dolphin	unidentified Delphinidae	70	33.03066667	-117.436667
9/26/2010	15:36:00	Unidentified Dolphin	unidentified Delphinidae	4	33.0565	-117.458500
9/26/2010	15:37:55	Common Dolphin sp.	undifferentiated *delphinus*	190	33.09633333	-117.513833
9/26/2010	15:47:00	Common Dolphin sp.	undifferentiated *delphinus*	100	33.32066667	-117.697167
9/26/2010	15:48:21	Common Dolphin sp.	undifferentiated *delphinus*	90	33.357	-117.722333
9/26/2010	16:01:01	Common Dolphin sp.	undifferentiated *delphinus*	450	33.374	-118.032500
9/26/2010	16:10:39	Common Dolphin sp.	undifferentiated *delphinus*	75	33.41466667	-118.014667
9/26/2010	16:19:29	Unidentified Dolphin	unidentified Delphinidae	125	33.2675	-118.302667
9/26/2010	16:53:35	Common Dolphin sp.	undifferentiated *delphinus*	400	33.129	-117.421500
9/27/2010	9:45:00	Unidentified Dolphin	unidentified Delphinidae	50	32.8965	-117.326667

Sighting Date	Sighting Time	Common Name	Species	Best Count	Latitude	Longitude
9/27/2010	9:54:58	Common Dolphin sp.	undifferentiated *delphinus*	2100	32.959	-117.788500
9/27/2010	9:55:00	Common Dolphin sp.	undifferentiated *delphinus*	550	32.959	-117.788500
9/27/2010	9:56:00	Common Dolphin sp.	undifferentiated *delphinus*	200	32.96633333	-117.834833
9/27/2010	9:57:00	Common Dolphin sp.	undifferentiated *delphinus*	150	32.97383333	-117.880833
9/27/2010	10:05:25	Unidentified Dolphin	unidentified Delphinidae	60	33.06966667	-118.257833
9/27/2010	10:06:29	Common Dolphin sp.	undifferentiated *delphinus*	2200	33.09116667	-118.294667
9/27/2010	10:11:14	California Sea Lion	*Zalophus californianus*	2	33.13433333	-118.497667
9/27/2010	10:17:19	Common Dolphin sp.	undifferentiated *delphinus*	250	33.17733333	-118.755667
9/27/2010	10:18:06	Common Dolphin sp.	undifferentiated *delphinus*	200	33.18233333	-118.785333
9/27/2010	10:19:22	Common Dolphin sp.	undifferentiated *delphinus*	25	33.18016667	-118.828833
9/27/2010	10:24:46	California Sea Lion	*Zalophus californianus*	1	33.09483333	-118.994500
9/27/2010	10:25:51	Common Dolphin sp.	undifferentiated *delphinus*	50	33.07866667	-119.025000
9/27/2010	10:46:42	California Sea Lion	*Zalophus californianus*	1	33.1285	-119.207667
9/27/2010	10:47:00	California Sea Lion	*Zalophus californianus*	1	33.137	-119.213167
9/27/2010	10:48:12	Risso's Dolphin	*Grampus griseus*	30	33.165	-119.227667
9/27/2010	11:15:41	California Sea Lion	*Zalophus californianus*	2	33.06183333	-119.368833
9/27/2010	11:16:55	California Sea Lion	*Zalophus californianus*	2	33.08083333	-119.343167
9/27/2010	11:23:30	Unidentified Small Marine Mammal	unidentified marine mammal	1	33.04083333	-119.299500
9/27/2010	11:27:28	California Sea Lion	*Zalophus californianus*	1	33.039	-119.274000
9/27/2010	11:29:58	California Sea Lion	*Zalophus californianus*	1	33.06883333	-119.214667
9/27/2010	11:35:46	California Sea Lion	*Zalophus californianus*	1	33.00183333	-119.233000
9/27/2010	11:36:10	California Sea Lion	*Zalophus californianus*	1	33.01183333	-119.223833
9/27/2010	11:37:18	California Sea Lion	*Zalophus californianus*	1	33.03616667	-119.204167
9/27/2010	11:38:11	California Sea Lion	*Zalophus californianus*	1	33.04566667	-119.183667
9/27/2010	11:50:24	California Sea Lion	*Zalophus californianus*	1	33.05833333	-119.233000
9/27/2010	11:51:24	California Sea Lion	*Zalophus californianus*	2	33.03733333	-119.252667
9/27/2010	11:52:01	California Sea Lion	*Zalophus californianus*	1	33.023	-119.264500
9/27/2010	11:55:13	Minke Whale	*Balaenoptera acutorostrata*	3	33.01866667	-119.326833
9/27/2010	12:00:00	California Sea Lion	*Zalophus californianus*	1	33.0155	-119.318667
9/27/2010	12:11:00	California Sea Lion	*Zalophus californianus*	1	33.05766667	-119.317333
9/27/2010	12:12:00	California Sea Lion	*Zalophus californianus*	5	33.037	-119.338167
9/27/2010	12:16:18	California Sea Lion	*Zalophus californianus*	2	33.118	-119.279333
9/27/2010	12:16:59	California Sea Lion	*Zalophus californianus*	1	33.13	-119.264333
9/27/2010	12:19:27	California Sea Lion	*Zalophus californianus*	1	33.14866667	-119.191833
9/27/2010	12:21:15	Risso's Dolphin	*Grampus griseus*	8	33.148	-119.128500
9/27/2010	12:45:15	Common Dolphin sp.	undifferentiated *delphinus*	100	33.16266667	-118.900000
9/27/2010	12:56:51	California Sea Lion	*Zalophus californianus*	4	33.08283333	-118.429167
9/27/2010	13:00:21	Common Dolphin sp.	undifferentiated *delphinus*	350	33.10783333	-118.288000
9/27/2010	13:01:00	Common Dolphin sp.	undifferentiated *delphinus*	40	33.11133333	-118.260167
9/27/2010	13:04:40	Common Dolphin sp.	undifferentiated *delphinus*	605	33.145	-118.109167
9/27/2010	13:11:46	Common Dolphin sp.	undifferentiated *delphinus*	180	33.20033333	-117.813833

Sighting Date	Sighting Time	Common Name	Species	Best Count	Latitude	Longitude
9/27/2010	13:13:10	Common Dolphin sp.	undifferentiated *delphinus*	40	33.21533333	-117.750167
9/27/2010	13:16:44	Common Dolphin sp.	undifferentiated *delphinus*	55	33.253	-117.597167
9/27/2010	13:17:49	Common Dolphin sp.	undifferentiated *delphinus*	450	33.24783333	-117.547167
9/27/2010	13:22:00	Unidentified Dolphin	unidentified Delphinidae	100	33.13216667	-117.432000
9/27/2010	13:24:00	Common Dolphin sp.	undifferentiated *delphinus*	300	33.0705	-117.389667
9/27/2010	13:25:00	Common Dolphin sp.	undifferentiated *delphinus*	850	33.03883333	-117.369167
9/27/2010	13:27:01	Unidentified Dolphin	unidentified Delphinidae	250	32.973	-117.333667
9/27/2010	13:28:20	Common Dolphin sp.	undifferentiated *delphinus*	750	32.92783333	-117.313167
9/27/2010	14:46:46	Common Dolphin sp.	undifferentiated *delphinus*	650	32.905	-117.288667
9/27/2010	14:48:20	Common Dolphin sp.	undifferentiated *delphinus*	125	32.9535	-117.319167
9/27/2010	14:50:13	Common Dolphin sp.	undifferentiated *delphinus*	50	33.00716667	-117.353000
9/27/2010	14:50:35	Common Dolphin sp.	undifferentiated *delphinus*	350	33.02116667	-117.362500
9/27/2010	14:51:30	Common Dolphin sp.	undifferentiated *delphinus*	75	33.044	-117.378000
9/27/2010	14:52:48	Common Dolphin sp.	undifferentiated *delphinus*	60	33.05033333	-117.417833
9/27/2010	14:57:14	Common Dolphin sp.	undifferentiated *delphinus*	12	33.01916667	-117.560333
9/27/2010	14:57:25	Common Dolphin sp.	undifferentiated *delphinus*	275	33.018	-117.566000
9/27/2010	15:01:05	Common Dolphin sp.	undifferentiated *delphinus*	40	33.01166667	-117.609667
9/27/2010	15:01:45	Common Dolphin sp.	undifferentiated *delphinus*	90	33.00683333	-117.630667
9/27/2010	15:02:30	Common Dolphin sp.	undifferentiated *delphinus*	135	33.0015	-117.652667
9/27/2010	15:17:17	Common Dolphin sp.	undifferentiated *delphinus*	30	32.98616667	-117.717500
9/27/2010	15:19:42	Common Dolphin sp.	undifferentiated *delphinus*	50	32.97366667	-117.785667
9/27/2010	15:27:44	Common Dolphin sp.	undifferentiated *delphinus*	1299	32.92566667	-118.025000
9/27/2010	15:27:53	Common Dolphin sp.	undifferentiated *delphinus*	70	32.92566667	-118.025000
9/27/2010	16:15:54	Unidentified Dolphin	unidentified Delphinidae	25	32.98366667	-117.551500
9/27/2010	16:19:51	Common Dolphin sp.	undifferentiated *delphinus*	505	33.0105	-117.426667
9/27/2010	16:24:24	Common Dolphin sp.	undifferentiated *delphinus*	450	32.9305	-117.318167
9/28/2010	8:49:00	Unidentified Dolphin	unidentified Delphinidae	1	32.88266667	-117.298333
9/28/2010	8:55:00	Unidentified Baleen Whale	unidentified balaenopterid	1	33.033	-117.442500
9/28/2010	8:58:27	Common Dolphin sp.	undifferentiated *delphinus*	600	33.04166667	-117.446333
9/28/2010	9:32:59	Common Dolphin sp.	undifferentiated *delphinus*	150	33.1005	-117.519333
9/28/2010	9:41:30	Sei/Bryde’s Whale	*Balaenoptera borealis/edeni/brydei*	3	33.27733333	-117.796000
9/28/2010	10:00:00	Unidentified Dolphin	unidentified Delphinidae	500	33.31366667	-117.798000
9/28/2010	10:27:45	Unidentified Dolphin	unidentified Delphinidae	8	33.42816667	-117.996833
9/28/2010	11:58:52	Unidentified Dolphin	unidentified Delphinidae	8	34.16033333	-119.328667
9/28/2010	12:20:37	Common Dolphin sp.	undifferentiated *delphinus*	100	34.038	-119.159833
9/28/2010	12:47:14	Common Dolphin sp.	undifferentiated *delphinus*	10	33.62366667	-118.260500
9/28/2010	12:53:20	Common Dolphin sp.	undifferentiated *delphinus*	80	33.54316667	-118.032833
9/28/2010	12:55:07	Common Dolphin sp.	undifferentiated *delphinus*	400	33.5205	-117.961500
9/28/2010	13:17:57	Unidentified Dolphin	unidentified Delphinidae	50	33.44666667	-117.950000
9/28/2010	13:19:28	Common Dolphin sp.	undifferentiated *delphinus*	15	33.43733333	-118.001167

Sighting Date	Sighting Time	Common Name	Species	Best Count	Latitude	Longitude
9/28/2010	13:20:50	Risso's Dolphin	*Grampus griseus*	25	33.429	-118.045333
9/28/2010	13:47:13	Common Dolphin sp.	undifferentiated *delphinus*	75	33.41966667	-118.108500
9/28/2010	13:50:13	Risso's Dolphin	Grampus griseus	1	33.4	-118.209667
9/28/2010	13:56:02	Common Dolphin sp.	undifferentiated *delphinus*	15	33.31833333	-118.226167
9/28/2010	13:58:04	Common Dolphin sp.	undifferentiated *delphinus*	25	33.2915	-118.286333
9/28/2010	14:01:58	Common Dolphin sp.	undifferentiated *delphinus*	200	33.24866667	-118.404167
9/28/2010	14:14:27	Common Dolphin sp.	undifferentiated delphinus	60	33.229	-118.367500
9/28/2010	14:17:54	Common Dolphin sp.	undifferentiated delphinus	100	33.256	-118.250333
9/28/2010	14:19:26	Bottlenose Dolphin	Tursiops truncatus	18	33.267	-118.201833
9/28/2010	14:26:26	California Sea Lion	undifferentiated *delphinus*	40	33.25916667	-118.213167
9/28/2010	14:43:30	Common Dolphin sp.	undifferentiated *delphinus*	12	33.34166667	-117.854167
9/28/2010	14:46:46	Common Dolphin sp.	undifferentiated *delphinus*	42	33.36466667	-117.739500
9/28/2010	14:54:18	Common Dolphin sp.	undifferentiated *delphinus*	750	33.24866667	-117.541833
9/28/2010	15:06:25	Common Dolphin sp.	undifferentiated delphinus	5	32.93133333	-117.316167
9/28/2010	15:07:35	Common Dolphin sp.	undifferentiated delphinus	550	32.899	-117.298833

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

Appendix B. Sighting Rates

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

Species (Common Name)	Nov-09				May-10				Jul-10				Sep-10			
	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	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	0	0	0	0
Fin Whale	5	0.001	0.003	0.19	2	0.0007	0.001	0.072	4	0.0013	0.0024	0.22	0	0	0	0
Sei Whale	0	0	0	0	0	0	0	0	0	0	0	0	1	0.0003	0.0005	0.05
Bryde's Whale	0	0	0	0	0	0	0	0	0	0	0	0	1	0.0003	0.0005	0.05
Minke Whale	1	0.0003	0.0005	0.037	1	0.0004	0.0007	0.036	0	0	0	0	1	0.0003	0.0005	0.05
Unidentified Baleen Whale	0	0	0	0	0	0	0	0	0	0	0	0	1	0.0003	0.0005	0.05
Unidentified Large Whale	1	0.0003	0.0005	0.037	1	0.0004	0.0007	0.036	0	0	0	0	0	0	0	0
Unidentified Medium Whale	1	0.0003	0.0005	0.037	0	0	0	0	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	0	0	0	0
Cuvier's Beaked Whale	2	0.0006	0.001	0.075	0	0	0	0	0	0	0	0	1	0.0003	0.0005	0.05
Risso's Dolphin	5	0.001	0.003	0.19	28	0.14	0.02	1.011	1	0.00032	0.00059	0.06	6	0.002	0.003	0.32
Common Dolphin sp.	25	0.007	0.013	0.94	15	1.27	0.01	0.54	40	0.013	0.024	2.21	125	0.032	0.06	6.6
Bottlenose Dolphin	0	0	0	0	9	0.98	0.006	0.32	3	0.00096	0.0018	0.17	4	0.001	0.002	0.21
Pacific White-sided Dolphin	6	0.002	0.003	0.22	2	0.03	0.001	0.072	0	0	0	0	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	32	0.008	0.015	1.7
Unidentified Small Dolphin	2	0.0006	0.001	0.075	4	0.17	0.003	0.14	2	0.00064	0.0012	0.11	0	0	0	0
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	71	0.018	0.034	3.7
Harbor Seal	0	0	0	0	1	0.0007	0.0007	0.036	0	0	0	0	0	0	0	0
Northern Elephant Seal	0	0	0	0	0	0	0	0	0	0	0	0	3	0.0008	0.0014	0.16
Unidentified Pinniped	4	0.001	0.002	0.15	2	0.0007	0.001	0.072	0	0	0	0	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	2	0.0005	0.0009	0.11
Unidentified Small Marine Mammal	1	0.0003	0.0005	0.037	2	0.0007	0.001	0.072	0	0	0	0	1	0.0003	0.0005	0.05
Unidentified Medium Marine Mammal	0	0	0	0	0	0	0	0	0	0	0	0	2	0.0005	0.0009	0.11
Overall Marine Mammal	**81**	**0.02**	**0.04**	3.034	**102**	**0.04**	**0.073**	3.68	**86**	**0.028**	**0.051**	**4.75**	**251**	**0.065**	**0.12**	**13.3**

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

Species (Common Name)	Nov-09				May-10				Jul-10				Sep-10			
	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	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	0	0	0	0
Fin Whale	5	0.001	0.003	0.19	2	0.0007	0.001	0.072	4	0.0013	0.0024	0.22	0	0	0	0
Sei Whale	0	0	0	0	0	0	0	0	0	0	0	0	1	0.0003	0.0005	0.05
Bryde's Whale	0	0	0	0	0	0	0	0	0	0	0	0	1	0.0003	0.0005	0.05
Minke Whale`	1	0.0003	0.0005	0.037	1	0.0004	0.0007	0.036	0	0	0	0	1	0.0003	0.0005	0.05
Unidentified Baleen Whale	0	0	0	0	0	0	0	0	0	0	0	0	1	0.0003	0.0005	0.05
Unidentified Large Whale	1	0.0003	0.0005	0.037	1	0.0004	0.0007	0.036	0	0	0	0	0	0	0	0
Unidentified Medium Whale	1	0.0003	0.0005	0.037	0	0	0	0	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	0	0	0	0
Cuvier's Beaked Whale	2	0.0006	0.001	0.075	0	0	0	0	0	0	0	0	1	0.0003	0.0005	0.05
Risso's Dolphin	5	0.001	0.003	0.19	28	0.14	0.02	1.011	1	0.00032	0.00059	0.06	6	0.002	0.003	0.32
Common Dolphin sp.	25	0.007	0.013	0.94	15	1.27	0.01	0.54	40	0.013	0.024	2.21	125	0.032	0.06	6.6
Bottlenose Dolphin	0	0	0	0	9	0.98	0.006	0.32	3	0.00096	0.0018	0.17	4	0.001	0.002	0.21
Pacific White-sided Dolphin	6	0.002	0.003	0.22	2	0.03	0.001	0.072	0	0	0	0	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	32	0.008	0.015	1.7
Unidentified Small Dolphin	2	0.0006	0.001	0.075	4	0.17	0.003	0.14	2	0.00064	0.0012	0.11	0	0	0	0
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	71	0.018	0.034	3.7
Harbor Seal	0	0	0	0	1	0.0007	0.0007	0.036	0	0	0	0	0	0	0	0
Northern Elephant Seal	0	0	0	0	0	0	0	0	0	0	0	0	3	0.0008	0.0014	0.16
Unidentified Pinniped	4	0.001	0.002	0.15	2	0.0007	0.001	0.072	0	0	0	0	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	2	0.0005	0.0009	0.11
Unidentified Small Marine Mammal	1	0.0003	0.0005	0.037	2	0.0007	0.001	0.072	0	0	0	0	1	0.0003	0.0005	0.05
Unidentified Medium Marine Mammal	0	0	0	0	0	0	0	0	0	0	0	0	2	0.0005	0.0009	0.11
Overall Marine Mammal	**81**	**0.02**	**0.04**	3.034	**102**	**0.04**	**0.073**	3.68	**86**	**0.028**	**0.051**	**4.75**	**252**	**0.065**	**0.12**	**13.3**

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

Effort Type	Species Group	Nov 18-23, 2009							May 13-18, 2010							July 27- August 3, 2010							September 23-28, 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	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	8.25	0.003	0.006	0.73	4	1268	685	7.26	0.003	0.006	0.5509	1	592	319.68	3	0.002	0.003	0.33	**1**	1428	771	7.5	0.0007	0.0013	0.133
	Dolphins	21				0.012	0.022	2.55	29				0.023	0.042	3.9939	13				0.022	0.041	4.33	49				0.034	0.064	6.533
	Pinnipeds	17				0.009	0.018	2.06	13				0.01	0.019	1.7904	0				0	0	0	49				0.034	0.064	6.533
	All MM	44				**0.025**	**0.046**	5.33	**46**				**0.036**	**0.067**	6.3351	**14**				0.024	0.044	4.67	99				0.069	0.128	13.2
Random	Whales	0	669	361	1.72	0	0	0	1	370	200	2.1	0.003	0.005	0.4768	0	111	59.94	0.5	0	0	0	2	164	89	1	0.012	0.022	2
	Dolphins	4				0.006	0.011	2.33	10				0.027	0.05	4.76821	3				0.027	0.050	6.00	7				0.043	0.079	7
	Pinnipeds	3				0.004	0.008	1.75	1				0.003	0.005	0.4768	0				0	0	0	9				0.055	0.101	9
	All MM	7				**0.01**	**0.019**	4.08	**12**				**0.032**	**0.06**	5.7219	**3**				0.027	0.050	6.00	18				0.182	0.54	18
Transit	Whales	**2**	983	531	3.73	0.002	0.004	0.54	1	956	516	4.53	0.001	0.002	0.2206	16	874	471.96	3.8	0.018	0.034	4.21	2	2286	1234	10.4	0.0009	0.0016	0.1923
	Dolphins	23				0.023	0.043	6.17	29				0.03	0.056	6.3971	42				0.048	0.089	11.05	109				0.0477	0.0883	10.5
	Pinnipeds	3				0.003	0.006	0.81	12				0.013	0.023	2.6471	1				0.001	0.002	0.26	11				0.0048	0.0089	1.058
	All MM	**28**				**0.028**	**0.053**	7.51	**42**				**0.044**	**0.081**	9.2647	**59**				0.068	0.125	15.53	122				0.0533	0.099	11.73
Circling	Whales	0	1335	721	7.2	0	0	0	0	2125	1147	12.91	0	0	0	5	1549	836.46	10	0.003	0.006	0.50	1	50	27	0.3	0.02	0.037	3.33
	Dolphins	1				0.001	0.001	0.14	0				0	0	0	5				0.003	0.006	0.50	2				0.04	0.074	6.66
	Pinnipeds	0				0	0	0	0				0	0	0	0				0	0	0	5				0.1	0.185	16.66
	All MM	**1**				**0.001**	**0.001**	0.14	**0**				**0**	**0**	0	**10**				0.006	0.012	1.00	8				0.16	0.297	26.66
Circumnavigating San Clemente Island	Whales	0	120	65	0.21	0	0	0	0	83	45	0.48	0	0	0	0	0	0	0	0	0	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	0				0	0	0
	Pinnipeds	5				0	0	23.32	37				0.446	0.826	77.4419	0				0	0	0	0				0	0	0
	All MM	**7**				**0.058**	**0.108**	32.64	**40**				**0.482**	**0.893**	83.7209	**0**				0	0	0	0				0	0	0
Navy-directed Transiting	Whales	0	137	74	0.63	0	0	0	0	91	49	0.39	0	0	0	0	0	0	0	0	0	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	0				0	0	0
	Pinnipeds	4				0	0	6.34	3				0.033	0.061	7.6056	0				0	0	0	0				0	0	0
	All MM	**5**				**0.036**	**0.068**	7.92	**10**				**0.11**	**0.204**	25.3521	**0**				0	0	0	0				0	0	0

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

Effort Type	Species Group	Nov 18-23, 2009							May 13-18, 2010							July 27- August 3, 2010							September 23-28, 2010						
		Total Indiv	Total km	Total nm	Total hr	Indiv/ km	Indiv/ nm	Indiv/ hr	Total Indiv	Total km	Total nm	Total hr	Indiv/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
Systematic	Whales	4	1790	967	8.25	0.0022	0.0041	0.48	6	1268	685	7.26	0.0047	0.0088	0.83	2	592	319.68	3	0.003	0.006	0.67	1	1428	771	7.5	0.0007	0.0013	0.1333
	Dolphins	3823				2.14	3.95	463.5	3080				2.43	4.5	424.18	1841				3.110	5.759	613.67	10119				7.09	13.12	1349.2
	Pinnipeds	8				0.0045	0.0083	0.97	20				0.016	0.029	2.75	0				0.000	0.000	0.00	151				0.106	0.196	20.133
	All MM	3835				2.14	3.97	464.96	**3106**				2.45	4.53	427.76	**1843**				3.113	5.765	614.33	**10271**				7.19	13.32	1369.5
Random	Whales	8	669	361	1.72	0.012	0.022	4.66	1	370	200	2.1	0.0027	0.005	0.477	0	111	59.94	0.5	0.000	0.000	0.00	4	164	89	1	0.024	0.045	4
	Dolphins	8207				12.27	22.73	4785.42	582				1.57	2.91	277.51	162				1.459	2.703	324.00	685				4.177	7.697	685
	Pinnipeds	77				0.12	0.21	44.9	25				0.068	0.125	11.92	0				0.000	0.000	0.00	13				0.079	0.146	13
	All MM	8292				12.39	22.97	4834.99	**608**				1.64	3.04	289.91	**162**				1.459	2.703	324.00	**702**				4.28	7.89	702
Transit	Whales	**2**	983	531	3.73	0.002	0.0038	0.54	1	956	516	4.53	0.001	0.0019	0.22	42	874	471.96	3.8	0.048	0.089	11.05	4	2286	1234	10.4	0.002	0.003	0.385
	Dolphins	3835				3.9	7.22	1029.22	1465				1.53	2.84	323.16	8564				9.799	18.146	2253.68	26065				11.4	21.12	2506.25
	Pinnipeds	3				0.0031	0.0056	0.81	18				0.019	0.035	3.97	2				0.002	0.004	0.53	10				0.004	0.008	0.96
	All MM	**28**				0.028	0.0527	7.51	**1495**				1.56	2.9	329.78	**8608**				9.849	18.239	2265.26	**26079**				11.4	21.13	2507.6
Circling	Whales	0	1335	721	7.2	0	0	0	0	2125	1147	12.91	0	0	0	7	1549	836.46	10	0.005	0.008	0.70	2	50	27	0.3	0.04	0.074	6.66
	Dolphins	150				0.11	0.2	20.84	0				0	0	0	470				0.303	0.562	47.00	900				18	33.33	3000
	Pinnipeds	0				0	0	0	0				0	0	0	0				0.000	0.000	0.00	48				0.96	1.77	160
	All MM	**150**				0.11	0.2	20.84	**0**				0	0	0	**477**				0.308	0.570	47.70	**950**				19	35.19	3166.7
Circumnavigating San Clemente Island	Whales	0	120	65	0.21	0	0	0	0	83	45	0.48	0	0	0	0	0	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	0				0	0	0
	Pinnipeds	35				0.29	0.54	163.21	96				1.16	2.13	200.93	0				0	0	0	0				0	0	0
	All MM	**85**				0.71	1.31	396.37	**149**				1.8	3.31	311.86	**0**				0	0	0	0				0	0	0
Navy-directed Transiting	Whales	0	137	74	0.63	0	0	0	0	91	49	0.39	0	0	0	0	0	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	0				0	0	0
	Pinnipeds	2				0.015	0.027	3.17	5				0.055	0.1	12.68	0				0	0	0	0				0	0	0
	All MM	**449**				3.28	6.068	711.13	**95**				1.044	1.94	240.85	**0**				0	0	0	0				0	0	0

Appendix C. Focal Follows

Table C-1. Focal follows performed during July SOCAL 2010 aerial monitoring surveys off San Diego, California.

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	8	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	

Date	Start Time	End Time	Duration of Focal (hr:min:sec)	Latitude	Longitude	Species	Group Size	Notes
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	
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

Number of 5 min-focals for July = 6

Number of 10-min focals for July = 13

Table C-2. Focal follows performed during September SOCAL 2010 aerial monitoring surveys off San Diego, California.

Date	Start Time	End Time	Duration of Focal (hr:min:sec)	Latitude	Longitude	Species	Group Size	Notes
24-Sep	13:42:13	13:48:48	0:06:35	32.839	-119.149	Unidentified Baleen Whale	1	Possibly a blue whale, very light
24-Sep	14:16:30	14:22:43	0:06:13	32.992	-118.318	Common Dolphin sp.	250	Very tight ball of dolphins travel fast with birds circled at 800 ft; see behavior sheet for 5 min focal
24-Sep	16:11:00	16:16:00	0:05:00	32.912	-117.348	Common Dolphin sp.	4000	
24-Sep	16:59:00	17:05:00	0:06:00	33.412	-117.861	Common Dolphin sp.	40	At least 4 subgroups, inverted swim, bird associated
26-Sep	13:13:30	13:42:00	0:28:30	33.175	-118.847	Common Dolphin sp.	1000	Circled for about 27 min took video and photos, Bernd used video regular lens then later put on UV lens thinks it helped some cutting back on the glare for video camera he thinks he got deeper into the water in no glare part of turns
26-Sep	16:01:01	16:10:00	0:08:59	33.337	-118.033	Common Dolphin sp.	450	
26-Sep	16:53:35	17:06:13	0:12:38	33. 129	-117.422	Common Dolphin sp.	400	Many subgroups of small groups of 5 to 12 or so, foraging, milling, some surface activity
27-Sep	10:48:12	11:09:00	0:20:48	33.165	-119.228	Risso's Dolphin	30	Headed up to 1500 ft. to do behaviors, slow travel entire time, we did focals on a group of about 17 Risso's, see behavior sheet on this day; 10:50:44 we are telling R/V Sproul about location of Risso's, but they are still with 1 beaked whale sighting

Date	Start Time	End Time	Duration of Focal (hr:min:sec)	Latitude	Longitude	Species	Group Size	Notes
27-Sep	11:55:13	12:02:00	0:06:47	33.019	-119.327	Minke Whale	3	3 small whales 1 confirmed with photo and view as minke, others are prob minkes too based on color under surface dark and size and behavior and synchrony MS LM saw chevron and white pec, Bernd got photos, Sproul saw 2 minkes this morning
27-Sep	12:21:15	12:44:00	0:22:45	33.148	-119.129	Risso's Dolphin	8	
27-Sep	15:02:30	15:14:00	0:11:30	33.002	-117.653	Common Dolphin sp.	135	doing focals w video because they are foraging and doing pirouetting circling; did focals on subgroup of about 12--see video
27-Sep	15:27:44	15:56:35	0:28:51	33.926	-118.025	Common Dolphin sp.	1299	Circling for photos and behavior 1 medium-sized recreational fishing vessel is following from about 0.5 nm
28-Sep	8:58:27	9:32:00	0:33:33	33.042	-117.446	Common Dolphin sp.	600	Spacer angle--commons feeding--photos trying to capture pairs feeding and distance between them
28-Sep	9:41:30	10:25:00	0:43:30	33.277	-117.796	Sei/Bryde’s Whale	3	Initially seen underwater and fluking up, looked like a small or med size whale; we circled it for over 30 min while the whales sporadically lunge fed, Bernd got photos of lunge feeding, got photos of head and looks like there is a secondary ridge characteristic of Brydes whales. Bernd took circled at 030 degrees declination distance to animals at 1500 ft. T. Jefferson later examined photos and determined to be a sei or Bryde’s whale

Date	Start Time	End Time	Duration of Focal (hr:min:sec)	Latitude	Longitude	Species	Group Size	Notes
28-Sep	13:20:50	13:45:00	0:24:10	33.429	-118.045	Risso's Dolphin	25	Did focals on a single Risso's for about 3+ surfacing sequences to get individual dive and blow times; BW got video, notes by LM on excel behavior sheet; was a single animal in this group, all individuals widely spread into subgroups of mostly 1-3 animals, a few subgroups of 5-10 indiv
28-Sep	14:26:26	14:34:46	0:08:20	33.259	-118.213	California Sea Lion	40	Resting at surface in tight group as we circled the bottlenose dolphins near Santa Catalina Isld; sea lions appeared to potentially react during third circling when plane passed over at about 70 degrees, some indiv diving with splash
		Total:	4:34:09					

Number of 5-min focals for September = 7

Number of 10-min focals for September = 9

Appendix D. List of July 2010 and September 2010 Video

Table D-1. Videos recorded during July SOCAL 2010 aerial monitoring surveys off San Diego, California.

Video Name	Date	Video Start Time	Video End Time	Total Video (hr:min:sec)	Daily Sighting ID	Species	Best Grp Size Estim	Video Notes	Taken By
SOCAL_2010July_27_SES_Video_141025-141438_ID01_Blue	7/27/2010	14:10:25	14:14:38	0:04:13	1	Blue Whale	4	Multiple blows, no vocals due to noise of helicopter, subsurface, 1 indiv.	BW
SOCAL_2010July_27_SES_Video_141538-141541_IDBoat_Boat	7/27/2010	14:15:38	14:15:41	0:00:03	Boat	Boat	1	Private sailboat only	BW
SOCAL_2010July_27_SES_Video_141610-141758_ID01_Bottlenose	7/27/2010	14:16:10	14:17:58	0:01:48	1	Bottlenose Dolphin	4	Fast travel, oriented at 350 degrees	BW
SOCAL_2010July_27_SES_Video_141828-141938_ID01_Bottlenose	7/27/2010	14:18:28	14:19:38	0:01:10	1	Bottlenose Dolphin	4	No audio, large group, fast travel	BW
SOCAL_2010July_27_SES_Video_142206-142658_ID01_Blue	7/27/2010	14:22:06	14:26:58	0:04:52	1	Blue Whale	4	1 indiv., below surface, multiple blows, slow travel, blew and dove	BW
SOCAL_2010July_27_SES_Video_143839-144109_ID01_Blue	7/27/2010	14:38:39	14:41:09	0:02:30	1	Blue Whale	4	below surface, 1 indiv., slow travel, blew and shallow dive	BW
SOCAL_2010July_27_SES_Video_144431-144520_ID01_Blue	7/27/2010	14:44:31	14:45:20	0:00:49	1	Blue Whale	4	1 indiv., below surface, blew and dove	BW
SOCAL_2010July_27_SES_Video_144703-144815_ID03_Fin	7/27/2010	14:47:03	14:48:15	0:01:12	3	Fin Whale	1	1 indiv, below surface, surfaces blows, and dives again and seen below surface	BW
SOCAL_2010July_27_SES_Video_145232-145253_ID01_Blue	7/27/2010	14:52:32	14:52:53	0:00:21	1	Blue Whale	4	Flukes up and dove	BW

Video Name	Date	Video Start Time	Video End Time	Total Video (hr:min:sec)	Daily Sighting ID	Species	Best Grp Size Estim	Video Notes	Taken By
SOCAL_2010July_27_SES_Video_145601-145825_ID01_Blue	7/27/2010	14:56:01	14:58:25	0:02:24	1	Blue Whale	4	1 indiv., below surface, multiple blows, slow travel,	BW
SOCAL_2010July_27_SES_Video_150525-150654_ID01_Blue	7/27/2010	15:05:25	15:06:54	0:01:29	1	Blue Whale	4	1 indiv., resting below surface, multiple blows	BW
SOCAL_2010July_27_SES_Video_150939-151242_IDX01_Blue	7/27/2010	15:09:39	15:12:42	0:03:03	1	Blue Whale	4	multiple blows, 1 indiv., shallow dive, slow travel,	BW
SOCAL_2010July_27_SES_Video_152454-152516_ID05_Blue	7/27/2010	15:24:54	15:25:16	0:00:22	5	Blue Whale	6	1 indiv, subsurface, blows, arched back then flukes up and dives	BW
SOCAL_2010July_27_SES_Video_152550-152832_IDX05_Blue	7/27/2010	15:25:50	15:28:32	0:02:42	5	Blue Whale	6	whale scat, 2 indiv., slow travel, looks like mother calf pair	BW
SOCAL_2010July_27_SES_Video_153626-154427_ID05_Blue	7/27/2010	15:36:26	15:44:27	0:08:01	5	Blue Whale	6	2 indiv., swimming towards helicopter, whale #2 reorients 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	BW
SOCAL_2010July_27_SES_Video_155012-155027_ID05_Blue	7/27/2010	15:50:12	15:50:27	0:00:15	5	Blue Whale	6	Flukes and dove	BW

Video Name	Date	Video Start Time	Video End Time	Total Video (hr:min:sec)	Daily Sighting ID	Species	Best Grp Size Estim	Video Notes	Taken By
SOCAL_2010July_27_SES_Video_155104-160113_ID05_Blue	7/27/2010	15:51:04	16:01:13	0:10:09	5	Blue Whale	6	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	BW
SOCAL_2010July_27_SES_Video_160446-160832_ID05_Blue	7/27/2010	16:04:46	16:08:32	0:03:46	5	Blue Whale	6	1 indiv. , 3 spots of scat, multiple blows, slow travel, arched back, flukes up and dove	BW
SOCAL_2010July_27_SES_Video_161013-161217_ID05_Blue	7/27/2010	16:10:13	16:12:17	0:02:04	5	Blue Whale	6	2 indiv., multiple blows, slow travel, front animal 4 body lengths apart, not 2 body lengths apart, the 2nd is behind to the left,	BW

Video Name	Date	Video Start Time	Video End Time	Total Video (hr:min:sec)	Daily Sighting ID	Species	Best Grp Size Estim	Video Notes	Taken By
SOCAL_2010July_27_SES_Video_161740-162107_ID05_Blue	7/27/2010	16:17:40	16:21:07	0:03:27	5	Blue Whale	6	1 indiv. subsurface, looks as if it is floating just below surface, milling, whale turns slightly on its side, arched back and dove	BW
SOCAL_2010July_27_SES_Video_162117-162127_IDXX_Unid	7/27/2010	16:21:17	16:21:27	0:00:10	XX	Unidentified Whale Scat		Whale scat	BW
SOCAL_2010July_27_SES_Video_162141-162147_IDXX_Unid	7/27/2010	16:21:41	16:21:47	0:00:06	XX	Unidentified Whale Scat		Big blob of whale scat	BW
SOCAL_2010July_28_SES_Video_134711-135024_ID02_Blue	7/28/2010	13:47:11	13:50:24	0:03:13	2	Blue Whale	3	cannot hear vocals, multiple blows, arched back and dove,	BW
SOCAL_2010July_28_SES_Video_135623-143050_ID02_Blue	7/28/2010	13:56:23	14:30:50	0:34:27	2	Blue Whale	3	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	BW
SOCAL_2010July_28_SES_Video_145741-150356_ID08_Commonsp.	7/28/2010	14:57:41	15:03:56	0:06:15	8	Common Dolphin sp.	400	Surface active milling, dispersal 1-8, 1400 ft, angle 26, well over 100 animals, 2 groups, 1st group scattered	BW
SOCAL_2010July_28_SES_Video_152622-152628_IDBoat_Boat	7/28/2010	15:26:22	15:26:28	0:00:06	Boat	Boat	1	Private Boat Only	BW

Video Name	Date	Video Start Time	Video End Time	Total Video (hr:min:sec)	Daily Sighting ID	Species	Best Grp Size Estim	Video Notes	Taken By
SOCAL_2010July_28_SES_Video_154558-155422_ID13_Blue_Fin	7/28/2010	15:45:58	15:54:22	0:08:24	13	Blue Whale/Fin Whale	5 Blue 3Fin	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	BW
SOCAL_2010July_29_SES_Video_143809-151936_ID01_Blue	7/29/2010	14:38:09	15:19:36	0:41:27	1	Blue Whale	2	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	BW
SOCAL_2010July_29_SES_Video_155244-155545_ID02_Commonsp.	7/29/2010	15:52:44	15:55:45	0:03:01	2	Common Dolphin sp.	380	800 ft., looking at subgroup, orientation 270, unidentified splash, 2 gulls over dolphin	BW
SOCAL_2010July_29_SES_Video_155549-155744_ID02_Commonsp.	7/29/2010	15:55:49	15:57:44	0:01:55	2	Common Dolphin sp.	380	Dispersion 1-2	BW
SOCAL_2010July_29_SES_Video_160820-160905_ID03_Commonsp.	7/29/2010	16:08:20	16:09:05	0:00:45	3	Common Dolphin sp.	110	Bird association	BW
SOCAL_2010July_30_SES_Video_131258-151332_ID01_Risso's	7/30/2010	15:12:58	15:13:32	0:00:34	1	Risso's Dolphin	9	Oriented at 2 o'clock	BW

Video Name	Date	Video Start Time	Video End Time	Total Video (hr:min:sec)	Daily Sighting ID	Species	Best Grp Size Estim	Video Notes	Taken By
SOCAL_2010July_30_SES_Video_151558-152732_ID01_Risso's	7/30/2010	15:15:58	15:27:41	0:11:43	1	Risso's Dolphin	9	line abreast, dispersal 1-2, oriented at 330, dispersal now 1-5	BW
SOCAL_2010July_31_SES_Video_143756-155920_ID03_Blue	7/31/2010	14:37:56	14:59:20	0:21:24	3	Blue whale	6	.5 body lengths apart, 2 indiv	MS
SOCAL_2010July_31_SES_Video_14592-1529163_ID03_Blue	7/31/2010	14:59:23	15:29:16	0:29:53	3	Blue Whale	6	2 indiv.	MS
SOCAL_2010July_31_SES_Video_153608-153732_ID03_Blue	7/31/2010	15:36:08	15:37:32	0:01:24	3	Blue Whale	6	oriented at 300, 2 ind., one whale fluked and the second one sounded, angle is 26	MS
SOCAL_2010July_31_SES_Video_174437-175548_ID22_Blue	7/31/2010	17:44:37	17:55:48	0:11:11	22	Blue Whale	1		MS
SOCAL_2010July_31_SES_Video_175549-181939_ID22_Blue	7/31/2010	17:55:49	18:19:39	0:23:50	22	Blue Whale	1	oriented at 150	MS

Video Name	Date	Video Start Time	Video End Time	Total Video (hr:min:sec)	Daily Sighting ID	Species	Best Grp Size Estim	Video Notes	Taken By
SOCAL_2010July_2August_SES_Video_155827-163641_ID24_Blue	8/2/2010	15:58:27	16:36:41	0:38:14	24	Blue Whale	2	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	MS
SOCAL_2010July_2August_SES_Video_165955-175930_ID31_Blue	8/2/2010	16:59:55	17:59:30	0:59:35	31	Blue Whale	2	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,	MS

Video Name	Date	Video Start Time	Video End Time	Total Video (hr:min:sec)	Daily Sighting ID	Species	Best Grp Size Estim	Video Notes	Taken By
SOCAL_2010July_3August_SES_Video_173759-180230_ID41_Blue	8/3/2010	17:37:59	17:54:27	0:16:28	41	Blue Whale	2	pair of blue whales surfaced, multiple blows, some glare, whales sounding, fluke up dive on whale #1, dispersal is one body length apart, gulls overhead, dolphins seen in water concentration on blue whale focal, 550 ft., fluke up again on whale #1, plane had to go low to get out of way of F16's, possible fin, blues surfaces, fast travel, sounded, whale #1 arch back and dive,	MS
SOCAL_2010July_3August_SES_Video_175429-180230_ID41_Blue	8/3/2010	17:54:29	18:02:30	0:08:01	41	Blue Whale	2	One whale seen, blow, fluke up, poss fin whale seen in beginning of video, 2 blues seen again from previous video, multiple blows by each blues, video camera put down for photos, 2000 ft.	MS

Table D-2. Videos recorded during September SOCAL 2010 aerial monitoring surveys off San Diego, California, based on preliminary review of video.

Video Name	Date	Start Time	End Time	Total Video (hr:min:sec)	Daily Sighting ID	Species	Approx. Group Size	Video Notes	Taken By
SOCAL_2010Sept_23_SES_Video_161914-162115_ID06_CommonDolphinSp.	9/23/2010	16:19:14	16:21:15	0:02:01	6	Common Dolphin sp.	60	No voice on video, bird association	MS
SOCAL_2010Sept_23_SES_Video_162118-162244_ID06_CommonDolphinSp.	9/23/2010	16:21:18	16:22:44	0:01:26	6	Common Dolphin sp.	60	No voice on video, bird association, animals spread out, inverted lunge	MS
SOCAL_2010Sept_23_SES_Video_162252-162416_ID06_CommonDolphinSp.	9/23/2010	16:22:52	16:24:16	0:01:24	6	Common Dolphin sp.	60	No voice on video, bird association, inverted lunge	MS
SOCAL_2010Sept_23_SES_Video_162418-162429_ID06_CommonDolphinSp.	9/23/2010	16:24:18	16:24:29	0:00:11	6	Common Dolphin sp.	60	No voice on video, 1 individual	MS
SOCAL_2010Sept_26_SES_Video_122055-122128_IDBoat_Boat	9/26/2010	12:20:55	12:21:28	0:00:33	Boat	Boat	1		BW
SOCAL_2010Sept_26_SES_Video_122421-122439_IDBoat_Boat	9/26/2010	12:24:21	12:24:39	0:00:18	Boat	Boat	1	R/V Robert Gordon Sproul	BW
SOCAL_2010Sept_26_SES_Video_122955-123021_IDBoat_Boat	9/26/2010	12:29:55	12:30:21	0:00:26	Boat	Boat	1	R/V Robert Gordon Sproul	BW

Video Name	Date	Start Time	End Time	Total Video (hr:min:sec)	Daily Sighting ID	Species	Approx. Group Size	Video Notes	Taken By
SOCAL_2010Sept_26_SES_Video_131518-133022_ID15_CommonDolphinSp.	9/26/2010	13:15:18	13:30:22	0:15:04	15	Common Dolphin sp.	1000	voice hard to understand, 1000 to 1200 individuals, bird association, dispersion 1-2, oriented at 090, group is more longer than horizontal, dispersion is 1-5, slow travel, no behavior changes seen	BW
SOCAL_2010Sept_26_SES_Video_133347-133845_ID15_CommonDolphinSp.	9/26/2010	13:33:47	13:38:45	0:04:58	15	Common Dolphin sp.	1000	Same group as above, oriented at 090, dispersion 1-2, slow surface active travel, bird association, group in a slight triangle shape, oriented at 080, shape is a rectangle, dispersion 1-3, birds circling above dolphin	BW
SOCAL_2010Sept_26_SES_Video_165617-165811_ID31_CommonDolphinSp.	9/26/2010	16:56:17	16:58:11	0:01:54	31	Common Dolphin sp.	400	Animals all spread out, 80-100 individuals, calf seen,	BW

Video Name	Date	Start Time	End Time	Total Video (hr:min:sec)	Daily Sighting ID	Species	Approx. Group Size	Video Notes	Taken By
SOCAL_2010Sept_26_SES_Video_165819-171548_ID31_CommonDolphinSp.	9/26/2010	16:58:19	17:15:48	0:17:29	31	Common Dolphin sp.	400	Animals spread out, bird association, foraging, inverted swimming, 12 subgroups, surface active milling with birds, occasional lunging, spacing 1-3, one subgroup has roughly 20 animals, spacing 1-2, traveling to 120, second subgroup- surface active milling, spacing 1-2, roughly 10 individuals, spacing 1-12, inverted swim, porpoise lunging with birds, spacing 1-15, split up into 3 groups of 5, inverted swim, sighting number 30, spacing 1-18, 3rd subgroup- surface active milling, spinning, turning, spacing is 1-2, 5 animals in subgroup, inverting swim, lunging, porpoising, still surface active swim, birds swoop down with dolphin come to surface	BW
SOCAL_2010Sept_27_SES_Video_105235-105354_ID16_Risso's	9/27/2010	10:52:35	10:53:54	0:01:19	16	Risso's Dolphin	30	oriented 220, spacing 1-18, one animal is 30 body lengths, another animal 60 body lengths, 17 animals, slow travel,	BW

Video Name	Date	Start Time	End Time	Total Video (hr:min:sec)	Daily Sighting ID	Species	Approx. Group Size	Video Notes	Taken By
SOCAL_2010Sept_27_SES_Video_105413-110843_ID16_Risso's	9/27/2010	10:54:13	11:08:43	0:14:30	16	Risso's Dolphin	30	spacing is 1-15, group really spread out, few animals 100 body lengths away, slow travel, foraging, bird flying by, 2 subgroups, 19 individuals, oriented at 220, line abreast formation, slow travel, 3 animals tightly grouped, in group spacing 1-2, otherwise 15-100 body lengths apart, animals not changing behavior, animals seem to be all coming together, animals turned to the west, spacing 1-3, slow travel, possible calf	BW
SOCAL_2010Sept_27_SES_Video_122343-124044_ID36_Risso's	9/27/2010	12:23:43	12:40:44	0:17:01	36	Risso's Dolphin	8	group of 2 trailing, with a group of 6-7 in the front, orientation 330, spacing 1-8, below surface, very tight in the front group, slow travel, 8 body lengths, orienting towards each other, spacing 1-4, oriented at 230, one animal in lead 100 body lengths away, logging, line abreast at surface, slow travel, spacing 1-7, most of group headed towards 230, resting at surface, spacing 1-1 in subgroup	BW

Video Name	Date	Start Time	End Time	Total Video (hr:min:sec)	Daily Sighting ID	Species	Approx. Group Size	Video Notes	Taken By
SOCAL_2010Sept_27_SES_Video_150429-151406_ID61_CommonDolphinSp.	9/27/2010	15:04:29	15:14:06	0:09:37	61	Common Dolphin sp.	135	birds on water, 1000 ft., foraging, dispersal within subgroup is 1-2, dolphin going in 2's and 3's chasing the birds, inverted swim, lunge and then dive	BW
SOCAL_2010Sept_27_SES_Video_153115-155635_ID65_CommonDolphinSp.	9/27/2010	15:31:15	15:56:35	0:25:20	65	Common Dolphin sp.	70	inverted swim, lunging, huge group of dolphin, roughly 1200 individuals, surface active travel, v shaped formation, orientation 350, fast travel, 1-2 spacing, boat 40 vessel lengths behind dolphins, group in front has 20 dolphins, oriented at 350, fast travel, spacing 1-2 for group in front, oblong formation, wider than long	BW
SOCAL_2010Sept_28_SES_Video_125907-130846_ID12_CommonDolphinSp.	9/28/2010	12:59:07	13:08:46	0:09:39	12	Common Dolphin sp.	400	bird association, two animals lunging together, spacing 1-2, 4-5 subgroups, milling with birds, 3 animals inverted lunge, multiple splashes, swimming inverted, competing for food, spacing 1-3, 2 inverted, one lunge turn, birds on water, split into 2 subgroups	BW

Video Name	Date	Start Time	End Time	Total Video (hr:min:sec)	Daily Sighting ID	Species	Approx. Group Size	Video Notes	Taken By
SOCAL_2010Sept_28_SES_Video_132405-134500_ID15_Risso's	9/28/2010	13:24:05	13:45:00	0:20:55	15	Risso's Dolphin	25	blow, blow, one animal, blow, heading is 7 o'clock, sub-surface, blow, traveling, heading towards 5 0'clock, slow travel below surface	BW

Appendix E. Photo Log

Table E-1. 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
27-Jul	1	Blue whale	4	5	196	142	14:09	15:06
27-Jul	2	Bottlenose dolphin	50	98	133	36	14:16	14:21
27-Jul	3	Fin whale	1	174	187	14	14:46	14:49
27-Jul	4	Common dolphin sp.	400	204	220	17	15:32	15:33
28-Jul	2	Blue whale	6	2	190	190	13:47	14:28
28-Jul	8	Common dolphin sp.	400	194	228	25	14:56	15:01
28-Jul	13	Blue/Fin whale	5/3	231	306	76	15:46	15:55
29-Jul	1	Blue whale	2	314	404	91	14:49	15:39
29-Jul	7	Blue whale	3	405	461	57	16:24	16:29
31-Jul	2	Common dolphin sp.	100	545	563	19	15:04	15:04
31-Jul	3	Blue whale	6	567	761	195	15:05	15:31
31-Jul	5	Common dolphin sp.	200	765	798	34	15:52	15:54
31-Jul	7	Common dolphin sp.	60	801	868	68	16:10	16:14
31-Jul	9	Unidentified dolphin	25	873	888	15	16:24	16:29
31-Jul	14	Common dolphin sp.	120	889	940	52	16:48	16:51
31-Jul	17	Common dolphin sp.	15	943	952	10	17:24	17:26
31-Jul	19	Common dolphin sp.	125	955	1003	49	17:34	17:36
31-Jul	22	Blue whale	1	1006	1321	310	17:53	18:13
2-Aug	2	Blue whale	2	1324	1347	24	16:57	16:59
2-Aug	8	Blue whale	2	1355	1434	80	17:57	18:27
2-Aug	10	Common dolphin sp.	55	1437	1454	18	18:50	18:50
2-Aug	11	Common dolphin sp.	125	1457	1508	52	18:53	18:55
2-Aug	12	Blue whale	2	1511	1826	302	18:56	17:28
3-Aug	7	Common dolphin sp.	1000	1657	1734	78	15:46	15:48
3-Aug	8	Common dolphin sp.		1736	1798	63	15:52	15:53
3-Aug	11	Common dolphin sp.	100	1800	1833	34	15:58	15:58
3-Aug	12	Common dolphin sp.		1835	1900	66	15:59	16:08
3-Aug	20	Common dolphin sp.	300	1902	1976	75	16:24	16:26
3-Aug	29	Common dolphin sp.	140	2003	2042	40	17:04	17:05
3-Aug	36	Common dolphin sp.	7	2044	2069	26	17:14	17:16
3-Aug	40	Blue whale	1	2076	2078	3	17:33	17:34
3-Aug	41	Blue whale	2	2080	2107	28	17:34	17:34
3-Aug	39	Common dolphin sp.	120	2109	2123	15	17:39	17:41
3-Aug	41	Blue whale	2	2125	2170	46	17:42	17:43
3-Aug	39	Common dolphin sp.	120	2171	2189	19	17:44	17:47
3-Aug	41	Blue whale	2	2190	2228	39	17:48	17:51
3-Aug	41	Blue whale	2	2230	2249	20	17:54	17:54
3-Aug	41	Blue whale	2	2251	2262	12	17:55	17:56

Table E-2. List of Photos taken during the 23 - 28 September 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
23-Sep	1	Common dolphin sp.	25	1	34	34	15:14	15:16
23-Sep	2	Common dolphin sp.	6	37	63	27	15:32	15:33
23-Sep	3	Unidentified marine mammal	1	67	111	45	15:55	15:57
23-Sep	4	Common dolphin sp.	15	114	144	31	16:09	16:10
23-Sep	6	Common dolphin sp.	60	147	211	65	16:17	16:19
24-Sep	7	Common dolphin sp.	700	1796	1811	16	12:30	12:32
24-Sep	23	Unidentified marine mammal	1	1812	1818	7	12:56	12:57
24-Sep	46	Bryde's whale	1	1819	1829	5	13:44	13:44
24-Sep	55	Common dolphin sp.	250	1832	1845	12	14:18	14:21
24-Sep	56	Unidentified dolphin	1	1849	1856	5	14:24	14:28
24-Sep	69-72	Common dolphin sp.	530	1857	1872	12	16:17	16:59
24-Sep	73	Common dolphin sp.	40	1871	1882	11	16:59	17:05
24-Sep	75	Common dolphin sp.	300	1884	1889	6	17:10	17:13
24-Sep	77	Common dolphin sp.	9	1890	1895	6	17:16	17:16
25-Sep	7	Common dolphin sp.	1100	1917	1920	4	11:08	11:12
25-Sep	8	Common dolphin sp.	400	54	60	6	11:09	11:11
25-Sep	11	Common dolphin sp.	100	1921	1929	9	11:41	11:43
25-Sep	11	Common dolphin sp.	100	61	64	4	11:41	11:43
25-Sep	12	Common dolphin sp.	400	1930	1932	3	11:48	11:49
25-Sep	13	Northern elephant seal	11	65	72	8	11:56	11:58
25-Sep	15	California sea lion	35	1938	1943	6	12:18	12:20
25-Sep	18	Common dolphin sp.	1600	78	87	10	12:43	12:44
25-Sep	19	Common dolphin sp.	150	89	92	4	12:53	12:53
25-Sep	19	Common dolphin sp.	150	1944	1955	12	12:54	12:58
25-Sep	21	Unidentified dolphin	50	1956	1966	11	13:03	13:06
25-Sep	23	Common dolphin sp.	75	1968	1972	5	13:23	13:25
25-Sep	24	Common dolphin sp.	200	94	98	5	13:24	13:24
26-Sep	15	Common dolphin sp.	1000	1987	2015	29	13:14	13:40
26-Sep	28	Common dolphin sp.	450	2021	2038	18	16:03	16:10
27-Sep	16	Risso's dolphin	5	1	6	6	10:50	11:56
27-Sep	29	Minke whale	1	7	19	13	11:56	11:57
27-Sep	58	Common dolphin sp.	275	28	34	7	14:58	15:00
27-Sep	64	Common dolphin sp.	1299	36	46	11	15:29	15:30
28-Sep	3	Common dolphin sp.	600	11	66	56	9:25	9:29
28-Sep	5	Sei/Bryde’s whale	3	68	126	59	9:56	9:58
28-Sep	12	Common dolphin sp.	400	130	210	71	13:10	13:12
28-Sep	23	Bottlenose dolphin	18	215	246	31	14:23	14:30

Appendix F. Photos

Aerial photographs of cetaceans using a telephoto lens from the aircraft during the July and September 2010 SOCAL aerial survey monitoring effort off San Diego, California, under NMFS Permit 15369.

Photo 1. Blue whale photographed 2 August 2010 by M.A. Smultea under NMFS Permit 15369.

Photo 2: Sei/Bryde's whales photographed 28 September 2010 by B. Würsig under NMFS Permit 15369.

Photo 3: Bryde's whale photographed 24 September 2010 by B. Würsig under NMFS Permit 15369.

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AERIAL SURVEYS CONDUCTED IN THE SOCAL OPAREA FROM 01 AUGUST 2010 TO 31 JULY 2011

Prepared for
Commander, Pacific Fleet, Pearl Harbor, Hawaii

Submitted to
Naval Facilities Engineering Command Southwest (NAVFAC SW), EV5 Environmental Planning, San Diego, CA, 92132

***Contract #* N62470-10-D-3011**

Prepared by

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HDR Inc.
San Diego, California

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Cover Photo: Blue whale (*Balaenoptera musculus*), photographed with a telephoto lens from the Partenavia fixed-wing aircraft during a winter 2011 SOCAL aerial monitoring survey. Photo by B. Würsig under NMFS permit 14451.

INTRODUCTION

This report summarizes all five aerial surveys conducted between 31 August 2010 and 31 July 2011 on the Navy's Southern California Range Complex (SOCAL) to monitor marine mammals in conjunction with or separate from Major Training Exercises (MTEs), as described in the Scopes of Work (SOW). The overall goal per the SOW was to complete approximately 169 hours of aerial survey effort during the fall and winter, weather permitting, which was as behaviorally focused as possible (previous monitoring surveys since 2008 have occurred in spring, summer, and fall). In particular, the SOW for the May aerial survey provided additional funding to conduct preliminary summary analyses of behavioral data. Behavioral data provide baseline information to assess potential changes in behavior (or lack thereof) relative to various received sound levels from mid-frequency active sonar and other MTE activities. Collection of baseline behavioral data is a goal identified in the Navy's SOCAL Marine Species Monitoring Plan (SMSMP) (DoN 2009).

Three surveys were scheduled to occur before, during, and/or after MTEs, while the remaining two surveys were specifically scheduled when no MTEs were occurring: the September 2010 survey occurred during and after MTEs; the February 2011 survey occurred before, during, and, after MTEs; the March and April 2011 surveys did not overlap with any MTEs; and the May 2011 survey occurred during an MTE. The March and April scheduling facilitated (1) more frequent access to the Southern California Anti-Submarine Warfare Range (SOAR), which is limited during MTEs, and (2) collection of baseline data on the cool-water period and behavior of marine mammals on the SOCAL Range.

Surveys occurred in the Northern Air Operating Area (NAOPA) and SOAR. In April and May, systematic survey lines were flown for the first time near Silver Strand and in San Diego Bay, just south of Point Loma.

Methods

Methods generally followed protocols implemented during aerial survey monitoring efforts conducted in SOCAL during seven previous surveys (e.g., Smultea & Lomac-MacNair 2010; Smultea et al. 2011a,b,c,d). Effort was divided into "on effort" (at least one observer searching for animals) and "off effort" (no observers searching; e.g., while flying over land, or while clouds obscured viewing). On effort was further divided into line-transect, connectors (i.e., short lines connecting systematic transect lines), transit, random, and circling modes (either focal follow or "identify" modes) (see Smultea et al. 2009a,b and Smultea & Lomac-MacNair 2010 for full definitions). The primary exceptions to past survey protocols are as follows.

1. Search effort was focused in areas where priority species (blue, fin, and beaked whales) were expected to occur (based on results of previous surveys) to maximize time conducting focal behavioral follows. Such areas included steep underwater drop-offs/ridges (particularly just west of San Clemente Island and about 40 kilometers [km] (22 nautical miles [nm]) west of San Diego), and an approximately 100-square-km (km2) area about 5 to 10 km (3 to 5.5 nm) offshore of San Diego where blue and fin whales have tended to concentrate.

2. The September 2010 survey was conducted on behalf of the Navy by Smultea Environmental Sciences (SES) under contract to Scripps' Institute of Oceanography. The remaining four surveys were conducted by HDR, Inc.
3. In September 2010, one pilot and three biologists (two observers and one recorder) flew the survey; the recorder sat in the co-pilot seat and took photos and video through the only opening port in a window in the Partenavia. This opening was a flip-up circular window approximately 10 cm (4 inches) in diameter at the right front seat. During the four subsequent 2011 surveys two pilots flew the plane as required under the indefinite delivery/indefinite quantity (IDIQ) contract to HDR; thus, the two observers sat in the middle seats and the recorder sat in the rear seat.
4. The September 2010 aerial survey was flown from a high-wing, fixed-wing, twin-engine Partenavia P68-OBS Observer airplane (tail number N6602L) with a glass nose. The February, March, and May surveys were flown from a Partenavia P68-C airplane model that did not have a glass nose. In April, a high-wing fixed-wing, twin-engine Twin Commander 685 aircraft was used for the first time to conduct aerial survey monitoring under the SMSMP. The aircraft holds up to eight observers; however, only two pilots and three observers/recorders sat in the plane for the survey (the recorder sat in the rear bench seat).
5. The Twin Commander model used had only one approximately 13-by-13 centimeter (5-by-5-inch) port opening in the left front pilot's window. Therefore, the professional observers could only take photographs and video through closed, double-paned Plexiglas windows. These windows distorted images and decreased the resolution such that photographs and video could not be used to differentiate some species, particularly long-beaked vs. short-beaked common dolphins. The degraded quality of photographs through the closed windows where the observers sat necessitated that the pilot sitting in the left front seat, who was not an experienced photographer, take species identification photos (the other pilot flew the plane when this occurred). The latter photos were of limited utility.
6. Video taken through the Twin Commander's closed windows could be used to track gross behaviors and relative positions of whales and, to some extent, Risso's dolphins due to their light body coloration. However, such video was not useful for tracking behavior of small dolphins or for tracking detailed behaviors such as social/touching interactions.
7. The Twin Commander did not have bubble windows. Its small flat windows curtailed the ability to see directly under the plane (maximum declination angle around 60 degrees vs. 90 degrees with the bubble window). The ability to see directly under the plane is an important assumption in line-transect theory.
8. The Twin Commander had a longer range than the Partenavia: the maximum length of each flight was about 6 hours vs. 3.5 hours in the Partenavia.
9. Line-transect surveys in the Twin Commander were flown at 120 to 125 knots (kts) (it could not safely fly any slower) vs. approximately 100 kts in the Partenavia. Circling was also conducted at 120 to125 kts vs. 85 to 90 kts in the Partenavia. The faster circling speed of the Twin Commander made it more difficult to keep sightings in view while photographing and videotaping vs. the slower-circling Partenavia.
10. The marine species observers' windows were smaller in the Twin Commander than the Partenavia. Thus, it was difficult for the designated focal-behavior observer to see and call

behaviors because the video recorder blocked the view through one window, and the view was blocked by the cowling in the rear windows. In contrast, in the Partenavia, the recorder sat in the rear bench seat where the only opening window was located; the focal observer sat in the center seat with a different window on the same side of the plane, but in front of the video recorder, and looked through a large bubble window.

11. In April and May, systematic survey lines were flown for the first time near Silver Strand. The eight transect lines extended 40 km (22 nm) west of Silver Strand and also included portions of San Diego Bay. The bay was surveyed to search for sea turtles. Transect lines were spaced 1.9 km (1 nm) apart during marginal weather conditions and 3.7 km (2 nm) apart at other times, to maximize the ability to see marine mammals.
12. In February and March, bubble windows at the center seats of the Partenavia were replaced with flat Plexiglas with an approximate 15-by-20-cm (6-by-8-inch) opening "flap" window suitable to allow photography and video without the distortion created by Plexiglas bubble windows. This occurred because, for the first time during the SOCAL surveys, two pilots were required per the Navy IDIQ awarded in 2010 to HDR, Inc. As a consequence:
    a. One marine species observer (MSO) could no longer sit in the co-pilot seat and take photos through a small opening port in the front, right, flat window. Due to structural limitations, an opening port could not be constructed within the bubble window to allow undistorted photography/video. Consequently, the flat window with an opening port was installed. A limitation of this approach was that the engine cowling obstructed the MSO's view during sharply banked turns, resulting in missed video and photo opportunities. This had not been an issue from the front co-pilot seat during previous surveys.
    b. The flat window curtailed the ability to see directly under the plane (maximum declination angle 63 degrees vs. 90 degrees with the bubble window). The ability to see directly under the plane is an important assumption in line-transect theory.
13. In May, the port-opening window of the Partenavia was placed in the left rear window and the bubble windows were replaced in the center seats. This proved to be a better position from which to take photos and video, as the cowling was less of a visual obstruction. However, exhaust fumes occasionally blurred the view.
14. Instead of a small, digital, hand-held voice recorder connected to a spare audio jack in the aircraft, a voice-activated, mini-microphone was taped into the headphone of one observer to record all audio on the plane. The previous recording method resulted in frequent noise interference from the aircraft despite the use of impedance cables, rendering recordings indiscernible on some occasions. The new method appeared to work better. However, when the mini-microphone was placed inside the headphone of the photographer, wind noise from the port window opened for photography/video interfered with the ability to hear the recorded audio. Recordings improved when placed inside the headphone of a non-photographer/videographer who did not open a nearby window; this much-reduced the wind noise interference.
15. In September, February, March, and April, a small PC laptop Acer computer was used to collect sighting, effort, and behavioral data with a custom-designed Excel spreadsheet with newly implemented "hot buttons" that automatically time-stamped entries. Ease of

data entry is critical due to the speed and volume of data streaming in and being recorded during the high-density SOCAL surveys. This format has been refined and tested over multiple surveys.

16. In April and May, the Mysticetus Observation Platform software, created by Entiat River Technologies, was Beta-tested during aerial surveys, at no expense, in order to provide feedback on software improvement. This program proved to be the "best fit" of any previously used aerial software based on the following features:
    a. Mysticetus provided real-time distance and bearing to a sighting by synthesizing real-time Global Positioning System (GPS) data with the declination angles (converted to distance) and times of sightings. This feature was critical in helping the pilots to relocate sightings quickly, even in higher Beaufort conditions when sightings are typically challenging to re-find. Relative location of the sighting to the aircraft was continuously displayed on the laptop screen, and adapted to changing distances and headings of the aircraft. The recorder communicated to the pilots how to adjust the flight pattern to relocate the sighting.
    b. Field data entries were expedited by alias lists (e.g., auto-fill features) and other shortcuts. This improved the ability to collect data in high-volume observation conditions.
    c. Post-survey analysis tools, including automated on-effort survey reports (e.g., total hours and kilometers of effort by date, total sightings by species, etc.), and Google Earth 3-D track display, were beta-tested for the potential to reduce data post-processing requirements. However, because both previous software and Mysticetus were used on different days due to the beta-testing process, this feature could not be universally applied to the data.
    d. Previously, the GPS data have been collected separately and subsequently merged with field data via Excel. This step is not necessary with Mysticetus, which merges GPS data in real-time with sightings, behavior, and environmental data. However, both processes were used during the survey due to the beta-testing phase (see paragraph above).
17. Ocean sunfish (*Mola mola*) counts and declination angles started being recorded during the March survey. The first counts were recorded on 1 April 2011, which was the last day of the March survey. This was done in response to communications with Navy personnel indicating that there was a desire to collect information on other large marine species observable from the aircraft. Ocean sunfish sightings are not included in the overall sighting counts for marine mammals reported under the Results section.
18. Guardian mobility satellite tracking— a satellite tracking device for Aspen Helicopters for tracking the airplane was used while the airplane was in the air. We had a team member on shore following our tracklines on the internet (e.g., when we had staff working onshore while we flew); Aspen Helicopters office staff also tracked the plane while it was flying.

Results

The following subsections briefly summarize results for the five aerial surveys conducted in September 2010 and February, March, April, and May 2011. Detailed summaries for each survey are presented in tables and figures (maps) in separate appendices as follows: Photos (**Appendix A**), Figures (**Appendix B**), and Tables (**Appendix C**).

23 September to 28 September. The September aerial survey was flown from a glass-nosed, fixed-wing, twin-engine Partenavia P68-OBS Observer airplane (tail identification number N6602L, www.aspenhelicopters.com). Effort occurred on all 6 scheduled survey days: 4 days in SOAR and 2 days in NAOPA. A total of 19.2 hours of flight time and 3918 km (2116 nm) of effort occurred between aircraft "wheels up" off the ground to "wheels down" when the plane landed (**Appendix C**). Observers were on-effort observing for about 96 percent of this time, with the remaining approximately 4 percent flown over land (**Appendix C**) (see Smultea & Lomac-MacNair 2010 for detailed protocol and definitions).

A total of 252 sightings of approximately 38,022 individual marine mammals comprising at least nine species were made on the 6 survey days in September (**Table 1**). The most frequently sighted species was the common dolphin (50% of all groups, 90% of all individuals), followed by the California sea lion (34% or 72 groups). The latter was a higher number of pinniped sightings than were made during any of the previous SOCAL aerial surveys conducted under the Navy's marine mammal monitoring (see Smultea et al. 2009a,b, Smultea and Lomac-MacNair 2010, Smultea et al. 2010). Two species only seen once during previous aerial monitoring surveys were observed: the Bryde's whale (one sighting) and Cuvier's beaked whale (one sighting). Two species previously never or rarely seen during the SMSMP aerial surveys were observed: the sei/Bryde's whale (one sighting) and northern elephant seal (three sightings). All four of the latter sightings were photo-documented, except the Cuvier's beaked whale.

Sixteen focal behavioral follows occurred, each of at least 5 minutes duration: nine of common dolphins, three of Risso's dolphins, one of a minke whale, one of sei/Bryde's whale, one of California sea lions, and one of an unidentified baleen whale. A detailed focal session (including photographs) of three sei/Bryde's whales occurred September 28 at 9:41 a.m. for about 43 minutes (**Table 2**). On 28 September, as we circled bottlenose dolphins near Santa Catalina Island, a tight group of California sea lions resting at the surface appeared to potentially react by changing their behavior during the third circling when the plane passed near them at about 70 degrees (379 meters). Some individuals made abrupt steep dives that created splashes.

14 February to 19 February. The February aerial survey was flown from a fixed-wing, twin-engine Partenavia P68-C (tail identification number N300LF, www.aspenhelicopters.com). This same model was used during past SOCAL aerial monitoring (e.g., Smultea et al. 2010). Effort occurred on 5 of the 6 scheduled survey days (**Appendix C**). No flight occurred on 19 February due to poor weather. Effort occurred in SOAR on 1 day, NAOPA on 4 days, and Silver Strand on 1 day. A total of 18 hours or 3,213 km (1,735 nm) of flight time from "wheels up" to "wheels down" was flown (**Appendix C**). Observers were on-effort observing for about 93 percent of this time, with the remaining approximately 7 percent flown over land or during poor weather (**Appendix C**).

A total of 83 sightings of approximately 11,131 individual marine mammals comprising at least nine species were made on the 5 February survey days (**Table 1**). The most frequently sighted species was the common dolphin (37% of all groups, 84% of all individuals), followed by the California sea lion (16% or 13 groups). Two species not seen during previous aerial monitoring surveys were observed: the eastern Pacific gray whale (five sightings) and Dall's porpoise (one sighting). No photos were available for the Dall's porpoises due to the poor sea state, though two observers each saw them twice.

Eight focal behavioral follows, each of at least 5 minutes duration, occurred: three of Risso's dolphins, two of gray whales, two of common dolphin sp. and one of a fin whale. One of the Risso's dolphin sessions included systematic circling to assess behavior relative to various aircraft altitudes, as done on numerous other SOCAL surveys (SES, unpublished data). A detailed focal session of a gray whale mother with a very young (estimated age less than several days old) calf occurred February 15 at 8:45 a.m. for about 30 minutes (**Table 2**). Both photos and video recorded the session. Individual data on respiration and behavioral events and states were collected for this pair as they traveled slowly south during a Beaufort 1-2 off Point Loma. The calf appeared to be "riding" the mother with occasional nursing bouts. See **Table 2** and **Appendix D** for further details on this sighting. No apparently unusual behaviors were noted for any species.

29 March to 3 April. The March aerial survey was also flown from the Partenavia P68-C, N300LF. Effort occurred on 3 of the 6 scheduled survey days: 30 and 31 March and 1 April; no flights occurred on 29 March or 2-3 April due to plane maintenance issues (**Appendix C**). Effort occurred in SOAR on one day and in NAOPA on two days. A total of 9.5 hours or 1,865 km (1,007 nm) of flight time from "wheels up" to "wheels down" was flown (**Appendix C**). Observers were on effort for about 95 percent of this time; the remaining 5 percent of time was spent flying over land or during poor weather (**Appendix C**).

A total of 71 sightings of approximately 2,165 individual marine mammals comprising at least 10 species were made on the 3 March survey days (**Table 1**). As in February, the common dolphin was the most frequently sighted species (27% of all groups, 62% of all individuals). The second most frequently seen species was the Risso's dolphin (21% or 15 groups). Two species not seen during the February 2011 survey were observed: the northern right whale dolphin (four sightings) and humpback whale (one sighting). Fin whales and Dall's porpoises were absent during this survey, but were seen during February 2011. Two sightings of ocean sunfish were made during the March survey; these sightings are not included in the overall sighting counts for marine mammals.

Fourteen focal behavioral follows of at least 5 minutes each occurred: five with Risso's dolphins, four with common dolphins, two with northern right whale dolphins, two with single minke whales, and one with a gray whale mother-calf pair. One of the Risso's dolphin sessions included systematic circling to assess behavior relative to various aircraft altitudes (SES, unpublished data). During this detailed focal session, potential reaction behaviors (clumping and going below the surface) were seen and might have been associated with an approximate 50 ft vessel passing within about 720 m (2,500 ft) of the Risso's group. A minke whale and 15 common dolphins were seen during the middle of this focal session.

On 1 April, Risso's dolphins were seen in close association with northern right whale dolphins on SOAR in Beaufort sea state 2 (**Appendix B**). Video and photographs were taken. This species association had not been previously observed during other SOCAL monitoring surveys. The Risso's dolphins appeared to be foraging. They were spread out with large inter-individual dispersal distances, with occasional "sprinting" that created white water, followed by a sudden dive, presumably to chase prey. The northern right whale dolphins were intermingled with the Risso's dolphins on several occasions.

12 April to 20 April. The April survey was flown using the Twin Commander 685, N9199N aircraft. Effort occurred on all nine of the scheduled survey days (**Appendix C**). Effort occurred in SOAR on two days, NAOPA on six days and in Silver Strand on two days. A total of 46.1 hours or 10,893 km (5,882 nm) of flight effort from "wheels up" to "wheels down" was flown (**Appendix C**). About 9.3 hours or 2,363 km (1276 nm) of this effort occurred in Silver Strand, and 0.4 hour or 102 km (55 nm) occurred within San Diego Bay. Observers were on watch for about 95 percent of the total 44.2 hours of flight effort, with the remaining 5 percent flown over land, or during poor weather (**Appendix C**). The weather was poor (marine fog layer) 18–20 April, which delayed our ability to do focal sessions (**Appendix C**).

A total of 136 sightings of approximately 14,130 individual marine mammals comprising at least 12 species was made over the 9 survey days (this includes Silver Strand—see next paragraph) (**Table 1**). Again, the most frequently sighted species was the common dolphin (33% of all groups, 86% of all individuals) followed by the Risso's dolphin (21% or 28 groups). A total of 44 sightings of ocean sunfish occurred during the April survey. These sightings are not included in the overall sighting counts for marine mammals.

Of the total 136 sightings, 21 sightings of approximately 2,177 individual marine mammals were seen within the Silver Strand survey area (**Appendix C**). Most sightings were seen more than 16 km (10 nm) offshore from Silver Strand. The latter total included eight common dolphin groups; three blue whales; three unidentified dolphin groups; two bottlenose dolphin groups; and one sighting each of Risso's dolphins fin, and humpback whales. **Appendix C** includes all April sightings in Silver Strand and provides their GPS locations.

Fifteen focal behavioral follows of at least 5 minutes each occurred: six with Risso's dolphins, four with fin whales, two with common dolphins, one with a gray whale mother-calf pair, one with Dall's porpoise, and one with a blue whale. Dall's porpoises were circled by the aircraft on 13 April at 3:23 p.m. for about 17 minutes. The three small porpoises exhibited the unique "rooster tailing" of this species during fast travel. A detailed focal session on a gray whale mother with a calf occurred April at 12:55 p.m. for about 15 minutes; video was taken of this pair. Individual respiration data and behavioral events and states were collected for the pair as they traveled slowly south during a Beaufort 2. The calf interacted with the mother and swam on top of her. The calf appeared to nurse on several occasions based on its position relative to the mother's peduncle area as it remained stationary at an angular position below the mother. The calf moved under the mother's tail flukes from one side to the other in an apparent effort to return to a nursing position on the opposite side of the mother. See **Table 2** and **Appendix D** for detailed information about this sighting.

9 May to 14 May. The May survey was flown from the same Partenavia P68-C (N300LF) airplane as the February and March surveys (**Appendix C**). Effort occurred on all 6 of the scheduled survey days: 1 day at SOAR and Silver Strand, 4 days at NAOPA, and 1 day at Silver Strand and NAOPA (**Appendix C**). A total of 27 hours or 4,896 km (2,642 nm) of flight time from "wheels up" to "wheels down" was flown (**Appendix C**). Observers were on-effort observing for about 94 percent of this time, with the remaining 6 percent spent flying over land or during poor weather (**Appendix C**).

A total of 81 sightings of approximately 3,309 individual marine mammals comprising at least 11 species were made over the 6 survey days (**Table 1**). Unlike previous surveys, three species were similar in terms of proportion and number of sightings: the common dolphin (16% or 13 groups), California sea lion (16 percent or 13 groups), and blue whale (15% or 12 groups) (**Table 3**). Again, by far the most frequently sighted species in terms of individuals was the common dolphin (73% of all individuals). However, there were twice as many individual fin whales seen (n = 30) than blue whales (n = 15) (**Table 3**). Three blue whales were consistently seen feeding about 19 km (10 nm) off San Diego. No gray whale or Dall's porpoise sightings were identified, in contrast to prior 2011 surveys. A dead humpback whale was seen on May 10 and 11 (**Table 2**); these two sightings were presumed to be the same animal based on examination of photos of the underside of the tail flukes. A blue shark (*Prionace glauca*) about 3 meters (9.8 feet) long was seen circling the dead whale on 11 May. On 10 May, the whale was seen about 7 km (4 nm) west of Soledad, San Diego, and no sharks were seen. During May, efforts were concentrated along underwater ridges where anticipated concentrations of species were to occur, especially fin whale and Risso's dolphin. On 9 May, a 10-meter (33-foot) whale shark was seen while circling a blue whale (33.255 N, 117.548 W).

For the first time since SOCAL aerial monitoring surveys began in fall 2008, sperm whales were seen (a group of 20 including 4 calves). They were associated with both Risso's and northern right whale dolphins. The sighting occurred on 14 May approximately 44 km (24 nm) west of San Diego near the edge of an underwater ridge (**Table 2**). A total of 14 sightings of ocean sunfish was made during the May survey.

Eighteen focal behavioral follows occurred of at least 5 minutes each: six with fin whales; five with Risso's dolphins; four with blue whales; and one each with sperm whales, Risso's dolphins, and northern right whale dolphins (the latter three in the same multi-species association). On 14 May at 10:36 a.m., a detailed focal session on 20 sperm whales (including 4 calves), northern right whale dolphins, and Risso's dolphins occurred (**Table 2**). Videos and photos were taken during the 67-minute focal session. One sperm whale calf was seen very close to the mother while Risso's dolphins were seen swimming with and harassing the sperm whale nursery group.

On numerous occasions, sperm whales were seen opening their mouths and dropping their lower jaws, only when a Risso's dolphin swam close by (**Appendices A** and **B**).

MAY 2011 AERIAL SURVEY BEHAVIORAL ANALYSIS

This report presents the summary analyses and descriptive statistics conducted for the May 9-14, 2011 SOCAL aerial survey. The SOW for the May survey was the only one of 12 aerial surveys conducted in SOCAL since 2008 that directed and funded summary analyses of behavioral data within the survey SOW. Summary statistics were performed for variables identified as potential quantitative indicators of stress or changes in behavior relative to stimuli, based on previous studies of different or similar species (e.g., summarized in Richardson et al. 1985a,b, 1995; also see Würsig et al. 1985, 1986, 1989; Vaughn et al. 2010). Variables were identified and summarized in Smultea et al. (2009a,b; **Appendix B** of the monitoring report). These included (1) minimum and maximum dispersal distance between nearest individuals within a subgroup (see Smultea et al. 2011 for behavioral ethogram); (2) behavior state; (3) heading; (4) behavioral event frequencies; and (5) respiration, dive, and surface-duration rates as applicable. Per the SOW and HDR Work Plan, behavioral data were summarized as done in previous SOCAL aerial survey reports from 2008-2010 (e.g., Smultea et al. 2009a, b, Smultea and Lomac-MacNair 2010, Smultea et al. 2010).

Behavioral data were analyzed and summarized in the following formats: (1) a tabular list of focal groups and associated descriptors (**Appendix C, Table 16**); (2) an inventory list of video names, times, durations, subjects, and a brief content summary (**Appendix C, Table 14**); (3) a detailed transcription and integration of the times and behaviors recorded on video, and audio collected simultaneously with video, into a formatted Excel spreadsheet (unpublished data provided as a separate deliverable to the Navy); and (4) summary statistical analyses of selected variables identified above. Associated video data summary formats and protocols followed those developed and provided to the Navy by SES in spring 2011 (SES, unpublished data; Smultea et al., in prep.).

It is important to note that behavioral analyses conducted herein were limited to only one (May 2011) of the total 12 aerial surveys conducted in SOCAL from October 2008-May 2011 based on available funding. Thus, the largest sample size for any one species is too small to represent statistically meaningful analyses and interpretation. However, the SOW indicated that power analyses were desired for sighting rates calculated from the May 2011 aerial survey data. Power analyses are commonly used to estimate the minimum sample size needed to be reasonably likely to detect an effect within a given probability level, or to estimate the minimum effect size likely to be detected in a study based on a known sample size (e.g., at probability 0.05 or 0.01, etc.). A power analysis (or sensitivity test) is used to assess the probability that a statistical test will reject the null hypothesis when the null hypothesis is false (i.e., a Type II error). With increasing power/ sensitivity (generally but not always associated with a greater sample size), the probability of committing a Type II error (i.e., a false negative) decreases. The degree of sampling error in a data set is related to the sample size, i.e., the larger the sample the less potential for error in the resulting trends. Thus, general statistical principles recommend that the largest available database be used to conduct power analyses (Cohen 1988, Aberson 2010). A more robust behavioral analysis has recently been conducted by Smultea Environmental Sciences (SES) using much larger sample sizes collected during 8 of the total 12 SOCAL aerial surveys (see **Appendix B** of monitoring report). To provide more meaningful power analyses, utilization of data from the 12 surveys is recommended, to avoid the likelihood of analyzing a potentially misleading smaller database from only the May 2011 survey.

Similarly, conducting power analyses from the sighting rate (number of sightings per 1000 km of observation effort) estimated from only the May 2011 aerial survey is considered suboptimal.

Rather, abundance and density estimates conducted using DISTANCE software is the standard approach for addressing “sighting rates” (T. Jefferson, pers. comm.). Again, more reliable and robust sighting rates have been estimated using the latter approach based on eight SOCAL aerial surveys conducted in 2008-2010 (see **Appendix B** of monitoring report). Thus, given the small species sample sizes collected only during the May 2011 aerial survey, power analyses have not been conducted for these data based on resulting summary analyses and examination of the survey results. Again, this was to avoid the potential for misleading extrapolation and interpretation of data from only one survey, particularly given that data are now available from 12 SOCAL aerial surveys from 2008-2011. Upon discussion with Navy NTRs, DISTANCE analyses are planned to be conducted in the near future based on data from all 12 surveys. This analysis will provide a more reliable and appropriate sample size as recommended for power analysis statistics.

Methods

Data collection protocol, equipment, locations and time periods were already summarized in the May 2011 field summary report (Smultea and Bacon 2011) and are thus not discussed herein.

Two types of behavior analyses were conducted. The first involved the first observed behavioral variables recorded for all sightings using modified scan sampling. This total included all sightings whether or not they were circled for photographs or focal follows. This analysis is the same type conducted in previous SOCAL aerial survey reports (e.g., Smultea et al. 2009a,b, 2010a,b, 2011), as requested per the SOW. The second approach was limited to focal follows which consisted of extended observations from the aircraft while it circled overhead outside Snell’s sound cone radius. Video was usually taken during focal sessions. See Smultea and Bacon (2011, **Appendix B** of monitoring report) for summaries of video and focals for the May 2011 aerial survey.

Results

Sighting Rates. Sighting rates (number of sightings per units of effort) of marine mammals during the May 2011 SOCAL aerial survey were estimated using a total of 49 sightings of 9 confirmed species (**Table 1**). Effort used to estimate sighting rates was limited to on-effort observations made during Beaufort sea state conditions of four or less during systematic, connector, random, and transit effort leg types (defined in Smultea and Bacon 2011). The latter effort totaled 2024 km or 10.7 hours. Note that this total effort does not meet the criteria of line-transect methodology, which requires more conservative filtering (e.g., consistent altitude and speed, effort during pre-determined survey lines meeting certain conditions and assumption, etc.). We included the less-conservative aforementioned effort and conditions in order to maximize sample size given the relatively small amount of effort expended during the one May 2011 aerial. We have not conducted power analyses on the May 2011-only data for reasons discussed previously. Sightings rates herein are estimated based on sightings per 1000 km of point-to-point flight rather than per 1 km as done in previous reports; this was to facilitate the reporting of whole numbers rather than decimal fractions of animal sightings. Note again that these sightings rates cannot be used to calculate areal density or abundance like DISTANCE analyses can (see **Appendix B** of monitoring report for abundance and density estimates from eight SOCAL aerials).

As illustrated in **Table 1**, overall sighting rates of dolphins were approximately one-third higher than sightings rates of whales. Sighting rates of blue, fin and unidentified whales were the same

(2.0 sightings/1000 km flown) based on the small sample sizes (**Table 1**). All other whale sighting rates were considerably less. Unidentified whales typically consisted of whales that were seen at a distance but for which there was not enough time to circle to confirm species. Common dolphin species had the highest overall sighting rate (11.0 groups/1000 km flown) which was over twice as high as that of Risso's dolphins (5.0 groups/1000 km flown). Based on examination of photos, three of the eight common dolphin species sightings were identified to species but these sightings were combined with common dolphin species unknown due to small sample sizes (**Table 1**).

Table 1. Sighting rates of marine mammals during the May 2011 SOCAL aerial survey. Estimates based on-effort observations made during systematic, connector, random, and transit effort leg types totaling 2024 km or 10.7 hours. (Note: all effort included here does not meet the criteria of line-transect methodology).

Species (Common Name)	May-11			
	Total Sightings	Sightings /1000 km	Sightings /1000 nm	Sightings /hour
Whales	**15**	**7.4**	**13.7**	**1.4**
Blue Whale	5	2.0	5.0	0.5
Fin Whale	4	2.0	4.0	0.4
Humpback Whale	1	0.5	0.9	0.1
Sperm Whale	1	0.5	0.9	0.1
Unidentified Baleen Whale	4	2.0	4.0	0.4
Unidentified Medium Whale	1	0.5	0.9	0.1
Dolphins	**24**	**12.0**	**22.0**	**2.2**
Risso's Dolphin	5	2.0	5.0	0.5
Common Dolphin sp. (includes 2 sightings of short-beaked and 1 sighting of long-beaked common dolphins)	11	5.4	10.0	1.0
Bottlenose Dolphin	3	1.0	2.0	0.3
Unidentified Dolphin	5	2.0	5.0	0.5
Pinnipeds	**9**	**4.0**	**8.0**	**0.8**
California Sea Lion	9	4.0	8.0	0.8
Overall Marine Mammal	**49**	**24.2**	**44.8**	**4.5**

Behavior. Behavioral results are discussed below. Results of the first approach involving initially observed behaviors are first described by species. This is followed by results of focal session data using the same variables but involving multiple observations from the same sightings. As discussed above, in May 2010, a total of 49 sightings were observed of eight confirmed species where at least one of the behavioral parameters was determined/recorded for initially observed behaviors. Mean initial behavioral state, heading, and/or dispersal data were recorded for most sightings when such information could be determined. Based on focal follow data, sample sizes by species were considered large enough (n>5) to conduct meaningful summary statistic for only three species: blue whales (n = 18), fin whales (n=7) and Risso's dolphins (n=6). Mean group sizes, and means and/or frequency distributions of headings, mean and maximum dispersal distances, and behavior states are presented in **Tables 1-3** and **Figures 1-13** for initially observed behaviors and for focal follow groups. Sample sizes were not large enough to assess behavior relative to diurnal or other time trends.

Behavior State. Initial behavior state data were determined for six species based on sample sizes ranging from 6-13 (**Table 2**). Whales predominantly traveled, although blue whales in May also were observed milling/foraging. Risso's dolphins in particular also predominantly traveled and rarely exhibited surface-active behaviors, unlike common dolphins. These trends are similar to those reported during previous SOCAL aerial surveys.

Group Size. As anticipated, mean group size of common dolphin species was highest followed by bottlenose dolphins and Risso's dolphins (**Table 2, Figure 1**). However, there was considerable variation in group size among dolphin species. Mean group size of fin and blue whales was 1.3 and 1.2, respectively, with little variation in group size based on the relatively small standard deviations (**Table 2**).

Dispersal Between Nearest Neighbors. Mean minimum dispersal distance between nearest neighbors was 1 body length for nearly all species (**Table 2**) with little variation based on standard deviations, except among bottlenose dolphins. However, sample sizes were predominantly small. Mean maximum dispersal distance was much more variable (**Table 2**). Bottlenose dolphins had the highest mean dispersal distance of 13 body lengths (BL), followed by blue whales (11.0 BL) and fin whales (6.0 BL). However, the standard deviation for the latter means was relatively large, which is not surprising considering the small sample sizes (n <11) (**Table 2**). An exception was the common dolphin species which tended to stay quite cohesive within subgroups: mean maximum dispersal was 3.0 ± 0.59 based on the largest sample size of all species for the May survey (n=12). In general, dispersal among whales was relatively larger than among dolphins in terms of body lengths (**Table 2**).

Orientation/Heading. Mean heading/orientation was generally southward or southwestward for most species, although there was considerable variability (**Table 2**). **Figures 12 and 13** suggest that whales in particular had headings that were quite variable. This was likely related to foraging by blue whales in particular. For example, during surfacing bouts, blue whales tended to maintain a consistent heading but by the next surfacing sequence would be often headed in another orientation, resulting in overall staying in the same general area.

Table 2. Number of groups sighted and summary statistics based on initially observed behavioral parameters from the May 2011 SOCAL aerial survey. BL = Body lengths; n = sample size. Dispersal distances were not applicable to groups of size 1 animal.

Species	Mean ± SD Group Size (n)	Mean ± SD of Smallest Initial Group Dispersal in BL (n)	Mean ± SD of Greatest Initial Group Dispersal in BL (n)	Mean ± SD of Initial Group Heading (n)	Initial Behavior State (percent of species sample size)				
					No. of Groups with Initial Behavior State	Travel/ Swim	Surface-Active Travel	Mill/ Forage	Surface-Active Mill/ Forage
Common dolphin sp.	185.0 ± 103.96 (n=13)	1.0 ± 0.17 (n=12)	3.0 ± 0.59 (n=12)	226 ± 131 (n=5)	9	34%	21%	8%	37%
California sea lion	3.0 ± 3.75 (n=13)	2.0 ± 0.00 (n=1)	2.0 ± 0.00 (n=1)	190 ± 98 (n=5)	13	60%	4%	33%	4%
Risso's dolphin	11.0 ± 6.23 (n=9)	1.0 ± 0.00 (n=8)	4.0 ± 3.37 (n=8)	213 ±522 (n=8)	9	80%	1%	17%	2%
Fin whale	1.3 ± 0.34 (n=9)	1.0 ± 0.00 (n=1)	6.0 ± 8.94 (n=3)	181 ± 93 (n=8)	9	92%	4%	4%	-
Blue whale	1.2 ± 0.27 (n=12)	1.0 ± 0.34 (n=3)	11.0 ± 19.44 (n=3)	206 ± 72 (n=10)	12	85%	4%	11%	-
Bottlenose dolphin	21.0 ± 16.02 (n=6)	1.0 ± 1.19 (n=5)	13.0 ± 18.89 (n=5)	200 ± 109 (n=6)	6	54%	21%	13%	13%
Sperm whale	24 ± n/a (n=1)	n/a	n/a	n/a	1	100%	-	-	-

Table 3. Number of focal groups circled and associated summary statistics from the May 2011 SOCAL aerial survey. Limited to the three species with at least 5 sightings. Dispersion distance was not applicable (n/a) for sightings with group size of one animal.

	Species		
	Fin Whale	**Blue Whale**	**Risso's Dolphin**
Total Focal Groups	7	18	6
Mean Orientation (degrees magnetic)	102.5	210	111
Standard Deviation (SD)	50.35	44.00	20.00
No. 30-min Scan Samples	12	30	11
Minimum Dispersal (Body Lengths (BL))	n/a	n/a	2
SD	n/a	n/a	0.31
No. 30-min Scan Samples	n/a	n/a	66
Maximum Dispersion (BL)	n/a	n/a	4
SD	n/a	n/a	0.79
No. 30-min Scan Samples	n/a	n/a	66

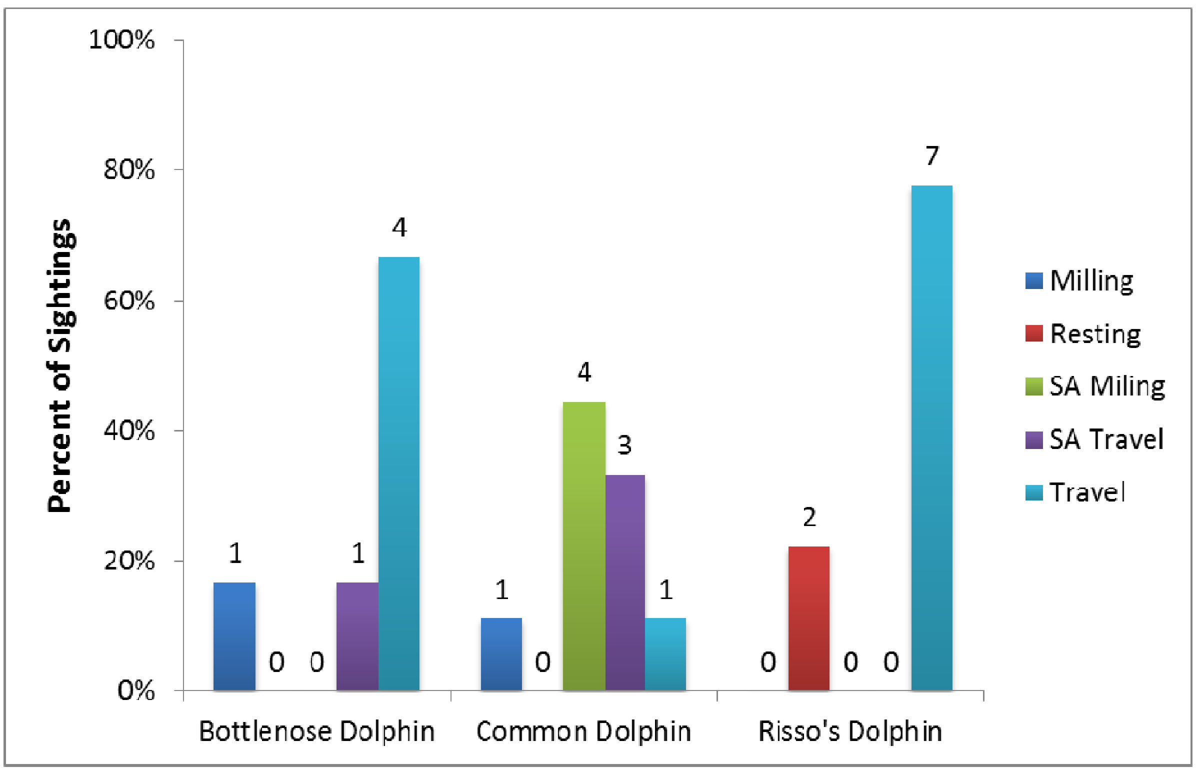

Figure 1. Percent of dolphin sightings engaged in various behavioral states when first observed. Sample sizes indicated above bars. Note: SA = surface active.

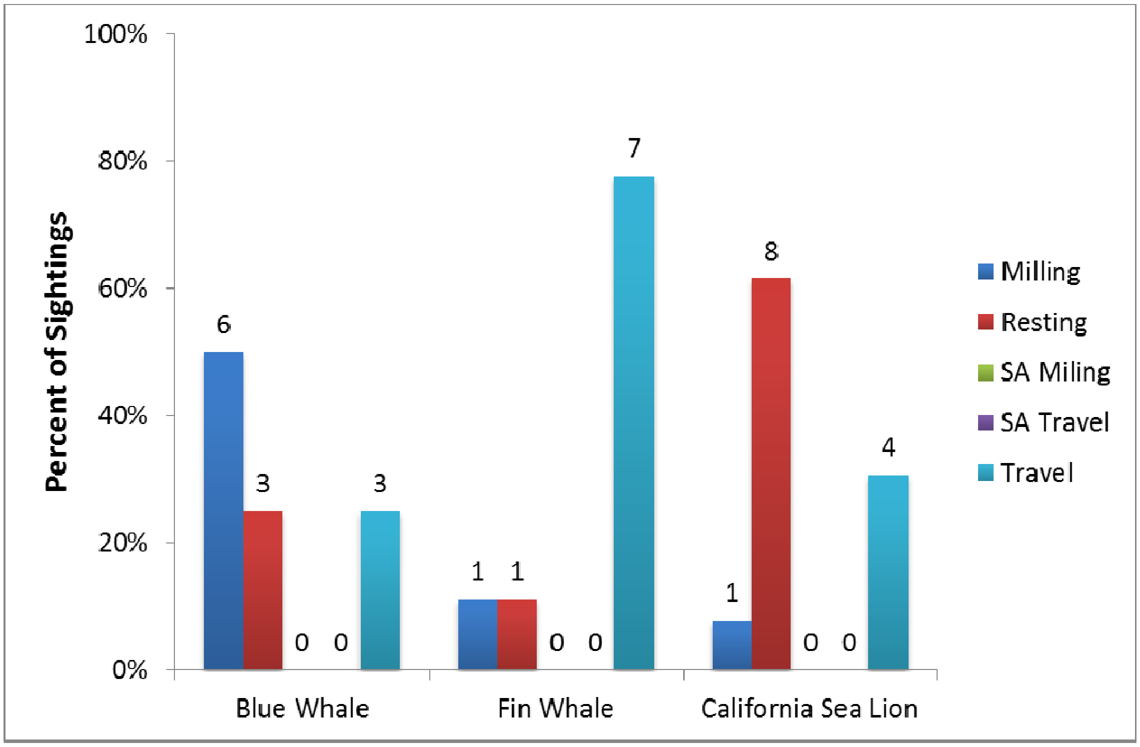

Figure 2. Percent of whale and California sea lion sightings engaged in various behavioral states when first observed. Sample sizes indicated above bars. Note: SA = surface active.

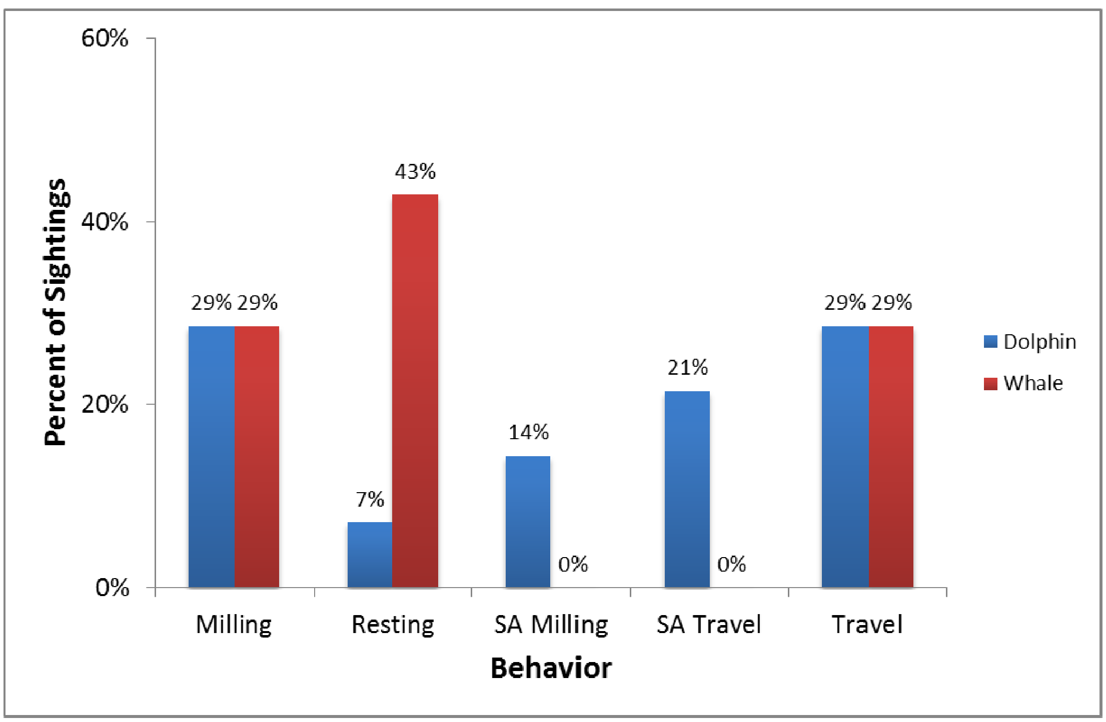

Figure 3. Percent of combined dolphin and whale sightings engaged in various behavioral states when first observed. Sample sizes indicated above bars. Note: SA = surface active.

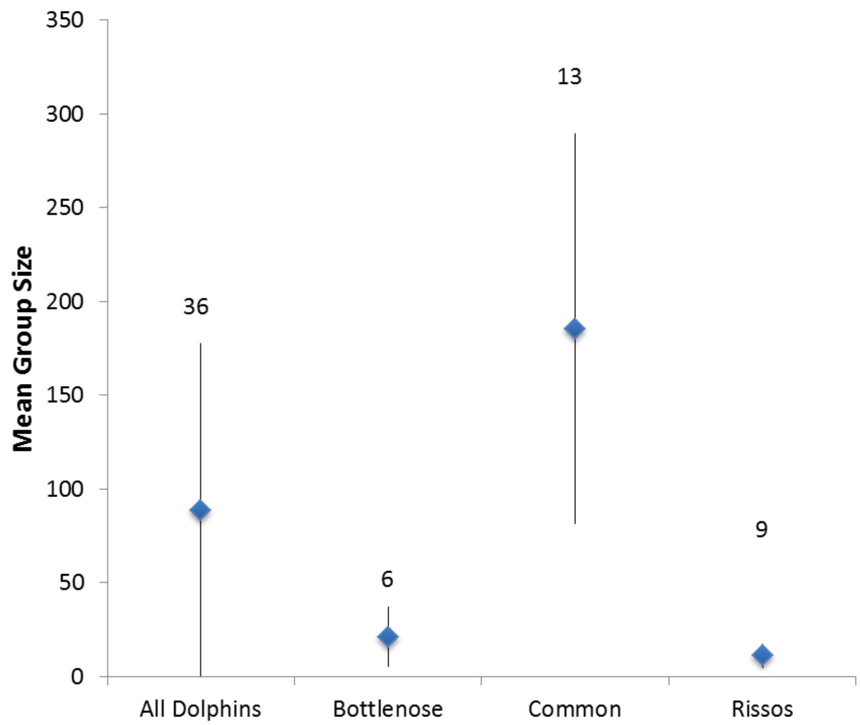

Figure 4. Mean and standard deviation of group size by dolphin species during the May 2011 SOCAL aerial survey. Sample sizes indicated above bars.

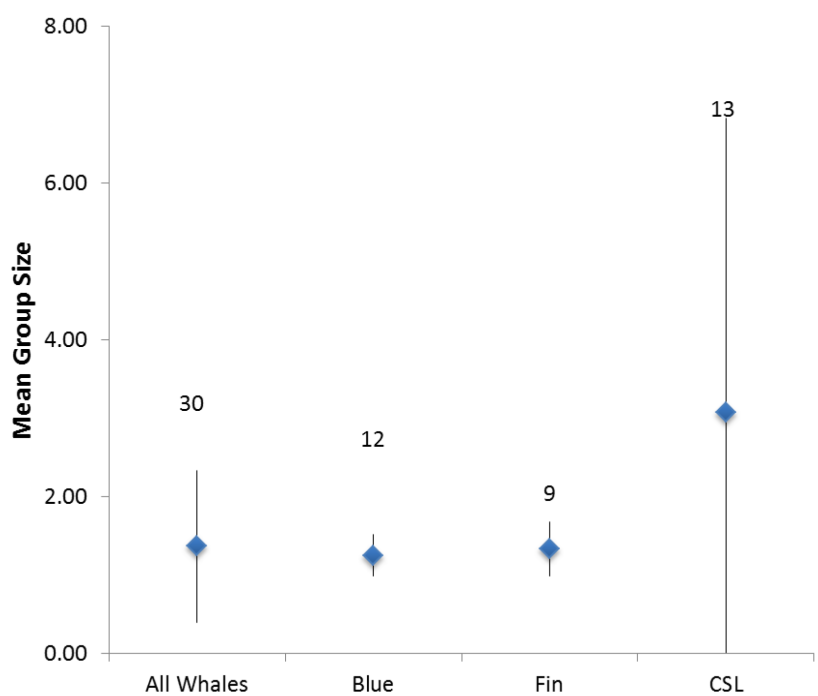

Figure 5. Mean and standard deviation of group size by whale and California sea lion (CSL) species during the May 2011 SOCAL aerial survey. Sample sizes indicated above bars.

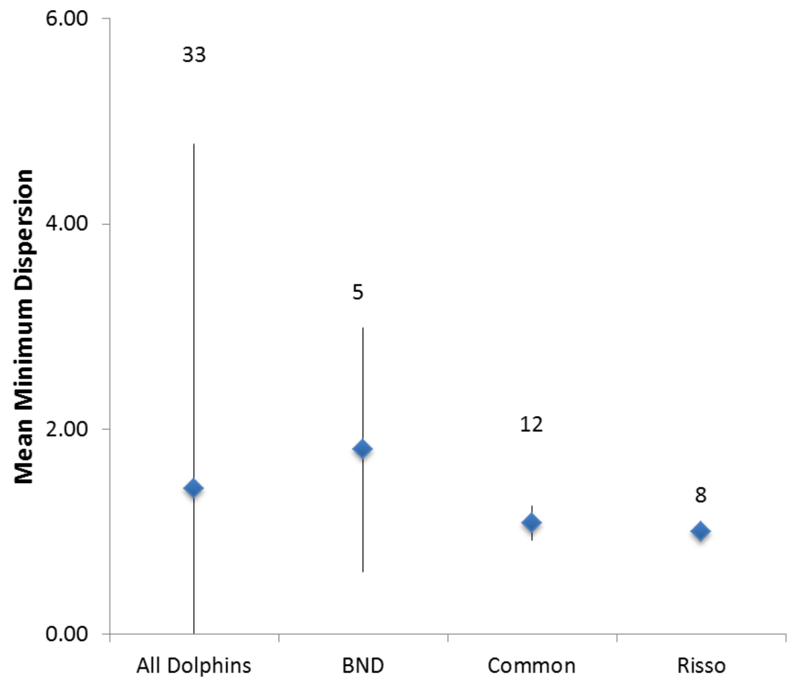

Figure 6. Mean and standard deviation of minimum dispersion distance in body lengths (BL) between nearest neighbors within a subgroup by dolphin species during the May 2011 SOCAL aerial survey. Sample sizes indicated above bars. Note: BND = Bottlenose dolphin.

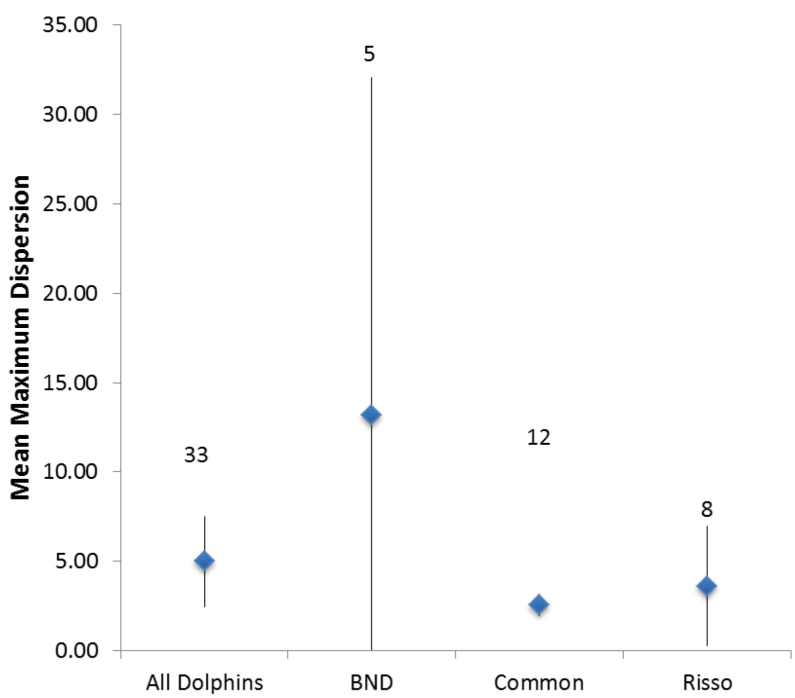

Figure 7. Mean and standard deviation of maximum dispersion distance in body lengths (BL) between nearest neighbors within a subgroup by dolphin species during the May 2011 SOCAL aerial survey. Sample sizes indicated above bars. Note: BND = Bottlenose dolphin.

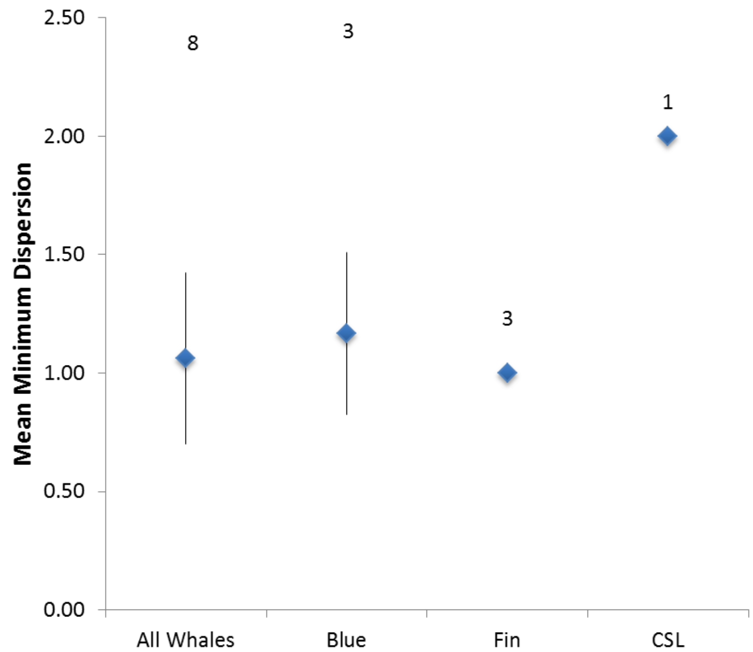

Figure 8. Mean and standard deviation of minimum dispersion distance in body lengths (BL) between nearest neighbors within a subgroup by whale and California sea lion (CSL) species during the May 2011 SOCAL aerial survey. Sample sizes indicated above bars.

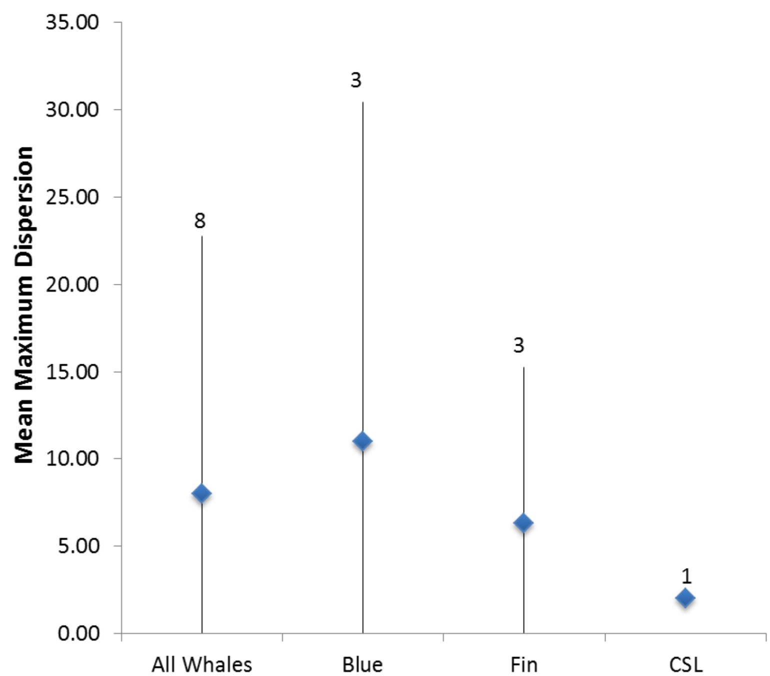

Figure 9. Mean and standard deviation of maximum dispersion distance in body lengths (BL) between nearest neighbors within a subgroup by whale and California sea lion (CSL) species during the May 2011 SOCAL aerial survey. Sample sizes indicated above bars.

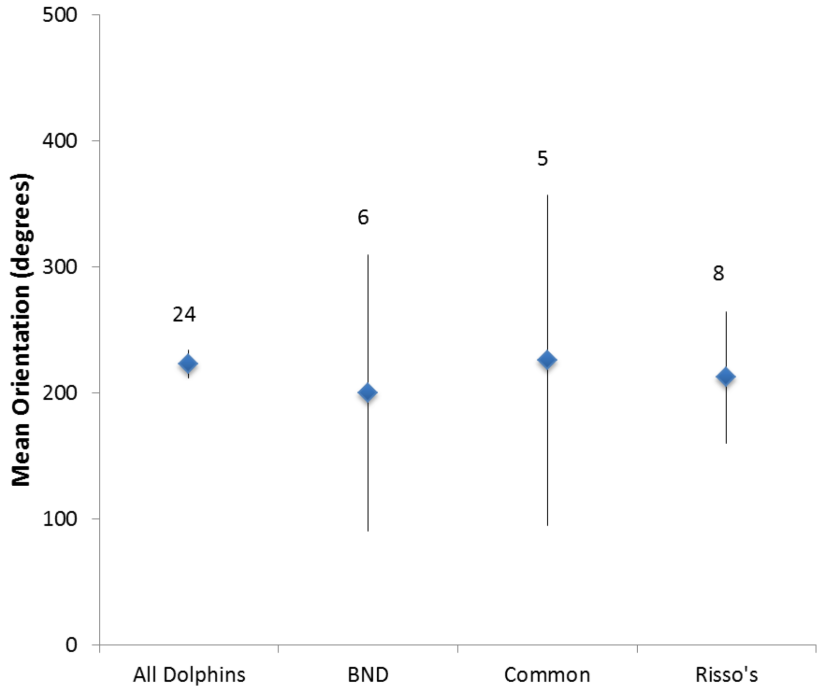

Figure 10. Mean and standard deviation of orientation/heading in degrees magnetic between nearest neighbors within a subgroup by dolphin species during the May 2011 SOCAL aerial survey. Sample sizes indicated above bars. Note: BND = Bottlenose dolphin.

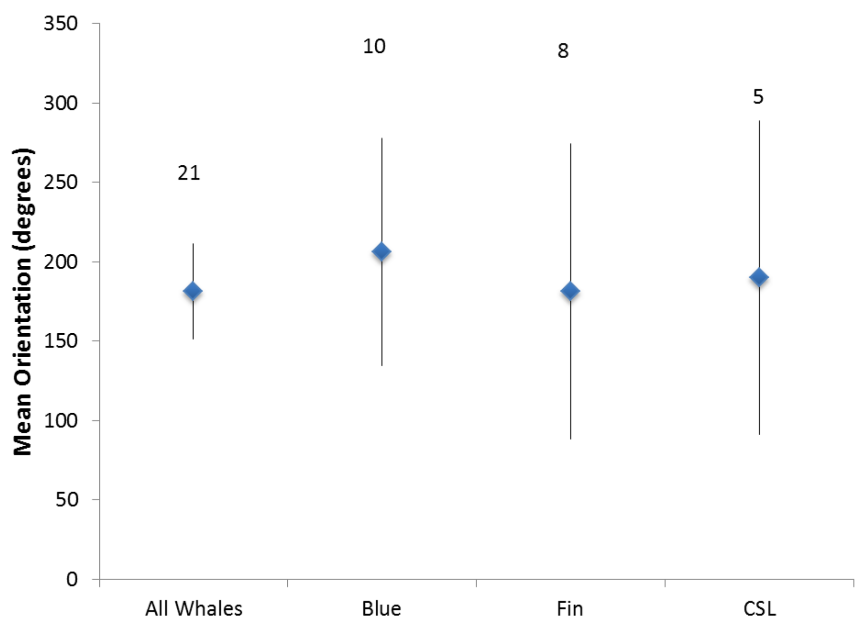

Figure 11. Mean and standard deviation of orientation/heading in degrees magnetic between nearest neighbors within a subgroup by whale and California sea lion (CSL) species during the May 2011 SOCAL aerial survey. Sample sizes indicated above bars.

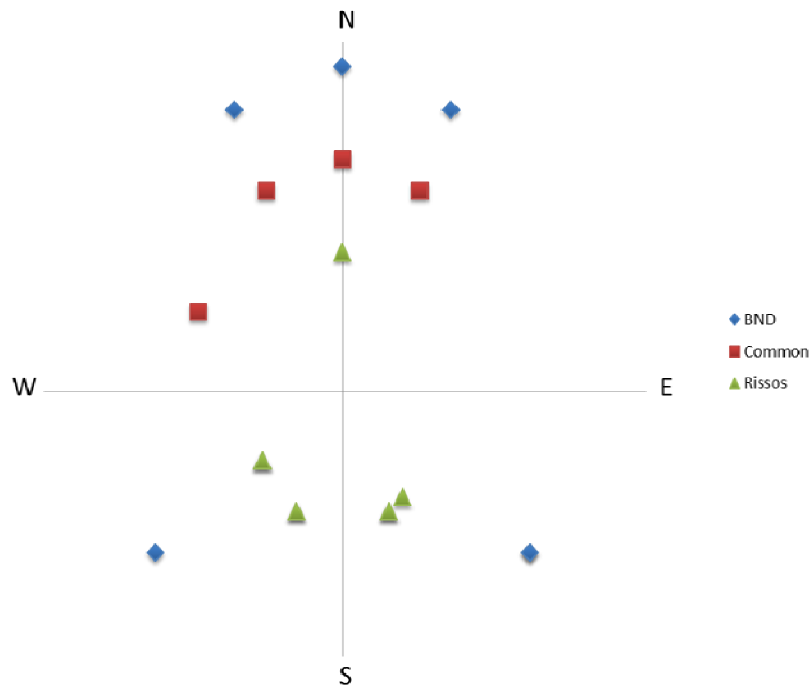

Figure 12. Distribution of first observed orientation/heading in degrees magnetic by dolphin species during the May 2011 SOCAL aerial survey. Note: BND = Bottlenose dolphin.

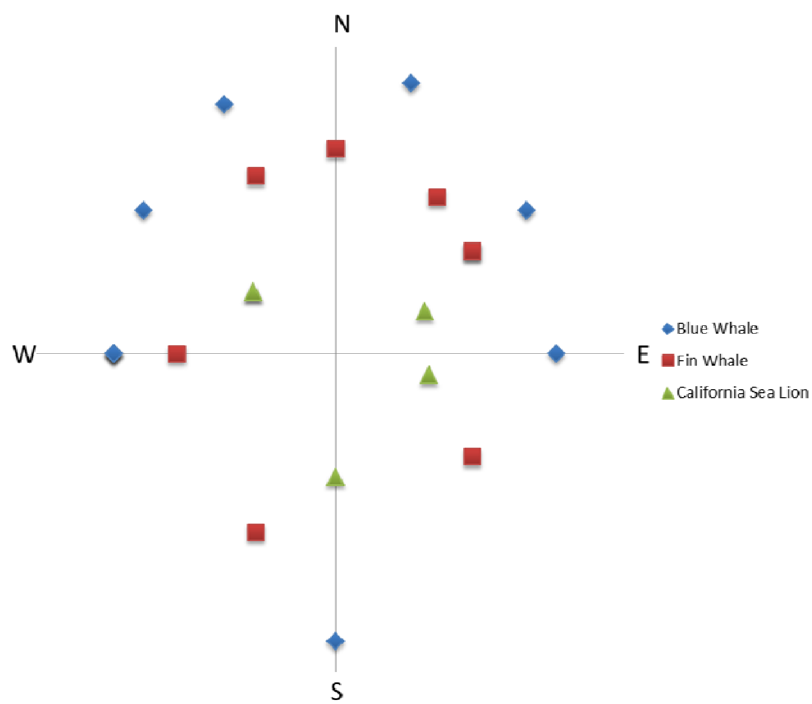

Figure 13. Distribution of first observed orientation/heading in degrees magnetic by whale and California sea lion species during the May 2011 SOCAL aerial survey.

Pre-Flight and In-Flight Communications

Conducting the aerial surveys involved considerable planning, communications and clearances given the logistical complexity and high degree of safety planning associated with operating in and near the busy airspace near the southern California coastline and on the SOCAL Range, especially during the MTEs. In-flight communications protocol was also critical to quickly communicate information between the aircraft and observation crews for data efficiency and safety. Coordinating communications between the aircraft crew and other researchers in the field also required planning.

Each morning, for the purposes of flight planning, the pilot checked the local aviation weather and forecasts through the NOAA online aviation website. The pilot then called the Navy's flight tower (i.e., "Beaver Control") for local weather and an updated range activity schedule, and requested clearance to enter Navy airspace, as relevant. NAOPA was nearly always clear for our flights except in the SHOBA range area south and east of SCI, which was frequently active and thus inaccessible to our aircraft. Clearance to fly SOAR was usually requested several weeks before the scheduled survey by the NTR in communication with SCORE. Navy activity schedules often changed, so the daily pre-flight check-in was always conducted by the pilot. Prior to entering Navy air space at SOAR, the pilot called Beaver on the aviation radio to request updated access to SOAR as applicable. When the aircraft flew near "hot" active areas, Beaver contacted the pilot on the radio and requested that the survey plan change its heading and/or location as applicable to avoid active areas. Entering the Silver Strand range required additional separate clearance from the Navy's North Island tower and other adjacent airspace that had to be updated just prior to each entry of the busy airspace in that area.

In-flight communications protocol included the observers remaining quiet during takeoff and landings, and whenever Beaver or other control towers were communicating with the pilot(s). The pilots were advised to remain quiet during focal observations as to not preclude the observers' need to communicate data to one another. They were also advised not to alert the observers of any sightings until the sighting had passed the mid-line of the plane and was not seen by the observers; the latter is important with respect to abundance-estimating protocol. When radio communications were busy, the pilot could isolate him or herself from the observers as needed, whereby the pilot could still hear the observers but the observers could not hear the pilot and other radio communications.

Across-platform communications were used between the survey aircraft crew and other researchers, including the BRS study, Cascadia small vessel crew, and UCSC/SIO small vessel crew. This was accomplished by pre-designating three marine VHF channels through which to communicate, as the channels had to be pre-programmed in the aircraft. The pilot or co-pilot was the only aircraft crew who could communicate directly with other research platforms. This was a less-than-ideal situation, as it decreased efficiency of communications. For example, during the BRS study, the delay in relaying the locations and surfacings of cetaceans between the two platforms delayed the ability to respond and relocate animals. It also was difficult to share detailed information between researchers in the air and on the water. Future coordinated efforts should involve use of a direct communications system between researchers on different platforms. When within cell phone range, texting between aircraft and vessel observers in coastal areas was also used with limited success.

Recommendations and Additional Notes

1. It is critical to have at least one opening window from which an observer can take high-definition video and photographs for species identification and detailed behavioral observations. This was demonstrated by a comparison of photos and video taken during March 2011 (through an opening window in the rear left seat of the Partenavia aircraft) vs. the April 2011 survey (either through double-paned Plexiglas or by the non-flying pilot, a novice photographer, through an opening window on the left front pilot side of the Twin Commander). See **Appendix A** for comparison photographs.
2. If the Twin Commander had opening portholes in the windows of the second-row seats, it would provide the advantage of a longer range than the Partenavia. A longer range is advantageous for the SOCAL survey: it maximizes survey time on SOAR which is approximately 150 km (81 nm) west of San Diego. However, the Twin Commander contracted during the April survey costs considerably more than the Partenavia. Additional research indicated that other Commanders can be leased in the region that are equipped with opening windows or bubble windows that are important to maximize efficacy of aerial surveys.
3. The option of using a Twin Otter aircraft should be considered. Though the hourly cost of this lease (as preliminarily investigated) would be about twice that of the Twin Commander, it is considered an ideal aircraft for conducting and videotaping focal behavioral follows, particularly given its long range (up to 7–8 hours) and ability to circle relatively slowly compared to other twin-engine, fixed-wing aircraft (pers. comm., Dr. B. Würsig 2011).
4. Aspen Helicopters, the contractor for the Partenavia, indicated that aircraft fuel can be carried via vessel to San Clemente Island (SCI) to refuel the aircraft. (Only helicopter fuel is currently available at SCI.) This would increase the range of the Partenavia at SOAR by allowing it to refuel at SCI. Beaked and fin whales tend to occur on the western and northwestern edges of SOAR where minimal effort has been expended by aircraft and small vessels given the distance from San Diego (and SCI).
5. Another flight platform option to consider is a helicopter stationed at SCI. Helicopter fuel is available on SCI. Two short flights (2 to 2.5 hours) in a helicopter on SOAR could be made each day from SCI with enough time to fly all SOAR transect lines and leave time for focal follows, based on past experience. This includes a feasibility survey conducted with the helicopter in July 2010 (Smultea et al. 2010).
6. Mysticetus should continue to be used during subsequent aerial surveys. It should also be tailored for use during vessel-based surveys to facilitate consistency of data collection. This software is easily adapted by the user to include specific parameters of interest.
7. Funding should be provided to analyze the following data:
    a. Video and behavioral data in detail for the February, March, and April 2011 surveys. This task should include transcription of videos, integration of videos with field behavioral notes and audio, and plotting of movement tracks in 3D on Google Earth with other data layers of relevance (e.g., surface temperature, bathymetry) to identify any potential patterns. These data should be compared with periods when sonar was on and off relative to distance and estimated received levels of sonar

sounds and the presence and behavior of nearby Navy ships. They should also be compared and combined with previous behavioral data collected since 2008 on the SOCAL Range during similar aerial surveys. This synthesis is needed to maximize sample sizes to identify trends and provide robust behavioral baseline data. From compiled data, statistical power analyses can be run to assess the variability in the data and the minimum sample size needed to identify any significant changes that might result from exposure to Navy activities.

b. February–May 2011 data should be further processed, filtered, and edited to be suitable for conducting DISTANCE analyses of density and abundance. These data should then be combined with data already analyzed in DISTANCE for SOCAL 2008–2010 aerial survey (Smultea et al. in prep.). The latter requires Geographical Information System (GIS) analyses to accurately quantify and identify the time and distances expended in each type of survey leg effort. In particular, GIS analyses are needed to filter the data to identify the subsample of on-effort periods that meet the basic requirements for analysis of sighting data for density and abundance estimates with DISTANCE software—on-effort periods on systematic lines while flying at 1,000-ft altitude and 100 kts with both observers on full effort in environmental conditions acceptable for given species.

c. The approximately 15+ systematic focal sessions collected in 2008-2011 from various cetacean species (mainly Risso's dolphins) in SOCAL while the aircraft circled for about 5 minutes at set descending altitudes (e.g., 2,000-, 1,500- and 1,000-foot altitude) should be analyzed in detail to assess behavior relative to the observation platform.

8. We recommend a detailed behavioral analysis be conducted for sightings that occurred when a Navy vessel was in view.

9. A feasibility/pilot study should be considered where the aircraft is opportunistically flown during playback of sonar sounds for the Navy-funded SOCAL Behavioral Response Study (BRS). The aircraft could be on stand-by mode awaiting periods before, during, and after playbacks by the BRS study. During the latter periods, preferably sequentially during these periods, the aircraft could conduct focal follows of other marine mammals that might be sighted within a distance of the playback vessel where the projected sonar sounds are audible to that species and focal group. The aerial survey in September 2010 was able to do this. However, the BRS vessel was busy with previous focal groups at the time and was not able to follow the group. Following this approach would potentially add to the BRS sample size of the behavior of marine mammals exposed to playbacks of sonar and other sounds.

10. A feasibility/pilot study should be considered where the aircraft drops sonobuoys equipped with GPS from the aircraft near priority focal follow sessions on species of interest. This would allow recording of underwater vocalizations of select species where species, group size/age class, behavior state, and other social structure information could be linked with confirmed species. The latter is a critical need of the passive acoustics studies in SOCAL and elsewhere; there are still many sounds that remain to be identified/linked with specific species.

11. A problem encountered was that we did not have an ops number from the Navy that was specific to what we were going to be doing. They would say the area was "hot" (i.e.,

inaccessible) and the pilot would say "I believe it's hot for us"---when the hot was us. Normally, the pilot recognized that the area was hot for our observation aircraft if the Navy indicated that "surface to 5000 ft" was hot. The Navy would subsequently check and clear us for access. Having an ops number in the future would facilitate and expedite our access to normally restricted areas.

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Appendix A. Photographs

Photo 1. Sei/Bryde's whales photographed 28 September 2010 by B. Würsig under NMFS permit 15369.

Photo 2. Bryde's whale photographed 24 September 2010 by B. Würsig under NMFS permit 15369.

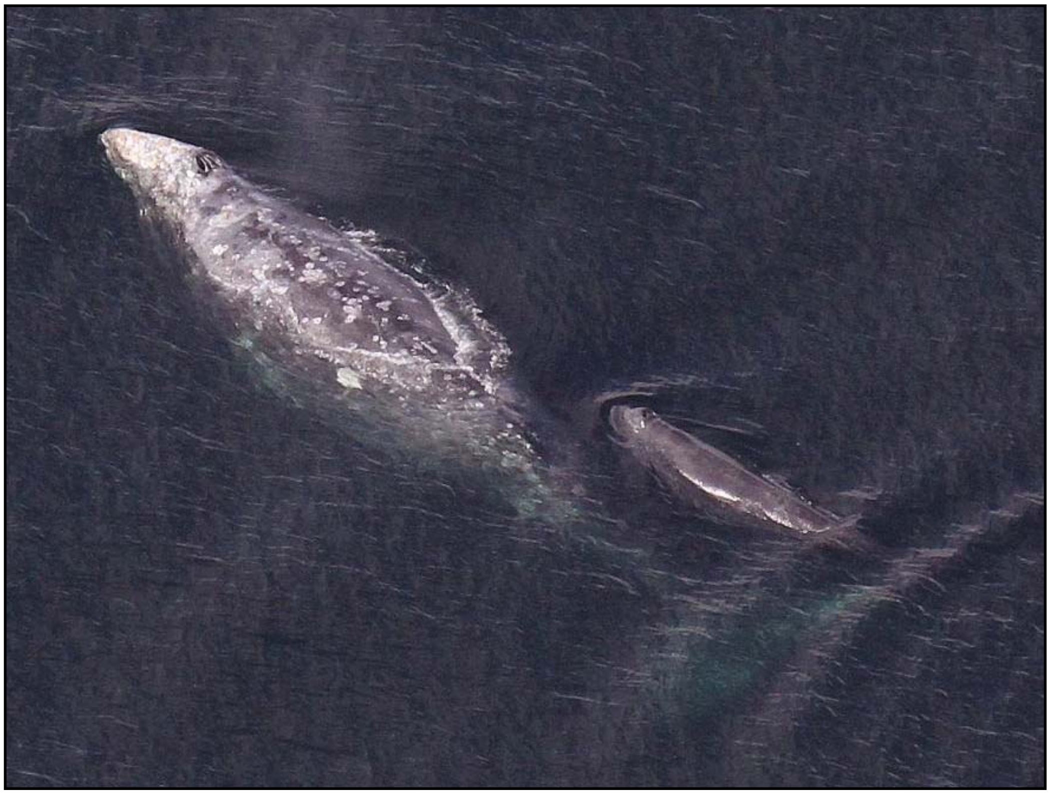

Photo 3. Gray whale mother and very young calf. Photographed 15 February 2011 by B. Würsig under NMFS permit 14451.

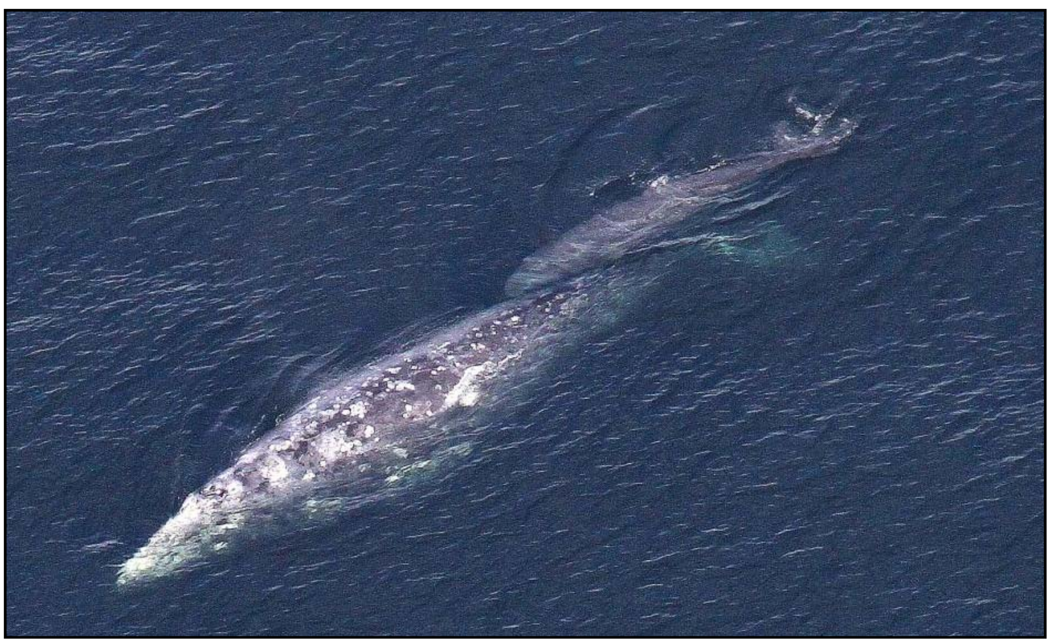

Photo 4. Gray whale mother and calf. Photographed 15 February 2011 by B. Würsig under NMFS permit 14451.

Photo 5. Fin whale. Photographed 15 February 2011 by B. Würsig under NMFS permit 14451.

Photo 6. Short-beaked common dolphins. Photographed 15 February 2011 by B. Würsig under NMFS permit 14451.

Photo 7. Risso's dolphins. Photographed 31 March, 2011, by T. Jefferson under NMFS permit 14451 through an open window on the Partenavia aircraft at altitude 1,500 feet.

Photo 8. Minke whales. Photographed 31 March 2011, by B. Würsig under NMFS permit 14451.

Photo 9. Northern right whale dolphins at SOAR. Photographed 01 April 2011, from the open window of the Partenavia at altitude 1,500 feet by D. Engelhaupt under NMFS permit 14451.

Photo 10. Fin whale photograph taken through the closed, double-paned Plexiglass window of the Twin Commander on 14 April 2011. Compare the degraded quality/resolution of this photo vs. photo of minke whales taken through the opening window in the Partenavia aircraft. Photographed by B. Würsig under NMFS permit 14451.

Photo 11. Blown-up photograph of two common dolphins photographed on 16 April 2011 through the small opening port window by the co-pilot (while the other pilot flew the plane). Photographed under NMFS permit 14451.

Photo 12. Porpoising long-beaked common dolphins photographed 16 April 2011, by the co-pilot (while the other pilot flew the plane) through the open window in the Twin Commander under NMFS permit 14451.

Photo 13. Dead humpback whale with blue shark photographed 10 May 2011 from the open window of the Partenavia by M. Smultea under NMFS permit 14451.

Photo 14. Fin whale photographed 10 May 2011 from the open window of the Partenavia at altitude 1,500 feet by M. Smultea under NMFS permit 14451.

Photo 15. Sperm whale photographed 14 May 2011 from the open window of the Partenavia by D. Steckler under NMFS permit 14451.

Photo 16. Sperm whales with northern right whale dolphins (left center and Risso's dolphins (top center) photographed 14 May 2011 from the open window of the Partenavia by D. Steckler under NMFS permit 14451.

Photo 17. Sperm whale and calf with Risso's dolphin photographed 14 May 2011 from the open window of the Partenavia by D. Steckler under NMFS permit 14451. Note sperm whale's open jaw.

*Photo 18. Sperm whale and calf photographed 14 May 2011
from the open window of the Partenavia
by D. Steckler under NMFS permit 14451.*

Photo 19. Sperm whales photographed 14 May 2011 from the open window of the Partenavia by D. Steckler under NMFS permit 14451. Risso's and northern right whale dolphins on left in front of sperm whales.

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Appendix B. Figures

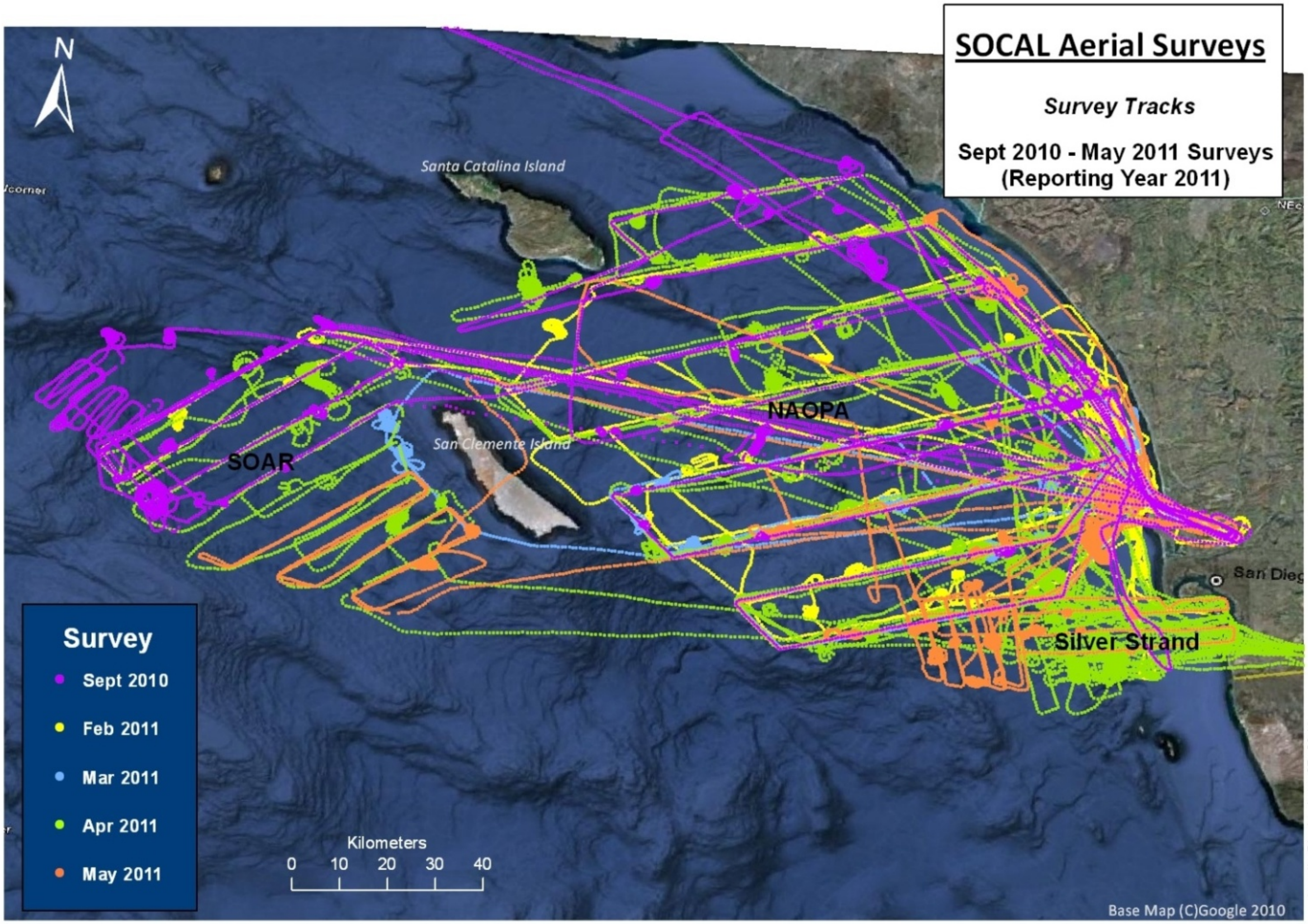

Figure 1. All aerial track lines made during the September 2010 and February-May 2011 aerial monitoring surveys in SOCAL, color-coded by survey month.

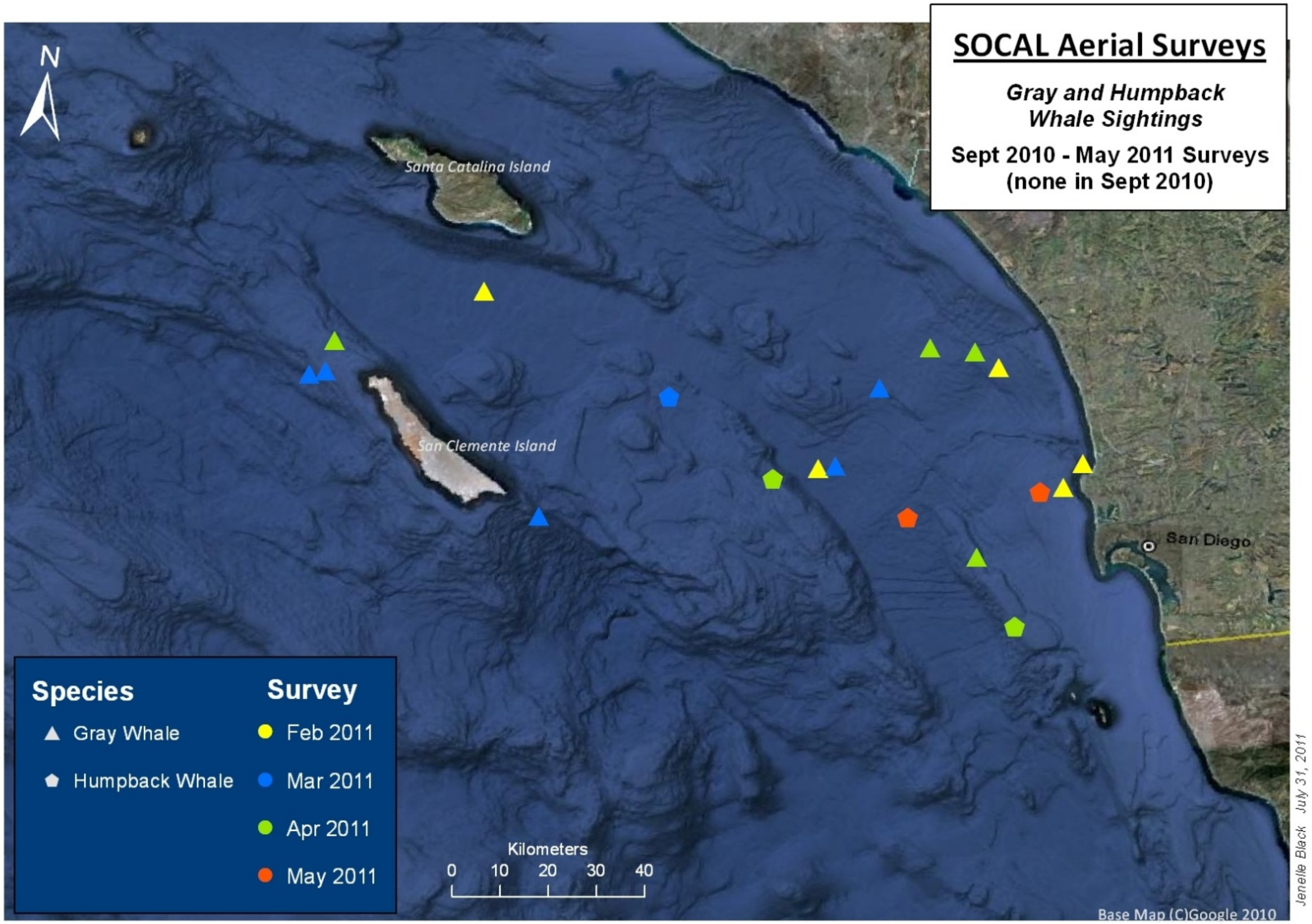

Figure 2. Gray whale and humpback whale sightings color-coded by month, during aerial surveys in SOCAL September 2010 and February – May 2011.

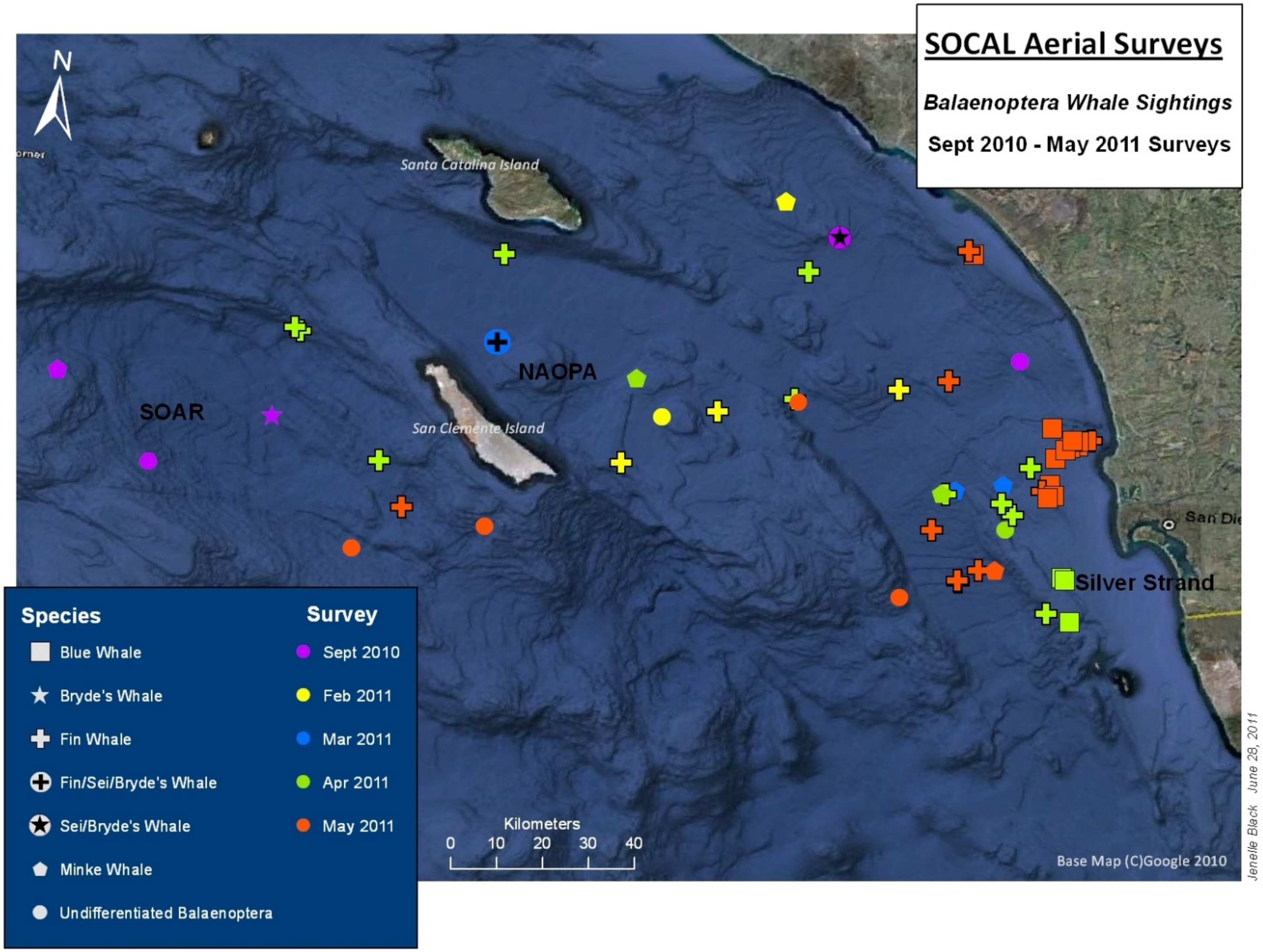

Figure 3. Balaenoptera whale sightings color-coded by month, during aerial surveys in SOCAL September 2010 and February – May 2011.

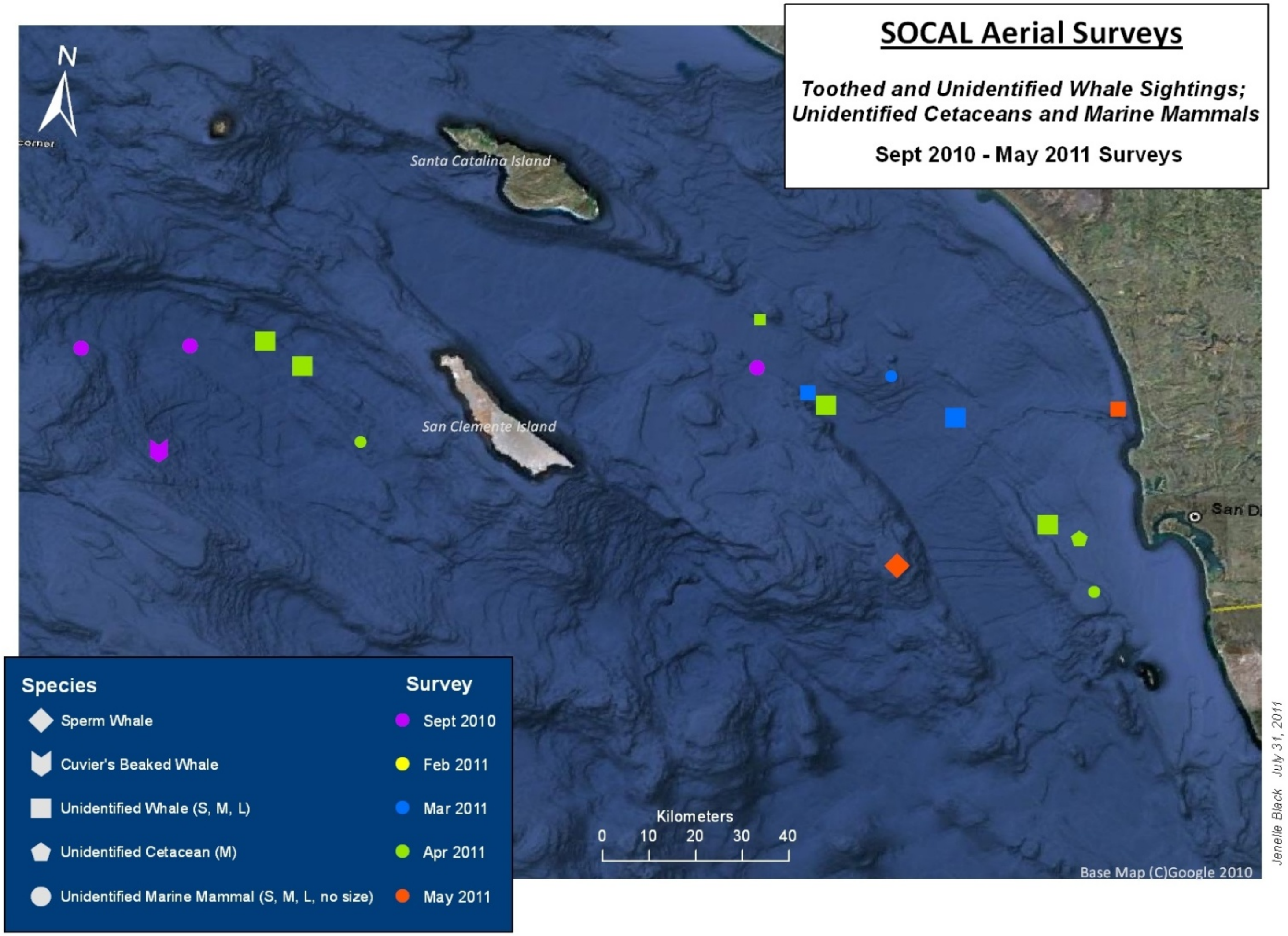

Figure 4. Toothed and unidentified whale sightings color-coded by month, during aerial surveys in SOCAL September 2010 and February – May 2011.

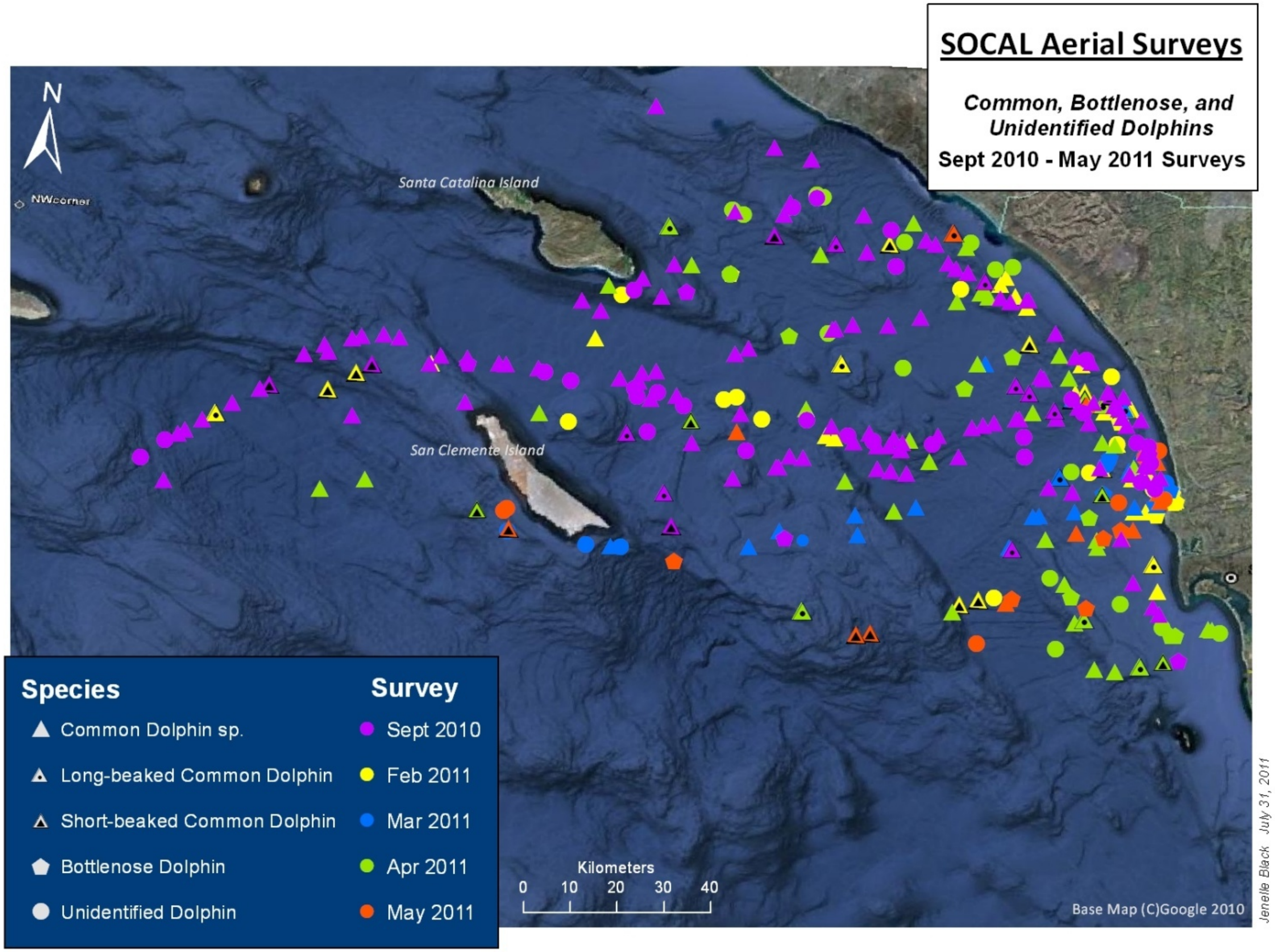

Figure 5. Common dolphin, bottlenose dolphin and unidentified dolphin sightings by species color-coded by month, during aerial surveys in SOCAL September 2010 and February – May 2011.

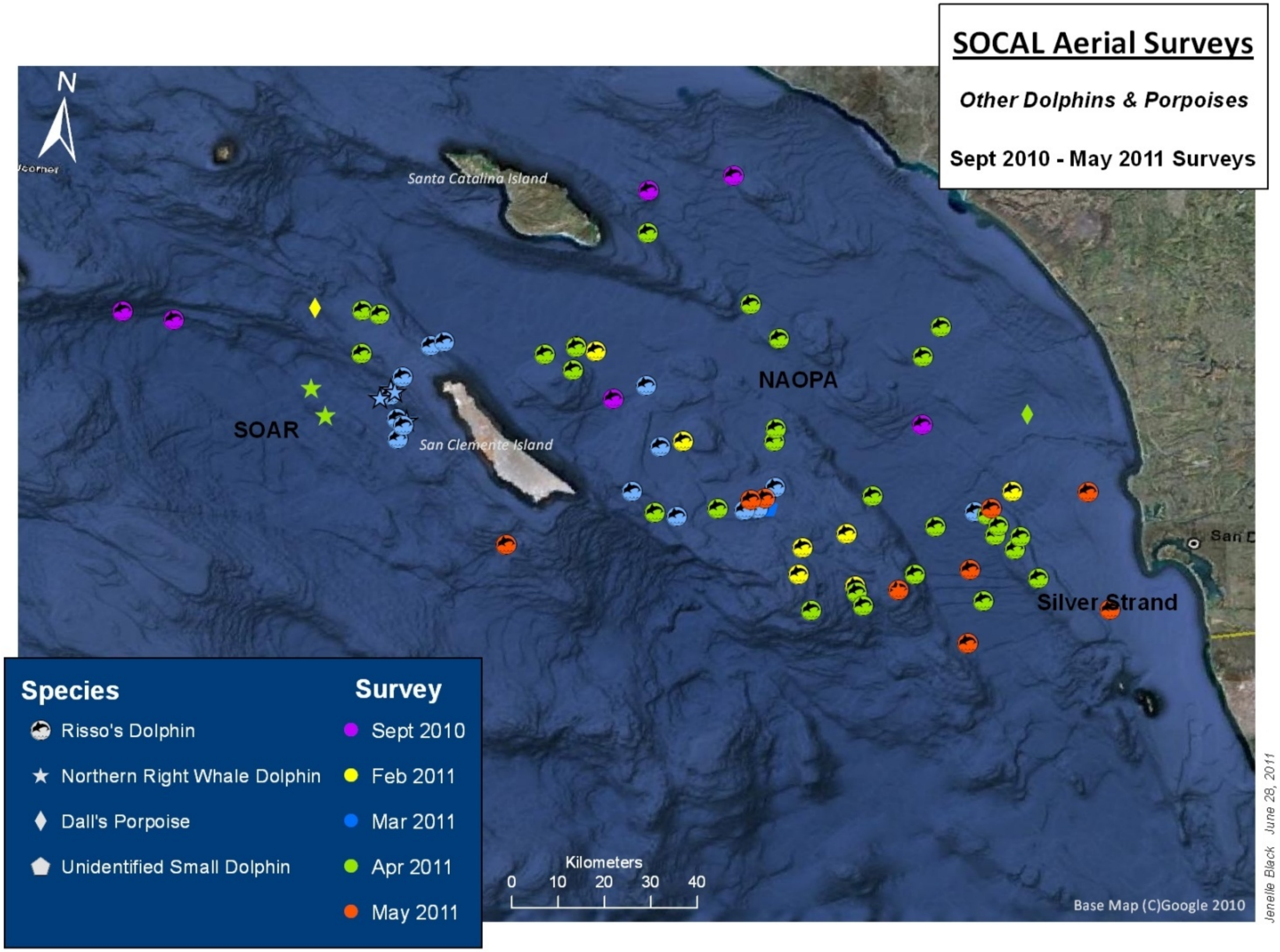

Figure 6. Risso's dolphin, Northern right whale dolphin and Dall's porpoise sightings by species color-coded by month, during aerial surveys in SOCAL September 2010 and February – May 2011.

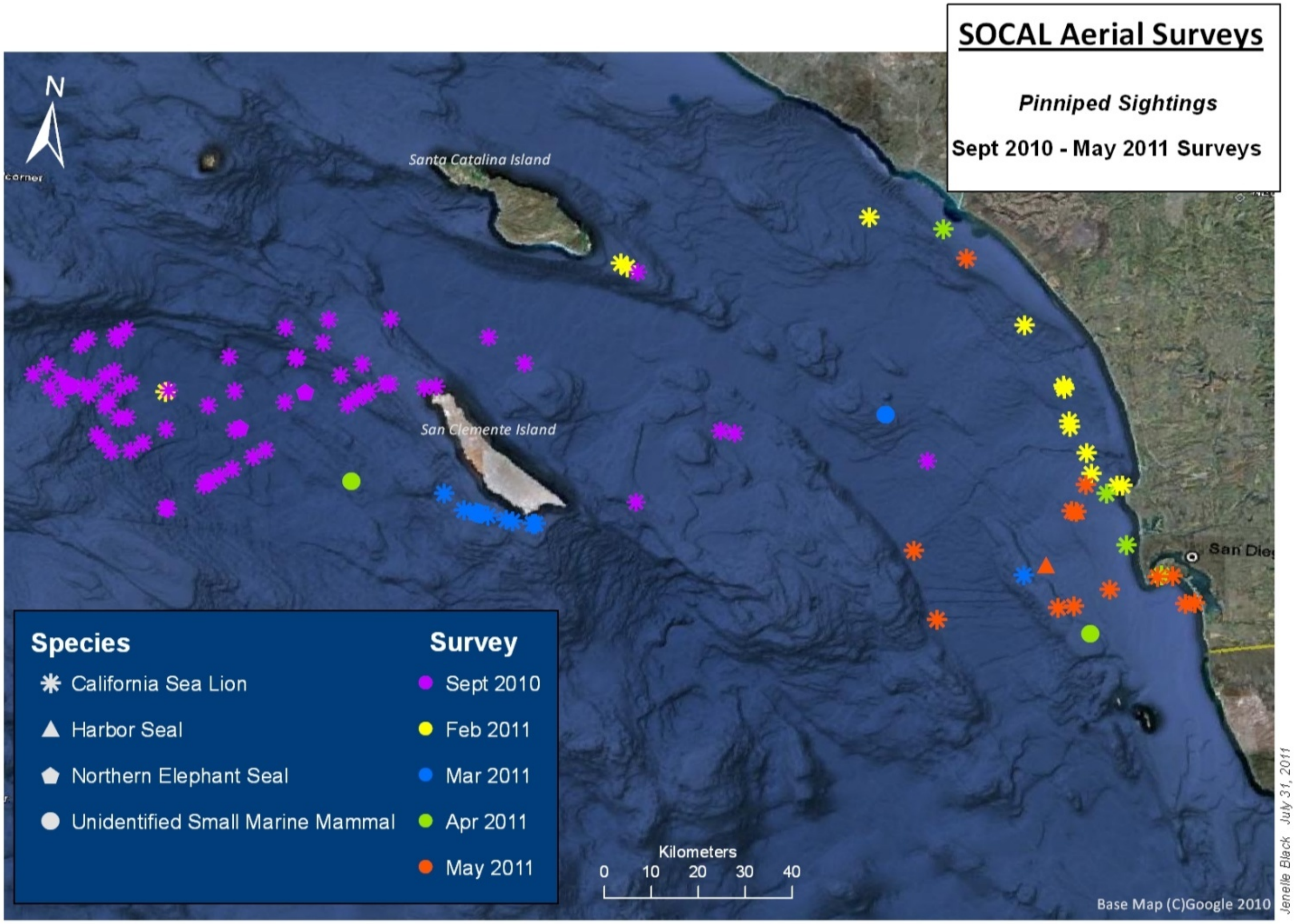

Figure 7. Pinniped sightings by species color-coded by month, during aerial surveys in SOCAL September 2010 and February – May 2011.

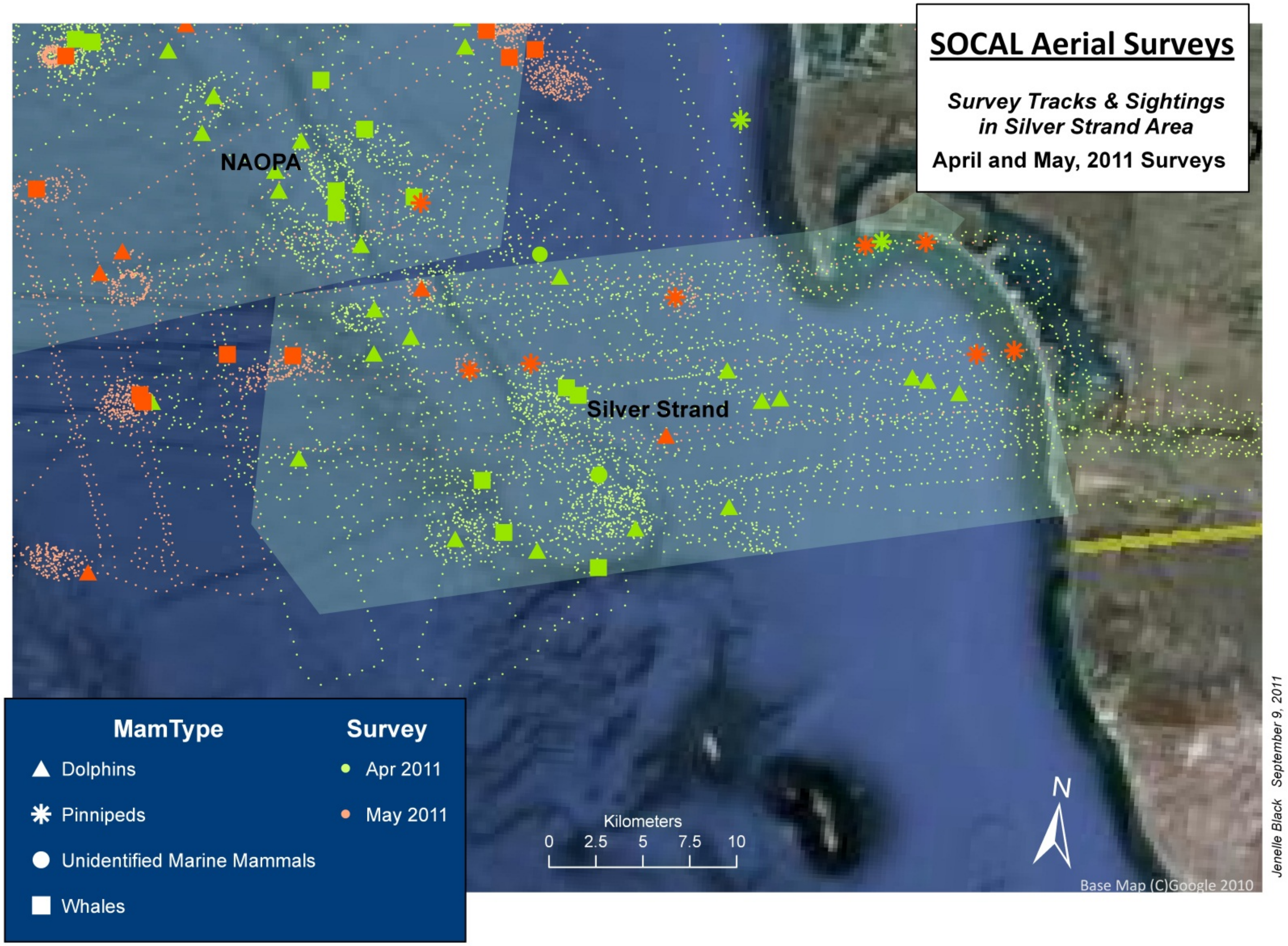

Figure 8. Aerial survey tracks and sightings in the Silver Strand area off San Diego flown in April and May 2011.

Appendix C. Tables

Table 1. Summary of Surveys September 2010 and February – May 2011.

Parameter	September	February	March	April	May	Total
Survey Dates	23-28 September 2010	14-19 February 2011	29 March - 3 April 2011	12-20 April 2011	9-14 May 2011	**5 surveys: September, February, March, April, May**
No. Days Flown	6	4	3	9	6	**28**
Platform Used	Partenavia P68-OBS	Partenavia P68-C	Partenavia P68-C	Twin Commander 685	Partenavia P68-C	**Partenavia or Twin Commander**
Major Training Exercise (MTE) Before, During or After Survey?	During, After	Before, During, After	none	none	During	**During, Before or After**
Total Flight Hr (Wheels up/down)	27.7	17.2	9.5	46.0	27.0	**127.4**
Total Observation Effort (km) *(excl. poor weather, over land)*	3918 km	3193 km	1865 km	10,976 km	4902 km	**24,854 km**
	(2116 nm)	(1724 nm)	(1007 nm)	(5926 nm)	(2647 nm)	**(13,420 nm)**
No. Groups Seen	252	83	71	136	81	**623**
Estimated No. Individuals	38,022	11,131	2,165	14,130	3,309	**68,757**
No. Dead Sightings	0	0	0	0	1	**1**
No. Species	9	8	8	11	11	**17**
No. Focal Groups Circled 5-9 min	6	2	4	0	0	**12**
No. Extended Focal Groups Circled >10 min	10	6	10	15	18	**59**
Longest Focal Follow Duration	45 min (Bryde's whale)	30 min (Gray whale)	22 min (Common dolphin sp.)	48 min (Fin whale)	67 min (Sperm whale)	**67 min (Sperm whale)**
No. Photos Taken	741	473	323	424	976	**2,937**
Estimated Usable Video (min)	143 min	79 min	95 min	239 min	299 min	**855 min**

Table 2. Unusual or noteworthy observations of marine mammals in the SOCAL aerial survey area September 2010 and February – May 2011.

Date	Time	Species	Group Size	Data Format Available for Review	Comments
9/24/2010	13:56:15	Bryde's whale, *Balaenoptera brydei/edeni*	1	field data sheet: observation record, photos	3 rostral ridges; Dr. Tom Jefferson confirmed photo as Bryde's whale
9/25/2010	11:55:00	Northern elephant seal, *Mirounga angustirostris*	11	field data sheet: observation record, photos	Stayed swimming at or near surface the whole time we circled
9/26/2010	12:00:00	Cuvier's beaked whale, *Ziphius cavirostris*	2	field data sheet: observation record	Blowing at surface and traveling slowly in opposite direction from the Cascadia Research Collective rigid-hulled inflatable research boat that was ~25 m away; D. Moretti group had been hearing them on hydrophone. Circled at 1 to 1.5 km radius to not interfere with the whales (well outside Snell's cone, at 304 m (1000 ft) altitude). Dr. B. Southall asked us to aid in sighting cetaceans for their ongoing SOCAL Behavioral Response Study (BRS), in particular helping to resight the Cuvier's beaked whales.
9/28/2010	9:41:30	Sei or Bryde's whale, *Balaenoptera borealis or B. brydei/edeni*	3	field data sheet: observation record, photos	Initially seen underwater then fluking up, circled for over 30 min while the whales sporadically lunge fed, 1 clear central rostral ridge and 2 small rostral ridges. Dr. Tom Jefferson examined photos but unclear if they were sei or Bryde's whales. No white on right side of jaw.
2/15/2011	8:45:10	Gray whale, *Eschrichtius robustus*	2	field data sheet: observation record; video, photos	A young (estimated under several days old) calf riding mother's back 3 times while mother rested/drifted. During apparent nursing, the calf faced mother at a 45° angle while mother held up her flukes.

Date	Time	Species	Group Size	Data Format Available for Review	Comments
2/17/2011	9:37:12	Dall's porpoise, *Phocoenoides dalli*	5	field data sheet: observation record	Small distinct black and white body coloration, small dolphin size of common dolphin but more robust and fatter.
4/1/2011	9:58:39	Risso's dolphins, *Grampus griseus*, northern right whale dolphins, *Lissodelphis borealis*	14 Risso's dolphins, 40 northern right whale dolphins	field data sheet: observation record; video, photos	Risso's dolphins and northern right whale dolphins appeared to forage and intersperse in same area. Both species occasionally sprinting followed by quick steep, brief dive and returning to the surface in the same area. Appeared to be foraging.
4/13/2011	15:23:10	*Dall's porpoise, *Phocoenoides dalli*	3	field data sheet: observation record	Identified as probable Dall's porpoise by the unique "rooster tailing" during fast travel and black and white contrasting color pattern and small body size.
4/14/2011	11:19:25	*Fin whales, *Balaenoptera physalus*	3	field data sheet: observation record, photos	Four fin whales seen for extended periods at the surface. Behaviors included animals rolling (ventral side at the surface) within 1 body length of each other (rarely observed or reported social behavior for fin whales)
4/19/2011	12:57:08	*Gray whale, *Eschrichtius robustus*	2	field data sheet: observation record	Gray whale calf observed interacting with mother. The calf moved on top of mother, apparently resting before and into nursing positions below mother. Team observed the calf moving under the mother's flukes from one side to the other in an apparent effort to return to a nursing position on the opposite side of mother.
5/9/2011	16:10:25	Whale shark, *Rhincodon typus*	1	field data sheet: vessel record	Seen while circling blue whale; brown body, seen swimming horizontally with tail like shark not like cetaceans. Smaller than a fin whale, maybe 10 m long. Head was much broader than latter half of body.

Date	Time	Species	Group Size	Data Format Available for Review	Comments
5/10/2011	12:06:26	Dead humpback whale, *Megaptera novaeangliae*	1	field data sheet: observation record, video, photos	19 nm off shore of Lindbergh Airport, one large (~ 4 m or 12-13 ft long) blue shark circling carcass. Many gulls on top of and circling carcass.
5/11/2011	15:59:54	Dead humpback whale, *Megaptera novaeangliae*	1	field data sheet: observation record, video, photos	Same humpback whale carcass seen previous day. Located about 4 nm west of Soledad, San Diego. 32 deg 48.17 N lat, 117 deg 19.22 W long. No sharks seen, some gulls, flesh hanging off chin into water, may be able to identify individual fluke patterns with N Pacific humpback catalog and animal's sex based on photos from plane.
5/14/2011	16:55:00	Risso's dolphins	14	field data sheet: video and observation record	Navy vessel seen ~2.5 nm away from group of Risso's. Risso's surface-active travel with a few individuals breaching. Such surface-active behavior by Risso's rarely observed during our previous SOCAL aerials surveys.
5/14/2011	10:36:14	Sperm whales, *Physeter macrocephalus;* Risso's dolphins, *Grampus griseus;* northern right whale dolphins*,* *Lissodelphis borealis*	20 sperm whales, 11 Risso's dolphins, 50 northern right whale dolphins	field data sheet: observation and behavior record, video, photos	Nursery group including 4 calves and no obvious large males; one calf very close to mother. Risso's dolphins swimming with and apparently harassing sperm whale nursery group by charging then fleeing repeatedly. Sperm whales seen opening their mouths and dropping their lower jaw on numerous occasions when Risso's dolphins swim close by the mouth of the sperm whale. Northern right whale dolphins interspersed as well.
4/1/2011-5/14/2011		Ocean sunfish, *mola mola*	n=2 during March survey, 44 in April survey, 14 in May survey	field data sheet: vessel record	Ocean sunfish counts and declination angles were taken during the March survey and continued through the May survey.

*Note: unable to get quality video and photos through the closed window of the Twin Commander. Open windows were not available to the research team.

Table 3. Numbers of individuals and groups by species seen during SOCAL marine species monitoring surveys, September 2010 and February - May 2011. Note: In descending order, except for Short and Long-Beaked Common Dolphins.

Common Name	Scientific Name	September		February		March		April		May		Total	
		# Grps	# Indiv	# Grps	# Indiv	# Grps	# Indiv	# Grps	# Indiv	# Grps	# Indiv	# Grps	# Indiv
Common Dolphin sp.	*Delphinus* sp.	113	32,297	20	4,860	15	713	35	5,432	9	1,845	**192**	**45,147**
Short-beaked Common Dolphin	*Delphinus delphis*	5	1,015	8	3,765	1	40	5	4,795	3	1,115	**22**	**10,730**
Long-beaked Common Dolphin	*Delphinus capensis*	8	874	3	752	3	580	5	1,900	1	50	**20**	**4,156**
California Sea Lion	*Zalophus californianus*	72	213	13	33	10	13	4	6	13	40	**112**	**305**
Unidentified Dolphin	Delphinidae sp.	31	3,459	12	1,399	5	449	17	723	7	501	**72**	**6,531**
Risso's Dolphin	*Grampus griseus*	6	76	8	178	15	232	28	1,069	9	100	**66**	**1,655**
Bottlenose Dolphin	*Tursiops truncatus*	5	49	8	127	5	38	7	146	6	127	**31**	**487**
Fin Whale	*Balaenoptera physalus*	0	0	3	4	0	0	12	20	8	11	**23**	**35**
Blue Whale	*Balaenoptera musculus*	0	0	0	0	0	0	3	4	12	15	**15**	**19**
Gray Whale	*Eschrichtius robustus*	0	0	5	6	5	14	4	7	0	0	**14**	**27**
Unidentified Baleen Whale	*Balaenoptera* sp.	2	2	1	1	0	0	1	1	4	5	**8**	**9**
Northern Right Whale Dolphin	*Lissodelphis borealis*	0	0	0	0	4	55	2	10	1	50	**7**	**115**
Minke Whale	*Balaenoptera acutorostrata*	1	3	1	1	2	3	2	3	1	1	**7**	**11**

Common Name	Scientific Name	September		February		March		April		May		Total	
		# Grps	# Indiv	# Grps	# Indiv	# Grps	# Indiv	# Grps	# Indiv	# Grps	# Indiv	# Grps	# Indiv
Humpback Whale	*Megaptera novaeangliae*	0	0	0	0	1	2	2	2	2	2	**5**	**6**
Unidentified Whale	Cetacea	0	0	0	0	1	3	3	4	0	0	**4**	**7**
Unidentified Small Marine Mammal	Cetacea or Pinnipedia	1	1	0	0	1	1	2	2	0	0	**4**	**4**
Northern Elephant Seal	*Mirounga angustirostris*	3	22	0	0	0	0	0	0	0	0	**3**	**22**
Unidentified Medium Whale	Cetacea	0	0	0	0	1	1	1	1	1	4	**3**	**6**
Harbor Seal	*Phoca vitulina*	0	0	0	0	0	0	0	0	2	4	**2**	**4**
Dall's Porpoise	*Phocoenoides dalli*	0	0	1	5	0	0	1	3	0	0	**2**	**8**
Unidentified Small Dolphin	Delphinidae sp.	0	0	0	0	1	20	0	0	0	0	**1**	**20**
Unidentified Medium Marine Mammal	Cetacea or Pinnipedia	1	1	0	0	0	0	0	0	0	0	**1**	**1**
Sperm Whale	*Physeter macrocephalus*	0	0	0	0	0	0	0	0	1	20	**1**	**20**
Unidentified Marine Mammal	Cetacea	1	4	0	0	0	0	0	0	0	0	**1**	**4**
Sei/Bryde's Whale	*Balaenoptera borealis or edeni/brydei*	1	3	0	0	0	0	0	0	0	0	**1**	**3**
Cuvier's Beaked Whale	*Ziphius cavirostris*	1	2	0	0	0	0	0	0	0	0	**1**	**2**
Fin/Sei/Bryde's Whale	*Balaenoptera* sp.	0	0	0	0	1	1	0	0	0	0	**1**	**1**

Common Name	Scientific Name	September		February		March		April		May		Total	
		# Grps	# Indiv	# Grps	# Indiv	# Grps	# Indiv	# Grps	# Indiv	# Grps	# Indiv	# Grps	# Indiv
Bryde's Whale	*Balaenoptera brydei/edeni*	1	1	0	0	0	0	0	0	0	0	**1**	**1**
Unidentified Large Whale	Cetacea	0	0	0	0	0	0	1	1	0	0	**1**	**1**
Unidentified Small Whale	Cetacea	0	0	0	0	0	0	1	1	0	0	**1**	**1**
Total		**252**	**38,022**	**83**	**11,131**	**71**	**2,165**	**136**	**14,130**	**81**	**3,309**	**623**	**68,757**

Table 4. Locations, species descriptions and group sizes for all sightings on September 2010 and February-May 2011 SOCAL aerial surveys.

Date & Time	Species Common Name	Species Scientific Name	Group Size	Latitude	Longitude
SEPTEMBER SURVEY: 23-28 September 2011					
09/23/2010 15:10:53	Long-Beaked Common Dolphin	*Delphinus capensis*	25	32.76800	-117.57533
09/23/2010 15:28:54	Common Dolphin sp.	undifferentiated *Delphinus*	6	32.92483	-117.40550
09/23/2010 15:54:04	Bottlenose Dolphin	*Tursiops truncatus*	1	32.79050	-118.01200
09/23/2010 16:07:24	Short-Beaked Common Dolphin	*Delphinus delphis*	15	32.81333	-118.23150
09/23/2010 16:08:24	California Sea Lion	*Zalophus californianus*	1	32.81683	-118.21700
09/23/2010 16:16:14	Long-Beaked Common Dolphin	*Delphinus capensis*	60	32.87733	-118.24733
09/23/2010 16:29:54	Common Dolphin sp.	undifferentiated *Delphinus*	700	32.90483	-118.11367
09/23/2010 16:54:14	Common Dolphin sp.	undifferentiated *Delphinus*	600	33.01700	-117.32650
09/23/2010 16:56:54	Bottlenose Dolphin	*Tursiops truncatus*	2	32.95150	-117.30950
09/23/2010 16:59:04	Common Dolphin sp.	undifferentiated *Delphinus*	80	32.89967	-117.31600
09/23/2010 17:09:15	Common Dolphin sp.	undifferentiated *Delphinus*	200	32.65517	-117.30383
09/23/2010 17:09:55	Common Dolphin sp.	undifferentiated *Delphinus*	300	32.64183	-117.29133
09/23/2010 17:14:55	Bottlenose Dolphin	*Tursiops truncatus*	3	32.55350	-117.25383
09/23/2010 17:21:15	Common Dolphin sp.	undifferentiated *Delphinus*	315	32.70167	-117.34133
09/23/2010 17:24:25	Common Dolphin sp.	undifferentiated *Delphinus*	40	32.78700	-117.36367
09/24/2010 12:02:38	Unidentified Medium Marine Mammal	unidentified marine mammal	1	33.00333	-117.99567
09/24/2010 12:07:30	Unidentified Dolphin	unidentified Delphinidae	250	33.04517	-118.20767
09/24/2010 12:08:57	Common Dolphin sp.	undifferentiated *Delphinus*	100	33.05783	-118.27133
09/24/2010 12:09:32	Unidentified Dolphin	unidentified Delphinidae	1000	33.06233	-118.29717
09/24/2010 12:16:55	Bottlenose Dolphin	*Tursiops truncatus*	25	33.12833	-118.62200
09/24/2010 12:21:05	California Sea Lion	*Zalophus californianus*	1	33.16700	-118.80450
09/24/2010 12:27:29	Short-Beaked Common Dolphin	*Delphinus delphis*	375	33.08733	-119.00617
09/24/2010 12:35:59	Unidentified Marine Mammal	unidentified marine mammal	4	33.03217	-119.11017
09/24/2010 12:36:42	California Sea Lion	*Zalophus californianus*	2	33.02883	-119.11800
09/24/2010 12:37:36	Common Dolphin sp.	undifferentiated *Delphinus*	75	33.01800	-119.13567
09/24/2010 12:38:52	Common Dolphin sp.	undifferentiated *Delphinus*	70	32.99900	-119.16950

Date & Time	Species Common Name	Species Scientific Name	Group Size	Latitude	Longitude
SEPTEMBER SURVEY: 23-28 September 2011 (continued)					
09/24/2010 12:39:22	Common Dolphin sp.	undifferentiated *Delphinus*	125	32.99150	-119.18300
09/24/2010 12:40:15	California Sea Lion	*Zalophus californianus*	30	32.97850	-119.20633
09/24/2010 12:40:25	Unidentified Dolphin	unidentified Delphinidae	4	32.97850	-119.20633
09/24/2010 12:42:14	California Sea Lion	*Zalophus californianus*	4	32.94633	-119.24717
09/24/2010 12:42:53	California Sea Lion	*Zalophus californianus*	1	32.93217	-119.23567
09/24/2010 12:43:00	California Sea Lion	*Zalophus californianus*	3	32.93217	-119.23567
09/24/2010 12:43:30	California Sea Lion	*Zalophus californianus*	1	32.93217	-119.23567
09/24/2010 12:43:44	California Sea Lion	*Zalophus californianus*	1	32.91367	-119.22017
09/24/2010 12:44:16	Common Dolphin sp.	undifferentiated *Delphinus*	*	32.90200	-119.21050
09/24/2010 12:48:38	California Sea Lion	*Zalophus californianus*	1	32.91600	-119.18317
09/24/2010 12:49:36	California Sea Lion	*Zalophus californianus*	2	32.93133	-119.15867
09/24/2010 12:50:05	California Sea Lion	*Zalophus californianus*	2	32.93133	-119.15867
09/24/2010 12:50:53	Unidentified Marine Mammal	unidentified marine mammal	5	32.95200	-119.12367
09/24/2010 12:54:06	Northern Elephant Seal	*Mirounga angustirostris*	5	32.96733	-119.12433
09/24/2010 13:06:17	California Sea Lion	*Zalophus californianus*	1	33.00250	-119.03433
09/24/2010 13:08:01	California Sea Lion	*Zalophus californianus*	1	33.02967	-118.98367
09/24/2010 13:11:57	California Sea Lion	*Zalophus californianus*	1	33.09317	-118.86650
09/24/2010 13:13:52	California Sea Lion	*Zalophus californianus*	2	33.12267	-118.81467
09/24/2010 13:21:23	California Sea Lion	*Zalophus californianus*	1	33.08183	-118.74050
09/24/2010 13:22:51	California Sea Lion	*Zalophus californianus*	2	33.06067	-118.78117
09/24/2010 13:25:15	Common Dolphin sp.	undifferentiated *Delphinus*	2	33.02567	-118.84583
09/24/2010 13:30:44	California Sea Lion	*Zalophus californianus*	25	33.00817	-118.88767
09/24/2010 13:34:12	California Sea Lion	*Zalophus californianus*	4	32.95600	-118.98417
09/24/2010 13:42:05	Unidentified Baleen Whale	unidentified balaenopterid	1	32.83850	-119.14900
09/24/2010 13:48:43	California Sea Lion	*Zalophus californianus*	1	32.80600	-119.11600
09/24/2010 13:48:50	California Sea Lion	*Zalophus californianus*	1	32.80600	-119.11600
09/24/2010 13:51:19	California Sea Lion	*Zalophus californianus*	2	32.84883	-119.04400
09/24/2010 13:51:50	California Sea Lion	*Zalophus californianus*	1	32.85667	-119.03067

Date & Time	Species Common Name	Species Scientific Name	Group Size	Latitude	Longitude
SEPTEMBER SURVEY: 23-28 September 2011 (continued)					
09/24/2010 13:52:10	California Sea Lion	*Zalophus californianus*	1	32.85667	-119.03067
09/24/2010 13:52:29	California Sea Lion	*Zalophus californianus*	1	32.86683	-119.01317
09/24/2010 13:52:42	California Sea Lion	*Zalophus californianus*	1	32.86683	-119.01317
09/24/2010 13:53:17	California Sea Lion	*Zalophus californianus*	2	32.86683	-119.01317
09/24/2010 13:53:22	California Sea Lion	*Zalophus californianus*	2	32.88083	-118.98800
09/24/2010 13:54:47	California Sea Lion	*Zalophus californianus*	1	32.90367	-118.94850
09/24/2010 13:55:04	California Sea Lion	*Zalophus californianus*	2	32.90367	-118.94850
09/24/2010 13:55:38	California Sea Lion	*Zalophus californianus*	4	32.91700	-118.92500
09/24/2010 13:56:15	Bryde's Whale	*Balaenoptera brydei/edeni*	1	32.91700	-118.92500
09/24/2010 14:02:33	California Sea Lion	*Zalophus californianus*	1	33.00467	-118.76850
09/24/2010 14:03:17	California Sea Lion	*Zalophus californianus*	1	33.01617	-118.74900
09/24/2010 14:03:46	California Sea Lion	*Zalophus californianus*	1	33.01617	-118.74900
09/24/2010 14:05:11	California Sea Lion	*Zalophus californianus*	1	33.04450	-118.69550
09/24/2010 14:05:25	California Sea Lion	*Zalophus californianus*	1	33.04417	-118.68733
09/24/2010 14:07:18	California Sea Lion	*Zalophus californianus*	1	33.03617	-118.62200
09/24/2010 14:07:56	California Sea Lion	*Zalophus californianus*	1	33.03617	-118.62200
09/24/2010 14:16:14	Long-Beaked Common Dolphin	*Delphinus capensis*	250	32.99217	-118.31783
09/24/2010 14:22:42	Risso's Dolphin	*Grampus griseus*	2	32.99467	-118.27783
09/24/2010 14:22:44	Unidentified Dolphin	unidentified Delphinidae	15	32.99467	-118.27783
09/24/2010 14:27:05	Common Dolphin sp.	undifferentiated *Delphinus*	300	32.97267	-118.19200
09/24/2010 14:30:00	Unidentified Dolphin	unidentified Delphinidae	5	32.95833	-118.08700
09/24/2010 14:30:56	California Sea Lion	*Zalophus californianus*	1	32.95367	-118.05467
09/24/2010 14:31:42	California Sea Lion	*Zalophus californianus*	1	32.95367	-118.05467
09/24/2010 14:32:26	Common Dolphin sp.	undifferentiated *Delphinus*	400	32.94750	-118.00283
09/24/2010 14:33:08	Common Dolphin sp.	undifferentiated *Delphinus*	400	32.94350	-117.97783
09/24/2010 14:37:03	Common Dolphin sp.	undifferentiated *Delphinus*	50	32.92250	-117.83400
09/24/2010 14:37:53	Common Dolphin sp.	undifferentiated *Delphinus*	200	32.91817	-117.80817
09/24/2010 14:38:50	Common Dolphin sp.	undifferentiated *Delphinus*	6	32.91383	-117.77783

Date & Time	Species Common Name	Species Scientific Name	Group Size	Latitude	Longitude
SEPTEMBER SURVEY: 23-28 September 2011 (continued)					
09/24/2010 14:42:18	California Sea Lion	*Zalophus californianus*	1	32.89667	-117.65817
09/24/2010 16:10:58	Common Dolphin sp.	undifferentiated *Delphinus*	400	32.91200	-117.34750
09/24/2010 16:15:58	Common Dolphin sp.	undifferentiated *Delphinus*	100	33.02083	-117.48933
09/24/2010 16:17:58	Long-Beaked Common Dolphin	*Delphinus capensis*	*	33.03483	-117.49433
09/24/2010 16:20:58	Long-Beaked Common Dolphin	*Delphinus capensis*	30	33.06867	-117.54217
09/24/2010 16:21:58	Long-Beaked Common Dolphin	*Delphinus capensis*	200	33.08400	-117.56750
09/24/2010 16:36:58	Long-Beaked Common Dolphin	*Delphinus capensis*	300	33.35767	-117.91533
09/24/2010 16:58:58	Common Dolphin sp.	undifferentiated *Delphinus*	40	33.41233	-117.86100
09/24/2010 17:04:58	Unidentified Dolphin	unidentified Delphinidae	150	33.38367	-117.80717
09/24/2010 17:08:58	Common Dolphin sp.	undifferentiated *Delphinus*	300	33.30950	-117.68300
09/24/2010 17:11:58	Common Dolphin sp.	undifferentiated *Delphinus*	300	33.30233	-117.65900
09/24/2010 17:12:58	Long-Beaked Common Dolphin	*Delphinus capensis*	9	33.28483	-117.62817
09/24/2010 17:17:58	Common Dolphin sp.	undifferentiated *Delphinus*	300	33.24483	-117.57750
09/24/2010 17:20:58	Common Dolphin sp.	undifferentiated *Delphinus*	75	33.18417	-117.49083
09/24/2010 17:24:58	Common Dolphin sp.	undifferentiated *Delphinus*	70	33.13867	-117.45267
09/25/2010 10:32:58	Common Dolphin sp.	undifferentiated *Delphinus*	700	32.94500	-117.67850
09/25/2010 10:33:01	Risso's Dolphin	*Grampus griseus*	10	32.94500	-117.67850
09/25/2010 10:38:58	Unidentified Dolphin	unidentified Delphinidae	19	32.98733	-117.89083
09/25/2010 10:44:48	Common Dolphin sp.	undifferentiated *Delphinus*	20	33.02883	-118.09717
09/25/2010 10:53:58	Unidentified Dolphin	unidentified Delphinidae	75	33.09350	-118.42567
09/25/2010 11:00:58	Common Dolphin sp.	undifferentiated *Delphinus*	350	33.14233	-118.67633
09/25/2010 11:06:58	California Sea Lion	*Zalophus californianus*	1	33.15267	-118.88733
09/25/2010 11:07:08	Common Dolphin sp.	undifferentiated *Delphinus*	1100	33.15267	-118.88733
09/25/2010 11:08:58	Unidentified Dolphin	unidentified Delphinidae	400	33.14433	-118.93867
09/25/2010 11:17:58	Common Dolphin sp.	undifferentiated *Delphinus*	15	33.05017	-119.07817
09/25/2010 11:37:58	California Sea Lion	*Zalophus californianus*	1	33.09500	-118.86500
09/25/2010 11:39:58	Short-Beaked Common Dolphin	*Delphinus delphis*	100	33.12667	-118.80767
09/25/2010 11:46:58	Common Dolphin sp.	undifferentiated *Delphinus*	400	33.12600	-118.69750

Date & Time	Species Common Name	Species Scientific Name	Group Size	Latitude	Longitude
SEPTEMBER SURVEY: 23-28 September 2011 (continued)					
09/25/2010 11:54:58	Northern Elephant Seal	*Mirounga angustirostris*	11	33.02967	-118.84833
09/25/2010 12:02:58	Northern Elephant Seal	*Mirounga angustirostris*	6	32.96183	-118.97300
09/25/2010 12:16:58	California Sea Lion	*Zalophus californianus*	35	32.85617	-119.03817
09/25/2010 12:29:58	California Sea Lion	*Zalophus californianus*	2	33.02450	-118.73500
09/25/2010 12:32:58	Common Dolphin sp.	undifferentiated *Delphinus*	1200	33.05167	-118.62867
09/25/2010 12:40:58	Common Dolphin sp.	undifferentiated *Delphinus*	1600	33.09733	-118.33067
09/25/2010 12:51:58	Common Dolphin sp.	undifferentiated *Delphinus*	150	33.15500	-118.08233
09/25/2010 13:01:58	Common Dolphin sp.	undifferentiated *Delphinus*	110	33.19183	-117.92133
09/25/2010 13:02:08	Common Dolphin sp.	undifferentiated *Delphinus*	50	33.19183	-117.92133
09/25/2010 13:05:58	Common Dolphin sp.	undifferentiated *Delphinus*	100	33.20100	-117.88233
09/25/2010 13:21:58	Short-Beaked Common Dolphin	*Delphinus delphis*	75	33.06433	-117.38400
09/25/2010 13:23:58	Common Dolphin sp.	undifferentiated *Delphinus*	200	33.06150	-117.36000
09/25/2010 13:27:58	Unidentified Dolphin	unidentified Delphinidae	40	32.96600	-117.31150
09/25/2010 13:28:58	Unidentified Dolphin	unidentified Delphinidae	8	32.93417	-117.30617
09/26/2010 10:46:10	Unidentified Dolphin	unidentified Delphinidae	1	32.94500	-117.55033
09/26/2010 10:50:30	Unidentified Dolphin	unidentified Delphinidae	30	32.97000	-117.72867
09/26/2010 10:52:20	Common Dolphin sp.	undifferentiated *Delphinus*	20	32.98167	-117.80300
09/26/2010 10:53:30	Common Dolphin sp.	undifferentiated *Delphinus*	40	32.99150	-117.84933
09/26/2010 10:55:20	Common Dolphin sp.	undifferentiated *Delphinus*	125	33.00550	-117.92333
09/26/2010 11:02:50	Common Dolphin sp.	undifferentiated *Delphinus*	200	33.06417	-118.22067
09/26/2010 11:04:50	Unidentified Dolphin	unidentified Delphinidae	20	33.07800	-118.30100
09/26/2010 11:09:10	Unidentified Dolphin	unidentified Delphinidae	2	33.10983	-118.47583
09/26/2010 11:11:00	Common Dolphin sp.	undifferentiated *Delphinus*	200	33.12467	-118.54967
09/26/2010 11:11:20	Common Dolphin sp.	undifferentiated *Delphinus*	60	33.12683	-118.56333
09/26/2010 11:12:50	Common Dolphin sp.	undifferentiated *Delphinus*	400	33.13800	-118.62500
09/26/2010 12:00:00	Cuvier's Beaked Whale	*Ziphius cavirostris*	2	32.84183	-119.15033
09/26/2010 12:43:10	California Sea Lion	*Zalophus californianus*	1	32.97950	-119.18967
09/26/2010 12:58:10	Unidentified Dolphin	unidentified Delphinidae	15	32.94583	-119.25417

Date & Time	Species Common Name	Species Scientific Name	Group Size	Latitude	Longitude
SEPTEMBER SURVEY: 23-28 September 2011 (continued)					
09/26/2010 13:13:30	Common Dolphin sp.	undifferentiated *Delphinus*	1000	33.17500	-118.84650
09/26/2010 13:43:10	California Sea Lion	*Zalophus californianus*	2	33.16850	-118.68533
09/26/2010 13:47:40	Common Dolphin sp.	undifferentiated *Delphinus*	75	33.11733	-118.48750
09/26/2010 13:59:00	Unidentified Dolphin	unidentified Delphinidae	24	33.01717	-117.96950
09/26/2010 14:01:50	Unidentified Dolphin	unidentified Delphinidae	150	32.97650	-117.84217
09/26/2010 14:02:30	Common Dolphin sp.	undifferentiated *Delphinus*	50	32.96667	-117.81217
09/26/2010 14:09:10	Common Dolphin sp.	undifferentiated *Delphinus*	250	32.88683	-117.50433
09/26/2010 14:10:10	Common Dolphin sp.	undifferentiated *Delphinus*	550	32.87683	-117.45817
09/26/2010 15:34:53	Unidentified Dolphin	unidentified Delphinidae	70	33.03067	-117.43667
09/26/2010 15:35:53	Unidentified Dolphin	unidentified Delphinidae	4	33.05650	-117.45850
09/26/2010 15:37:53	Common Dolphin sp.	undifferentiated *Delphinus*	190	33.09633	-117.51383
09/26/2010 15:46:53	Common Dolphin sp.	undifferentiated *Delphinus*	100	33.32067	-117.69717
09/26/2010 15:48:13	Common Dolphin sp.	undifferentiated *Delphinus*	90	33.35700	-117.72233
09/26/2010 16:00:53	Short-Beaked Common Dolphin	*Delphinus delphis*	450	33.37400	-118.03250
09/26/2010 16:10:33	Common Dolphin sp.	undifferentiated *Delphinus*	75	33.41467	-118.01467
09/26/2010 16:19:23	Unidentified Dolphin	unidentified Delphinidae	125	33.26750	-118.30267
09/26/2010 16:53:33	Common Dolphin sp.	undifferentiated *Delphinus*	400	33.12900	-117.42150
09/27/2010 09:44:54	Unidentified Dolphin	unidentified Delphinidae	50	32.89650	-117.32667
09/27/2010 09:54:54	Common Dolphin sp.	undifferentiated *Delphinus*	2100	32.95900	-117.78850
09/27/2010 09:55:00	Common Dolphin sp.	undifferentiated *Delphinus*	550	32.95900	-117.78850
09/27/2010 09:55:54	Common Dolphin sp.	undifferentiated *Delphinus*	200	32.96633	-117.83483
09/27/2010 09:56:54	Common Dolphin sp.	undifferentiated *Delphinus*	150	32.97383	-117.88083
09/27/2010 10:05:24	Unidentified Dolphin	unidentified Delphinidae	60	33.06967	-118.25783
09/27/2010 10:06:24	Common Dolphin sp.	undifferentiated *Delphinus*	2200	33.09117	-118.29467
09/27/2010 10:11:04	California Sea Lion	*Zalophus californianus*	2	33.13433	-118.49767
09/27/2010 10:17:14	Common Dolphin sp.	undifferentiated *Delphinus*	250	33.17733	-118.75567
09/27/2010 10:18:04	Common Dolphin sp.	undifferentiated *Delphinus*	200	33.18233	-118.78533
09/27/2010 10:19:14	Common Dolphin sp.	undifferentiated *Delphinus*	25	33.18017	-118.82883

Date & Time	Species Common Name	Species Scientific Name	Group Size	Latitude	Longitude
SEPTEMBER SURVEY: 23-28 September 2011 (continued)					
09/27/2010 10:24:44	California Sea Lion	*Zalophus californianus*	1	33.09483	-118.99450
09/27/2010 10:25:44	Common Dolphin sp.	undifferentiated *Delphinus*	50	33.07867	-119.02500
09/27/2010 10:46:35	California Sea Lion	*Zalophus californianus*	1	33.12850	-119.20767
09/27/2010 10:46:55	California Sea Lion	*Zalophus californianus*	1	33.13700	-119.21317
09/27/2010 10:48:05	Risso's Dolphin	*Grampus griseus*	30	33.16500	-119.22767
09/27/2010 11:15:35	California Sea Lion	*Zalophus californianus*	2	33.06183	-119.36883
09/27/2010 11:16:45	California Sea Lion	*Zalophus californianus*	2	33.08083	-119.34317
09/27/2010 11:23:25	Unidentified Small Marine Mammal	unidentified marine mammal	1	33.04083	-119.29950
09/27/2010 11:27:25	California Sea Lion	*Zalophus californianus*	1	33.03900	-119.27400
09/27/2010 11:29:56	California Sea Lion	*Zalophus californianus*	1	33.06883	-119.21467
09/27/2010 11:35:36	California Sea Lion	*Zalophus californianus*	1	33.00183	-119.23300
09/27/2010 11:36:06	California Sea Lion	*Zalophus californianus*	1	33.01183	-119.22383
09/27/2010 11:37:16	California Sea Lion	*Zalophus californianus*	1	33.03617	-119.20417
09/27/2010 11:38:06	California Sea Lion	*Zalophus californianus*	1	33.04567	-119.18367
09/27/2010 11:50:16	California Sea Lion	*Zalophus californianus*	1	33.05833	-119.23300
09/27/2010 11:51:16	California Sea Lion	*Zalophus californianus*	2	33.03733	-119.25267
09/27/2010 11:51:56	California Sea Lion	*Zalophus californianus*	1	33.02300	-119.26450
09/27/2010 11:55:06	Minke Whale	*Balaenoptera acutorostrata*	3	33.01867	-119.32683
09/27/2010 11:59:56	California Sea Lion	*Zalophus californianus*	1	33.01550	-119.31867
09/27/2010 12:10:56	California Sea Lion	*Zalophus californianus*	1	33.05767	-119.31733
09/27/2010 12:11:56	California Sea Lion	*Zalophus californianus*	5	33.03700	-119.33817
09/27/2010 12:16:16	California Sea Lion	*Zalophus californianus*	2	33.11800	-119.27933
09/27/2010 12:16:56	California Sea Lion	*Zalophus californianus*	1	33.13000	-119.26433
09/27/2010 12:19:26	California Sea Lion	*Zalophus californianus*	1	33.14867	-119.19183
09/27/2010 12:21:06	Risso's Dolphin	*Grampus griseus*	8	33.14800	-119.12850
09/27/2010 12:45:06	Common Dolphin sp.	undifferentiated *Delphinus*	100	33.16267	-118.90000
09/27/2010 12:56:46	California Sea Lion	*Zalophus californianus*	4	33.08283	-118.42917
09/27/2010 13:00:16	Common Dolphin sp.	undifferentiated *Delphinus*	350	33.10783	-118.28800

Date & Time	Species Common Name	Species Scientific Name	Group Size	Latitude	Longitude
SEPTEMBER SURVEY: 23-28 September 2011 (continued)					
09/27/2010 13:00:56	Common Dolphin sp.	undifferentiated *Delphinus*	40	33.11133	-118.26017
09/27/2010 13:04:36	Common Dolphin sp.	undifferentiated *Delphinus*	605	33.14500	-118.10917
09/27/2010 13:11:36	Common Dolphin sp.	undifferentiated *Delphinus*	180	33.20033	-117.81383
09/27/2010 13:13:06	Common Dolphin sp.	undifferentiated *Delphinus*	40	33.21533	-117.75017
09/27/2010 13:16:36	Common Dolphin sp.	undifferentiated *Delphinus*	55	33.25300	-117.59717
09/27/2010 13:17:46	Common Dolphin sp.	undifferentiated *Delphinus*	450	33.24783	-117.54717
09/27/2010 13:21:56	Unidentified Dolphin	unidentified Delphinidae	100	33.13217	-117.43200
09/27/2010 13:23:56	Common Dolphin sp.	undifferentiated *Delphinus*	300	33.07050	-117.38967
09/27/2010 13:24:56	Common Dolphin sp.	undifferentiated *Delphinus*	850	33.03883	-117.36917
09/27/2010 13:26:56	Unidentified Dolphin	unidentified Delphinidae	250	32.97300	-117.33367
09/27/2010 13:28:16	Common Dolphin sp.	undifferentiated *Delphinus*	750	32.92783	-117.31317
09/27/2010 14:46:43	Common Dolphin sp.	undifferentiated *Delphinus*	650	32.90500	-117.28867
09/27/2010 14:48:13	Common Dolphin sp.	undifferentiated *Delphinus*	125	32.95350	-117.31917
09/27/2010 14:50:03	Common Dolphin sp.	undifferentiated *Delphinus*	50	33.00717	-117.35300
09/27/2010 14:50:33	Common Dolphin sp.	undifferentiated *Delphinus*	350	33.02117	-117.36250
09/27/2010 14:51:23	Common Dolphin sp.	undifferentiated *Delphinus*	75	33.04400	-117.37800
09/27/2010 14:52:43	Common Dolphin sp.	undifferentiated *Delphinus*	60	33.05033	-117.41783
09/27/2010 14:57:13	Common Dolphin sp.	undifferentiated *Delphinus*	12	33.01917	-117.56033
09/27/2010 14:57:23	Common Dolphin sp.	undifferentiated *Delphinus*	275	33.01800	-117.56600
09/27/2010 15:01:03	Common Dolphin sp.	undifferentiated *Delphinus*	40	33.01167	-117.60967
09/27/2010 15:01:43	Common Dolphin sp.	undifferentiated *Delphinus*	90	33.00683	-117.63067
09/27/2010 15:02:23	Common Dolphin sp.	undifferentiated *Delphinus*	135	33.00150	-117.65267
09/27/2010 15:17:13	Common Dolphin sp.	undifferentiated *Delphinus*	30	32.98617	-117.71750
09/27/2010 15:19:33	Common Dolphin sp.	undifferentiated *Delphinus*	50	32.97367	-117.78567
09/27/2010 15:27:43	Common Dolphin sp.	undifferentiated *Delphinus*	1299	32.92567	-118.02500
09/27/2010 15:27:53	Common Dolphin sp.	undifferentiated *Delphinus*	70	32.92567	-118.02500
09/27/2010 16:15:53	Unidentified Dolphin	unidentified Delphinidae	25	32.98367	-117.55150
09/27/2010 16:19:43	Common Dolphin sp.	undifferentiated *Delphinus*	505	33.01050	-117.42667

Date & Time	Species Common Name	Species Scientific Name	Group Size	Latitude	Longitude
SEPTEMBER SURVEY: 23-28 September 2011 (continued)					
09/27/2010 16:24:23	Common Dolphin sp.	undifferentiated *Delphinus*	450	32.93050	-117.31817
09/28/2010 08:48:59	Unidentified Dolphin	unidentified Delphinidae	1	32.88267	-117.29833
09/28/2010 08:54:59	Unidentified Baleen Whale	unidentified balaenopterid	1	33.03300	-117.44250
09/28/2010 08:58:19	Common Dolphin sp.	undifferentiated *Delphinus*	600	33.04167	-117.44633
09/28/2010 09:32:49	Common Dolphin sp.	undifferentiated *Delphinus*	150	33.10050	-117.51933
09/28/2010 09:41:29	Sei/Bryde's Whale	*Balaenoptera borealis/edeni/brydei*	3	33.27733	-117.79600
09/28/2010 09:59:59	Unidentified Dolphin	unidentified Delphinidae	500	33.31367	-117.79800
09/28/2010 10:27:39	Unidentified Dolphin	unidentified Delphinidae	8	33.42817	-117.99683
09/28/2010 11:58:51	Unidentified Dolphin	unidentified Delphinidae	8	34.16033	-119.32867
09/28/2010 12:20:31	Common Dolphin sp.	undifferentiated *Delphinus*	100	34.03800	-119.15983
09/28/2010 12:47:11	Common Dolphin sp.	undifferentiated *Delphinus*	10	33.62367	-118.26050
09/28/2010 12:53:11	Common Dolphin sp.	undifferentiated *Delphinus*	80	33.54317	-118.03283
09/28/2010 12:55:01	Common Dolphin sp.	undifferentiated *Delphinus*	400	33.52050	-117.96150
09/28/2010 13:17:51	Unidentified Dolphin	unidentified Delphinidae	50	33.44667	-117.95000
09/28/2010 13:19:21	Common Dolphin sp.	undifferentiated *Delphinus*	15	33.43733	-118.00117
09/28/2010 13:20:41	Risso's Dolphin	*Grampus griseus*	25	33.42900	-118.04533
09/28/2010 13:47:11	Common Dolphin sp.	undifferentiated *Delphinus*	75	33.41967	-118.10850
09/28/2010 13:50:11	Risso's Dolphin	Grampus griseus	1	33.40000	-118.20967
09/28/2010 13:56:01	Common Dolphin sp.	undifferentiated *Delphinus*	15	33.31833	-118.22617
09/28/2010 13:58:01	Common Dolphin sp.	undifferentiated *Delphinus*	25	33.29150	-118.28633
09/28/2010 14:01:51	Common Dolphin sp.	undifferentiated *Delphinus*	200	33.24867	-118.40417
09/28/2010 14:14:21	Common Dolphin sp.	undifferentiated Delphinus	60	33.22900	-118.36750
09/28/2010 14:17:51	Common Dolphin sp.	undifferentiated Delphinus	100	33.25600	-118.25033
09/28/2010 14:19:21	Bottlenose Dolphin	Tursiops truncatus	18	33.26700	-118.20183
09/28/2010 14:26:21	California Sea Lion	undifferentiated *Delphinus*	40	33.25917	-118.21317
09/28/2010 14:43:21	Common Dolphin sp.	undifferentiated *Delphinus*	12	33.34167	-117.85417
09/28/2010 14:46:41	Common Dolphin sp.	undifferentiated *Delphinus*	42	33.36467	-117.73950
09/28/2010 14:54:11	Common Dolphin sp.	undifferentiated *Delphinus*	750	33.24867	-117.54183

Date & Time	Species Common Name	Species Scientific Name	Group Size	Latitude	Longitude
SEPTEMBER SURVEY: 23-28 September 2011 (continued)					
09/28/2010 15:06:21	Common Dolphin sp.	undifferentiated Delphinus	5	32.93133	-117.31617
09/28/2010 15:07:31	Common Dolphin sp.	undifferentiated Delphinus	550	32.89900	-117.29883
FEBRUARY SURVEY: 14-19 FEBRUARY 2011					
2/14/2011 13:21:54	Bottlenose Dolphin	*Tursiops truncatus*	10	32.85983	-117.25833
2/14/2011 13:22:24	Bottlenose Dolphin	*Tursiops truncatus*	25	32.876	-117.26567
2/14/2011 13:50:04	Bottlenose Dolphin	*Tursiops truncatus*	6	33.01383	-117.36517
2/14/2011 14:03:44	Unidentified Dolphin	unidentified Delphinidae	1	32.97067	-117.37217
2/14/2011 14:03:44	Common Dolphin sp.	undifferentiated *Delphinus*	75	32.97067	-117.37217
2/14/2011 13:35:54	Common Dolphin sp.	undifferentiated *Delphinus*	50	33.03633	-117.34383
2/14/2011 15:56:09	Unidentified Dolphin	unidentified Delphinidae	6	33.10067	-117.382
2/14/2011 16:08:59	Bottlenose Dolphin	*Tursiops truncatus*	1	32.8345	-117.29633
2/14/2011 16:27:29	Long-Beaked Common Dolphin	*Delphinus capensis*	30	32.73883	-117.30333
2/15/2011 8:45:08	Gray Whale	*Eschrichtius robustus*	2	32.8215	-117.31133
2/15/2011 9:25:19	Unidentified Dolphin	unidentified Delphinidae	1	32.67333	-117.61
2/15/2011 9:33:09	Short-Beaked Common Dolphin	*Delphinus delphis*	25	32.66967	-117.6405
2/15/2011 9:54:29	Short-Beaked Common Dolphin	*Delphinus delphis*	20	32.66117	-117.67633
2/15/2011 10:06:59	Risso's Dolphin	*Grampus griseus*	6	32.63033	-117.80867
2/15/2011 10:48:19	Risso's Dolphin	*Grampus griseus*	100	32.65333	-117.91817
2/15/2011 11:22:29	Risso's Dolphin	*Grampus griseus*	25	32.81517	-117.50433
2/15/2011 11:27:29	Common Dolphin sp.	undifferentiated *Delphinus*	80	32.83867	-117.33967
2/15/2011 11:28:09	Common Dolphin sp.	undifferentiated *Delphinus*	60	32.83983	-117.3175
2/15/2011 13:19:23	Bottlenose Dolphin	*Tursiops truncatus*	65	32.86183	-117.27117
2/15/2011 13:21:53	Common Dolphin sp.	undifferentiated *Delphinus*	50	32.90333	-117.34317
2/15/2011 13:24:03	Short-Beaked Common Dolphin	*Delphinus delphis*	500	32.92433	-117.4015
2/15/2011 13:41:03	Gray Whale	*Eschrichtius robustus*	1	32.85633	-117.76817
2/15/2011 14:00:43	Fin Whale	*Balaenoptera physalus*	1	32.83433	-118.22417
2/15/2011 14:06:53	Risso's Dolphin	*Grampus griseus*	8	32.912	-118.14183
2/15/2011 14:07:33	Unidentified Baleen Whale	undifferentiated *Balaenoptera*	1	32.92533	-118.14317

Date & Time	Species Common Name	Species Scientific Name	Group Size	Latitude	Longitude
FEBRUARY SURVEY: 14-19 FEBRUARY 2011 (continued)					
2/15/2011 14:32:53	Fin Whale	*Balaenoptera physalus*	2	32.935	-118.03517
2/15/2011 14:59:33	Common Dolphin sp.	undifferentiated *Delphinus*	1000	33.069	-117.452
2/15/2011 15:00:03	Short-Beaked Common Dolphin	*Delphinus delphis*	500	33.07217	-117.435
2/15/2011 15:07:43	Gray Whale	*Eschrichtius robustus*	1	33.04417	-117.431
2/15/2011 15:18:53	Short-Beaked Common Dolphin	*Delphinus delphis*	900	33.16483	-117.54033
2/15/2011 15:34:23	Long-beaked Common Dolphin	*Delphinus capensis*	22	33.12733	-117.90383
2/15/2011 15:59:13	Unidentified Dolphin	unidentified Delphinidae	6	33.2705	-117.67333
2/15/2011 16:01:53	Common Dolphin sp.	undifferentiated *Delphinus*	1000	33.29333	-117.58683
2/15/2011 16:09:33	Common Dolphin sp.	undifferentiated *Delphinus*	700	33.1235	-117.441
2/15/2011 16:18:13	Unidentified Dolphin	unidentified Delphinidae	25	32.89983	-117.3155
2/15/2011 16:18:53	Unidentified Dolphin	unidentified Delphinidae	900	32.88383	-117.30217
2/17/2011 8:55:54	Bottlenose Dolphin	*Tursiops truncatus*	16	32.85967	-117.26283
2/17/2011 8:56:14	Gray Whale	*Eschrichtius robustus*	1	32.865	-117.27517
2/17/2011 8:56:44	Common Dolphin sp.	undifferentiated *Delphinus*	100	32.873	-117.294
2/17/2011 9:00:04	Unidentified Dolphin	unidentified Delphinidae	8	32.91567	-117.4245
2/17/2011 9:06:24	Fin Whale	*Balaenoptera physalus*	1	32.97817	-117.68117
2/17/2011 9:17:44	Unidentified Dolphin	unidentified Delphinidae	50	33.057	-118.13033
2/17/2011 9:22:24	Risso's Dolphin	*Grampus griseus*	19	33.08817	-118.31067
2/17/2011 9:23:24	Risso's Dolphin	*Grampus griseus*	3	33.09583	-118.3485
2/17/2011 9:37:04	Dall's Porpoise	*Phocoenoides dalli*	5	33.17067	-118.85483
2/17/2011 9:52:44	Long-Beaked Common Dolphin	*Delphinus capensis*	700	33.03267	-119.11117
2/17/2011 9:52:54	California Sea Lion	*Zalophus californianus*	1	33.03	-119.11617
2/17/2011 10:27:54	Short-Beaked Common Dolphin	*Delphinus delphis*	10	33.078	-118.894
2/17/2011 10:33:34	Short-Beaked Common Dolphin	*Delphinus delphis*	10	33.10933	-118.8385
2/17/2011 10:41:04	Common Dolphin sp.	undifferentiated *Delphinus*	100	33.1265	-118.69483
2/17/2011 10:52:44	Unidentified Dolphin	unidentified Delphinidae	2	33.014	-118.4295
2/17/2011 11:27:14	California Sea Lion	*Zalophus californianus*	1	32.87383	-117.34517
2/17/2011 13:49:19	Common Dolphin sp.	undifferentiated *Delphinus*	25	32.86233	-117.26

Date & Time	Species Common Name	Species Scientific Name	Group Size	Latitude	Longitude
FEBRUARY SURVEY: 14-19 FEBRUARY 2011 (continued)					
2/17/2011 13:49:39	Common Dolphin sp.	undifferentiated *Delphinus*	125	32.868	-117.27017
2/17/2011 13:52:29	California Sea Lion	*Zalophus californianus*	1	32.913	-117.35383
2/17/2011 13:54:29	California Sea Lion	*Zalophus californianus*	1	32.96317	-117.38633
2/17/2011 13:54:49	California Sea Lion	*Zalophus californianus*	1	32.97317	-117.38783
2/17/2011 13:56:49	Common Dolphin sp.	undifferentiated *Delphinus*	300	33.03183	-117.39633
2/17/2011 13:56:59	California Sea Lion	*Zalophus californianus*	1	33.03683	-117.39733
2/17/2011 13:57:09	California Sea Lion	*Zalophus californianus*	1	33.04167	-117.39833
2/17/2011 14:01:39	California Sea Lion	*Zalophus californianus*	1	33.15817	-117.47267
2/17/2011 14:04:59	Common Dolphin sp.	undifferentiated *Delphinus*	100	33.2345	-117.54483
2/17/2011 14:05:59	Common Dolphin sp.	undifferentiated *Delphinus*	50	33.25567	-117.56817
2/17/2011 14:07:09	Common Dolphin sp.	undifferentiated *Delphinus*	300	33.279	-117.59733
2/17/2011 14:13:39	California Sea Lion	*Zalophus californianus*	1	33.36567	-117.77067
2/17/2011 14:14:49	Short-Beaked Common Dolphin	*Delphinus delphis*	1800	33.35867	-117.81017
2/17/2011 14:22:59	Minke Whale	*Balaenoptera acutorostrata*	1	33.34767	-117.90217
2/17/2011 14:35:09	Bottlenose Dolphin	*Tursiops truncatus*	2	33.301	-118.1165
2/17/2011 14:45:19	California Sea Lion	*Zalophus californianus*	2	33.2775	-118.24483
2/17/2011 14:46:09	California Sea Lion	*Zalophus californianus*	15	33.26983	-118.23267
2/17/2011 14:49:19	Unidentified Dolphin	unidentified Delphinidae	50	33.25983	-118.32533
2/17/2011 14:53:09	Gray Whale	*Eschrichtius robustus*	1	33.1855	-118.3915
2/17/2011 15:16:29	Common Dolphin sp.	undifferentiated *Delphinus*	50	33.176	-118.3775
2/17/2011 15:37:09	Unidentified Dolphin	unidentified Delphinidae	100	33.06133	-118.10583
2/17/2011 15:42:19	Unidentified Dolphin	unidentified Delphinidae	250	33.01917	-118.056
2/17/2011 15:46:09	Common Dolphin sp.	undifferentiated *Delphinus*	75	32.987	-117.933
2/17/2011 15:46:39	Common Dolphin sp.	undifferentiated *Delphinus*	220	32.9825	-117.91683
2/17/2011 16:04:59	California Sea Lion	*Zalophus californianus*	4	32.85017	-117.2965
2/17/2011 16:05:19	California Sea Lion	*Zalophus californianus*	3	32.85	-117.285
2/18/2011 9:59:05	Bottlenose Dolphin	*Tursiops truncatus*	2	32.86083	-117.26433
2/18/2011 11:04:15	Risso's Dolphin	*Grampus griseus*	5	32.70467	-117.90983

Date & Time	Species Common Name	Species Scientific Name	Group Size	Latitude	Longitude
FEBRUARY SURVEY: 14-19 FEBRUARY 2011 (continued)					
2/18/2011 11:14:04	Risso's Dolphin	*Grampus griseus*	12	32.73217	-117.82483
2/18/2011 12:28:45	Common Dolphin sp.	undifferentiated *Delphinus*	400	32.68533	-117.29483
MARCH SURVEY: 30 MARCH - 01 APRIL 2011					
3/30/2011 17:40:51	Bottlenose Dolphin	*Tursiops truncatus*	5	32.88317	-117.26817
3/30/2011 17:41:21	Unidentified Dolphin	unidentified Delphinidae	25	32.89517	-117.27817
3/30/2011 17:45:37	Unidentified Dolphin	unidentified Delphinidae	300	32.9305	-117.39367
3/30/2011 18:07:18	Short-Beaked Common Dolphin	*Delphinus delphis*	40	33.056	-117.45817
3/30/2011 18:24:08	Common Dolphin sp.	undifferentiated *Delphinus*	18	33.12467	-117.626
3/30/2011 18:53:18	Bottlenose Dolphin	*Tursiops truncatus*	13	32.94633	-117.38633
3/30/2011 18:54:38	Common Dolphin sp.	undifferentiated *Delphinus*	50	32.91767	-117.3485
3/31/2011 8:54:44	Bottlenose Dolphin	*Tursiops truncatus*	3	32.85533	-117.297
3/31/2011 8:54:44	Bottlenose Dolphin	*Tursiops truncatus*	5	32.85533	-117.297
3/31/2011 9:02:14	California Sea Lion	*Zalophus californianus*	1	32.67767	-117.475
3/31/2011 9:36:04	Risso's Dolphin	*Grampus griseus*	18	32.775	-117.57733
3/31/2011 9:39:54	Minke Whale	*Balaenoptera acutorostrata*	1	32.7795	-117.5705
3/31/2011 9:44:54	Common Dolphin sp.	undifferentiated *Delphinus*	15	32.77067	-117.58067
3/31/2011 10:40:24	Minke Whale	*Balaenoptera acutorostrata*	2	32.79067	-117.47683
3/31/2011 11:02:34	Bottlenose Dolphin	*Tursiops truncatus*	12	32.8755	-117.39767
3/31/2011 11:11:54	Long-beaked Common Dolphin	*Delphinus capensis*	35	32.95567	-117.324
3/31/2011 15:06:45	Long-beaked Common Dolphin	*Delphinus capensis*	300	32.908	-117.484
3/31/2011 15:20:15	Common Dolphin sp.	undifferentiated *Delphinus*	225	32.84883	-117.76
3/31/2011 15:24:15	Gray Whale	*Eschrichtius robustus*	5	32.86083	-117.73583
3/31/2011 15:34:15	Common Dolphin sp.	undifferentiated *Delphinus*	25	32.83283	-117.87783
3/31/2011 15:36:45	Risso's Dolphin	*Grampus griseus*	35	32.82217	-117.96333
3/31/2011 15:38:35	Common Dolphin sp.	undifferentiated *Delphinus*	30	32.80317	-118.02317
3/31/2011 15:42:35	Risso's Dolphin	*Grampus griseus*	12	32.76667	-118.155
3/31/2011 16:10:45	Risso's Dolphin	*Grampus griseus*	20	32.8145	-118.24133
3/31/2011 16:38:05	Risso's Dolphin	*Grampus griseus*	22	32.90233	-118.18667

Date & Time	Species Common Name	Species Scientific Name	Group Size	Latitude	Longitude
MARCH SURVEY: 30 MARCH - 01 APRIL 2011 (continued)					
3/31/2011 17:06:35	Unidentified Medium Whale	unidentified medium whale	1	32.95417	-117.89883
3/31/2011 17:10:55	Unidentified Small Marine Mammal	unidentified small marine mammal	1	32.98617	-117.73767
3/31/2011 17:13:15	Gray Whale	*Eschrichtius robustus*	2	33.00533	-117.65433
3/31/2011 17:21:25	Long-beaked Common Dolphin	*Delphinus capensis*	245	33.0405	-117.35767
3/31/2011 17:31:25	Common Dolphin sp.	undifferentiated *Delphinus*	11	32.89883	-117.2875
4/1/2011 8:39:48	Common Dolphin sp.	undifferentiated *Delphinus*	10	32.84783	-117.33833
4/1/2011 8:42:48	Common Dolphin sp.	undifferentiated *Delphinus*	20	32.8385	-117.4535
4/1/2011 8:44:38	Common Dolphin sp.	undifferentiated *Delphinus*	20	32.83117	-117.5225
4/1/2011 8:44:58	Common Dolphin sp.	undifferentiated *Delphinus*	250	32.82933	-117.5355
4/1/2011 8:53:28	Common Dolphin sp.	undifferentiated *Delphinus*	15	32.79533	-117.87267
4/1/2011 8:56:08	Unidentified Small Dolphin	unidentified small dolphin	20	32.7845	-117.97767
4/1/2011 8:56:38	Risso's Dolphin	*Grampus griseus*	12	32.78183	-117.99717
4/1/2011 8:57:18	Risso's Dolphin	*Grampus griseus*	8	32.77867	-118.02317
4/1/2011 8:58:48	Common Dolphin sp.	undifferentiated *Delphinus*	6	32.772	-118.08267
4/1/2011 9:03:58	Gray Whale	*Eschrichtius robustus*	2	32.768	-118.28867
4/1/2011 9:04:58	Unidentified Dolphin	unidentified Delphinidae	22	32.77233	-118.32867
4/1/2011 9:05:28	Common Dolphin sp.	undifferentiated *Delphinus*	3	32.77333	-118.34883
4/1/2011 9:06:38	Unidentified Dolphin	unidentified Delphinidae	100	32.77633	-118.39533
4/1/2011 9:06:58	California Sea Lion	*Zalophus californianus*	2	32.77667	-118.40867
4/1/2011 9:07:08	California Sea Lion	*Zalophus californianus*	2	32.7765	-118.41517
4/1/2011 9:08:08	California Sea Lion	*Zalophus californianus*	1	32.782	-118.45217
4/1/2011 9:08:28	California Sea Lion	*Zalophus californianus*	1	32.78483	-118.464
4/1/2011 9:09:28	California Sea Lion	*Zalophus californianus*	2	32.79283	-118.49933
4/1/2011 9:09:58	California Sea Lion	*Zalophus californianus*	1	32.79683	-118.51683
4/1/2011 9:10:08	California Sea Lion	*Zalophus californianus*	1	32.798	-118.52267
4/1/2011 9:10:48	Unidentified Dolphin	unidentified Delphinidae	2	32.803	-118.54617
4/1/2011 9:10:48	California Sea Lion	*Zalophus californianus*	1	32.803	-118.54617
4/1/2011 9:12:18	California Sea Lion	*Zalophus californianus*	1	32.8345	-118.58333

Date & Time	Species Common Name	Species Scientific Name	Group Size	Latitude	Longitude
MARCH SURVEY: 30 MARCH - 01 APRIL 2011 (continued)					
4/1/2011 9:17:28	Risso's Dolphin	*Grampus griseus*	20	32.95567	-118.69717
4/1/2011 9:28:28	Northern Right Whale Dolphin	*Lissodelphis borealis*	8	32.9515	-118.67733
4/1/2011 9:52:38	Risso's Dolphin	*Grampus griseus*	18	32.91667	-118.6955
4/1/2011 9:56:28	Risso's Dolphin	*Grampus griseus*	2	32.94283	-118.68383
4/1/2011 9:58:38	Risso's Dolphin	*Grampus griseus*	11	33.0015	-118.70867
4/1/2011 10:00:38	Northern Right Whale Dolphin	*Lissodelphis borealis*	2	33.013	-118.70783
4/1/2011 10:02:48	Gray Whale	*Eschrichtius robustus*	3	33.031	-118.71667
4/1/2011 10:10:18	Northern Right Whale Dolphin	*Lissodelphis borealis*	25	32.9965	-118.728
4/1/2011 10:18:08	Northern Right Whale Dolphin	*Lissodelphis borealis*	20	33.0075	-118.69933
4/1/2011 10:28:08	Gray Whale	*Eschrichtius robustus*	2	33.037	-118.686
4/1/2011 10:28:08	Risso's Dolphin	*Grampus griseus*	11	33.037	-118.686
4/1/2011 10:30:18	Risso's Dolphin	*Grampus griseus*	12	33.09867	-118.63117
4/1/2011 10:30:58	Risso's Dolphin	*Grampus griseus*	20	33.10517	-118.6055
4/1/2011 10:34:28	Fin/Sei/Bryde's Whale	*Balaenoptera physalus/borealis/edeni*	1	33.07067	-118.467
4/1/2011 10:40:38	Risso's Dolphin	*Grampus griseus*	11	33.02083	-118.21433
4/1/2011 10:44:48	Humpback Whale	*Megaptera novaeangliae*	2	32.99017	-118.04617
4/1/2011 10:55:58	Unidentified Whale	unidentified whale	3	32.9065	-117.614
4/1/2011 11:04:08	Common Dolphin sp.	undifferentiated *Delphinus*	15	32.853	-117.29633
APRIL SURVEY: 12-19 APRIL 2011					
4/12/2011 11:46:19	Common Dolphin sp.	undifferentiated *Delphinus*	440	32.69917	-117.4735
4/12/2011 12:20:36	Common Dolphin sp.	undifferentiated *Delphinus*	85	32.646	-117.69
4/12/2011 12:23:46	Risso's Dolphin	*Grampus griseus*	3	32.654	-117.69317
4/12/2011 12:32:35	Risso's Dolphin	*Grampus griseus*	25	32.61783	-117.805
4/12/2011 13:12:02	Risso's Dolphin	*Grampus griseus*	40	32.74667	-117.65367
4/12/2011 13:20:32	Risso's Dolphin	*Grampus griseus*	25	32.76917	-117.553
4/12/2011 13:40:02	Common Dolphin sp.	undifferentiated *Delphinus*	30	32.84033	-117.80183
4/12/2011 14:08:51	Risso's Dolphin	*Grampus griseus*	20	32.91267	-117.96617
4/12/2011 14:19:41	Common Dolphin sp.	undifferentiated *Delphinus*	400	32.97717	-117.772

Date & Time	Species Common Name	Species Scientific Name	Group Size	Latitude	Longitude
APRIL SURVEY: 12-19 APRIL 2011 (continued)					
4/12/2011 14:45:21	Common Dolphin sp.	undifferentiated *Delphinus*	15	33.0385	-117.972
4/12/2011 15:45:41	Fin Whale	*Balaenoptera physalus*	2	33.24417	-118.45333
4/12/2011 16:42:20	Common Dolphin sp.	undifferentiated *Delphinus*	855	33.277	-118.352
4/12/2011 16:59:50	Unidentified Dolphin	unidentified Delphinidae	4	33.424	-118.11283
4/12/2011 17:00:20	Unidentified Dolphin	unidentified Delphinidae	18	33.41433	-118.09233
4/13/2011 10:51:24	Common Dolphin sp.	undifferentiated *Delphinus*	80	32.611	-117.189
4/13/2011 10:55:14	Unidentified Dolphin	unidentified Delphinidae	30	32.66083	-117.36517
4/13/2011 10:58:14	Gray Whale	*Eschrichtius robustus*	3	32.69133	-117.4725
4/13/2011 11:34:55	Risso's Dolphin	*Grampus griseus*	24	32.72967	-117.53683
4/13/2011 11:47:35	Risso's Dolphin	*Grampus griseus*	8	32.74733	-117.53133
4/13/2011 12:19:55	Bottlenose Dolphin	*Tursiops truncatus*	55	32.8305	-117.42483
4/13/2011 12:33:41	Common Dolphin sp.	undifferentiated *Delphinus*	80	32.968	-117.37633
4/13/2011 12:34:21	Common Dolphin sp.	undifferentiated *Delphinus*	125	32.973	-117.40033
4/13/2011 13:04:40	Common Dolphin sp.	undifferentiated *Delphinus*	10	32.937	-117.73367
4/13/2011 13:13:20	Common Dolphin sp.	undifferentiated *Delphinus*	35	33.05933	-117.39383
4/13/2011 13:45:00	Unidentified Dolphin	unidentified Delphinidae	2	33.1845	-117.92867
4/13/2011 13:52:20	Common Dolphin sp.	undifferentiated *Delphinus*	90	33.26283	-117.63583
4/13/2011 13:59:09	Unidentified Dolphin	unidentified Delphinidae	5	33.30717	-117.60583
4/13/2011 14:12:39	Unidentified Dolphin	unidentified Delphinidae	75	33.2985	-118.11783
4/13/2011 14:39:36	Unidentified Dolphin	unidentified Delphinidae	40	33.44817	-117.9375
4/13/2011 14:57:26	Common Dolphin sp.	undifferentiated *Delphinus*	45	33.2685	-117.63133
4/13/2011 14:57:56	Common Dolphin sp.	undifferentiated *Delphinus*	450	33.255	-117.61933
4/13/2011 15:17:36	Common Dolphin sp.	undifferentiated *Delphinus*	23	33.14167	-117.48233
4/13/2011 15:18:56	Common Dolphin sp.	undifferentiated *Delphinus*	24	33.0975	-117.46433
4/13/2011 15:23:06	Dall's Porpoise	*Phocoenoides dalli*	3	32.964	-117.47483
4/14/2011 9:14:26	Unidentified Dolphin	unidentified Delphinidae	4	32.605	-117.17383
4/14/2011 9:14:56	Common Dolphin sp.	undifferentiated *Delphinus*	75	32.6125	-117.19633
4/14/2011 9:20:56	Unidentified Baleen Whale	undifferentiated *Balaenoptera*	1	32.70183	-117.4725

Date & Time	Species Common Name	Species Scientific Name	Group Size	Latitude	Longitude
APRIL SURVEY: 12-19 APRIL 2011 (continued)					
4/14/2011 9:21:36	Unidentified Dolphin	unidentified Delphinidae	40	32.7115	-117.50183
4/14/2011 9:27:56	Risso's Dolphin	*Grampus griseus*	20	32.806	-117.77467
4/14/2011 9:44:06	Common Dolphin sp.	undifferentiated *Delphinus*	18	33.031	-118.48533
4/14/2011 10:17:46	Fin Whale	*Balaenoptera physalus*	1	33.10117	-118.86283
4/14/2011 11:02:56	Fin Whale	*Balaenoptera physalus*	2	33.09417	-118.85133
4/14/2011 11:08:46	Fin Whale	*Balaenoptera physalus*	1	33.10133	-118.86183
4/14/2011 11:41:48	Risso's Dolphin	*Grampus griseus*	60	33.08317	-118.76567
4/14/2011 12:06:49	Unidentified Whale	unidentified whale	1	33.00683	-118.87433
4/14/2011 12:45:25	Common Dolphin sp.	undifferentiated *Delphinus*	55	32.8845	-118.90883
4/14/2011 13:27:25	Common Dolphin sp.	undifferentiated *Delphinus*	700	32.8455	-118.6055
4/14/2011 14:02:55	Risso's Dolphin	*Grampus griseus*	556	32.59167	-117.794
4/15/2011 8:38:14	Bottlenose Dolphin	*Tursiops truncatus*	15	32.60133	-117.2685
4/15/2011 8:42:54	Bottlenose Dolphin	*Tursiops truncatus*	25	32.676	-117.46067
4/15/2011 9:16:24	Fin Whale	*Balaenoptera physalus*	4	32.77317	-117.5895
4/15/2011 9:53:04	Minke Whale	*Balaenoptera acutorostrata*	2	32.7745	-117.5975
4/15/2011 10:33:13	Common Dolphin sp.	undifferentiated *Delphinus*	250	32.78633	-117.511
4/15/2011 10:59:53	Humpback Whale	*Megaptera novaeangliae*	1	32.83867	-117.85283
4/15/2011 11:20:33	Risso's Dolphin	*Grampus griseus*	19	32.781	-118.07567
4/15/2011 11:44:53	Risso's Dolphin	*Grampus griseus*	8	32.77417	-118.19767
4/15/2011 12:10:43	Risso's Dolphin	*Grampus griseus*	10	32.937	-117.96267
4/15/2011 12:12:53	Fin Whale	*Balaenoptera physalus*	2	32.95933	-117.88417
4/15/2011 12:19:13	Unidentified Whale	unidentified whale	2	32.9315	-117.8635
4/15/2011 12:37:03	Short-Beaked Common Dolphin	*Delphinus delphis*	1200	33.06033	-117.43433
4/15/2011 12:51:53	California Sea Lion	*Zalophus californianus*	1	32.83583	-117.31567
4/15/2011 12:54:53	California Sea Lion	*Zalophus californianus*	2	32.73567	-117.27867
4/15/2011 14:49:13	Common Dolphin sp.	undifferentiated *Delphinus*	400	32.771	-117.41067
4/15/2011 15:06:23	Risso's Dolphin	*Grampus griseus*	2	33.135	-117.642
4/15/2011 15:10:13	Unidentified Dolphin	unidentified Delphinidae	450	33.11817	-117.78417

Date & Time	Species Common Name	Species Scientific Name	Group Size	Latitude	Longitude
APRIL SURVEY: 12-19 APRIL 2011 (continued)					
4/15/2011 15:28:53	Short-Beaked Common Dolphin	*Delphinus delphis*	1100	33.0165	-118.194
4/15/2011 15:45:13	Risso's Dolphin	*Grampus griseus*	24	33.08117	-118.41067
4/15/2011 16:04:03	Risso's Dolphin	*Grampus griseus*	23	33.09467	-118.34967
4/15/2011 16:24:03	Fin Whale	*Balaenoptera physalus*	1	33.20933	-117.85733
4/16/2011 13:04:50	Bottlenose Dolphin	*Tursiops truncatus*	10	32.6025	-117.25967
4/16/2011 13:20:30	Common Dolphin sp.	undifferentiated *Delphinus*	250	32.8985	-117.89717
4/16/2011 13:27:10	Minke Whale	*Balaenoptera acutorostrata*	1	33.001	-118.19467
4/16/2011 13:30:40	Risso's Dolphin	*Grampus griseus*	9	33.051	-118.355
4/16/2011 13:39:50	Risso's Dolphin	*Grampus griseus*	1	33.166	-118.763
4/16/2011 13:46:20	Risso's Dolphin	*Grampus griseus*	1	33.15883	-118.7295
4/16/2011 13:52:10	Unidentified Large Whale	unidentified large whale	1	33.05583	-118.94467
4/16/2011 14:21:48	Northern Right Whale Dolphin	*Lissodelphis borealis*	6	33.014	-118.86233
4/16/2011 14:29:36	Gray Whale	*Eschrichtius robustus*	1	33.09317	-118.66967
4/16/2011 14:36:59	Northern Right Whale Dolphin	*Lissodelphis borealis*	4	32.9605	-118.83533
4/16/2011 14:46:19	Common Dolphin sp.	undifferentiated *Delphinus*	200	32.90267	-118.82267
4/16/2011 15:00:51	Unidentified Small Marine Mammal	unidentified small marine mammal	1	32.85833	-118.76033
4/16/2011 15:10:41	Fin Whale	*Balaenoptera physalus*	1	32.83883	-118.69867
4/16/2011 16:09:31	Long-Beaked Common Dolphin	*Delphinus capensis*	300	32.64967	-117.98067
4/16/2011 16:29:31	Unidentified Dolphin	unidentified Delphinidae	3	32.57383	-117.4905
4/16/2011 16:31:41	Humpback Whale	*Megaptera novaeangliae*	1	32.56317	-117.4025
4/17/2011 14:30:43	Unidentified Dolphin	unidentified Delphinidae	5	32.61583	-117.285
4/18/2011 12:51:50	Risso's Dolphin	*Grampus griseus*	18	32.702	-117.5
4/18/2011 12:52:30	Risso's Dolphin	*Grampus griseus*	35	32.726	-117.48933
4/18/2011 13:15:09	Risso's Dolphin	*Grampus griseus*	7	33.076	-117.67783
4/18/2011 13:19:59	Bottlenose Dolphin	*Tursiops truncatus*	5	33.08017	-117.66633
4/18/2011 14:07:23	Risso's Dolphin	*Grampus griseus*	12	33.11117	-117.95583
4/18/2011 14:09:23	Unidentified Small Whale	unidentified small whale	1	33.09667	-117.99083
4/18/2011 15:13:19	Bottlense Dolphin	Tursiops truncatus	4	33.18167	-118.00317

Date & Time	Species Common Name	Species Scientific Name	Group Size	Latitude	Longitude
APRIL SURVEY: 12-19 APRIL 2011 (continued)					
4/18/2011 15:13:29	Risso's Dolphin	*Grampus griseus*	40	33.1795	-118.01067
4/18/2011 15:44:48	Unidentified Dolphin	unidentified Delphinidae	22	33.31267	-117.5725
4/18/2011 15:46:08	California Sea Lion	*Zalophus californianus*	2	33.34283	-117.628
4/18/2011 15:46:48	Unidentified Dolphin	unidentified Delphinidae	3	33.3595	-117.65317
4/18/2011 16:14:38	Unidentified Dolphin	unidentified Delphinidae	2	33.36117	-117.78133
4/18/2011 16:17:58	Common Dolphin sp.	undifferentiated *Delphinus*	50	33.35083	-117.66267
4/18/2011 16:25:48	Common Dolphin sp.	undifferentiated *Delphinus*	145	33.2455	-117.68017
4/18/2011 16:55:37	Bottlenose Dolphin	*Tursiops truncatus*	32	33.14117	-117.57317
4/18/2011 17:18:46	Long-Beaked Common Dolphin	*Delphinus capensis*	175	33.0475	-117.4015
4/18/2011 17:26:36	Common Dolphin sp.	undifferentiated *Delphinus*	70	33.0315	-117.53433
4/18/2011 17:40:16	Unidentified Dolphin	unidentified Delphinidae	10	32.91667	-117.45983
4/18/2011 17:43:26	Common Dolphin sp.	undifferentiated *Delphinus*	105	32.92383	-117.34
4/19/2011 10:30:13	Common Dolphin sp.	undifferentiated *Delphinus*	25	32.78467	-117.41217
4/19/2011 10:35:32	Fin Whale	*Balaenoptera physalus*	3	32.82383	-117.4235
4/19/2011 11:25:42	Common Dolphin sp.	undifferentiated *Delphinus*	120	33.39767	-117.76433
4/19/2011 11:34:11	Unidentified Dolphin	unidentified Delphinidae	10	33.45267	-117.95033
4/19/2011 11:41:51	Long-Beaked Common Dolphin	*Delphinus capensis*	350	33.3935	-118.2365
4/19/2011 12:00:59	Common Dolphin sp.	undifferentiated *Delphinus*	150	33.31617	-118.19233
4/19/2011 12:04:09	Risso's Dolphin	*Grampus griseus*	25	33.31783	-118.21
4/19/2011 12:31:58	Common Dolphin sp.	undifferentiated *Delphinus*	225	33.33667	-117.9435
4/19/2011 12:55:38	Gray Whale	*Eschrichtius robustus*	2	33.07183	-117.47533
4/19/2011 13:14:27	Gray Whale	*Eschrichtius robustus*	1	33.08017	-117.55933
4/19/2011 13:27:57	Unidentified Medium Cetacean	unidentified medium cetacean	1	32.67133	-117.37483
4/19/2011 15:53:34	Fin Whale	*Balaenoptera physalus*	1	32.73133	-117.45883
4/19/2011 16:06:34	Unidentified Whale	unidentified whale	1	32.69883	-117.43517
4/19/2011 16:11:44	Fin Whale	*Balaenoptera physalus*	1	32.75483	-117.47983
4/19/2011 16:42:13	Common Dolphin sp.	undifferentiated *Delphinus*	100	33.1245	-117.64167
4/19/2011 17:09:42	Short-Beaked Common Dolphin	*Delphinus delphis*	1750	32.87483	-117.40033

Date & Time	Species Common Name	Species Scientific Name	Group Size	Latitude	Longitude
APRIL SURVEY: 12-19 APRIL 2011 (continued)					
4/19/2011 17:38:31	California Sea Lion	*Zalophus californianus*	1	32.6775	-117.211
4/19/2011 17:49:31	Risso's Dolphin	*Grampus griseus*	24	32.64517	-117.45417
4/19/2011 18:08:34	Risso's Dolphin	*Grampus griseus*	8	32.60083	-117.56083
4/20/2011 10:10:31	Short-Beaked Common Dolphin	*Delphinus delphis*	45	32.5505	-117.28417
4/20/2011 10:27:44	Fin Whale	*Balaenoptera physalus*	1	32.53817	-117.39217
4/20/2011 10:30:53	Common Dolphin sp.	undifferentiated *Delphinus*	350	32.5295	-117.37617
4/20/2011 10:33:03	Blue Whale	*Balaenoptera musculus*	2	32.52133	-117.34683
4/20/2011 11:21:08	Unidentified Small Marine Mammal	unidentified small marine mammal	1	32.56583	-117.3465
4/20/2011 11:28:58	Common Dolphin sp.	undifferentiated *Delphinus*	35	32.53517	-117.4155
4/20/2011 12:42:47	Blue Whale	*Balaenoptera musculus*	1	32.6075	-117.36217
4/20/2011 13:23:34	Blue Whale	*Balaenoptera musculus*	1	32.60383	-117.3565
4/20/2011 13:45:49	Risso's Dolphin	*Grampus griseus*	22	32.5835	-117.89383
4/20/2011 14:19:29	Common Dolphin sp.	undifferentiated *Delphinus*	22	32.624	-117.4545
4/20/2011 14:22:18	Long-Beaked Common Dolphin	*Delphinus capensis*	800	32.632	-117.43667
4/20/2011 15:27:16	Long-Beaked Common Dolphin	*Delphinus capensis*	275	32.54017	-117.329
MAY SURVEY: 09-14 MAY 2011					
5/9/2011 15:37:55	Common Dolphin sp.	undifferentiated *Delphinus*	50	33.37983	-117.688
5/9/2011 15:44:15	California Sea Lion	*Zalophus californianus*	1	33.28617	-117.58433
5/9/2011 15:46:35	Blue Whale	*Balaenoptera musculus*	1	33.243	-117.53467
5/9/2011 15:47:55	Fin Whale	*Balaenoptera physalus*	2	33.2515	-117.54317
5/10/2011 9:35:30	Unidentified Dolphin	unidentified Delphinidae	40	32.8635	-117.28067
5/10/2011 9:42:01	Blue Whale	*Balaenoptera musculus*	2	32.791	-117.38567
5/10/2011 9:44:26	Bottlenose Dolphin	*Tursiops truncatus*	10	32.79	-117.3975
5/10/2011 9:55:59	Fin Whale	*Balaenoptera physalus*	1	32.77867	-117.4005
5/10/2011 10:33:16	California Sea Lion	*Zalophus californianus*	1	32.8015	-117.38367
5/10/2011 10:40:29	Harbor Seal	*Phoca vitulina*	3	32.79983	-117.37333
5/10/2011 10:40:29	California Sea Lion	*Zalophus californianus*	2	32.79983	-117.37333
5/10/2011 10:59:11	Risso's Dolphin	*Grampus griseus*	16	32.81267	-117.35833

Date & Time	Species Common Name	Species Scientific Name	Group Size	Latitude	Longitude
MAY SURVEY: 09-14 MAY 2011 (continued)					
5/10/2011 11:05:12	Bottlenose Dolphin	*Tursiops truncatus*	3	32.806	-117.36433
5/10/2011 11:19:36	Harbor Seal	*Phoca vitulina*	1	32.696	-117.432
5/10/2011 11:32:46	Short-Beaked Common Dolphin	*Delphinus delphis*	140	32.6065	-117.84783
5/10/2011 11:40:03	Short-Beaked Common Dolphin	*Delphinus delphis*	625	32.604	-117.8755
5/10/2011 12:06:23	Humpback Whale	*Megaptera novaeangliae*	1	32.76633	-117.60217
5/10/2011 12:19:16	Risso's Dolphin	*Grampus griseus*	9	32.78167	-117.5445
5/10/2011 12:41:21	Common Dolphin sp.	undifferentiated *Delphinus*	120	32.79783	-117.45167
5/10/2011 12:45:22	Blue Whale	*Balaenoptera musculus*	1	32.90217	-117.38017
5/10/2011 12:50:27	Unidentified Dolphin	unidentified Delphinidae	20	32.94383	-117.31917
5/10/2011 12:51:22	Unidentified Medium Whale	unidentified medium whale	4	32.92183	-117.29967
5/10/2011 15:32:57	Common Dolphin sp.	undifferentiated *Delphinus*	30	33.04683	-117.4315
5/10/2011 15:42:07	Unidentified Dolphin	unidentified Delphinidae	6	32.95817	-117.29167
5/10/2011 15:46:27	Fin Whale	*Balaenoptera physalus*	2	32.87783	-117.30467
5/10/2011 15:55:17	Blue Whale	*Balaenoptera musculus*	2	32.87733	-117.31383
5/10/2011 16:08:27	Blue Whale	*Balaenoptera musculus*	1	32.86767	-117.33017
5/10/2011 16:25:57	Blue Whale	*Balaenoptera musculus*	1	32.86433	-117.34617
5/10/2011 16:50:57	Blue Whale	*Balaenoptera musculus*	1	32.87583	-117.32933
5/11/2011 9:51:03	Blue Whale	*Balaenoptera musculus*	1	32.84283	-117.37417
5/11/2011 10:04:53	Blue Whale	*Balaenoptera musculus*	1	32.85933	-117.35467
5/11/2011 10:14:13	California Sea Lion	*Zalophus californianus*	1	32.85167	-117.35583
5/11/2011 10:58:42	Blue Whale	*Balaenoptera musculus*	1	32.877	-117.34083
5/11/2011 13:58:10	Common Dolphin sp.	undifferentiated *Delphinus*	40	32.6625	-117.58583
5/11/2011 13:58:10	Risso's Dolphin	*Grampus griseus*	32	32.6625	-117.58583
5/11/2011 13:59:30	Bottlenose Dolphin	*Tursiops truncatus*	8	32.673	-117.575
5/11/2011 14:41:19	California Sea Lion	*Zalophus californianus*	1	32.59217	-117.64117
5/11/2011 15:04:29	Risso's Dolphin	*Grampus griseus*	7	32.80117	-117.98383
5/11/2011 15:27:09	Risso's Dolphin	*Grampus griseus*	4	32.798	-118.01133
5/11/2011 15:59:49	Humpback Whale	*Megaptera novaeangliae*	1	32.81417	-117.35517

Date & Time	Species Common Name	Species Scientific Name	Group Size	Latitude	Longitude
MAY SURVEY: 09-14 MAY 2011 (continued)					
5/12/2011 10:26:22	Bottlenose Dolphin	*Tursiops truncatus*	16	32.86567	-117.28467
5/12/2011 10:50:12	Bottlenose Dolphin	*Tursiops truncatus*	50	32.747	-118.22567
5/12/2011 10:57:02	Risso's Dolphin	*Grampus griseus*	6	32.7115	-118.4855
5/12/2011 10:57:12	Unidentified Baleen Whale	undifferentiated *Balaenoptera*	1	32.71033	-118.49167
5/12/2011 11:04:42	Unidentified Baleen Whale	undifferentiated *Balaenoptera*	1	32.66783	-118.75183
5/12/2011 11:13:52	Short-Beaked Common Dolphin	*Delphinus delphis*	350	32.80817	-118.54583
5/12/2011 12:46:22	Fin Whale	*Balaenoptera physalus*	1	32.7475	-118.65417
5/12/2011 13:29:12	Unidentified Dolphin	unidentified Delphinidae	250	32.84283	-118.554
5/12/2011 13:29:22	Unidentified Dolphin	unidentified Delphinidae	150	32.8465	-118.54867
5/12/2011 13:50:22	Common Dolphin sp.	undifferentiated *Delphinus*	125	32.994	-118.1055
5/12/2011 13:56:22	Unidentified Baleen Whale	undifferentiated *Balaenoptera*	1	32.954	-117.87733
5/12/2011 16:03:05	Fin Whale	*Balaenoptera physalus*	1	32.60067	-117.565
5/12/2011 16:44:05	Fin Whale	*Balaenoptera physalus*	1	32.60417	-117.56667
5/12/2011 16:54:55	Risso's Dolphin	*Grampus griseus*	14	32.51917	-117.5915
5/12/2011 17:36:55	Common Dolphin sp.	undifferentiated *Delphinus*	30	32.8035	-117.34117
5/13/2011 13:28:42	Common Dolphin sp.	undifferentiated *Delphinus*	25	32.85883	-117.28933
5/13/2011 13:36:02	Common Dolphin sp.	undifferentiated *Delphinus*	175	32.935	-117.2945
5/13/2011 13:42:02	Common Dolphin sp.	undifferentiated *Delphinus*	400	32.87517	-117.29217
5/13/2011 13:49:22	Common Dolphin sp.	undifferentiated *Delphinus*	300	32.78717	-117.3635
5/13/2011 13:57:22	Fin Whale	*Balaenoptera physalus*	2	32.6235	-117.52467
5/13/2011 14:20:32	Minke Whale	*Balaenoptera acutorostrata*	1	32.62283	-117.49333
5/13/2011 14:40:52	Fin Whale	*Balaenoptera physalus*	1	32.70267	-117.61617
5/13/2011 15:05:56	Unidentified Dolphin	unidentified Delphinidae	5	32.5855	-117.64217
5/13/2011 15:19:56	Unidentified Baleen Whale	undifferentiated *Balaenoptera*	2	32.56967	-117.67883
5/13/2011 16:40:57	Fin Whale	*Balaenoptera physalus*	1	32.99517	-117.583
5/14/2011 9:43:54	California Sea Lion	*Zalophus californianus*	1	32.72483	-117.685
5/14/2011 10:00:54	California Sea Lion	*Zalophus californianus*	3	32.67567	-117.21883
5/14/2011 10:01:44	California Sea Lion	*Zalophus californianus*	1	32.67717	-117.18983

Date & Time	Species Common Name	Species Scientific Name	Group Size	Latitude	Longitude
MAY SURVEY: 09-14 MAY 2011 (continued)					
5/14/2011 10:09:24	California Sea Lion	*Zalophus californianus*	25	32.65067	-117.31
5/14/2011 10:21:54	Bottlenose Dolphin	*Tursiops truncatus*	40	32.65517	-117.4315
5/14/2011 10:36:14	Sperm Whale	*Physeter macrocephalus*	20	32.617	-117.72617
5/14/2011 10:41:24	Risso's Dolphin	*Grampus griseus*	11	32.62283	-117.72467
5/14/2011 10:41:24	Northern Right Whale Dolphin	*Lissodelphis borealis*	50	32.62283	-117.72467
5/14/2011 11:51:04	California Sea Lion	*Zalophus californianus*	1	32.61567	-117.4085
5/14/2011 11:56:04	California Sea Lion	*Zalophus californianus*	1	32.619	-117.37917
5/14/2011 12:02:14	California Sea Lion	*Zalophus californianus*	1	32.6235	-117.1655
5/14/2011 12:02:44	California Sea Lion	*Zalophus californianus*	1	32.62517	-117.1475
5/14/2011 12:10:24	Risso's Dolphin	*Grampus griseus*	1	32.58467	-117.31433
5/14/2011 12:24:34	Blue Whale	*Balaenoptera musculus*	1	32.7695	-117.37717
5/14/2011 13:29:05	Unidentified Dolphin	unidentified Delphinidae	30	32.85667	-117.36817
5/14/2011 13:32:25	Blue Whale	*Balaenoptera musculus*	2	32.76567	-117.3895

Table 5. Summary of Flight Effort during SOCAL Marine Mammal Aerial Survey Monitoring 23–28 September 2010.

Date 2010	Platform	Location	Time Lift Off	Time Landed	Total Flight Time	Total Engine Time	Total "On Effort" Observ	MTE-assoc. MFAS?	Survey Notes
23-Sep	Partenavia OBS	n/a	14:10	14:12	0:02	n/a	n/a	n/a	Headed SW to NAOPA line; as soon as we took off had to land again pilot says nose of plane feels heavy so we redistributed weight in plane
23-Sep	Partenavia OBS	S NAOPA	14:20	17:33	3:13	3:38	3:06	Yes	Second take-off today; completed 4 southernmost NAOPA lines, relatively few sightings compared to previous surveys
24-Sep	Partenavia OBS	N SOAR	11:42	14:57	3:15	3:25	3:10	No	First survey flight flew straight to N SOAR did 4 N legs at SOAR then flew back; fog nearshore on way in morning, no observing until part-way through transit. Focal on blue whale and common dolphins.
24-Sep	Partenavia OBS	Coastal NAOPA	16:05	17:41	1:36	1:54	1:46	No	Second flight of day-we flew N about 10 nm from shore, hit Bf 5, then turned back and headed S about 5 nm offshore and went in to airport
25-Sep	Partenavia OBS	NE SOAR	10:19	13:37	3:18	3:28	3:13	No	Headed straight out to T2 in NE SOAR where BRS vessel was this morning; did not circle any groups on way out because needed to conserve fuel for coordination with BRS and SOAR survey
26-Sep	Partenavia OBS	N SOAR	10:35	14:18	3:43	3:50	3:36	No	Flew straight to N SOAR since BRS vessel restricted to N SOAR; we will call them on vhf 16 when we get near SOAR and see if they need us for anything. Otherwise we will survey N SOAR start an E end of Line 1 in northernmost SOAR. We are flying at 1000 ft altitude doing line transect surveys. Our tail number is zero two lima (02L). Focals on common dolphins.
26-Sep	Partenavia OBS	Coastal NAOPA	15:24	17:25	2:01	2:19	1:54	No	Second flight of day. Plan is to head N parallel shore by about 8 nm and look for feeding commons or Risso's or whales to do focal video behavioral sessions on.

Date 2010	Platform	Location	Time Lift Off	Time Landed	Total Flight Time	Total Engine Time	Total "On Effort" Observ	MTE-assoc. MFAS?	Survey Notes
27-Sep	Partenavia OBS	N SOAR	9:38	13:34	3:56	4:07	3:49	Yes	Flew straight over to N SOAR Line 1 flew this line E to W then talked to BRS R/V Sproul and they asked us to help them find whales just N of SOAR Range in NW corner and to relocate beaked whales so we flew there and flew improvised systematic lines 1 nm apart paralleling SOAR lines and 3 nm long, saw 3 minkes and Sproul had seen 2 minkes earlier this morning. Did focals on 2 groups of Risso's before and after seeing Sproul may have been same group. VERY HOT in plane today, 95 degrees. Focal on Risso's dolphins and minke whales.
27-Sep	Partenavia OBS	W NAOPA	14:37	16:32	1:55	1:59	1:48	Yes	Second flight of today. Headed W on NAOPA Line 4 to SCI and will then head N along underwater drop off where we often see deep-water species such as Pacific white-sided dolphins, Risso's, beaked, so we can let BRS know since they can't be on SOAR tomorrow. Focals on common dolphins.
28-Sep	Partenavia OBS	Coastal NAOPA	8:44	11:02	2:18	2:29	2:11	No	We did a short local behavior flight this morning and then attempted to assist BRS in Santa Catalina Basin but this region was not accessible to us per Navy communications. BRS has asked us to assist in locating animals since they will not be in SOAR and thus the hydrophone Moretti range to put them on animals. Focal on sei/Brydes whales lunge feeding.
28-Sep	Partenavia OBS	N NAOPA	11:55	15:14	3:19	3:25	3:12	No	Took off from Oxnard airport where we refueled and headed W to San Clemente Island. Focal on Risso's dolphins.
		Total Flight Time:			**28:51:00**	**30:37:00**	**27:27:00**		

Table 6. Summary of Flight Effort during SOCAL Marine Mammal Aerial Survey Monitoring 14–18 February 2011. Note: No survey occurred 16 and 19 February due to inclement weather.

Date	Flight of Day	Time Engines On	Time Engines Off	Total Engine Time	Time Wheels Up	Time Wheels Down	Total Flight Time	Total Flight Dist (km)	Total Flight Dist (nm)	Start Obs.	End Obs.	Total Obs. Time	Flight Area	General Weather	Comments
14 Feb	1	13:08	14:35	1:27	13:10	14:34	1:24	239	129	13:18	14:32	1:14	S of Point Loma near Mexican airspace in Silver Strand†	Bf 2-3	Coordinated with Scripps' RHIB to find unid. whale. Guided RHIB to bottlenose dolphins off Encinitas.
14 Feb	2	15:25	17:22	1:57	15:26	17:23	1:57	342	184	15:34	17:20	1:46	Near E end of Line 3 NAOPA - coordinated with Scripps RHIB to look for focals	Bf 2-3	Coordinated with Scripps' RHIB in attempt to find unid. whale.
15 Feb	1	8:29	11:36	3:07	8:31	11:37	3:06	513	277	8:40	11:34	2:54	S NAOPA	Clear skies Bf 1-2	Scripps' RHIB could not launch due to large swells.
15 Feb	2	13:09	16:25	3:16	13:11	16:26	3:15	561	303	13:16	16:25	3:09	Central NAOPA	Clear skies Bf 1-2	-
16 Feb	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	No flight	Thunderstorms and heavy clouds	Unable to fly due to weather
17 Feb	1	8:43	11:37	2:54	8:52	11:34	2:42	521	281	8:58	11:29	2:31	N SOAR	Clear skies Bf 2	SOAR open only in morning
17 Feb	2	13:36	16:13	2:37	13:42	16:10	2:28	439	237	13:48	16:07	2:19	N NAOPA	Clear skies Bf 2	-
18 Feb	1	9:43	13:01	3:18	9:48	12:59	3:11	598	323	9:54	12:44	2:50	SW & W NAOPA; Carlsbad to Mt. Soledad; S of Pt Loma toward Silver Strand ‡	Partly cloudy, Bf 3-5, thunderstorms started in afternoon	SOAR open in morning but >20-kt winds. Only one AM flight and no PM flight due to weather.

Date	Flight of Day	Time Engines On	Time Engines Off	Total Engine Time	Time Wheels Up	Time Wheels Down	Total Flight Time	Total Flight Dist (km)	Total Flight Dist (nm)	Start Obs.	End Obs.	Total Obs. Time	Flight Area	General Weather	Comments
19 Feb	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	No flight	Thunder-storms, heavy clouds, high winds	Unable to fly due to weather
Total Engine Time:				**18:36:00**	**Total Flown:**		**18:03:00**	**3213**	**1735**	**Total Obs Time**		**16:43:00**			**Add 3 hours (RT) for ferry time to and from Oxnard for aircraft**

Notes:

† Stayed 8 nm offshore due to U.S. Navy airspace restrictions. Short flight due to weight and fuel restrictions.

‡ Flew SW and W NAOPA but Beaufort 5+, so headed inshore. Flew zig-zag systematic from Carlsbad to Mt. Soledad 1–6 km (0.5 -3 nm) from coast in partial lee; flew S of Pt. Loma toward Silver Strand paralleling nearshore but airspace conflicts limited access.

Table 7. Summary of Flight Effort during SOCAL Marine Mammal Aerial Survey Monitoring March 30-1 April, 2011.

Date	Flight of Day	Time Wheels Up	Time Wheels Down	Total Flight Time	Total Flight Dist (km)	Total Flight Dist (nm)	Start Obs.	End Obs.	Total Obs. Time	Flight Area	General Weather	Comments
30-Mar	1	17:36	19:03	1:26	269	145	17:38	18:58	1:20	Line 5 NAOPA then fly W	Clear skies Bf 1-3	Late start due to plane delay in arriving at airport
31-Mar	1	8:50	11:41	2:51	521	281	8:54	11:36	2:42	S NAOPA and headed north	Clear skies Bf 0-1	
31-Mar	2	14:55	17:37	2:42	535	289	14:59	17:33	2:34	Central NAOPA	Clear skies Bf 1-3	
Total Flown:				**9:35:16**	**1865**	**1007**	**Total Obs. Time:**		**9:03:00**			

Table 8. Summary of Flight Effort during SOCAL Marine Mammal Aerial Survey Monitoring April 12-20, 2011.

Date	Flight of the Day	Time Wheels Up	Time Wheels Down	Total Flight Time	Total Flight Effort (km)	Total Flight Effort (nm)	On-Effort Start Time (hh:mm)	On-Effort End Time (hh:mm)	Total On-Effort Time	Flight Area	General Weather (Bf = Beaufort sea state)	Comments
12-Apr	1	11:34	17:37	6:03	1457.1	786.8	11:45	17:32	5:47	NAOPA	Heavy overcast Bf 1-5	Late start due to fog, SHOBA was hot, flew almost all of NAOPA survey lines
13-Apr	1	10:47	15:59	5:12	1181.0	637.7	10:50	15:49	4:59	NAOPA	Overcast Bf 2-5	Late start due to aircraft headphone equipment issue
14-Apr	1	9:10	14:24	5:14	1164.3	628.7	9:13	14:17	5:04	SOAR	Winds light and variable, high ceilings Bf 2-4	Flew all lines in SOAR
15-Apr	1	8:32	13:07	4:35	963.7	520.4	8:36	13:01	4:25	NAOPA	Bf 2-4	Good sighting visibility
15-Apr	2	14:36	17:14	2:38	557.9	301.3	14:39	17:08	2:29	NAOPA	Bf 2-4	Good sighting visibility
16-Apr	1	12:59	16:55	3:56	907.0	489.8	13:03	16:49	3:46	SOAR	Low haze Bf 3-6	Truncated survey lines due to high Bf, shut out of S end of SOAR by active SHOBA area
17-Apr	1	13:49	16:25	2:36	592.2	319.7	13:49	16:22	2:33	Silver Strand	Bf 3-5	Silver: effort directed at identifying animals (not abundance)
18-Apr	1	12:32	18:08	5:36	1317.6	711.4	12:35	18:02	5:27	NAOPA	Morning fog Bf 1-4	Late start due to fog
19-Apr	1	10:16	13:45	3:29	820.5	443.0	10:21	13:41	3:20	NAOPA	Bf 1-3	West side of NAOPA fogged in couldn't fly there
19-Apr	2	15:37	18:27	2:50	615.7	332.4	15:42	18:21	2:39	Silver Strand	Heavy overcast Bf 1-3	Flew all Silver Strand lines
20-Apr	1	10:03	15:58	5:54	1405.8	759.0	10:07	15:53	5:46	Silver Strand/ NAOPA	Heavy cloud cover Bf 2-4	North NAOPA socked in by fog, low clouds delayed departure
Total Flown:				**46:33**	**10983**	**5882**	**Total On-Effort Time:**		**44:15**			

Table 9. Flight Effort during SOCAL Marine Mammal Aerial Survey Monitoring 9-14 May 2011.

Date	Flight of Day	Time Engines On	Time Engines Off	Total Engine Time	Time Wheels Up	Time Wheels Down	Total Flight Time	Total Flight Dist (km)	Total Flight Dist (nm)	Start Obs.	End Obs.	Total Obs. Time	Flight Area	General Weather	Comments
09 May	1	14:55	17:18	2:23	15:03	17:16	2:13	394.4	212.8	15:07	17:10	2:03	NAOPA	Variable winds Bf 3-4	Small craft advisory
10 May	1	9:23	13:03	3:40	9:31	12:58	3:27	590.1	318.4	9:35	12:53	3:18	NAOPA	Clear skies Bf 2-5	
10 May	2	14:33	18:05	3:32	14:45	18:02	3:17	588.3	317.5	14:49	17:56	3:07	NAOPA	Clear skies Bf 2-5	SHOBA hot
11 May	1	9:34	11:09	1:35	9:42	11:05	1:23	248.0	133.9	9:46	11:01	1:15	NAOPA	Partly sunny Bf 2	Flew along underwater ridge
11 May	2	13:32	16:15	2:43	13:42	16:12	2:30	465.6	251.2	13:48	16:06	2:18	NAOPA	Partly sunny Bf 2-3	Dead humpback
12 May	1	10:18	14:22	4:04	10:22	14:17	3:55	770.6	415.9	10:26	14:10	3:44	SOAR	Patchy fog Bf 1-4	Late start due to fog, ceiling limited us to altitudes 800-1200 ft.
12 May	2	15:23	17:50	2:27	15:33	17:45	2:12	390.2	210.6	15:36	17:38	2:02	Silver Strand	Clear skies Bf 2-3	
13 May	1	13:16	17:19	4:03	13:23	17:14	3:51	681.3	367.6	13:28	17:09	3:41	NAOPA	Clear skies Bf 1-3	Late start due to heavy clouds
14 May	1	9:23	12:37	3:14	9:26	12:33	3:07	553.4	298.6	9:30	12:27	2:57	Silver Strand	Patchy fog Bf 2-3	Large pod of sperm whales
14 May	2	13:16	14:36	1:20	13:21	14:32	1:11	214.4	115.7	13:25	14:27	1:02	NAOPA	Partly cloudy Bf 1-3	
Total Engine Time:				**29:01:00**	**Total Flown:**		**27:01:00**	**4896.3**	**2642.2**	**Total Obs Time:**		**25:27:00**			

Table 10. Video recorded during 23-28 September SOCAL 2010 aerial monitoring surveys off San Diego, California.

Navy Range	Video Name	Date	Start Time	End Time	Total Video (hr:min:sec)	Sighting ID	Species	Video Notes	Taken By
SOCAL	SOCAL_2010Sept_23_SES_ Video_161914-162115_ID6_ CommonDolphinSp.	9/23/2010	16:19:14	16:21:15	0:02:01	6	Long-Beaked Common Dolphin	No voice on video, bird association	Mari Smultea
SOCAL	SOCAL_2010Sept_23_SES_ Video_162118-162244_ID6_ CommonDolphinSp.	9/23/2010	16:21:18	16:22:44	0:01:26	6	Long-Beaked Common Dolphin	No voice on video, bird association, animals spread out, inverted lunge	Mari Smultea
SOCAL	SOCAL_2010Sept_23_SES_ Video_162252-162416_ID6_ CommonDolphinSp.	9/23/2010	16:22:52	16:24:16	0:01:24	6	Long-Beaked Common Dolphin	No voice on video, bird association, inverted lunge	Mari Smultea
SOCAL	SOCAL_2010Sept_23_SES_ Video_162418-162429_ID6_ CommonDolphinSp.	9/23/2010	16:24:18	16:24:29	0:00:11	6	Long-Beaked Common Dolphin	No voice on video, 1 individual	Mari Smultea
SOCAL	SOCAL_2010Sept_26_SES_ Video_122055-122128_ IDBoat_Boat	9/26/2010	12:20:55	12:21:28	0:00:33	Boat	Boat		Bernd Würsig
SOCAL	SOCAL_2010Sept_26_SES_ Video_122421-122439_ IDBoat_Boat	9/26/2010	12:24:21	12:24:39	0:00:18	Boat	Boat	R/V Robert Gordon Sproul	Bernd Würsig
SOCAL	SOCAL_2010Sept_26_SES_ Video_122955-123021_ IDBoat_Boat	9/26/2010	12:29:55	12:30:21	0:00:26	Boat	Boat	R/V Robert Gordon Sproul	Bernd Würsig
SOCAL	SOCAL_2010Sept_26_SES_ Video_131518-133022_ID15_ CommonDolphinSp.	9/26/2010	13:15:18	13:30:22	0:15:04	15	Common Dolphin sp.	voice hard to understand, 1000 to 1200 individuals, bird association, dispersion 1-2, oriented at 090, group is more longer than horizontal, dispersion is 1-5, slow travel, no behavior changes seen	Bernd Würsig
SOCAL	SOCAL_2010Sept_26_SES_ Video_133347-133845_ID15_ CommonDolphinSp.	9/26/2010	13:33:47	13:38:45	0:04:58	15	Common Dolphin sp.	Same group as above, oriented at 090, dispersion 1-2, slow surface active travel, bird association, group in a slight triangle shape, oriented at 080, shape is a rectangle, dispersion 1-3, birds circling above dolphin	Bernd Würsig

Navy Range	Video Name	Date	Start Time	End Time	Total Video (hr:min:sec)	Sighting ID	Species	Video Notes	Taken By
SOCAL	SOCAL_2010Sept_26_SES_Video_165617-165811_ID31_CommonDolphinSp.	9/26/2010	16:56:17	16:58:11	0:01:54	31	Common Dolphin sp.	Animals all spread out, 80-100 individuals, calf seen,	Bernd Würsig
SOCAL	SOCAL_2010Sept_26_SES_Video_165819-171548_ID31_CommonDolphinSp.	9/26/2010	16:58:19	17:15:48	0:17:29	31	Common Dolphin sp.	Animals spread out, bird association, foraging, inverted swimming, 12 subgroups, surface active milling with birds, occasional lunging, spacing 1-3, one subgroup has roughly 20 animals, spacing 1-2, traveling to 120, second subgroup- surface active milling, spacing 1-2, roughly 10 individuals, spacing 1-12, inverted swim, porpoise lunging with birds, spacing 1-15, split up into 3 groups of 5, inverted swim, sighting number 30, spacing 1-18, 3rd subgroup- surface active milling, spinning, turning, spacing is 1-2, 5 animals in subgroup, inverting swim, lunging, porpoising, still surface active swim, birds swoop down with dolphin come to surface	Bernd Würsig
SOCAL	SOCAL_2010Sept_27_SES_Video_105235-105354_ID16_Risso's	9/27/2010	10:52:35	10:53:54	0:01:19	16	Risso's Dolphin	oriented 220, spacing 1-18, one animal is 30 body lengths, another animal 60 body lengths, 17 animals, slow travel	Bernd Würsig
SOCAL	SOCAL_2010Sept_27_SES_Video_105413-110843_ID16_Risso's	9/27/2010	10:54:13	11:08:43	0:14:30	16	Risso's Dolphin	spacing is 1-15, group really spread out, few animals 100 body lengths away, slow travel, foraging, bird flying by, 2 subgroups, 19 individuals, oriented at 220, line abreast formation, slow travel, 3 animals tightly grouped, in group spacing 1-2, otherwise 15-100 body lengths apart, animals not changing behavior, animals seem to be all coming together, animals turned to the west, spacing 1-3, slow travel, possible calf	Bernd Würsig

Navy Range	Video Name	Date	Start Time	End Time	Total Video (hr:min:sec)	Sighting ID	Species	Video Notes	Taken By
SOCAL	SOCAL_2010Sept_27_SES_ Video_122343-124044_ ID36_Risso's	9/27/2010	12:23:43	12:40:44	0:17:01	36	Risso's Dolphin	group of 2 trailing, with a group of 6-7 in the front, orientation 330, spacing 1-8, below surface, very tight in the front group, slow travel, 8 body lengths, orienting towards each other, spacing 1-4, oriented at 230, one animal in lead 100 body lengths away, logging, line abreast at surface, slow travel, spacing 1-7, most of group headed towards 230, resting at surface, spacing 1-1 in subgroup	Bernd Würsig
SOCAL	SOCAL_2010Sept_27_SES_ Video_150429-151406_ID61_ CommonDolphinSp.	9/27/2010	15:04:29	15:14:06	0:09:37	61	Common Dolphin sp.	birds on water, 1000 ft., foraging, dispersal within subgroup is 1-2, dolphin going in 2's and 3's chasing the birds, inverted swim, lunge and then dive	Bernd Würsig
SOCAL	SOCAL_2010Sept_27_SES_ Video_153115-155635_ID65_ CommonDolphinSp.	9/27/2010	15:31:15	15:56:35	0:25:20	65	Common Dolphin sp.	inverted swim, lunging, huge group of dolphin, roughly 1200 individuals, surface active travel, v shaped formation, orientation 350, fast travel, 1-2 spacing, boat 40 vessel lengths behind dolphins, group in front has 20 dolphins, oriented at 350, fast travel, spacing 1-2 for group in front, oblong formation, wider than long	Bernd Würsig
SOCAL	SOCAL_2010Sept_28_SES_ Video_125907-130846_ID12_ CommonDolphinSp.	9/28/2010	12:59:07	13:08:46	0:09:39	12	Common Dolphin sp.	bird association, two animals lunging together, spacing 1-2, 4-5 subgroups, milling with birds, 3 animals inverted lunge, multiple splash's, swimming inverted, competing for food, spacing 1-3, 2 inverted, one lunge turn, birds on water, split into 2 subgroups	Bernd Würsig
SOCAL	SOCAL_2010Sept_28_SES_ Video_132405-134500_ ID15_Risso's	9/28/2010	13:24:05	13:45:00	0:20:55	15	Risso's Dolphin	blow, blow, one animal, blow, heading is 7 o'clock, sub-surface, blow, traveling, heading towards 5 0'clock, slow travel below surface	Bernd Würsig
			Total Hours:		**2:24:05**				

Table 11. Video recorded during 14-19 February SOCAL 2011 aerial monitoring surveys off San Diego, California.

Navy Range	Video Name	Date	Start Time	End Time	Total Video (hr:min:sec)	Daily Sighting ID	Species	Best Group Size	Beaufort sea state	Video Notes	Taken By	Video Utility/ Quality[a]
SOCAL	SOCAL_2011Feb_15_HDR_ Video_095256-095318_ID1_Gray	2/15/2011	9:52:56	9:53:18	0:00:22	1	Gray whale	2	2	Mother calf pair, slow travel	Bernd Würsig	Poor
SOCAL	SOCAL_2011Feb_15_HDR_ Video_095344-95459_ID1_Gray	2/15/2011	9:53:44	9:54:59	0:01:15	1	Gray whale	2	2	Mother calf pair, slow travel below surface, oriented at 150	Bernd Würsig	Fair
SOCAL	SOCAL_2011Feb_15_HDR_ Video_95601-95810_ID1_Gray	2/15/2011	9:56:01	9:58:10	0:02:09	1	Gray whale	2	2	Mother calf pair, slow travel, multiple blows, calf seen directly below mother	Bernd Würsig	Fair
SOCAL	SOCAL_2011Feb_15_HDR_ Video_095854-100010_ID1_Gray	2/15/2011	9:58:54	10:00:10	0:01:16	1	Gray whale	2	2	Shallow dives, mother calf pair, multiple blows,	Bernd Würsig	Fair
SOCAL	SOCAL_2011Feb_15_HDR_ Video_100143-101119_ID1_Gray	2/15/2011	10:01:43	10:11:19	0:09:36	1	Gray whale	2	2	Calf on moms back, multiple blows, traveling subsurface	Bernd Würsig	Good
SOCAL	SOCAL_2011Feb_15_HDR_ Video_104220-105141_ID5_Risso's	2/15/2011	10:42:20	10:51:41	0:09:21	5	Risso's dolphin	6	2	Traveling, dispersal 1-10, bird associated with group, possible feeding, sprinting, surface active mill, leaping	Bernd Würsig	Fair
SOCAL	SOCAL_2011Feb_15_HDR_ Video_110915-111413_ID5_Risso's	2/15/2011	11:09:15	11:14:13	0:04:58	5	Risso's dolphin	6	2	Very slow travel, one calf, line abreast	Bernd Würsig	Good

Navy Range	Video Name	Date	Start Time	End Time	Total Video (hr:min:sec)	Daily Sighting ID	Species	Best Group Size	Beaufort sea state	Video Notes	Taken By	Video Utility/ Quality[a]
SOCAL	SOCAL_2011Feb_15_HDR_Video_111414-112457_ID5_Risso's	2/15/2011	11:14:14	11:24:57	0:10:43	5	Risso's dolphin	6	2	Very slow travel, one calf, line abreast, social	Bernd Würsig	Excellent
SOCAL	SOCAL_2011Feb_15_HDR_Video_112500-113854_ID5_Risso's	2/15/2011	11:25:00	11:38:54	0:13:54	5	Risso's dolphin	6	2	Slow travel, one calf, dove, multiple blows, calf seems to surface each time mother does	Bernd Würsig	Good
SOCAL	SOCAL_2011Feb_15_HDR_Video_115741-115828_ID6_Risso's	2/15/2011	11:57:41	11:58:28	0:00:47	6	Risso's dolphin	100	2	11 subgroups, one tight group touching each other, milling	Bernd Würsig	Good
SOCAL	SOCAL_2011Feb_15_HDR_Video_115846-115904_ID6_Risso's	2/15/2011	11:58:46	11:59:04	0:00:18	6	Risso's dolphin	100	2	Very short video, Rolling over, socializing, touching, milling	Bernd Würsig	Good
SOCAL	SOCAL_2011Feb_15_HDR_Video_120000-120121_ID6_Risso's	2/15/2011	12:00:00	12:01:21	0:01:21	6	Risso's dolphin	100	2	Focusing on one subgroup of animals, socializing, milling, in tight group	Bernd Würsig	Good
SOCAL	SOCAL_2011Feb_15_HDR_Video_120138-120207_ID6_Risso's	2/15/2011	12:01:38	12:02:07	0:00:29	6	Risso's dolphin	100	2	Focusing on one subgroup of animals, socializing, milling, in tight group, 3 facing each other and came together	Bernd Würsig	Good

Navy Range	Video Name	Date	Start Time	End Time	Total Video (hr:min:sec)	Daily Sighting ID	Species	Best Group Size	Beaufort sea state	Video Notes	Taken By	Video Utility/ Quality[a]
SOCAL	SOCAL_2011Feb_15_HDR_Video_1200216-120623_ID6_Risso's	2/15/2011	12:02:16	12:06:23	0:04:07	6	Risso's dolphin	100	2	Group of 21 individuals, line abreast, socializing, part of group milling, tail slap, slow travel	Bernd Würsig	Good
SOCAL	SOCAL_2011Feb_15_HDR_Video_151224-152241_ID15_Risso's	2/15/2011	15:12:24	15:22:41	0:10:17	15	Risso's dolphin	8	2	Slow travel, groups of 4, 4 and 2 figuration	Bernd Würsig	Fair
SOCAL	SOCAL_2011Feb_17_HDR_Video_155621-155757_ID38_Gray	2/17/2011	15:56:21	15:57:57	0:01:36	38	Gray whale	1	1	One individual seen traveling slowly at the surface	Mari Smultea	Fair
SOCAL	SOCAL_2011Feb_17_HDR_Video_160943-161643_ID38_Gray	2/17/2011	16:09:43	16:16:43	0:07:00	38	Gray whale	1	1	Traveling slowly at surface	Mari Smultea	Fair
SOCAL	SOCAL_2011Feb_17_HDR_Video_161648-161909_ID38_Gray	2/17/2011	16:16:48	16:19:09	0:02:21	38	Gray whale	1	1	Slow travel at the surface	Mari Smultea	Fair
			Total Hours:		**1:11:13**							

Table 12. Video recorded during 30 March-1 April SOCAL 2011 aerial monitoring surveys off San Diego, California.

Navy Range	Video Name	Date	Start Time	End Time	Total Video (hr:min:sec)	Daily Sighting ID	Species	Best Group Size	Beaufort sea state	Video Notes	Taken By	Video Utility/ Quality[a]
SOCAL	SOCAL_2011March_30_HDR_Video_183738-183809_ID5_Commonsp.	3/30/2011	18:37:38	18:38:09	0:00:31	5	Common Dolphin sp.	18	2	Milling, dispersion 1-3, birds close to water diving, swimming in tight circles	Bernd Würsig	Good
SOCAL	SOCAL_2011March_30_HDR_Video_183903-183955_ID5_Commonsp.	3/30/2011	18:39:03	18:39:55	0:00:52	5	Common Dolphin sp.	18	2	Dispersion 1-2, bird association, surface-active mill, a dolphin seen spinning	Bernd Würsig	Excellent
SOCAL	SOCAL_2011March_30_HDR_Video_184031-184139_ID5_Commonsp.	3/30/2011	18:40:31	18:41:39	0:01:08	5	Common Dolphin sp.	18	2	Dispersion 1-3, birds seen diving	Bernd Würsig	Fair
SOCAL	SOCAL_2011March_30_HDR_Video_184232-184303_ID5_Commonsp.	3/30/2011	18:42:32	18:43:03	0:00:31	5	Common Dolphin sp.	18	2	Inverted swimming, bird association	Bernd Würsig	Good
SOCAL	SOCAL_2011March_30_HDR_Video_184359-184400_ID5_Commonsp.	3/30/2011	18:43:59	18:44:00	0:00:01	5	Common Dolphin sp.	18	2	Video not long enough	Bernd Würsig	Poor
SOCAL	SOCAL_2011March_30_HDR_Video_184449-184531_ID5_Commonsp.	3/30/2011	18:44:49	18:45:31	0:00:42	5	Common Dolphin sp.	18	2	Inverted swimming, bird association, dispersion 1-4	Bernd Würsig	Good
SOCAL	SOCAL_2011March_31_HDR_Video_093730-100535_ID4_Risso's	3/31/2011	9:37:30	10:05:35	0:28:05	4	Risso's dolphin	18	1	Staggered line abreast, 17 animals, slow travel, dispersal 1-4	Bernd Würsig	Good

Navy Range	Video Name	Date	Start Time	End Time	Total Video (hr:min:sec)	Daily Sighting ID	Species	Best Group Size	Beaufort sea state	Video Notes	Taken By	Video Utility/ Quality[a]
SOCAL	SOCAL_2011March_31_HDR_Video_102217-103531_ID4_Risso's	3/31/2011	10:22:17	10:35:31	0:13:14	4	Risso's dolphin	18	1	Tight group, staggered line abreast, vessel seen 50 vessel lengths away from dolphin, common dolphin seen 100 body lengths away swimming in opposite direction	Bernd Würsig	Good
SOCAL	SOCAL_2011March_31_HDR_Video_104835-105726_ID7_Minke	3/31/2011	10:48:35	10:57:26	0:08:51	7	Minke whale	2	0	Multiple blows, 2 animals, slow travel, one whale inverted swim, other whale ~3 body lengths away	Bernd Würsig	Fair
SOCAL	SOCAL_2011March_31_HDR_Video_112109-113241_ID9_LBCommon	3/31/2011	11:21:09	11:32:41	0:11:32	9	Long-beaked Common Dolphin	35	0	Medium travel, possible calf see, dispersion 1-6	Bernd Würsig	Fair
SOCAL	SOCAL_2011March_April01_HDR_Video_092241-092640_ID23_Risso's	4/1/2011	9:22:41	9:26:40	0:03:59	23	Risso's Dolphin	20	2	4 individuals, slow travel, dispersal 15-40, milling, one pair	Dan Engelhaupt	Fair
SOCAL	SOCAL_2011March_April01_HDR_Video_092654-092822_ID23-24_NRWDolphin	4/1/2011	9:26:54	9:28:22	0:01:28	23,24	NRW Dolphins	8	2	2-3 Risso's with 5 NRWD	Dan Engelhaupt	Fair

Navy Range	Video Name	Date	Start Time	End Time	Total Video (hr:min:sec)	Daily Sighting ID	Species	Best Group Size	Beaufort sea state	Video Notes	Taken By	Video Utility/ Quality[a]
SOCAL	SOCAL_2011March_April01_HDR_Video_093500-093944_ID24_NRWDolphin	4/1/2011	9:35:00	9:39:44	0:04:44	24	NRW Dolphins	8	2	tight group, dispersal 1-1, behavior has not changed throughout video, foraging dives, possible competition for food	Dan Engelhaupt	Poor
SOCAL	SOCAL_2011March_April01_HDR_Video_093948-094010_ID24_Risso's-NRWDolphin	4/1/2011	9:39:48	9:40:10	0:00:22	24	Risso's Dolphin, NRW Dolphins	8 NRWD, 20 Risso's	2	group of 4, video too short	Dan Engelhaupt	Fair
SOCAL	SOCAL_2011March_April01_HDR_Video_094043-095111_ID24_Risso's-NRWDolphin	4/1/2011	9:40:43	9:51:11	0:10:28	24	Risso's Dolphin, NRW Dolphins	8 NRWD, 20 Risso's	2	foraging, 7 NRWD, dispersal 3-7, NRWD interspersed with Risso's, 3 Risso's 2 NRWD	Dan Engelhaupt	Good
SOCAL	SOCAL_2011March_April01_HDR_Video_100142-101003_ID28-31_Risso's-NRWDolphin-Gray	4/1/2011	10:01:42	10:10:03	0:08:21	28,29,30, 31	Risso's Dolphin, NRW Dolphins, Gray whale	20 Risso's, 25 NRWD, 3 Gray	1	Single Risso's surface-active travel, 3 gray whales, poss. calf on back of adult, slow travel, a lot of barnacles seen on one, sub-group of Risso's ~40 body lengths from single Risso's	Dan Engelhaupt	Good
			Total Hours:		**1:34:49**							

Table 13. Video recorded during 12- 20 April SOCAL 2011 aerial monitoring surveys off San Diego, California.

Navy Range	Video Name	Date	Start Time	End Time	Total Video (hr:min:sec)	Daily Sighting ID	Species	Best Group Size	Beaufort sea state	Video Notes	Taken By	Video Utility/ Quality[a]
SOCAL	SOCAL_2011April_12_HDR_Video_120047-120557_ID1_Commonsp.	4/12/2011	12:00:47	12:05:57	0:05:10	1	Common dolphin sp.	440	3	Surface-active travel, angle 120, altitude 700 ft. , animals rarely seen in video, bird association, dispersal 1-5	Bernd Würsig	fair
SOCAL	SOCAL_2011April_12_HDR_Video_124153-125438_ID4_Risso's	4/12/2011	12:41:53	12:54:38	0:12:45	4	Risso's dolphin	25	2	2 subgroups heading in same direction, dispersal 1-5, slow travel, staggered line abreast, 1500 ft., .5 mile from shore	Bernd Würsig	fair
SOCAL	SOCAL_2011April_12_HDR_Video_160255-163327_ID11_Fin	4/12/2011	16:02:55	16:33:27	0:30:32	11	Fin whale	2	3	2 animals 3 body lengths away, asynchronous and sometimes synchronous surfacing times, medium travel, multiple blows	Bernd Würsig	good
SOCAL	SOCAL_2011April_12_HDR_Video_105902-113353_ID3_Gray	4/13/2011	10:59:52	11:33:53	0:34:01	3	Gray whale	3	3	Traveling subsurface, multiple blows	Bernd Würsig	fair
SOCAL	SOCAL_2011April_13_HDR_Video_113649-114751_ID4_Risso's	4/13/2011	11:36:49	11:47:51	0:11:02	4	Risso's dolphin	24	3	Staggered line abreast, no audio during video	Bernd Würsig	fair

Navy Range	Video Name	Date	Start Time	End Time	Total Video (hr:min:sec)	Daily Sighting ID	Species	Best Group Size	Beaufort sea state	Video Notes	Taken By	Video Utility/ Quality[a]
SOCAL	SOCAL_2011April_13_HDR_ Video_141659- 142351_ID15_Risso's	4/13/2011	14:16:59	14:23:51	0:06:52	15	Risso's dolphin	75	3	Dispersal 1-2, slow travel	Bernd Würsig	fair
SOCAL	SOCAL_2011April_13_HDR_ Video_150217- 151444_ID18_Commonsp.	4/13/2011	15:02:17	15:14:44	0:12:27	18	Common dolphin sp.	450	3	Surface-active mill, splashing, bird association, zigzagging seen	Bernd Würsig	fair
SOCAL	SOCAL_2011April_14_HDR_ Video_114902- 114958_ID18_Fin	4/14/2011	11:49:02	11:49:58	0:00:56	10	Fin whale	1	3	Animal never seen, one whale, Risso's seen in distance	Bernd Würsig	poor
SOCAL	SOCAL_2011April_14_HDR_ Video_115324- 115431_ID11_Risso's	4/14/2011	11:53:24	11:54:31	0:01:07	11	Risso's dolphin	60	3	Very spread out, animals rarely seen in video	Bernd Würsig	poor
SOCAL	SOCAL_2011April_15_HDR_ Video_095453- 095512_ID5_Minke	4/15/2011	9:54:53	9:55:12	0:00:19	5	Minke whale	2	2	Animal sub-surface, not seen in video	Bernd Würsig	poor
SOCAL	SOCAL_2011April_15_HDR_ Video_095933- 100009_ID5_Minke	4/15/2011	9:59:33	10:00:09	0:00:36	5	Minke whale	2	2	never seen in video	Bernd Würsig	poor
SOCAL	SOCAL_2011April_15_HDR_ Video_100226- 100316_ID5_Minke	4/15/2011	10:02:26	10:03:16	0:00:50	5	Minke whale	2	2	never seen in video	Bernd Würsig	poor
SOCAL	SOCAL_2011April_15_HDR_ Video_101631- 102021_ID5_Minke	4/15/2011	10:16:31	10:20:21	0:03:50	5	Minke whale	2	2	scat seen in video, one animal, arch dive, 2 other minke's seen 1.25 miles ahead,	Bernd Würsig	fair

Navy Range	Video Name	Date	Start Time	End Time	Total Video (hr:min:sec)	Daily Sighting ID	Species	Best Group Size	Beaufort sea state	Video Notes	Taken By	Video Utility/ Quality[a]
SOCAL	SOCAL_2011April_15_HDR_ Video_102028- 102947_ID5_Minke	4/15/2011	10:20:28	10:29:47	0:09:19	5	Minke whale	2	2	no blow rise, poss. calf in front, dispersal 1-1, slow travel, multiple blows, social mill	Bernd Würsig	good
SOCAL	SOCAL_2011April_15_HDR_ Video_112502- 114040_ID7_Risso's	4/15/2011	11:25:02	11:40:40	0:15:38	7	Risso's dolphin	19	3	rest/slow travel, 800 feet altitude	Bernd Würsig	fair
SOCAL	SOCAL_2011April_15_HDR_ Video_154642- 160219_ID19_Risso's	4/15/2011	15:46:42	16:02:19	0:15:37	19	Risso's dolphin	24	3	rest/slow travel, dispersal 1-10	Bernd Würsig	fair
SOCAL	SOCAL_2011April_16_HDR_ Video_151809- 152922_ID12_Fin	4/16/2011	15:18:09	15:29:22	0:11:13	12	Fin whale	1	4	medium to fast travel, multiple blows, traveled over 3km since first observed	Mari Smultea	poor
SOCAL	SOCAL_2011April_16_HDR_ Video_152927- 153009_ID12_Fin	4/16/2011	15:29:27	15:30:09	0:00:42	12	Fin whale	1	4	animal rarely seen, blow	Mari Smultea	poor
SOCAL	SOCAL_2011April_16_HDR_ Video_153058- 163333_ID12_Fin	4/16/2011	15:30:58	15:33:33	0:02:35	12	Fin whale	1	4	medium travel, subsurface, multiple blows	Mari Smultea	fair
SOCAL	SOCAL_2011April_16_HDR_ Video_153335- 153537_ID12_Fin	4/16/2011	15:33:35	15:35:37	0:02:02	12	Fin whale	1	4	rarely seen, traveling to the 3 o'clock	Mari Smultea	poor
SOCAL	SOCAL_2011April_18_HDR_ Video_131749- 131809_ID3_Risso's	4/18/2011	13:17:49	13:18:09	0:00:20	3	Risso's dolphin	7	2	2 Risso's seen at the end of the video traveling	Mari Smultea	poor
SOCAL	SOCAL_2011April_18_HDR_ Video_131813- 132519_ID3_Risso's	4/18/2011	13:18:13	13:25:19	0:07:06	3	Risso's dolphin	7	2	Milling	Mari Smultea	fair

Navy Range	Video Name	Date	Start Time	End Time	Total Video (hr:min:sec)	Daily Sighting ID	Species	Best Group Size	Beaufort sea state	Video Notes	Taken By	Video Utility/ Quality[a]
SOCAL	SOCAL_2011April_18_HDR_Video_132542-133727_ID3_Risso's	4/18/2011	13:25:42	13:37:27	0:11:45	3	Risso's dolphin	7	2	2 subgroups, traveling line abreast, *Tursiops* in front of Risso's but not seen in video, socializing	Mari Smultea	fair
SOCAL	SOCAL_2011April_18_HDR_Video_133745-134141_ID3_Risso's	4/18/2011	13:37:45	13:41:41	0:03:56	3	Risso's dolphin	7	2	Social travel	Mari Smultea	good
SOCAL	SOCAL_2011April_18_HDR_Video_134227-134508_ID3_Risso's	4/18/2011	13:42:27	13:45:08	0:02:41	3	Risso's dolphin	7	2	Slow travel, social, tight line abreast	Mari Smultea	fair
SOCAL	SOCAL_2011April_18_HDR_Video_134514-134813_ID3_Risso's	4/18/2011	13:45:14	13:48:13	0:02:59	3	Risso's dolphin	7	2	2 subgroups separated by 15 body lengths, traveling	Mari Smultea	poor
SOCAL	SOCAL_2011April_18_HDR_Video_134823-134906_ID3_Risso's	4/18/2011	13:48:23	13:49:06	0:00:43	3	Risso's dolphin	7	2	Traveling	Mari Smultea	poor
SOCAL	SOCAL_2011April_18_HDR_Video_134929-135038_ID3_Risso's	4/18/2011	13:49:29	13:50:38	0:01:09	3	Risso's dolphin	7	2	Staggered line abreast, traveling	Mari Smultea	poor
SOCAL	SOCAL_2011April_18_HDR_Video_135053-135103_ID3_Risso's	4/18/2011	13:50:53	13:51:03	0:00:10	3	Risso's dolphin	7	2	Seen traveling at surface, very short video	Mari Smultea	poor
SOCAL	SOCAL_2011April_18_HDR_Video_141752-141920_ID5_Risso's	4/18/2011	14:17:52	14:19:20	0:01:28	5	Risso's dolphin	12	1	Traveling staggered line abreast, video is far from animals and not clear	Mari Smultea	poor

Navy Range	Video Name	Date	Start Time	End Time	Total Video (hr:min:sec)	Daily Sighting ID	Species	Best Group Size	Beaufort sea state	Video Notes	Taken By	Video Utility/ Quality[a]
SOCAL	SOCAL_2011April_18_HDR_ Video_142344- 142422_ID5_Risso's	4/18/2011	14:23:44	14:24:22	0:00:38	5	Risso's dolphin	12	1	Group seen traveling at surface, video very short and plane in the way	Mari Smultea	poor
SOCAL	SOCAL_2011April_18_HDR_ Video_142845- 142947_ID5_Risso's	4/18/2011	14:28:45	14:29:47	0:01:02	5	Risso's dolphin	12	1	Slow travel line abreast	Mari Smultea	fair
SOCAL	SOCAL_2011April_18_HDR_ Video_143131- 143240_ID5_Risso's	4/18/2011	14:31:31	14:32:40	0:01:09	5	Risso's dolphin	12	1	Line abreast, slow travel	Mari Smultea	poor
SOCAL	SOCAL_2011April_18_HDR_ Video_143323- 143514_ID5_Risso's	4/18/2011	14:33:23	14:35:14	0:01:51	5	Risso's dolphin	12	1	Slow travel line abreast	Mari Smultea	fair
SOCAL	SOCAL_2011April_18_HDR_ Video_143548- 143819_ID5_Risso's	4/18/2011	14:35:48	14:38:19	0:02:31	5	Risso's dolphin	12	1	Surface-active mill	Mari Smultea	poor
SOCAL	SOCAL_2011April_18_HDR_ Video_144039- 144122_ID5_Risso's	4/18/2011	14:40:39	14:41:22	0:00:43	5	Risso's dolphin	12	1	Surface-active mill, 6 animals seen in video	Mari Smultea	fair
SOCAL	SOCAL_2011April_18_HDR_ Video_144321- 144715_ID5_Risso's	4/18/2011	14:43:21	14:47:15	0:03:54	5	Risso's dolphin	12	1	Same group, surface-active mill	Mari Smultea	fair
SOCAL	SOCAL_2011April_18_HDR_ Video_144843- 144922_ID5_Risso's	4/18/2011	14:48:43	14:49:22	0:00:39	5	Risso's dolphin	12	1	Same group, surface-active mill	Mari Smultea	fair
SOCAL	SOCAL_2011April_18_HDR_ Video_145000- 145018_ID5_Risso's	4/18/2011	14:50:00	14:50:18	0:00:18	5	Risso's dolphin	12	1	Traveling subsurface	Mari Smultea	poor
SOCAL	SOCAL_2011April_18_HDR_ Video_145107- 145151_ID5_Risso's	4/18/2011	14:51:07	14:51:51	0:00:44	5	Risso's dolphin	12	1	Same group, surface-active mill	Mari Smultea	poor

Navy Range	Video Name	Date	Start Time	End Time	Total Video (hr:min:sec)	Daily Sighting ID	Species	Best Group Size	Beaufort sea state	Video Notes	Taken By	Video Utility/ Quality[a]
SOCAL	SOCAL_2011April_18_HDR_Video_145201-145319_ID5_Risso's	4/18/2011	14:52:01	14:53:19	0:01:18	5	Risso's dolphin	12	1	Surface-active mill, same group as above	Mari Smultea	poor
SOCAL	SOCAL_2011April_18_HDR_Video_145402-145504_ID5_Risso's	4/18/2011	14:54:02	14:55:04	0:01:02	5	Risso's dolphin	12	1	Same group as above	Mari Smultea	fair
SOCAL	SOCAL_2011April_18_HDR_Video_145537-145620_ID5_Risso's	4/18/2011	14:55:37	14:56:20	0:00:43	5	Risso's dolphin	12	1	Same group as above, Surface-active mill	Mari Smultea	good
SOCAL	SOCAL_2011April_18_HDR_Video_145631-145713_ID5_Risso's	4/18/2011	14:56:31	14:57:13	0:00:42	5	Risso's dolphin	12	1	Same group as above, Surface-active mill, U shape formation	Mari Smultea	good
SOCAL	SOCAL_2011April_18_HDR_Video_145746-145949_ID5_Risso's	4/18/2011	14:57:46	14:59:49	0:02:03	5	Risso's dolphin	12	1	Same group as above, Surface-active mill	Mari Smultea	good
SOCAL	SOCAL_2011April_18_HDR_Video_150121-150153_ID5_Risso's	4/18/2011	15:01:21	15:01:53	0:00:32	5	Risso's dolphin	12	1	Same group as above, Surface-active mill	Mari Smultea	fair
SOCAL	SOCAL_2011April_18_HDR_Video_150229-150307_ID5_Risso's	4/18/2011	15:02:29	15:03:07	0:00:38	5	Risso's dolphin	12	1	Same group as above, Surface-active mill	Mari Smultea	fair
SOCAL	SOCAL_2011April_18_HDR_Video_150319-150405_ID5_Risso's	4/18/2011	15:03:19	15:04:05	0:00:46	5	Risso's dolphin	12	1	Same group as above, Surface-active mill	Mari Smultea	fair
SOCAL	SOCAL_2011April_18_HDR_Video_150440-150610_ID5_Risso's	4/18/2011	15:04:40	15:06:10	0:01:30	5	Risso's dolphin	12	1	Same group as above, Surface-active mill	Mari Smultea	fair
SOCAL	SOCAL_2011April_18_HDR_Video_170026-170052_ID15_Bottlenose	4/18/2011	17:00:26	17:00:52	0:00:26	15	Bottlenose dolphin	32	2	Surface-active mill	Mari Smultea	fair

Navy Range	Video Name	Date	Start Time	End Time	Total Video (hr:min:sec)	Daily Sighting ID	Species	Best Group Size	Beaufort sea state	Video Notes	Taken By	Video Utility/ Quality[a]
SOCAL	SOCAL_2011April_18_HDR_ Video_170142- 170315_ID15_Bottlenose	4/18/2011	17:01:42	17:03:15	0:01:33	15	Bottlenose dolphin	32	2	Surface-active mill, same group as above	Mari Smultea	fair
SOCAL	SOCAL_2011April_18_HDR_ Video_170520- 170610_ID15_Bottlenose	4/18/2011	17:05:20	17:06:10	0:00:50	15	Bottlenose dolphin	32	2	Surface-active mill	Mari Smultea	fair
SOCAL	SOCAL_2011April_18_HDR_ Video_170650- 170737_ID15_Bottlenose	4/18/2011	17:06:50	17:07:37	0:00:47	15	Bottlenose dolphin	32	2	Surface-active mill, same group as above	Mari Smultea	fair
SOCAL	SOCAL_2011April_18_HDR_ Video_170739- 170821_ID15_Bottlenose	4/18/2011	17:07:39	17:08:21	0:00:42	15	Bottlenose dolphin	32	2	Surface-active mill	Mari Smultea	fair
SOCAL	SOCAL_2011April_18_HDR_ Video_171040- 171205_ID15_Bottlenose	4/18/2011	17:08:44	17:10:29	0:01:45	15	Bottlenose dolphin	32	2	Surface-active mill, same group as above	Mari Smultea	fair
SOCAL	SOCAL_2011April_18_HDR_ Video_171040- 171205_ID15_Bottlenose	4/18/2011	17:10:40	17:12:05	0:01:25	15	Bottlenose dolphin	32	2	Surface-active mill	Mari Smultea	fair
SOCAL	SOCAL_2011April_18_HDR_ Video_174625- 174655_ID19_Common	4/18/2011	17:46:25	17:46:55	0:00:30	19	Common dolphin sp.	105	2	Sprinting, surface-active travel, bird association	Mari Smultea	fair
SOCAL	SOCAL_2011April_18_HDR_ Video_174657- 174742_ID19_Common	4/18/2011	17:46:57	17:47:42	0:00:45	19	Common dolphin sp.	105	2	Zigzag swim, bird association, surface-active travel	Mari Smultea	poor
SOCAL	SOCAL_2011April_18_HDR_ Video_174815- 174828_ID19_Common	4/18/2011	17:48:15	17:48:28	0:00:13	19	Common dolphin sp.	105	2	Bird association, surface-active travel, unidentified splash seen	Mari Smultea	fair

Navy Range	Video Name	Date	Start Time	End Time	Total Video (hr:min:sec)	Daily Sighting ID	Species	Best Group Size	Beaufort sea state	Video Notes	Taken By	Video Utility/ Quality[a]
SOCAL	SOCAL_2011April_18_HDR_Video_174902-174923_ID19_Common	4/18/2011	17:49:02	17:49:23	0:00:21	19	Common dolphin sp.	105	2	Bird association, surface-active travel, airplane in way of video	Mari Smultea	poor
SOCAL	SOCAL_2011April_18_HDR_Video_174945-175051_ID19_Common	4/18/2011	17:49:45	17:50:51	0:01:06	19	Common dolphin sp.	105	2	Bird association, surface-active travel	Mari Smultea	fair
SOCAL	SOCAL_2011April_19_HDR_Video_103913-104027_ID2_Fin	4/19/2011	10:39:13	10:40:27	0:01:14	2	Fin whale	3	2	Animal seen once, surfaced, blew and dove	Mari Smultea	poor
SOCAL	SOCAL_2011April_19_HDR_Video_104119-104504_ID2_Fin	4/19/2011	10:41:19	10:45:04	0:03:45	2	Fin whale	3	2	Animals rarely seen in video	Mari Smultea	poor
SOCAL	SOCAL_2011April_19_HDR_Video_105450-105550_ID2_Fin	4/19/2011	10:54:50	10:55:50	0:01:00	2	Fin whale	3	2	2 adults seen subsurface, dispersal less than one	Mari Smultea	fair
SOCAL	SOCAL_2011April_19_HDR_Video_105601-110501_ID2_Fin	4/19/2011	10:56:01	11:05:11	0:09:10	2	Fin whale	3	2	3 animals seen traveling subsurface, defecation	Mari Smultea	fair
SOCAL	SOCAL_2011April_19_HDR_Video_114701-114848_ID5_Common	4/19/2011	11:47:01	11:48:48	0:01:47	5	Long-Beaked Common dolphin	350	1	Surface-active travel, foraging, inverted swimming, sprinting, bird association	Mari Smultea	fair
SOCAL	SOCAL_2011April_19_HDR_Video_114855-115339_ID5_Common	4/19/2011	11:48:55	11:53:39	0:04:44	5	Long-Beaked Common dolphin	350	1	Surface-active travel, foraging, inverted swimming, sprinting, bird association	Mari Smultea	good

Navy Range	Video Name	Date	Start Time	End Time	Total Video (hr:min:sec)	Daily Sighting ID	Species	Best Group Size	Beaufort sea state	Video Notes	Taken By	Video Utility/ Quality[a]
SOCAL	SOCAL_2011April_19_HDR_Video_115506-115627_ID5_Common	4/19/2011	11:55:06	11:56:27	0:01:21	5 Flight 1	Long-Beaked Common dolphin	350	1	Surface-active travel, foraging, inverted swimming, sprinting, bird association	Mari Smultea	fair
SOCAL	SOCAL_2011April_19_HDR_Video_121140-122605_ID7_Risso's	4/19/2011	12:11:40	12:26:05	0:14:25	7	Risso's dolphin	25	3	Medium travel staggered line abreast, milling	Mari Smultea	fair
SOCAL	SOCAL_2011April_19_HDR_Video_155644-155843_ID12_Fin	4/19/2011	15:56:44	15:58:43	0:01:59	12	Fin whale	1	2	Seen traveling subsurface, multiple blows	Mari Smultea	fair
SOCAL	SOCAL_2011April_19_HDR_Video_171155-172300_ID12_Fin	4/19/2011	15:59:44	16:01:19	0:01:35	12	Fin whale	1	2	Seen traveling subsurface, multiple blows	Mari Smultea	fair
SOCAL	SOCAL_2011April_19_HDR_Video_171155-172300_ID16_Common	4/19/2011	17:11:55	17:23:00	0:11:05	16	Common dolphin sp.	1000	3	Apparent foraging, splashing, bird association, zig zag swimming, surface-active travel	Mari Smultea	fair
SOCAL	SOCAL_2011April_19_HDR_Video_172310-172551_ID16_Common	4/19/2011	17:23:10	17:25:51	0:02:41	5 Flight 2	Short-Beaked Common Dolphin	1000	3	Surface-active travel, bird association, loose aggregation	Mari Smultea	fair
SOCAL	SOCAL_2011April_19_HDR_Video_175155-175329_ID18_Risso's	4/19/2011	17:51:55	17:53:29	0:01:34	18	Risso's dolphin	24	3	Fast travel at surface	Mari Smultea	fair
SOCAL	SOCAL_2011April_19_HDR_Video_175340-180236_ID18_Risso's	4/19/2011	17:53:40	18:02:36	0:08:56	18	Risso's dolphin	24	3	Fast travel at surface, 1000 feet altitude	Mari Smultea	fair

Navy Range	Video Name	Date	Start Time	End Time	Total Video (hr:min:sec)	Daily Sighting ID	Species	Best Group Size	Beaufort sea state	Video Notes	Taken By	Video Utility/ Quality[a]
SOCAL	SOCAL_2011April_20_HDR_Video_101319-101759_ID1_Common	4/20/2011	10:13:19	10:17:59	0:04:40	1	Long-Beaked Common dolphin	45	2	2-3 subgroups, fast travel	Mari Smultea	poor
SOCAL	SOCAL_2011April_20_HDR_Video_103151-103421_ID4_Blue	4/20/2011	10:31:51	10:34:21	0:02:30	4	Blue whale	2	2	2 animals seen traveling, multiple blows	Mari Smultea	fair
SOCAL	SOCAL_2011April_20_HDR_Video_103951-104148_ID4_Blue	4/20/2011	10:39:51	10:41:48	0:01:57	4	Blue whale	2	2	Multiple blows, 2 animals seen, defecation	Mari Smultea	fair
SOCAL	SOCAL_2011April_20_HDR_Video_104453-104639_ID4_Blue	4/20/2011	10:44:53	10:46:39	0:01:46	4	Blue whale	2	2	Two animals seen slow travel subsurface	Mari Smultea	fair
SOCAL	SOCAL_2011April_20_HDR_Video_105538-105755_ID4_Blue	4/20/2011	10:55:38	10:57:55	0:02:17	4	Blue whale	2	2	Two animals seen slow travel subsurface	Mari Smultea	good
SOCAL	SOCAL_2011April_20_HDR_Video_110853-111125_ID4_Blue	4/20/2011	11:08:53	11:11:25	0:02:32	4	Blue whale	2	2	One animal visible subsurface, slow travel with multiple blows	Mari Smultea	fair
SOCAL	SOCAL_2011April_20_HDR_Video_111426-111726_ID4_Blue	4/20/2011	11:14:26	11:17:26	0:03:00	4	Blue whale	2	2	One animal traveling subsurface, multiple blows	Mari Smultea	fair
SOCAL	SOCAL_2011April_20_HDR_Video_124517-124910_ID8_Blue	4/20/2011	12:45:17	12:49:10	0:03:53	8	Blue whale	1	3	Seen slow travel subsurface, multiple blows,	Mari Smultea	fair
SOCAL	SOCAL_2011April_20_HDR_Video_125434-130141_ID8_Blue	4/20/2011	12:54:34	13:01:41	0:07:07	8	Blue whale	1	3	Seen slow travel subsurface, multiple blows,	Mari Smultea	fair

Navy Range	Video Name	Date	Start Time	End Time	Total Video (hr:min:sec)	Daily Sighting ID	Species	Best Group Size	Beaufort sea state	Video Notes	Taken By	Video Utility/ Quality[a]
SOCAL	SOCAL_2011April_20_HDR_Video_130737-131046_ID8_Blue	4/20/2011	13:07:37	13:10:46	0:03:09	8	Blue whale	1	3	Seen traveling subsurface, multiple blows	Mari Smultea	fair
SOCAL	SOCAL_2011April_20_HDR_Video_131357-131449_ID8_Blue	4/20/2011	13:13:57	13:14:49	0:00:52	8	Blue whale	1	3	Very short video, multiple blows while whale traveling	Mari Smultea	fair
SOCAL	SOCAL_2011April_20_HDR_Video_131957-132333_ID8_Blue	4/20/2011	13:19:57	13:23:33	0:03:36	8	Blue whale	1	3	Traveling, multiple blows	Mari Smultea	fair
SOCAL	SOCAL_2011April_20_HDR_Video_132724-132914_ID8_Blue	4/20/2011	13:27:24	13:29:14	0:01:50	8	Blue whale	1	3	seen traveling subsurface, multiple blows	Mari Smultea	good
SOCAL	SOCAL_2011April_20_HDR_Video_135008-135511_ID9_Risso's	4/20/2011	13:50:08	13:55:11	0:05:03	9	Risso's dolphin	22	3	medium travel, dispersal 1-3, line abreast, oriented at 320, 800 feet altitude	Mari Smultea	good
			Total Hours:		**5:15:47**							

Table 14. Video recorded during 9-14 May SOCAL 2011 aerial monitoring surveys off San Diego, California.

Navy Range	Video Name	Date (day mo yr)	Start Time (hr:min:sec)	End Time (hr:min:sec)	Total Video (hr:min:sec)	Daily Sighting ID#	Species	Group Size (best estim.)	Beaufort sea state	Taken by?	Video Utility/ Quality[a]	General Description of Video Content
SOCAL	SOCAL_2011May_9_HDR_ Video_154828- 155054_ID4_Fin	5/9/2011	15:48:28	15:50:54	0:02:26	4	Fin whale	1	3	Mari Smultea	fair	Audio is very hard to hear. Very short video, with little behavior. One whale seen subsurface then dove. Surfaced and blew, and dove again.
SOCAL	SOCAL_2011May_9_HDR_ Video_160130- 160435_ID3_Blue	5/9/2011	16:01:30	16:04:35	0:03:05	3	Blue whale	1	3	Mari Smultea	fair	Audio is very hard to hear. One whale seen traveling and dove.
SOCAL	SOCAL_2011May_9_HDR_ Video_161737- 162057_ID3_Blue	5/9/2011	16:17:37	16:20:57	0:03:20	3	Blue whale	1	3	Mari Smultea	fair	Audio is very hard to hear. Whale surfaced and dove.
SOCAL	SOCAL_2011May_9_HDR_ Video_162611- 162733_ID3_Blue	5/9/2011	16:26:11	16:27:33	0:01:22	3	Blue whale	1	3	Mari Smultea	poor	Audio is very hard to hear. Whale seen traveling at surface, blew, and dove.
SOCAL	SOCAL_2011May_9_HDR_ Video_163127- 163526_ID3_Blue	5/9/2011	16:31:27	16:35:26	0:03:59	3	Blue whale	1	3	Mari Smultea	fair	Audio is very hard to hear. Whale seen traveling subsurface, multiple surfacings with blows. Whale seen resting at surface, fluke up and dove.

Navy Range	Video Name	Date (day mo yr)	Start Time (hr:min:sec)	End Time (hr:min:sec)	Total Video (hr:min:sec)	Daily Sighting ID#	Species	Group Size (best estim.)	Beaufort sea state	Taken by?	Video Utility/ Quality[a]	General Description of Video Content
SOCAL	SOCAL_2011May_9_HDR_Video_165143-165502_ID3_Blue	5/9/2011	16:51:43	16:55:02	0:03:19	3	Blue whale	1	3	Mari Smultea	fair	Audio is very hard to hear.
SOCAL	SOCAL_2011May_10_HDR_Video_094256-095416_ID2_Blue	5/10/2011	9:42:56	9:54:16	0:11:20	2	Blue whale	1	2	Mari Smultea	excellent	Bottlenose dolphins swimming and touching rostrum of blue whale.
SOCAL	SOCAL_2011May_10_HDR_Video_095452-100458_ID2_Blue	5/10/2011	9:54:52	10:04:58	0:10:06	2	Blue whale	1	2	Mari Smultea	excellent	Bottlenose dolphins swimming and touching rostrum of blue whale.
SOCAL	SOCAL_2011May_10_HDR_Video_100616-104735_ID2-4_Blue/Fin/Bottlenose	5/10/2011	10:06:16	10:47:35	0:41:19	2	Blue whale/ Fin whale	2 blue/ 1 fin	2	Mari Smultea	excellent	2 blue whales seen with large bottlenose dolphins. Blue whale seen bubble blasting when dolphins near whale. Fin whale seen 30 body lengths from blue whales
SOCAL	SOCAL_2011May_10_HDR_Video_105015-111008_ID2_Blue/Risso's	5/10/2011	10:50:15	11:10:08	0:19:53	2, 7	Blue whale/ Risso's	1	2	Mari Smultea	excellent	First half of video blue whale, then focuses on Risso's dolphin behavior
SOCAL	SOCAL_2011May_11_HDR_Video_100231-100449_ID2_Blue	5/11/2011	10:02:31	10:04:49	0:02:18	1	Blue whale	1	2	Mari Smultea	fair	Multiple surfacings with blows, short video

Navy Range	Video Name	Date (day mo yr)	Start Time (hr:min:sec)	End Time (hr:min:sec)	Total Video (hr:min:sec)	Daily Sighting ID#	Species	Group Size (best estim.)	Beaufort sea state	Taken by?	Video Utility/ Quality[a]	General Description of Video Content
SOCAL	SOCAL_2011May_11_HDR_Video_101312-101825_ID2_Blue	5/11/2011	10:13:12	10:18:25	0:05:13	2	Blue whale	2	2	Mari Smultea	fair	2 blue whales synchronized but not seen in video together. Roughly 12 body lengths apart
SOCAL	SOCAL_2011May_11_HDR_Video_102450-102959_ID2_Blue	5/11/2011	10:24:50	10:29:59	0:05:09	2	Blue whale	1	2	Mari Smultea	fair	Multiple surfacings with blows
SOCAL	SOCAL_2011May_11_HDR_Video_103625-103822_ID2_Blue	5/11/2011	10:36:25	10:38:22	0:01:57	2	Blue whale	1	2	Mari Smultea	fair	Multiple surfacings with blows
SOCAL	SOCAL_2011May_11_HDR_Video_104000-104203_ID2_Blue	5/11/2011	10:40:00	10:42:03	0:02:03	2	Blue whale	1	2	Mari Smultea	fair	Short video, sailboat seen in vicinity of whale
SOCAL	SOCAL_2011May_11_HDR_Video_104652-104852_ID2_Blue	5/11/2011	10:46:52	10:48:52	0:02:00	2	Blue whale	1	2	Mari Smultea	fair	Short video, multiple bows and surfacings
SOCAL	SOCAL_2011May_11_HDR_Video_105210-105400_ID2_Blue	5/11/2011	10:52:10	10:54:00	0:01:50	2	Blue whale	1	2	Mari Smultea	good	Blue whale seen tail popping and a bubble blast, multiple blows
SOCAL	SOCAL_2011May_11_HDR_Video_140710-142216_ID6-7_Risso's/Bottlenose	5/11/2011	14:07:10	14:22:16	0:15:06	6, 7	Risso's dolphin /Bottle-nose	32	3	Mari Smultea	good	2 groups of Risso's dolphins separated by 8 bottlenose dolphins
SOCAL	SOCAL_2011May_11_HDR_Video_142219-142440_ID6_Risso's/Bottle nose	5/11/2011	14:22:19	14:24:40	0:02:21	6, 7	Risso's dolphin	32	3	Mari Smultea	fair	2 groups of Risso's dolphins separated by 8 bottlenose dolphins
SOCAL	SOCAL_2011May_11_HDR_Video_150529-151358_ID9_Risso's	5/11/2011	15:05:29	15:13:58	0:08:29	9	Risso's dolphin	7	2	Mari Smultea	good	dolphins resting and diving

Navy Range	Video Name	Date (day mo yr)	Start Time (hr:min:sec)	End Time (hr:min:sec)	Total Video (hr:min:sec)	Daily Sighting ID#	Species	Group Size (best estim.)	Beaufort sea state	Taken by?	Video Utility/ Quality[a]	General Description of Video Content
SOCAL	SOCAL_2011May_11_HDR_Video_151450-151547_ID9_Risso's	5/11/2011	15:14:50	15:15:47	0:00:57	9	Risso's dolphin	7	2	Mari Smultea	fair	very short video, Risso's seen resting
SOCAL	SOCAL_2011May_11_HDR_Video_151625-151754_ID9_Risso's	5/11/2011	15:16:25	15:17:54	0:01:29	9	Risso's dolphin	7	2	Mari Smultea	fair	Very short video, Risso's seen resting
SOCAL	SOCAL_2011May_11_HDR_Video_151911-152511_ID9_Risso's	5/11/2011	15:19:11	15:25:11	0:06:00	9	Risso's dolphin	7	2	Mari Smultea	fair	Dolphins seen staying down longer than usual, seen resting at surface
SOCAL	SOCAL_2011May_11_HDR_Video_153112-154103_ID10_Risso's	5/11/2011	15:31:12	15:41:03	0:09:51	10	Risso's dolphin	4	3	Mari Smultea	good	1300 feet, all subsurface, seen fast travel fanning out and then slowing down
SOCAL	SOCAL_2011May_12_HDR_Video_163536-164336_ID11_Fin	5/12/2011	16:35:36	16:43:36	0:08:00	11	Fin whale	1	2	Mari Smultea	poor	Whale not seen in video very much, few blows seen
SOCAL	SOCAL_2011May_12_HDR_Video_165831-172447_ID12_Risso's	5/12/2011	16:58:31	17:24:47	0:26:16	13	Risso's dolphin	14	3	Mari Smultea	fair	Risso's seen fast travel with social behaviors
SOCAL	SOCAL_2011May_13_HDR_Video_140509-142208_ID5_Fin	5/13/2011	14:05:09	14:22:08	0:16:59	5	Fin whale	2	2	Mari Smultea	good	2 Fin whales traveling subsurface, lined up 10 body lengths apart
SOCAL	SOCAL_2011May_13_HDR_Video_142628-142748_ID5_Fin	5/13/2011	14:26:28	14:27:48	0:01:20	5	Fin whale	2	2	Mari Smultea	poor	Heading 060, whale blew once and dove very short video.

Navy Range	Video Name	Date (day mo yr)	Start Time (hr:min:sec)	End Time (hr:min:sec)	Total Video (hr:min:sec)	Daily Sighting ID#	Species	Group Size (best estim.)	Beaufort sea state	Taken by?	Video Utility/ Quality[a]	General Description of Video Content
SOCAL	SOCAL_2011May_13_HDR_ Video_144526-144718_ID7_Fin	5/13/2011	14:45:26	14:47:18	0:01:52	7	Fin whale	1	2	Mari Smultea	poor	Heading 270, whale only seen once for a short period
SOCAL	SOCAL_2011May_13_HDR_ Video_144820-145113_ID7_Fin	5/13/2011	14:48:20	14:51:13	0:02:53	7	Fin whale	1	2	Mari Smultea	fair	Whale seen subsurface, multiple blows
SOCAL	SOCAL_2011May_13_HDR_ Video_165538-165920_ID11_Fin	5/13/2011	16:55:38	16:59:20	0:03:42	11	Fin whale	1	3	Mari Smultea	fair	Heading 360, seen subsurface, multiple blows, possible defecation seen, possible feeding
SOCAL	SOCAL_2011May_14_HDR_ Video_104320-111922_ID6-8_Sperm/Risso's/NRWD	5/14/2011	10:43:20	11:19:22	0:36:02	6, 7, 8	Sperm whale/ Risso's dolphin /NRWD	20/11/50	2	Mari Smultea	excellent	Sperm whales seen with Risso's dolphin heading 360, all sperm whales seen at distance, 4 sperm calves seen, 16 adults. Risso's seen swimming at mouth of one sperm whale. Risso's seen breaching in from of sperm whale, harassing it.

Navy Range	Video Name	Date (day mo yr)	Start Time (hr:min:sec)	End Time (hr:min:sec)	Total Video (hr:min:sec)	Daily Sighting ID#	Species	Group Size (best estim.)	Beaufort sea state	Taken by?	Video Utility/ Quality[a]	General Description of Video Content
SOCAL	SOCAL_2011May_14_HDR_Video_112229-114239_ID6-8_Risso's/Sperm/NRWD	5/14/2011	11:22:29	11:42:39	0:20:10	6, 7, 8	Risso's dolphin /Sperm whales/ NRWD	20/11/50	2	Mari Smultea	excellent	Breach by Risso's dolphin, surface-active travel, heading 060. Northern right whale dolphins seen porpoising and close to Risso's. Risso's harassing sperm whales.
SOCAL	SOCAL_2011May_14_HDR_Video_134233-134553_ID16_Blue	5/14/2011	13:42:33	13:45:53	0:03:20	16	Blue whale	2	3	Mari Smultea	Good	Blue whale seen tail popping and a bubble blast, multiple blows
SOCAL	SOCAL_2011May_14_HDR_Video_135137-135411_ID16_Blue	5/14/2011	13:51:37	13:54:11	0:02:34	16	Blue whale	2	3	Mari Smultea	Good	Blue whale seen traveling at surface, multiple blows
SOCAL	SOCAL_2011May_14_HDR_Video_140955-141310_ID16_Blue	5/14/2011	14:09:55	14:13:10	0:03:15	16	Blue whale	2	3	Mari Smultea	fair	Whale seen traveling at surface, multiple blows.
SOCAL	SOCAL_2011May_14_HDR_Video_141954-142344_ID16_Blue	5/14/2011	14:19:54	14:23:44	0:03:50	16	Blue whale	2	3	Mari Smultea	fair	Boat seen traveling towards whale, whale traveling at surface and then dove as boat approached.
			Total Hours:		**5:05:11**							

Table 15. List of Photographs Taken during September 2010 and February – May 2011 Navy SOCAL Aerial Surveys off San Diego, California

Date	Daily Sighting ID No.	Species Common Name	Best Group Size Estim.	Start Frame #	End Frame #	Total Photos	First Frame Time	Last Frame Time
23-28 September 2011 Photos								
23-Sep	1	Long-Beaked Common Dolphin	25	1	34	34	15:14	15:16
23-Sep	2	Common dolphin sp.	6	37	63	27	15:32	15:33
23-Sep	3	Bottlenose Dolphin	1	67	111	45	15:55	15:57
23-Sep	4	Short-Beaked Common Dolphin	15	114	144	31	16:09	16:10
23-Sep	6	Long-Beaked Common Dolphin	60	147	211	65	16:17	16:19
24-Sep	7	Short-Beaked Common Dolphin	700	1796	1811	16	12:30	12:32
24-Sep	23	California Sea Lion	5	1812	1818	7	12:56	12:57
24-Sep	46	Bryde's whale	1	1819	1829	5	13:44	13:44
24-Sep	55	Long-Beaked Common Dolphin	250	1832	1845	12	14:18	14:21
24-Sep	56	Unidentified Dolphin	1	1849	1856	5	14:24	14:28
24-Sep	69-72	Long-Beaked Common Dolphin	530	1857	1872	12	16:17	16:59
24-Sep	73	Common dolphin sp.	40	1871	1882	11	16:59	17:05
24-Sep	75	Common dolphin sp.	300	1884	1889	6	17:10	17:13
24-Sep	77	Long-Beaked Common Dolphin	9	1890	1895	6	17:16	17:16
25-Sep	7	Common dolphin sp.	1100	1917	1920	4	11:08	11:12
25-Sep	8	Common dolphin sp.	400	54	60	6	11:09	11:11
25-Sep	11	Short-Beaked Common Dolphin	100	1921	1929	9	11:41	11:43
25-Sep	11	Short-Beaked Common Dolphin	100	61	64	4	11:41	11:43
25-Sep	12	Common dolphin sp.	400	1930	1932	3	11:48	11:49
25-Sep	13	Northern elephant seal	11	65	72	8	11:56	11:58
25-Sep	15	California sea lion	35	1938	1943	6	12:18	12:20

Date	Daily Sighting ID No.	Species Common Name	Best Group Size Estim.	Start Frame #	End Frame #	Total Photos	First Frame Time	Last Frame Time
23-28 September 2011 Photos (continued)								
25-Sep	18	Common dolphin sp.	1600	78	87	10	12:43	12:44
25-Sep	19	Common dolphin sp.	150	89	92	4	12:53	12:53
25-Sep	19	Common dolphin sp.	150	1944	1955	12	12:54	12:58
25-Sep	21	Common Dolphin sp.	50	1956	1966	11	13:03	13:06
25-Sep	23	Short-Beaked Common Dolphin	75	1968	1972	5	13:23	13:25
25-Sep	24	Common dolphin sp.	200	94	98	5	13:24	13:24
26-Sep	15	Common dolphin sp.	1000	1987	2015	29	13:14	13:40
26-Sep	28	Short-Beaked Common Dolphin	450	2021	2038	18	16:03	16:10
27-Sep	16	Risso's dolphin	5	1	6	6	10:50	11:56
27-Sep	29	Minke whale	1	7	19	13	11:56	11:57
27-Sep	58	Common dolphin sp.	275	28	34	7	14:58	15:00
27-Sep	64	Common dolphin sp.	1299	36	46	11	15:29	15:30
28-Sep	3	Common dolphin sp.	600	11	66	56	9:25	9:29
28-Sep	5	Sei/Bryde's whale	3	68	126	59	9:56	9:58
28-Sep	12	Common dolphin sp.	400	130	210	71	13:10	13:12
28-Sep	23	Bottlenose dolphin	18	215	246	31	14:23	14:30
14-Feb	3	Bottlenose dolphin	6	778	780	3	13:52	13:52
14-19 February 2011 Photos								
14-Feb	5	Common dolphin sp.	75	798	813	16	14:21	14:24
15-Feb	1	Gray whale	2	838	882	45	8:47	9:14
15-Feb	3	Short-Beaked Common Dolphin	25	884	889	16	9:37	9:38
15-Feb	4	Short-Beaked Common Dolphin	20	901	906	6	10:01	10:01

Date	Daily Sighting ID No.	Species Common Name	Best Group Size Estim.	Start Frame #	End Frame #	Total Photos	First Frame Time	Last Frame Time
14-19 February 2011 Photos (continued)								
15-Feb	5	Risso's dolphin	6	908	937	30	10:07	10:47
15-Feb	6	Risso's dolphin	100	938	976	39	10:51	11:07
15-Feb	12	Short-Beaked Common Dolphin	500	978	992	15	13:25	13:27
15-Feb	13	Gray whale	1	994	1003	10	13:43	13:43
15-Feb	14	Fin whale	1	1005	1007	3	14:02	14:02
15-Feb	15	Risso's dolphin	8	1009	1034	26	14:08	14:09
15-Feb	17	Fin whale	2	1035	1052	18	14:35	14:37
15-Feb	19	Short-Beaked Common Dolphin	500	1055	1068	14	15:01	15:06
15-Feb	20	Gray whale	1	1070	1079	10	15:10	15:10
15-Feb	21	Short-Beaked Common Dolphin	900	1081	1107	27	15:18	15:20
15-Feb	22	Long-Beaked Common Dolphin	22	1109	1155	47	15:37	15:48
14-19 February 2011 Photos								
17-Feb	10	Long-Beaked Common Dolphin	700	1161	1166	6	9:54	9:55
17-Feb	14	Short-Beaked Common Dolphin	10	1168	1172	5	10:28	10:30
17-Feb	15	Short-Beaked Common Dolphin	10	1174	1178	5	10:34	10:34
17-Feb	32	Short-Beaked Common Dolphin	1800	1181	1225	45	14:16	14:19
17-Feb	34	Bottlenose dolphin	2	1227	1233	7	14:39	14:40
17-Feb	38	Gray whale	1	1235	1315	79	14:54	15:17
30 March - 1 April 2011 Photos								
30-Mar	4	Short-Beaked Common Dolphin	40	1373	1382	10	19:10	19:12
30-Mar	5	Common dolphin sp.	18	1383	1386	4	19:26	19:26
31-Mar	4	Risso's dolphin	18	1415	1468	33	11:06	11:18

Date	Daily Sighting ID No.	Species Common Name	Best Group Size Estim.	Start Frame #	End Frame #	Total Photos	First Frame Time	Last Frame Time
30 March - 1 April 2011 Photos (continued)								
31-Mar	5	Minke whale	1	1426	1455	20	11:08	11:11
31-Mar	7	Minke whale	2	1470	1512	44	11:43	11:47
31-Mar	9	Long-beaked common dolphin	35	1513	1527	15	12:13	12:15
31-Mar	11	Long-beaked common dolphin	300	6	48	42	16:08	16:10
31-Mar	12	Common dolphin sp.	225	50	62	13	16:21	16:23
31-Mar	13	Gray whale	5	63	82	20	16:26	16:28
31-Mar	17	Risso's dolphin	12	101	123	22	16:52	16:53
31-Mar	18	Risso's dolphin	20	124	244	120	17:14	17:18
1-Apr	23	Risso's dolphin	20	12	29	17	9:20	9:20
1-Apr	24	Northern right whale dolphin	8	30	117	81	9:20	9:33
12-20 April 2011 Photos								
12-Apr	1	Common dolphin sp.	440	1	17	12	11:46	12:10
12-Apr	4	Risso's dolphin	25	24	32	8	12:38	12:40
12-Apr	10	Common dolphin sp.	15	34	38	5	14:43	14:45
13-Apr	6	Bottlenose dolphin	55	39	48	9	12:25	12:26
14-Apr	7	Fin whale	1	52	72	21	10:24	10:52
14-Apr	14	Common dolphin sp.	700	73	81	8	13:29	13:29
15-Apr	1	Bottlenose dolphin	25	82	85	4	8:47	8:47
15-Apr	5	Common dolphin sp.	1100	87	93	6	10:36	10:36
15-Apr	6	Humpback whale	1	95	105	11	11:11	11:11
15-Apr	12	Short-Beaked Common Dolphin	1200	107	119	12	12:40	12:42
15-Apr	4	Short-Beaked Common Dolphin	1100	123	133	10	15:30	15:33

Date	Daily Sighting ID No.	Species Common Name	Best Group Size Estim.	Start Frame #	End Frame #	Total Photos	First Frame Time	Last Frame Time
12-20 April 2011 Photos (continued)								
16-Apr	11	Common dolphin sp.	200	138	148	10	14:48	14:49
16-Apr	14	Long-Beaked Common Dolphin	300	150	160	10	16:10	16:12
18-Apr	5	Risso's dolphin	12	163	170	8	13:54	13:59
18-Apr	7	Bottlenose Dolphin	4	172	177	5	15:19	15:23
18-Apr	13	Common dolphin sp.	50	178	180	3	14:19	14:19
18-Apr	14	Common dolphin sp.	145	182	183	2	14:28	14:28
18-Apr	15	Bottlenose dolphin	32	185	193	8	16:58	16:48
18-Apr	16	Long-Beaked Common Dolphin	175	195	196	2	17:21	17:21
18-Apr	19	Common dolphin sp.	105	198	204	5	17:44	17:47
19-Apr	1	Common dolphin sp.	105	205	223	18	10:31	10:32
19-Apr	3	Common dolphin sp.	120	224	248	24	11:28	11:29
19-Apr	5	Long-Beaked Common Dolphin	350	250	273	23	11:36	11:44
19-Apr	8	Common dolphin sp.	225	276	287	11	12:35	12:35
19-Apr	4	Common dolphin sp.	100	281	301	20	16:43	16:44
19-Apr	5	Short-Beaked Common Dolphin	1750	302	323	21	17:11	17:13
20-Apr	1	Long-Beaked Common Dolphin	445	325	342	17	10:21	10:23
20-Apr	7	Blue whale	1	343	364	21	11:31	11:42
20-Apr	11	Long-Beaked Common Dolphin	800	366	393	27	14:23	14:44
20-Apr	12	Long-Beaked Common Dolphin	200	395	469	74	15:33	15:38
9-14 May 2011 Photos								
9-May	1	Long-Beaked Common Dolphin	50	470	491	21	15:33:00	15:43:00
10-May	4	Fin whale	1	501	630	129	10:15:00	10:38:00

Date	Daily Sighting ID No.	Species Common Name	Best Group Size Estim.	Start Frame #	End Frame #	Total Photos	First Frame Time	Last Frame Time
9-14 May 2011 Photos (continued)								
10-May	3	Harbor seal	1	631	636	5	10:40:00	10:40:00
10-May	10	Short-Beaked Common Dolphin	140	638	651	13	11:34:00	11:35:00
10-May	11	Short-Beaked Common Dolphin	625	652	677	25	11:35:00	11:42:00
10-May	12	Humpback whale (dead)	1	680	709	29	12:07:00	12:10:00
10-May	20	Fin whale	1	711	719	8	16:40:00	16:40:00
10-May	23	Blue whale	1	722	734	12	16:43:00	16:44:00
10-May	24	Blue whale	1	737	756	19	16:46:00	16:47:00
11-May	1	Humpback whale (dead; same animal as above)	1	795	855	60	16:01:00	16:04:00
12-May	6	Short-Beaked Common Dolphin	350	858	889	31	11:16:00	11:20:00
12-May	9	Common dolphin sp.	125	892	899	7	13:50:00	13:50:00
12-May	11	Fin whale	1	913	936	23	16:09:00	16:09:00
12-May	1	Fin whale	1	939	1135	196	16:25:00	16:43:00
13-May	2	Common dolphin sp.	175	1136	1170	34	13:37:00	13:39:00
13-May	4	Common dolphin sp.	300	1173	1175	2	13:49:00	13:49:00
13-May	11	Fin whale	1	1178	1212	34	16:41:00	16:44:00
14-May	4	California sea lion	4	1215	1270	55	10:15:00	10:16:00
14-May	5	Bottlenose dolphin	40	1273	1299	26	10:23:00	10:24:00
14-May	6	Sperm whale	20	1301	1469	168	10:37:00	10:47:00
14-May	9	California sea lion	1	1472	1494	22	11:52:00	11:57:00

Table 16. List of all focal behavioral follows longer than 10 minutes duration conducted during the May SOCAL 2011 aerial monitoring surveys off San Diego, California (no focals were videotaped for <10 min). Video was taken on some of these groups as indicated in Appendix C and within the table.

Date	Start Time	End Time	Duration of Focal (hr:min)	Latitude	Longitude	Species	Group Size	Notes
9-May	15:46	17:01	1:14	33.243000	-117.534667	Blue whale	1	First sighting was a few blows as it traveled north then dove. No video or behaviors recorded until after the 2 fins below were followed.
9-May	15:48	16:21	0:33	33.251500	-117.543167	Fin whale	2	Seen while circling looking for blue whale; did one surfacing sequence on video then did rest of video session on blue whale above. Definite dark bodies and white right jaw seen.
10-May	9:42	11:10	1:28	32.791000	-117.385677	Blue whale	2	Initial focal group was 2 blues that then disaffiliated not long after. We continued following one of these blue whales then followed bottlenose dolphins then presumably the same blue again then Risso's for 15 min then left the approx. 1-mile radius area.
10-May	9:56	10:47	0:51	32.778667	-117.400500	Fin whale	1	Seen while circling and doing focals on blue whale.
10-May	10:59	11:10	0:11	32.813	-117.35833	Risso's dolphin	16	Socializing, seen while circling blue whale group. First half of video blue whale, then focuses on Risso's dolphin behavior.
10-May	15:57	16:08	0:11	32.87733	-117.31383	Blue whale	2	Feeding, no reaction observed even when we flew close to them (approx 300 m distance).
11-May	13:58	14:24	0:26	32.66250	-117.58583	Risso's dolphin	32	20 Risso's line abreast initially seen on transect just before turning for bottlenose dolphins. Bottlenose dolphins interspersed with the Risso's. Video taken during this focal

Date	Start Time	End Time	Duration of Focal (hr:min)	Latitude	Longitude	Species	Group Size	Notes
11-May	13:59	14:22	0:23	32.67300	-117.57500	Common bottlenose dolphin	8	Interspersed with the Risso's group above, video taken during this focal.
11-May	15:05	15:25	0:20	32.80117	-117.98383	Risso's dolphin	7	Dolphins appeared to be staying below water surface longer than usual. Video taken during this focal.
11-May	15:27	15:43	0:16	32.79800	-118.01133	Risso's dolphin	4	Traveling fast fanning out then slowed down. Video taken during this focal.
12-May	16:03	16:43	0:40	32.60067	-117.56500	Fin whale	1	Video and photos taken during this focal of a fin whale with unusually white pectoral fins.
12-May	16:54	17:23	0:29	32.51917	-117.59150	Risso's dolphin	14	Video taken during this focal. Surface-active behaviors, moving all different directions, breaching (Navy vessel in area and seen in video).
13-May	13:57	14:28	0:31	32.62350	-117.52467	Fin whale	2	Video taken during this focal. 2 fin whales traveling subsurface, lined up 10 body lengths apart.
13-May	14:40	14:51	0:11	32.70267	-117.61617	Fin whale	1	Video taken during this focal. One animal seen subsurface. Another fin whale was approximately 1 km (0.5 nm) away from this focal fin whale.
13-May	16:40	16:59	0:19	32.99517	-117.58300	Fin whale	1	Video taken during this focal. Whale seen subsurface, multiple blows, defecating; animal believed to be feeding.

Date	Start Time	End Time	Duration of Focal (hr:min)	Latitude	Longitude	Species	Group Size	Notes
14-May	10:36	11:43	1:07	32.61700	-117.72617	Sperm whale	20	Video and photos taken during this focal of 4 sperm whale calves seen &16 adults (no bulls seen). One adult initially followed then the other 19 sperm whales surfaced in tight association. Sperm whales eventually spread out then dove within ~1 min of each other. Associated with northern right whale dolphins and Risso's dolphins. Risso's seen swimming at/"rushing" heads of sperm whales; sperm whales appeared to react to Risso's approaches to head by dropping their lower jaw. Risso's seen breaching in from of sperm whale, harassing it.
14-May	10:41	11:43	1:02	32.62283	-117.72467	Risso's dolphin	11	Video and photos taken during this focal. Breach by Risso's dolphin, surface-active travel. Northern right whale dolphins seen porpoising and close to Risso's. Risso's appeared to be harassing sperm whales (see sperm whales above).
14-May	10:41	11:43	1:02	32.62283	-117.72467	Northern right whale dolphin	50	Video and photos taken during this focal. Interspersed with the sperm whale nursery group above. Porpoising in front of sperm whale group.
14-May	13:32	14:21	0:49	32.76567	-117.38950	Blue whale	2	Video taken during this focal. Blue whale seen "tail cocking" and bubble blasting multiple times. This behavior rarely seen previously.
		Total:	**12:03**					

Number of 5-10 min focals for May = 0

Number of >10 min focals for May = 18

APPENDIX B: ABSTRACTS SUBMITTED TO THE 19TH BIENNIAL CONFERENCE ON THE BIOLOGY OF MARINE MAMMALS 2011

Interactions between Sperm Whales and Risso's and Northern Right Whale Dolphins off San Diego

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Aerial surveys provide a valuable platform to record and document behavior of marine mammals above and below the sea surface. This approach is advantageous in avoiding disturbance from the observational platform while circling outside the sound cone of the plane. Since 2008, the U.S. Navy has instituted a marine mammal monitoring program in southern California from several platforms, including aerial surveys, and previously undocumented behaviors and species interactions have been recorded during the aerial effort. This included focal behavioral interactions between sperm whales, northern right whale dolphins, and Risso's dolphins on 14 May 2011, 24 nm west of San Diego, CA. This ~1.5 hr encounter was documented in detail with high-definition digital photographs and video as the group traveled NE along the edge of a steep underwater drop-off. Risso's dolphins initiated charges towards the heads of the sperm whales on multiple occasions, followed by fast retreats. Sperm whale adults responded by displaying an open lower jaw. Risso's dolphins appeared to direct this behavior only toward adult sperm whales that had recently surfaced from long (> 20 min) dives; it was not directed toward the four calves in the group. Northern right whale dolphins intermingled with the Risso's dolphins and sperm whales, although they did not approach sperm whales as closely or abruptly as the Risso's dolphins. While similar apparently aggressive Risso's dolphin behavior has been documented toward other cetacean species, this is the first known occurrence of head-on charging by Risso's dolphins, accompanied by the elicited jaw display response from sperm whales. The interaction may be similar to pilot whales being aggressive towards sperm whales, and may function in acquiring regurgitated sperm whale food, or other needs by the Risso's dolphins.

Comparison of Blue and Fin Whale Behavior, Headings and Group Characteristics in the Southern California Bight during Summer and Fall 2008-2010

Cathy Bacon[1], Mari A. Smultea[1], Bernd Würsig[2], and Kate Lomac-MacNair[1]

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Baseline undisturbed behavior and social patterns of blue (*Balaenoptera musculus)* and fin whales (*B. physalus*) are not well described and are needed to identify and understand potential effects of anthropogenic activities. Behavioral data for blue and fin whales were collected during line-transect and focal-follow effort. Initially observed behavior state, heading, and minimum and maximum inter-individual dispersal distance were recorded during line-transect sampling. Focal

groups were circled for 10-60+ minutes and videotaped from outside Snell's sound cone to avoid disturbance. During 24,736 km of survey effort, 51 fin whale sightings (85 individuals) and 49 blue whale sightings (81 individuals) were seen. Over 7 hours of video was collected for 16 blue and 15 fin focal follows. During the summer seasons, blues (n=48) were seen more commonly than fins (n=35); in fall, fins (n=16) were seen significantly more frequently than blues (n=1). Mean group size was 1.7 whales for both species. Initially observed blue behavior was usually travel (85%) or mill (11%). Observed fin whale behavior was also mostly travel (90%), mill (4%), or surface-active travel (4%). Both species were seen socializing in fall but not summer; foraging was observed in summer through fall. Mean initial dispersal for blues and fins was 9.1 and 14.2 body lengths, respectively. In summer, blues were most frequently (26%) seen headed S; in fall (n=2), they were headed only inshore (E). In summer, fin whales were most commonly headed SSW (26%) or WNW (26%); in fall, they were headed mostly NE (38%) or WSW (38%). Dive/respiration/behavioral event rates were also collected. Both species may directly compete for food based on observations of inter-specific maneuvering for a bait ball. Data represent the most extensive record of systematic undisturbed behavior on these species in SOCAL and include social interactions not previously documented in this region.

Got Milk? Aircraft Observations Provide Rare Glimpses into Whale Calf Nursing and Back Riding.

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Nursing behavior by large cetaceans in situ is not well described. During ~30,000 km of aerial surveys off Southern California to monitor marine mammals relative to U.S. Navy military training activities (2008-2011), nursing behaviors were documented for three species: Eastern Pacific gray whale (*Eschrichtius robustus*), fin whale (*Balaenoptera physalus*) and killer whale (*Orcinus orca*). Photographs, video, notes and audio recordings were used to analyze mother-calf interactions. Back riding occurred in gray and fin whales, as described for bowhead whale (*Balaena mysticetus*) mother-calf pairs by Würsig et al. (1999). During slow sub-surface travel, a fin whale calf swam alongside mother's peduncle area, touching her head-first for short (<1 min) bouts at a 45° angle. During the sighting (~50 min) the calf switched from one side of the mother's peduncle to the other 12 times, usually by "riding" (n=8) the mother's back or swimming underneath her (n=4). Nursing was assumed based on the persistent (~1 min) position of the calf's head relative to mother's peduncle/teat area. Observations of the gray whale pair showed similar behavior (~19 min) with calf riding mothers back 3 times, except mother was resting not traveling. During nursing, the calf faced mother at a 45° angle while mother held up her flukes. Two apparent nursing positions of a traveling killer whale mother-calf pair were also photo-documented (~40 min). One position showed both whales lying parallel, facing one another, in the same orientation. The second position showed the same mother lying on her back, with calf nursing on top of mother, ventral side to ventral side. These positions were similar to those described among captive killer whales. Observations indicate nursing occurs during travel and calves of other whale species back ride. Data contribute to rare documentations of whales nursing in the wild, furthering the understanding of cetacean mother-calf interactions.

Changes in Abundance, Density and Diversity of Marine Mammals in the Southern California Bight 1998-1999 vs. 2008-2011

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Twelve line-transect aerial surveys occurred during fall/summer 2008-2011 to monitor the occurrence, abundance and behavior of marine mammals in the Southern California Bight. The study area overlapped where Carretta et al. (2000) flew surveys in 1998-1999, coinciding with their "warm-water period". Density and abundance were estimated using standard line transect methods and DISTANCE software. Analyses were limited to 12,206 km flown in Beaufort 0-4 conditions and 495 marine mammal sightings of the seven most commonly observed species. Blue whale densities were all well below historical estimates. Fin whales continue to be the most commonly abundant large whale. Risso's dolphins have apparently dramatically increased in numbers and/or distribution over the last several decades: calculated density east of San Clemente Island (SCI) was 19.99 animals/100 km^2. This is much higher than those for Carretta et al.'s warm season, but similar to those they estimated for the cold season. Our densities of common dolphins were lower than Carretta et al.'s warm-water season (318.99 animals/100 km^2 east of and 58.43 animals/100 km^2 west of SCI). However, short-beaked common dolphins were still by far the most abundant species (~29,044 individuals). Historically, Pacific white-sided dolphins were seen only in the cold-water season, but we had 26 sightings (density 19.7 individuals/100 km^2) in the warm-water period. Pilot whales, though historically common, were never seen. Results indicate that recent patterns of cetacean relative abundance and presence are, in many cases, very different from historical records. This is likely related to previous exploitation and depletion of these species and long-term changes in oceanographic conditions, concomitant changes in prey distribution and densities, and anomalous El Niño and La Niña events. This study provides the only available recent estimates of abundance for marine mammal species east and west of San Clemente Island where the U.S. Navy conducts major training exercises.

Rare Sightings of Bryde's Whales (*Balaenoptera brydei/edeni*) in the Southern California Bight

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Bryde's whales (*Balaenoptera brydei/edeni*) have been considered an anomalous occurrence in the Southern California Bight (SCB). Thus, they typically have been excluded from species lists associated with SCB management documents. In the last 40 years only two visual sightings of

Bryde's whales were documented in California waters, the last one in 1991 (Carretta et al. 2008). This is despite extensive systematic vessel and aerial surveys and presumed recent recordings of Bryde's whale vocalizations in the SCB. Bryde's whales are notoriously difficult to differentiate in the field, both from each other and also from fin (*B. physalus*) and sei whales (*B. borealis*), given the subtle differences in physical characteristics. Between August 2006 and September 2010, we photo-documented five sightings of five single Bryde's whales in the SCB. Two of the five sightings occurred in October 2008 and September 2010 during 33,880 km of aerial surveys. The remaining three sightings occurred during small-vessel surveys that included offshore waters: two in June 2006 and one in September 2010. These sightings combined with other reports of presumed vocalizations suggest that Bryde's whale numbers may be increasing in the SCB. This may be related to global warming, large-scale oceanographic events (e.g., El Nino and La Nina) and resulting changes in prey availability. Recent sightings reported herein indicate that the Bryde's whale should be considered as a species present in the SCB and photo-documentation is critical to ascertain species.

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Bryde's Whale (*Balaenoptera brydei/edeni*) Sightings in the Southern California Bight[1]

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ABSTRACT

The typically tropical Bryde's whale (*Balaenoptera brydei/edeni*) has been considered an extralimital occurrence in the Southern California Bight (SCB); thus, it has frequently been excluded from species lists associated with SCB management documents. In the past 40 years, only two visual sightings of Bryde's whales were documented in California waters, most recently in 1991. This is despite extensive systematic vessel and aerial surveys, and recent presumed recordings of Bryde's whale calls in the SCB. Bryde's whales are notoriously difficult to differentiate in the field from fin (*B. physalus*) and sei whales (*B. borealis*) given the subtle differences in physical characteristics. Between August 2006 and September 2010, we photo-documented five sightings of single Bryde's whales in the SCB. Two of the five sightings occurred in October 2008 and September 2010 during 33,880 km of Navy-funded aerial survey monitoring of marine mammals. The remaining three sightings occurred during small-vessel surveys that included offshore SCB waters: two in June 2006 and one in September 2010. These sightings, combined with recently recorded Bryde's calls, suggest that Bryde's whale numbers may be increasing in the SCB. These may be related to climate change, large-scale oceanographic events (e.g., El Niño Southern Oscillation (ENSO) events) and resulting changes in prey distribution and availability. We suggest that the Bryde's whale should be considered as a species normally present

in the SCB and that photo-documentation or genetic sampling is critical to confirm species for stock management purposes.

Introduction

Given the paucity of confirmed sightings over the last 20 years, and its traditional, more southern warm-water distribution, the Bryde's whale (*Balaenoptera brydei/edeni*) has been excluded from many comprehensive reviews of cetaceans occurring in the Southern California Bight (SCB) (Carretta et al. 2011). The last United States Pacific marine mammal stock assessment to include the Bryde's whale was in 2006 (Carretta et al. 2007). During the past nearly five decades only two confirmed published visual sightings of Bryde's whales were documented off southern California (**Table 1**). In January 1963, a Bryde's whale (originally misidentified as a fin whale) was seen near La Jolla, California (Nicklin 1963, Morejohn and Rice 1973) (**Table 1**). In October 1991, another was sighted off Monterey Bay (Barlow 1997). The latter sighting along with five other possible sightings (labeled as sei (*B. borealis*) or Bryde's whales) occurred during extensive systematic vessel and aerial surveys conducted in California waters between 1991 and 2008 by the Southwest Fisheries Science Center of the National Marine Fisheries Service (e.g., Carretta and Forney 1993, Hamilton et al. 2009, Barlow et al. 2010) (**Table 1**).

The natural history of the Bryde's whale is not well known (Kato and Perrin 2009), though it is the most common rorqual species in the eastern tropical Pacific (ETP) and the Gulf of California (located approximately 350 km south of San Diego) (e.g., Tershy et al. 1990, Tershy 1992, Jackson et al. 2008, Barlow et al. 2009). Breeding and calving occur year-round, and short seasonal migrations take place in some areas (Jefferson et al. 2008). However, longer movements of Bryde's whales from the tropical Pacific (25°N) to the east coast of Japan (43°N) have also been documented by Japanese tagging in the western Pacific in the late 1980s (Kishiro 1996).

Bryde's whales in California are believed to belong to the ETP stock for which there is no current population trend data and no biological basis for stock separation (Carretta et al. 2007). The last estimated abundance of Bryde's whales in California, Oregon, and Washington coastal waters in 2006 was 12 individuals (CV=2.0) (Barlow 1997, Carretta et al. 2007). Bryde's whales are not listed as a Threatened or Endangered species under the ESA and are not considered a strategic stock under the MMPA (Carretta et al. 2007, Jefferson et al. 2008). Kanda et al. 2007 suggested low genetic variability occurs between various sub-populations of Bryde's whales in the western North Pacific, South Pacific, and Indian oceans, and that these sub-populations may need separate management actions. It is unknown if the ETP stock of Bryde's whale is also genetically isolated.

Recent passive acoustic monitoring data from 2000-2009 suggest that Bryde's whale occurrence in the SCB has been increasing since 2003, with peak call rates recorded between August and October (Kerosky et al. in prep.). However, no Bryde's whale sightings have been matched to these calls. Bryde's whales are notoriously difficult to differentiate in the field from sei and fin whales (*B. physalus*) given the subtle differences in physical characteristics including body shape and coloration (Jefferson et al. 2008, Smultea et al. 2010). A clear close-up view of the unique presence of three prominent rostrum ridges, combined with dorsal fin shape, is typically required to confirm a Bryde's whale at sea (Omura 1966, Jefferson et al. 2008). All other balaeonopterids have only one prominent central rostrum ridge, although fin and sei whales sometimes have much-reduced auxiliary rostrum ridges (T. Jefferson pers. observ. 2011). Consequently, many historical sightings typically have not distinguished between Bryde's and sei whales and sometimes fin whales when the latter's distinctive right white jaw cannot be seen (Jefferson et al. 2008).

Between August 2006 and September 2010, we photo-documented five separate single Bryde's whales in SCB waters. Details of our five and the two Bryde's whale sightings documented over 20 years prior are summarized in **Table 1**. Sightings occurred over bottom depths ranging up to 5,000 m and approximately 75 to 120 km from the mainland southern California coast (four of the five sightings were 35 to 70 km west of San Clemente Island) (**Figure 1**). One sighting occurred in October 2008 and another in September 2010 during 33,880 km of aerial surveys conducted from a fixed-wing Partenavia P68-C or P68-OBS aircraft (Smultea et al. 2009, 2011). The remaining three sightings occurred during extensive small-vessel surveys that included offshore waters west of San Clemente Island: two in June 2006 and one in September 2010. Photographs were taken with a Canon 20D digital camera and a Canon 100-400 mm zoom lens or a 70-200 2.8 zoom lens with a 1.4x converter. Sample photographs of our sightings are provided in **Figures 2-4**. All of our sightings required close examination of the photographs to confirm species identification and were reviewed by at least three species experts.

Recent Bryde's whale calls and sightings in southern California waters may represent a range expansion related to increasing periods or areas of warmer water temperatures including the summer/fall, El Niño Southern Oscillation (ENSO) events; the offshore poleward-flowing Davidson Current period from late fall to late winter (November to January) inshore of the California Current; and climate change (Kerosky et al., in prep.). Southern California occasionally experiences seasonal El Niño oceanographic events that typically increase water temperatures based on a threshold of 0.5 degrees Celsius for the Oceanic Niño Index (ONI) from fall through winter (NOAA 2011). Since 1990, warmer El Niño water temperatures have occurred in Southern California during 14 of the past 21 years (NOAA 2011). Most recently, El Niño started in September 2006 and lasted until early 2007 (NOAA 2011). From June 2007, a moderate La Niña (cool-water) event strengthened through early 2008 but weakened by summer 2008 (NOAA 2011). The 2007–2008 La Niña event was the strongest since the 1988–1989 event. El Niño conditions started again in June 2009, peaked in January–February 2010, and persisted until May 2010 (NOAA 2011). Since then, sea surface temperature (SST) anomalies have been negative (i.e., colder La Niña) (NOAA 2011).

Of the seven Bryde's whale sightings known from southern California, five were seen during winter or fall with the remaining two seen during summer (August) (**Table 1**). Three of these were seen during warm-water El Niños in 1991 and 2006, three were seen during cool-water La Niñas in 1963 and 2010, and one was seen during a non-El Niño/La Niña period (fall 2008). Five of the seven sightings occurred in offshore waters west of San Clemente Island (**Figure 1**). Although our sightings do not appear to be directly correlated with ENSO events, recent increased sightings and calls in the SCB may be indirectly related through effects on prey distribution.

Data reported herein indicate that Bryde's whales occur off southern California more often than previously believed. This may be a fairly recent phenomenon related to warming of ocean temperatures associated with oceanographic events such as ENSO and climate change that influence the availability and distribution of prey (Learmonth et al. 2006, Kerosky et al. in prep.). Salvadeo et al. (2011) determined that inter-annual variability of Bryde's whale occurrence in the southwestern Gulf of California was highly correlated with the ENSO and its likely impact on prey availability. Our sightings combined with presumed recordings of Bryde's whale calls suggest that this species' use of the SCB is increasing, possibly in response to increasing water temperatures and other oceanographic changes affecting prey distribution. Our limited sightings point to offshore use of the SCB, consistent with Kerosky et al.'s (in prep.) suggestion that SCB Bryde's whales may initially travel north offshore then return south closer to shore. It is our hope that the reporting of our sightings here will lead to: (1) a better understanding of this species' occurrence in the SCB; (2) consistent inclusion of the Bryde's whale in environmental impact analyses and stock assessment reports in southern California; and (3) increased efforts to photo-document and/or genetically sample future sightings to ascertain species.

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Table 1. Documented sighting information for Bryde's whales (Balaenoptera brydei/edeni) off central and southern California including the Southern California Bight 1963-2010.

Date	Time	Sighting Platform	Location	Lat./Long.	Group Size	Approx. Body Length (m)[2]	Total Obs. Time (min)	Species Confirmation Source	Comments	Source
8-Jan-1963	-	vessel	1 km from La Jolla shore, San Diego, CA	32.47/ -118.44	1	13.7	180	still photographs, video	whale entangled in gill net	Nicklin 1963, Morejohn and Rice 1973
5-Oct-1991	-	vessel	Monterey Bay, CA	36.1162/-125.1496	2	13	20	naked eye, photographs	Travel at surface for nearly two minutes blowing 5-6 times before submerging for approx. 6 minutes; evasive at close range abruptly changing course while submerged	J. Barlow pers. comm., NMFS SWFSC
17-Aug-2006	11:04	rigid-hulled inflatable boat (RHIB)	-	32.9/-119.1815	1	Adult	42	digital photographs	Milling, foraging. Some dives 8-9 minutes, surfacing within 300m of descent location	Cascadia, Sighting N No. N1-9
18-Aug-2006	14:29	RHIB	_	32.7515/-118.9345	1	Adult	6	digital photographs	Milling and traveling	Cascadia, Sighting N No. N1-5
19-Oct-2008	12:56	airplane	75 mi NE of SCI	33.1184/-118.3312	1	Adult_	>1	digital photographs	Whale surfaced then dove while the aircraft circled once at an altitude of approx. 250 m whale was traveling, blow was relatively small	Smultea et al. 2009, SES Daily Sighting N No. 6

Date	Time	Sighting Platform	Location	Lat./Long.	Group Size	Approx. Body Length (m)[2]	Total Obs. Time (min)	Species Confirmation Source	Comments	Source
24-Sept-2010	13:56	airplane	–	32.9278/-118.9063	1	_Adult	5	digital photographs	Initially called unidentified baleen whale but then looked at photos and saw 3 rostral ridges; same night T.A. Jefferson confirmed photo as Bryde's whale	Smultea et al. 2011, SES Daily Sighting N No. 5
25-Sept-2010	9:49	RHIB	–	32.8549/-119.0826	1	–	25	digital photographs	Fast travel west	Cascadia, Sighting N No. PHY-1

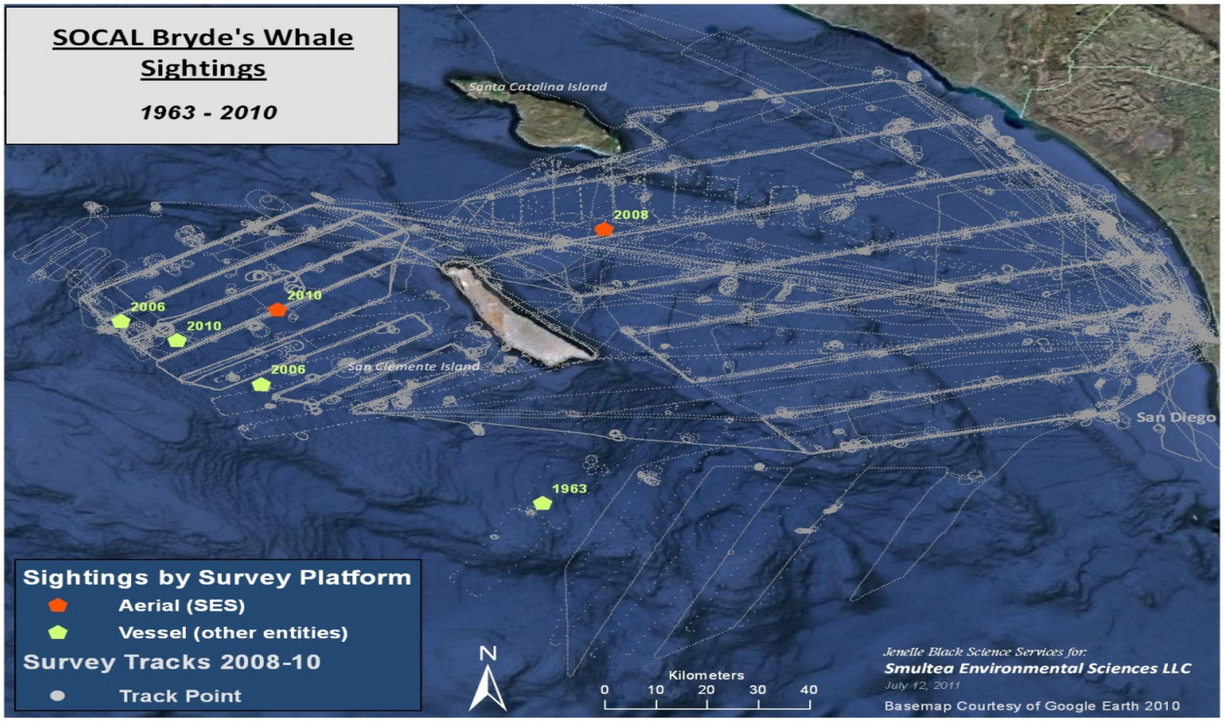

Figure 1. Bryde's whale sighting locations from 1963-2010 in the Southern California Bight. Note: the 1991 central California Bryde's whale sighting is excluded from this map due to distance from the other sightings depicted here.

Figure 2. Bryde's whale seen 24 September 2010. Photographed by Bernd Würsig under NMFS permit 15369.

Figure 3. Bryde's whale seen during 19 October 2008, showing diagnostic characters of the species. Photographed by Lori Mazzuca under NMFS permit 14451.

Figure 4. Bryde's whale seen 17 August 2006. Photographed by Annie Douglas under NMFS permit 540-1811-00.

DENSITY AND ABUNDANCE OF MARINE MAMMALS AROUND SAN CLEMENTE ISLAND, SAN DIEGO COUNTY, CALIFORNIA, IN 2008-2010

Thomas A. Jefferson, Mari A. Smultea, and Jenelle Black

Note: This paper is in draft form and does not include the cool-water surveys conducted in winter 2011, which will be added in the near future. Please do not cite without permission.

Abstract

In order to provide the US Navy with up-to-date estimates of density and abundance of marine mammals in waters off the San Diego coastline used extensively for training and other exercises, we conducted a set of eight aerial surveys of the waters around San Clemente Island between October 2008 and September 2010. The platform used was a *Partenavia* P68-C or P68-OBS (glass-nosed) high-wing airplane. Estimates of abundance were made using line transect methods and the software DISTANCE 6.0. We sighted 18 species of marine mammals during the surveys. Due to limited sample sizes for some species, we pooled species with similar sighting characteristics and made four estimates of the probability density function for baleen whales, large delphinids, small dolphins, and California sea lions. Estimates of density and abundance were calculated for species observed more than five times on effort. We estimated that during the warm-water (May-October) season of the 2008-2010 study period, there were 13 blue whales (*Balaenoptera musculus*), 66 fin whales (*Balaenoptera physalus*), 135 Pacific white-sided dolphins (*Lagenorhynchus obliquidens*), 2,537 Risso's dolphins (*Grampus griseus*), 585 common bottlenose dolphins (*Tursiops truncatus*), 30,034 common dolphins (*Delphinus* spp., mostly *D. delphis*), and 2,534 California sea lions (*Zalophus californianus*) present. Recent surveys should allow the calculation of cold-water (November-April) season estimates in the near future.

Introduction

Southern California is home to perhaps more marine mammal biologists than any similarly sized geographic region in the world. Extensive research has been conducted on marine mammals in the Southern California Bight (SCB), and hundreds of papers have been published on the marine mammals of this region. The pinniped populations of the area, which mostly use the offshore islands for breeding and hauling out, have been extensively monitored for many decades (Lowry et al. 1992, 2008; Stewart et al. 1993). A large-scale set of ship and aerial surveys assessed density and abundance from 1975-1978 in the SCB, but this information is now well over 30 years old and is considerably out-of-date (Dohl et al. 1981, 1986). The California coastal bottlenose dolphin population, which has a large portion of its range in the SCB, has been extensively studied, and ranging patterns (Defran et al. 1999) and abundance/population size have been recently assessed (Carretta et al. 2000; Dudzik et al. 2006). Also recently, passive acoustic monitoring (PAM) studies have begun to supplement knowledge from observational studies. In particular, distribution and habitat patterns of some delphinids species have been studied using these sensors (Soldevilla et al. 2008, 2010).

Extensive ship-based surveys of the entire US exclusive economic zone (EEZ) along the Pacific coast conducted since the early 1980s (with more extensive and consistent coverage since the early 1990s) have provided estimates of abundance and density for US waters of California, Oregon, and Washington, and in some cases information on abundance trends of certain species occurring there (e.g., Barlow 1995, 2003, 2010; Barlow and Forney 2007; Barlow and Gerrodette 1996; Barlow and Taylor 2001; Forney 1997, 2007; Forney and Barlow 1998). However, these surveys generally provide very coarse-scale data from a very large area, and generally do not provide the fine-scale precision that is required for the monitoring and analyses the Navy needs to conduct federally mandated environmental impact assessments and mitigation. Recently, some progress has been made in using the extensive datasets that have been accumulated over the last several decades to model densities, and thereby provide information that can be applied over smaller scales (see Barlow et al. 2009). However, models are notoriously susceptible to assumption violations, and paucity of data in certain areas weakens their real-world utility.

The waters off San Diego County, and especially the region around San Clemente Island, are heavily used by the Navy for various operations. These include training exercises involving low- and mid-frequency active sonars, which have been implicated in some cases as causing disturbance and even injury and mortality to some marine mammal species. Carretta et al. (2000) conducted extensive year-round aerial surveys of the area around San Clemente Island in 1998 and 1999. This information has been very relevant for Navy marine mammal resource management; however, the estimates are now over 13 years old and are out of date. Further, there is compelling evidence suggesting that the distribution and density of some marine mammal species has changed in the area. To effectively assess potential impacts of military activities that may cause disturbance or harm to marine mammals, and to implement effective mitigation measures to reduce or eliminate those impacts, updated data are needed on the seasonal density of marine mammal species occurring in the SCB. Our study was conducted to meet this goal as identified in the Navy's Southern California Marine Species Monitoring Plan (DoN 2009). As such, aerial surveys were conducted across the year to provide the most recent and comprehensive, up-to-date information available on marine mammal density and abundance in the SCB, focusing on the San Clemente Island region of most relevance to the Navy.

Methods

Data Collection

Surveys occurred from a small high-wing, twin-engine *Partenavia* P68-C or P68-OBS (glass-nosed) airplane following protocol similar to previous aerial surveys conducted to monitor marine mammals and sea turtles on behalf of the Navy in Hawaii and elsewhere (e.g., Mobley 2004, 2007, 2008a,b; Smultea and Mobley 2009; Smultea et al. 2009). Surveys occurred in October and November 2008; June, July and November 2009; and May, July and September 2010. The pilots were highly experienced with the voice reporting procedures for the Southern California (SOCAL) Range Complex as well as local and regional airspace. A Position-on-Demand (POD) GPS tracking device was installed on the observer aircraft so that it could be tracked by the Navy.

Survey effort involved four modes as described below (see **Table 1**):

1. *Search Mode* to locate and describe marine mammals and sea turtles via both *systematic* line-transect and *connector* aerial survey observation effort. Connector effort included observation effort between adjacent systematic transect lines and during transits to and from line transect locations.

2. *Identify* involving circling of the sighting to photo-document and confirm species, as possible, and to estimate group size and presence/minimum number of calves.
3. *Focal Follow* involving circling of a cetacean sighting to conduct extended behavioral observation sampling after species of interest is located.
4. *Shoreline Survey* involving circumnavigating clockwise around San Clemente Island ~0.5 km from shore to search for potentially stranded or near-stranded animals.

The pilot and three professionally trained marine mammal biologists (at least two with over 10 years of related experience) were aboard the aircraft. Two biologists served as observers in the middle seats of the aircraft and the third biologist was the recorder in the front right co-pilot seat.

Surveys were flown at altitudes of ~227-357 m (800-1,000 ft) following established line-transect survey protocol (see Carretta et al. 2000; Buckland et al. 2001; Mobley 2004, 2008a,b). In practice, however, altitude at the time of sightings ranged from 116-484 m, with an average of 261 ± 49 m. As feasible, line-transect design layout followed that of previous aerial surveys conducted 1-2 times per month over ~1.5 year in part of the survey area in 1998-99 by NMFS/SWFSC on behalf of the Navy (Carretta et al. 2000). Thus, as logistically feasible, transect lines were positioned primarily along a WNW to ESE orientation generally perpendicular to the bathymetric contours/coastline to avoid biasing of surveys by following depth contours (**Figure 1**). Transect lines described in Carretta et al. (2000) were spaced 22 km apart. Our transect lines were also spaced ~22 km apart between the coast and San Clemente Island (**Figure 1**). To the west and south of San Clemente Island our transect lines were spaced 11 km apart, given the goal to intensively survey in a prescribed area. Total distance surveyed in Beaufort 0-4 conditions was 12,206 km.

We used the following hardware and software for data collection including basic sighting and environmental data (e.g., Beaufort sea state, observation effort, glare, etc.): (1) BioSpectator on a Palm Pilot TX (pull-down menus or screen keyboard) or an Apple iPhone or iTouch in 2008 and 2009; or (2) a customized Excel spreadsheet on a mini-laptop Acer computer (2010). Each new entry was automatically assigned a time stamp and a sequential sighting number. Geographical Positioning System (GPS) locations were automatically recorded at 10-sec intervals on a Garmin 495 aviation WAAS-enabled GPS as well as by the aircraft WAAS GPS. Environmental data (involving various glare and visibility conditions) were collected at the beginning of each leg type and whenever conditions changed. GPS data were post-merged with sighting data using Excel.

One of three Canon EOS digital cameras with Image Stabilized (IS) zoom lenses was used to photo-document and verify species for each sighting as feasible/needed (40D with 100-400 mm ET-83C lens; 20D with 70-200 mm 2.8 lens and 1.4X converter; D50 with 100-400 mm lens). Observers used Steiner 7 X 25 or Swarovski 10 X 32 binoculars as needed to identify species, group size, behaviors, etc. A Suunto handheld clinometer was used to measure declination angles to sightings when the sighting was perpendicular to the aircraft.

Data Analysis

We used standard line transect methods to analyze the aerial survey data, and calculated estimates of density and abundance using the following formulae:

$$\hat{D} = \frac{n\ \hat{f}(0)\ \hat{E}(s)}{2\ L\ \hat{g}(0)}$$

$$\hat{N} = \frac{n\ \hat{f}(0)\ \hat{E}(s)\ A}{2\ L\ \hat{g}(0)}$$

$$C\hat{V} = \sqrt{\frac{\hat{\mathrm{var}}\,(n)}{n^2} + \frac{\hat{\mathrm{var}}\,[\hat{f}(0)]}{[\hat{f}(0)]^2} + \frac{\hat{\mathrm{var}}\,[\hat{E}(s)]}{[\hat{E}(s)]^2} + \frac{\hat{\mathrm{var}}\,[\hat{g}(0)]}{[\hat{g}(0)]^2}}$$

where D = density (of individuals),

n = number of on-effort sightings,

f(0) = trackline probability density at zero distance,

E(s) = unbiased estimate of average group size,

L = length of transect lines surveyed on effort,

g(0) = trackline detection probability,

N = abundance,

A = size of the survey area,

CV = coefficient of variation, and

var = variance.

Line transect parameters were calculated using the software DISTANCE 6.0, Release 2 (Thomas et al. 2010). Only survey lines flown during systematic (the main line transect survey lines) and connector (the connecting lines at the ends of the main lines) conditions were used to estimate line transect parameters. We used a strategy of selective pooling and stratification to minimize bias and maximize precision in making density and abundance estimates (see Buckland et al. 2001). Due to low sample sizes for most species, we pooled species with similar sighting characteristics in estimating the detection function [f(0)], with the goal of producing statistically robust values for f(0) using sample sizes of at least 40-60 sightings for each group. The four species groups were: 1) baleen whales, 2) large delphinids, 3) small dolphins, and 4) California sea lion (see **Table 2**).

We used all data collected in sea state conditions of Beaufort 0-4, and did not stratify estimates by sea state or other environmental parameters. We produced stratified (in terms of sighting rate and group size) estimates of density and abundance for the three survey subregions using the pooled f(0) species group values described above. The exception to this rule was for California sea lions, which had adequate sample size for estimation of f(0).

Since a significant proportion of sightings was unidentified to species (although most of these were identified to a higher-level taxonomic grouping, e.g., unidentified baleen whale, unidentified small dolphin, unidentified pinniped, unidentified *Balaenoptera* sp., or unidentified *Delphinus* sp.), we prorated these sightings to species using the proportions of species in the identified sample, and adjusted our sightings rates appropriately. To avoid potential overestimation of group size, we used the size-bias-adjusted estimate of average group size available in DISTANCE.

Truncation involved the most-distant 5% of the sightings for each species group. We also used left truncation at 250 m, due to indications that poor visibility below the aircraft resulted in missed detections near the transect line. We modeled the data with half-normal (with hermite polynomial and cosine series expansions), hazard rate (with cosine adjustment), and uniform (with cosine and simple polynomial adjustments) models, selecting the model with the lowest value for Akaike's Information Criterion.

We did not have data available to make empirical estimates of trackline detection [g(0)]. However, since our surveys were very similar to those of Carretta et al. (2000), values for g(0) from their study were used to correct for uncertain trackline detection. Estimates of density and abundance were produced only for those species with more than five useable, on-effort sightings in the line transect database.

Results

A total of 1,284 marine mammal groups were sighted during the surveys; however, 50 percent (n = 496) of these were made during off-effort periods for line transect, and thus could not be used to estimate density and abundance. There were 495 marine mammal sightings made during systematic and connector transects that were available to estimate density and abundance by line-transect methods (**Table 3**). The most commonly sighted species were blue whales (n=8), fin whales (n=26), Risso's dolphins (n=61), common bottlenose dolphins (n=11), Pacific white-sided dolphins (n=11), common dolphins (n=141), and California sea lions (n=127), and abundance was estimated for these species. Line-transect estimates of density and abundance (and their associated coefficient of variation) are shown in **Table 4**.

Identification of common dolphins to species level was often not possible during flights, and for this reason extensive photos were taken of common dolphin schools for later detailed examination. We examined a sample of these photos later to see if we could identify the species, and we could in many cases. Clearly, short-beaked common dolphins predominated, and based on preliminary sample of photos in which we able to determine species, 96% of common dolphins sighted were *D. delphis* and only 4% were *D. capensis*.

Discussion

Potential Biases of the Estimates

As is true of any statistical technique there are certain assumptions that must hold for line transect estimates of density and abundance to be accurate. Below we will describe the various assumptions of line transect and other issues that may cause bias in our estimates.

<u>Assumption 1: Certain Trackline Detection</u>

Target animals on and very near the trackline must be detected to avoid estimates that are biased low (Buckland and York 2009). This is a central assumption of basic line transect theory, but in reality it is often violated, especially by diving animals like marine mammals. However, this can be dealt with by incorporating a factor into the line transect equation that accounts the proportion of missed animals (the detection function, g(0)). We have done this in the present study, by use of g(0) factors from studies of diving behavior of the target species, but these only account for part of the potential bias (availability bias). Another fraction, termed visibility bias, represents the proportion missed despite the fact that they were available to be seen by the observers. This is much more difficult to model, and our estimates do not account for this, making them likely underestimates to some extent.

Assumption 2: No Responsive Movement

Although it often stated that there must be no responsive movement to the survey platform, this is not strictly true. However, any responsive movement must occur after detection by the observers, and such movement must be slow relative to the speed of the survey platform (Buckland and York 2009). In our case, the use of a fast-moving aircraft as survey platform minimizes the chances of this being a significant issue. This is much more of a concern with vessel surveys, and in aerial surveys is generally not considered to be a problem.

Assumption 3: No Distance Errors

It is quite obvious that distances must be measured accurately to avoid inaccuracies in the resulting estimates (Buckland and York 2009). However, in practice, distances are difficult to measure at sea, and it is likely that every marine mammal line transect survey has suffered from some inaccuracy in distance measurement. However, small and random errors generally do not cause significant problems. It is large and/or directional errors that are of serious concern. We have no indications that large or directional errors in distance measurement were an issue in this study.

Other Factors

Besides the above-listed issues, there are a few other factors that may cause some bias in resulting line transect estimates. Line placement, lack of independence of detections, and non-uniform distribution of animals can in some cases cause problems. But, these are generally not major issues and we believe that they are not factors in causing any significant bias in our estimates.

Placing the Estimates into Context

Historically, the patterns of cetacean relative abundance and presence in southern California waters are, in many cases, very different from what are currently observed. This is likely related to previous exploitation and depletion of these species and long-term changes in oceanographic conditions, and concomitant changes in prey distributions and densities. Peterson et al. (2006) summarized the anomalous conditions (including several El Niño and La Niña events) that have characterized the California Current System in the last several years. Below, we place the information obtained in the current study into the context of our historical knowledge.

Carretta et al. (2000) conducted extensive year-round aerial surveys of an overlapping (although not completely-so) area in 1998/1999. We followed very similar methods and used similar equipment to the surveys of Carretta et al. (2000), including the same aircraft. Our surveys mostly covered the period of the year defined by Carretta et al. (2000) as the warm-water period, and thus our estimates will most closely correspond to theirs from this period. Although, we cannot compare abundance estimates directly, since our study area boundaries differ somewhat, estimates of density for the Southern California Anti-Submarine Warfare Range (SOAR) and South of San Clemente Island overlap largely with the areas used by Carretta et al. (2000). Comparison to those estimates, in particular, can provide some useful information on potential changes in distribution and abundance of marine mammal species in the last 12-13 years.

Blue whale *Balaenoptera musculus*

Blue whales are relatively common off the coasts of southern and central California (Hamilton et al. 2009). Since protection was provided by the International Whaling Commission (IWC) in 1966, the eastern North Pacific stock is expected to be recovering from heavy exploitation by commercial whalers in the 20th century. The species is listed as Endangered under the Endangered Species Act (ESA). Cetacean surveys conducted in southern California waters in the 1950s did not mention the blue whale (Brown and Norris 1956; Norris and Prescott 1961). The best estimate of stock size is 2,842 whales (CV=0.41, Carretta et al. 2010). Despite this apparent increase, Carretta et al. (2010) found no evidence of an increasing trend in abundance from surveys in the last two decades. This may be partly related to high variance in inter-annual numbers of blue whales since blue whales appear to shift preferred feeding locations from year to year (Carretta et al 1995; Redfern et al. 2011).

Blue whales were observed nine times by Carretta et al. (2000), all but once during the warm-water season. A density of 0.47 animals/100 km^2 (CV=0.39) was calculated for the Carretta et al. (2000) surveys in the warm-water season. Our estimates (0-0.12 animals/100km^2) were all well below those of Carretta et al. (2000). However, it is known that feeding blue whales aggregate in different areas in various years. Thus, this may not be a good indication of long-term changes in abundance of this species along the San Diego coast.

Fin whale *Balaenoptera physalus*

The fin whale is one of the most common large whales off southern California and is present in all seasons (Carretta et al. 1995; Hamilton et al. 2009). Fin whales were protected by the IWC in 1976, and the population is predicted to have recovered somewhat. The fin whale was not mentioned in reports of cetacean surveys conducted in southern California waters in the 1950s (Brown and Norris 1956; Norris and Prescott 1961). The best estimate of stock size is 2,636 (CV=0.15, Carretta et al. 2010). The species is listed as Endangered under the ESA. Although there was some evidence of an increase from 1979-1996 (Barlow 1994, 1997), there is no evidence of a population increase in the California/Oregon/Washington stock from recent line transect surveys (Carretta et al. 2010). The effects of illegal whaling, as well as ship strikes and gillnet entanglement are considered possible reasons for this.

Carretta et al. (2000) sighted fin whales 21 times (six in the cold- and 15 in the warm-water season), which, compared to large whales, is ranked second only to the gray whale (sighted only in the cold-water season). Densities of 0.27 (CV=0.34, cold) and 0.89 (CV=0.33, warm) animals/100 km^2 were calculated from the Carretta et al. (2000) surveys. Our estimate for SOAR (1.22 animals/100 km^2) is similar to their warm-water estimate, although our estimate for the Northern Air Operating Area (NAOPA) (0.18 animals/100 km^2) is much lower. Despite a lower estimate, fin whales are clearly the most common and abundant large whales in the study area during the warm-water months, and a significant number of these whale (n = 66) appear to use the study area at this time of year.

Sei whale *Balaenoptera borealis*

Sei whales are not commonly observed off California, although it is clearly part of their normal range (see Barlow 1994; Hamilton et al. 2009). Their range and migration patterns are not fully understood, though they clearly prefer oceanic waters and are not often seen in coastal regions (Horwood 1987). Sei whales often appear to have an erratic or 'irruptive' pattern of movements: they occur in a feeding area for a period of time then virtually disappear, apparently moving elsewhere (Jonsgard and Darling 1977; Horwood 1987; Schilling et al. 1992). There is no reliable abundance estimate for the Eastern North Pacific stock. The best estimate of numbers off the US west coast is only 46 whales (CV=0.61), which is likely a vast underestimate (Carretta et al. 2010). Although the species is listed as Endangered under the ESA, nothing specific is known of trends for this stock. This species was not sighted in the Carretta et al. (2000) surveys. The single sighting in the current study was considered insufficient for making a reliable abundance estimate.

Bryde's whale *Balaenoptera edeni/brydei*

Bryde's whales are very uncommon off the California coast (Hamilton et al. 2009). Although they are common further south off southern Baja California, in the Gulf of California, and in the eastern tropical Pacific, only two confirmed records of this species are known from the US west coast. A sighting was made off La Jolla in 1963 (Morejohn and Rice 1973), and another sighting was made during a SWFSC survey in offshore waters (ca. 36°N) in fall 1991 (Hill and Barlow 1992; Barlow 1995; Hamilton et al. 2009). There is no stock recognized for US west coast waters, and records from this area have generally been considered extralimital wanderings of stocks further south off Mexico and the eastern tropical Pacific (Carretta et al. 2011). Carretta et al. (2000) did not observe Bryde's whales in their surveys. The single sighting in this study was considered insufficient for making a reliable abundance estimate.

Common minke whale *Balaenoptera acutorostrata*

Although minke whales are reasonably common off the California coast, they are not often observed on visual surveys (Hamilton et al. 2009). These animals have a low surfacing profile, an often invisible or indistinct blow, and can easily be missed by visual observers (see Rankin et al. 2007). The California/Oregon/Washington stock of minke whales is currently thought to number 806 animals (CV=0.63, Carretta et al. 2010). There are no data on trends in abundance. Carretta et al. (2000) only observed a single group in their surveys, and provided an estimated density of 0.095 animals/100 km^2 (CV=0.91). Only four sightings occurred in the current study, and so no estimates of density or abundance were attempted.

Humpback whale *Megaptera novaeangliae*

Humpback whales were depleted off the California coast by shore-based whaling in two phases: first before 1925 and again between 1956 and 1965 (Carretta et al. 2010). These animals feed off the California coast and have become very common in many areas of central and northern California in the last couple of decades (Hamilton et al. 2009). They are now seen regularly in southern

California. The single stock recognized in US west coast waters is the California/Oregon/ Washington stock, which breeds mainly in Mexican waters (Carretta et al. 2010). The best estimate of stock size is 1,391 (CV=0.13, Carretta et al. 2010). The species is listed as Endangered under the ESA, and therefore is considered depleted under the ESA. However, NMFS is currently considering delisting or downlisting this species given indications of a strong recovery for North Pacific populations over the last several decades (Carretta et al. 2010).

Carretta et al. (2000) sighted humpback whales twice in their surveys, both times in the cold-water season. A density of 0.15 (CV=0.46) animals/100 km^2 was calculated from the Carretta et al. (2000) surveys for the cold-water season. We only observed five groups of humpback whales, and this was considered insufficient for estimating their abundance.

Cuvier's beaked whale *Ziphius cavirostris*

While Cuvier's beaked whales are probably reasonably common off the coast of California, this species is infrequently observed on visual sighting surveys (Hamilton et al. 2009). As with all beaked whales, this may have much more to do with their long dives, low surfacing profile, and cryptic habits than with actual rarity. Nothing is known about population trends for the California/Oregon/Washington stock, which is thought to number about 2,830 (CV=0.73, Carretta et al. 2010). A recent study using a combination of visual and acoustic techniques to locate *Ziphius* groups suggested that the deeper-water region west of San Clemente Island is an important area for this species (Falcone et al. 2009). This region may have great potential to aid in investigations of impacts of military sonar on beaked whales.

Carretta et al. (2000) observed Cuvier's beaked whales three times (all in the cold-water season) and calculated a density of 1.9 animals/100 km^2 (0.52) from their surveys off San Clemente Island. Only four sightings were made in the current study, and so no estimates of abundance were attempted.

Killer whale *Orcinus orca*

Killer whales are observed relatively infrequently off the coast of southern California (Hamilton et al. 2009). There are several stocks along the California coast, and animals observed around San Clemente Island would most likely be from the Eastern North Pacific Offshore stock. This stock is currently estimated to number at least 353 individuals, and nothing is known about the trend in the population (Carretta et al. 2010). This species was not seen in the surveys conducted by Carretta et al. (2000). We only observed killer whales twice, so no estimates of density or abundance were attempted.

Risso's dolphin *Grampus griseus*

Currently one of the most common species of delphinids off the coast of California (Hamilton et al. 2009), Risso's dolphins have apparently undergone significant changes in numbers and/or distribution over the last several decades (Kruse et al. 1999). Older reports from the middle of the 20th century did not identify these animals as common. In fact, they were not even mentioned by Brown and Norris (1956) and Norris and Prescott (1961), who conducted extensive cruises in the Southern California Bight in the 1950s. Similarly, Risso's dolphins were not discussed by Walker (1975), who conducted many searches in the Southern California Bight, in 1966-1972 for the purpose of live-capture of small cetaceans. Leatherwood et al. (1980) stated that the periods of greatest abundance in southern California were associated with periods of protracted warm water, and they considered the Risso's dolphin to be primarily a tropical species. Our current understanding of this species does not support this view, as areas of greatest abundance generally appear to be areas with colder waters, such as central California.

The California/Oregon/Washington stock of Risso's dolphin is currently thought to number 11,621 individuals (CV=0.17), and there is no empirical evidence of an overall trend in abundance from recent line-transect surveys conducted off the US west coast (Carretta et al. 2010). Risso's were common in the late 1990s, when the Carretta et al. (2000) surveys were conducted, and those authors observed 23 groups (16 of them during the cold-water season). They calculated densities of 18.0 (CV=40, cold) and 6.1 (CV=56, warm) individuals/100 km^2. Our calculated densities for NAOPA and South of San Clemente Island (19.99 and 16.01 animals/100 km^2) are much higher than those for Carretta et al.'s (2000) warm season, but similar to those they estimated for the cold season. These densities indicate that a substantial number of Risso's dolphins used the area during the study period (n = 2,537 individuals) making them the second-most abundant species after common dolphins. Although this may be partly due to the larger proportion of shallower waters in our study area (continental shelf and upper slope waters are preferred by this species), it is probably also indicative of increased use of the San Diego area during the warmer months.

Common bottlenose dolphin *Tursiops truncatus*

The NMFS currently recognizes two stocks of bottlenose dolphins in southern California. The coastal stock does not venture over 1 km from the mainland shore. Thus animals observed in the present study around San Clemente Island would presumably be mostly members of the California/Oregon/ Washington stock. These offshore bottlenose dolphins present in California may actually comprise more than one stock, and there is some evidence of separate island-associated populations, but this has not yet been confirmed. Nevertheless, the currently recognized offshore (California/Oregon/Washington) stock is estimated to number 3,495 individuals and there is no information on trends for this stock (CV=0.31, Carretta et al. 2010).

Older records of bottlenose dolphins in more offshore waters of southern California usually stated that they were almost always in the company of short-finned pilot whales (Norris and Prescott 1961; Walker 1975). Pilot whales were previously considered to be "quite common" in southern California waters (Brown and Norris 1956). This association was not seen in the present study, as pilot whales were never observed.

Bottlenose dolphins were seen by Carretta et al. (2000) in both warm- and cold-water seasons, and densities of 3.4 (CV=0.66, cold) and 1.5 animals/100 km^2 (CV=0.67, warm) were estimated from their surveys in the late 1990s. Our estimate of 6.92 animals/100 km^2 for NAOPA is somewhat higher, which is expected for this coastal area. Bottlenose dolphins generally have higher densities in shallow, coastal waters.

Short-beaked common dolphin *Delphinus delphis*

Until 1994, only a single species of common dolphin was considered to occur off the California coast, *D. delphis* (Heyning and Perrin 1994). We now know that there are actually two species, *D. delphis* and *D. capensis,* and that before 1994 the two species were erroneously lumped as *D.*

delphis. Work conducted before the mid-1990s did not distinguish the two species, but conclusions from these studies are probably mainly attributable to the more-abundant short-beaked species. This species has long been known as one of the most abundant in the Southern California Bight (Brown and Norris 1956; Norris and Prescott 1961; Walker 1975; Dohl et al. 1986; Hamilton et al. 2009). Although older records are sometimes contradictory (e.g., Brown and Norris 1956; Norris and Prescott 1961), extensive aerial surveys for common dolphins in the 1980s showed them to be much more widespread and with much higher densities (0.8-2.4 individuals/km^2) in summer/autumn months than during winter/spring (0.2-1.2 individuals/km^2 – Dohl et al. 1986). The latter authors identified an influx of animals from the south into the bight in the warm-water months.

Short-beaked common dolphins are extremely common in southern California waters. The population currently numbers an estimated 392,733 individuals (CV=0.18), making it the most abundant cetacean in the Southern California Bight (Carretta et al. 2010). There is good evidence of an increasing trend in the southern California waters, and this may be correlated with a decline in numbers of 'northern common dolphins' (which includes both species) in Mexican waters and the eastern tropical Pacific.

The short-beaked common dolphin was the most-frequently observed cetacean species during the Carretta et al. (2000) study. Short-beaked common dolphins were observed in both seasons, with estimated densities of 178.0 (CV=0.37, cold) and 465.0 (CV=0.39, warm) animals/100 km^2. We observed both species of common dolphins in our surveys. However, *D. delphis* comprised 96% of 13, 673 identified individuals, so the estimates below primarily refer to *D. delphis*. Densities of common dolphins in our study were lower than for Carretta et al.'s warm-water season (318.99 animals/100 km^2 in NAOPA and 58.43 animals/100 km^2 in SOAR). This may be at least partly related to cooler water temperatures in recent years (for instance 2010 was a La Niña year, with unseasonably, cool water temperatures). However, short-beaked common dolphins were still very abundant in the study area (the most abundant species, by far) with an estimated 29,044 individuals present.

Long-beaked common dolphin *Delphinus capensis*

The long-beaked species of common dolphin is frequently observed in nearshore waters of southern California, within 50 nm from the coast (Hamilton et al. 2009; Carretta et al. 2010). There is not much information on the historical status of this species, since it was not recognized as a separate species until 1994 (Heyning and Perrin 1994). The California stock of the long-beaked common dolphin is currently estimated to number 15,335 individuals (CV=0.56). There is nothing known about the overall population trends for this species. Oceanographic conditions (especially warming of local waters during El Niño conditions) cause fluctuations in the densities of these dolphins in the Southern California Bight (Heyning and Perrin 1994; Carretta et al. 2010).

Carretta et al. (2000) did not report any sightings of this species during their late-1990s surveys, and all identified common dolphins in that survey were considered to be *D. delphis* (J. Carretta, pers. comm., Dec. 2010). We did observe several groups of long-beaked common dolphins, although they were much less frequent and in much smaller groups than short-beaked common dolphins. Based on our estimates that only 4% of common dolphins in our study would be *D. capensis*, we estimate about 900 long-beaked common dolphins for NAOPA, 75 for SOAR, and 15 for the South of San Clemente Island areas.

Pacific white-sided dolphin *Lagenorhynchus obliquidens*

Pacific white-sided dolphins have long been recognized as one of the most abundant cetaceans in southern California waters (Brown and Norris 1956; Norris and Prescott 1961; Walker 1975; Leatherwood et al. 1984). They are relatively common in the Southern California Bight during the cold-water season, as they move inshore in the winter and spring months (Brown and Norris 1956; Norris and Prescott 1961; Leatherwood et al. 1984; Hamilton et al. 2009). Currently, two geographic forms/populations are known off the US west coast, a northern and a southern form. These are based on subtle differences in morphology and genetics, but no reliable indicators have been identified that would allow individuals seen at sea to be referred to a specific form (Walker et al. 1986; Carretta et al. 2010). Due to the inability to reliably distinguish animals from the two stocks in surveys, only a single stock is currently recognized by NMFS for management purposes (Carretta et al. 2010). An estimated 20,719 dolphins (CV=0.22) of this species occur off California, Oregon, and Washington (including animals of both stocks). There is no indication of a long-term trend in abundance for these animals off the US west coast. The Southern California Bight represents an area of potential overlap of both forms. Thus, it is not clear to which stock animals sighted in this study would belong.

In the Carretta et al. (2000) surveys, Pacific white-sided dolphins were only seen in the cold-water season. There were 26 sightings, and a density of 19.7 individuals/100 km^2 (CV=0.44) was calculated. We observed this species several times in our surveys during the warm-water season, and densities of 0.53 and 2.15 individuals/100 km^2 were calculated for NAOPA and SOAR, respectively – much lower than the cold-water estimates of Carretta et al (2000). This may indicate increased use of the San Diego area by the species during our warm-water study period; it may also be related to unseasonably cool water temperatures experienced during at least some recent surveys (especially 2010).

Northern right whale dolphin *Lissodelphis borealis*

The northern right whale dolphin has traditionally been considered one of the two or three most abundant cetacean species in southern California waters (Norris and Prescott 1961; Leatherwood and Walker 1979; Carretta et al. 1995; Hamilton et al. 2009). They occur in the Southern California Bight primarily during periods of cold-water temperatures and highest squid abundance; they move north when water temperatures increase, especially during late spring and summer months (Leatherwood and Walker 1979; Carretta et al. 2010). A single stock is recognized in US waters, the California/Oregon/Washington stock. The current best estimate of abundance for this stock is 12,876 individuals (CV=0.30), and there is currently no evidence of any significant trend in numbers (Carretta et al. 2010).

In surveys conducted by Carretta et al. (2000) around San Clemente Island, northern right whale dolphins were only observed in the cold-water season. There were 11 sightings, yielding a density of 9.0 individuals/100 km^2 (CV=0.40). The two sightings of this species obtained in this study were considered insufficient for estimating density or abundance.

California sea lion *Zalophus californianus*

California sea lions are very common in waters of southern California, and are the most abundant pinniped species along the coast of California. A single US stock is recognized, and the current best estimate of stock size is 238,000 individuals (Carretta et al. 2010). The population has been generally increasing for many decades, although there have been several dips in abundance in recent years. The population is believed to have reached carrying capacity, though this cannot currently be confirmed (Carretta et al. 2010). In-water densities of California sea lions have traditionally not been estimated before in southern California, although Carretta et al. (2000) provided the first such estimates based on several hundred sightings. Their estimates ranged from 19.4 to 119.0 animals/100 km^2 in the cold-water season, and from 5.6 to 75.0 animals/100 km^2 in the warm-water season. Our estimates ranging from 5.74-31.08 individuals/100 km^2 are in general agreement though somewhat lower. A total of 2,534 California sea lions were estimated to be at sea in the study area during our study. The lower density in our study may be expected, as our surveys did not have extensive coverage in the nearshore shallow waters, where California sea lions are most frequently observed (Carretta et al. 2000 did, however). Density at sea tends to be lower during the summer months, when much of the population is on the island for the breeding season. Carretta et al. (2000) counted as many 3,941 California sea lions hauled out on San Clemente Island in April 1999.

Northern elephant seal *Mirounga angustirostris*

There is a single stock of the northern elephant seal in US waters, the California breeding stock. These animals are common in the Southern California Bight, and they breed on the California Channel Islands. In 2005, the California breeding stock was estimated at 124,000 seals. Births have been rapidly increasing since at least 1960, and the population is considered to have not yet reached its carrying capacity (Carretta et al. 2010). The five sightings made in this study were considered insufficient for making a reliable density or abundance estimate.

Harbor seal *Phoca vitulina*

Common in waters of southern California, the harbor seal comprises several stocks in US west coast waters. The California stock is currently estimated to number 34,233 individuals. It is still increasing overall, but it is thought that it is approaching carrying capacity (Carretta et al. 2010). Only three sightings were obtained in the current study, so no estimates of abundance were attempted.

Conclusions

This study has provided the only available recent estimates of density or abundance for marine mammal species in the majority of coastal and offshore waters off of San Diego. Our results are in general agreement with those of Carretta et al. (2000), who surveyed a largely overlapping area using similar methods in the late 1990s. Our results indicate that the study area continues to be used by a substantial number of marine mammal species during the warm-water season. However, numerically the region is dominated by only a few species. For great whale species (i.e., blue and fin), abundance was estimated to be in the tens. Pacific white-sided and bottlenose dolphins numbered in the hundreds, and Risso's and common dolphins, as well as California sea lions, numbered in the thousands. Other species were not seen frequently enough to calculate useful abundance estimates, but in some cases may actually be reasonably abundant, at least in some parts of the year. We have recently conducted several additional surveys in the cold-water winter and spring months, and we hope to calculate year-round estimates of density and abundance for a larger set of species based on much larger sample sizes in the future.

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Table 1. Description of the four primary study modes designed to address monitoring goals of the aerial survey.

Mode	Aircraft Speed (kt)	Aircraft Altitude (m)	Flight Pattern	Duration	Data Collected
Search	~100	~305	• Systematic transect lines • Random shorter connecting lines • Transits	Until MM or ST seen, then switch to Identify or Focal Follow Mode	• Time & location of sighting • Species, group size, % calves • Bearing & declination angle to sighting • Behavior state • Initial reaction (yes or no & type) • Status (alive or dead) • Heading of sighting (magnetic) • Dispersal distance (min. & max. in estim. body lengths)
Identify	~85	~305	Circling at ~305 m radius	<5 min	• Photograph to verify species • Estimate group size, % calves • Note any apparent reaction to plane or unusual behavior
Focal Follow	~85	~365-457	Circling at ~1 km radius	≥5– 60+ min	In order of priority every ~1 min: • Time • Focal group heading (magnetic) • Lat. /long. (automatic GPS) • Behavior state • Dispersal distance • Aircraft altitude (ft) • Distance of aircraft to MM (declination angle) • Reaction? • Individual aerial behavior events • Bearing & distance to vessels <10 km away or other nearby activity • Surface & dive times (whales) • Individual respirations (whales)
Shoreline Survey	~100	~305	Circumnavigate San Clemente Island in clockwise direction ~0.2 km from shoreline (random effort)	~45 min	• Status (alive, dead or injured) • Species, group size, % calves/young • Bearing & declination angle to sighting • Behavior state & heading • Initial reaction?

Table 2. Estimates of the detection function for the four species groups.

Species Group	Species Included	n	f(0)	%CV
Baleen whales	*B. musculus, B. physalus, B. borealis, B. edeni, B. acutorostrata, Balaenoptera* sp., *M. novaeangilae*	60	0.7881	9.27
Large delphinids	*G. griseus, T. truncatus, O. orca*	74	2.2332	6.44
Small dolphins	*D. delphis, D. capensis, Delphinus sp., L. obliquidens, L. borealis*, unid. small dolphin	193	1.3698	9.08
CA sea lion	*Z. californianus*	127	8.4030	21.57

Table 3. Marine mammal species observed during the surveys, with total sightings (nT), sightings used in line transect estimation (nD), and months observed. (Surveys were flown in months 5-11).

SPECIES	nT	nD	Months Observed
Blue whale - *Balaenoptera musculus*	50	8	5, 6, 7, 8, 10, 11
Fin whale - *Balaenoptera physalus*	51	26	5, 6, 7, 10, 11
Sei whale - *Balaenoptera borealis*	1	0	9
Bryde's whale - *Balaenoptera brydeii/edeni*	1	1	9
Common minke whale - *Balaenoptera acutorostrata*	5	3	5, 7, 9, 11
Humpback whale - *Megaptera novaeangliae*	5	5	6, 11
Cuvier's beaked whale - *Ziphius cavirostris*	4	2	7, 9, 11
Killer whale - *Orcinus orca*	2	2	11
Pacific white-sided dolphin - *Lagenorhynchus obliquidens*	21	11	5, 7, 11
Risso's dolphin - *Grampus griseus*	157	61	5, 6, 9, 10, 11
Common bottlenose dolphin - *Tursiops truncatus*	27	11	5, 6, 7, 9, 10
Short-beaked common dolphin - *Delphinus delphis*	35	19	10, 11
Long-beaked common dolphin - *Delphinus capensis*	10	2	6, 9, 10, 11
Common dolphin - *Delphinus* sp.	299	120	5, 6, 7, 9, 10, 11
Northern right whale dolphin - *Lissodelphis borealis*	3	2	6
California sea lion - *Zalophus californianus*	300	127	5, 6, 7, 9, 10, 11
Harbor seal - *Phoca vitulina*	13	1	7, 10, 11
Northern elephant seal - *Mirounga angustirostris*	6	5	5, 9, 11
Unid. baleen whale	19	17	6, 7, 9, 11
Unid. dolphin	161	39	5, 6, 7, 9, 10, 11
Unid. pinniped	45	17	5, 6, 7, 10, 11
Unid. marine mammal	24	16	5, 6, 7, 11
TOTAL	1,239	495	

Table 4. Estimates of individual density (Di), abundance (N), and coefficient of variation (%CV) for marine mammals in the SoCal area.

SPECIES	Di	N	%CV	TOTAL N
Blue whale - *Balaenoptera musculus*				**13**
NAOPA	0.00124	11	40.73	
SOAR	0.00047	2	99.83	
South of SCI	0	0		
Fin whale - *Balaenoptera physalus*				**66**
NAOPA	0.00177	15	56.67	
SOAR	0.01219	51	33.90	
South of SCI	0	0		
Pacific white-sided dolphin - *Lagenorhynchus obliquidens*				**135**
NAOPA	0.00530	45	100.67	
SOAR	0.02154	90	86.50	
South of SCI	0	0		
Risso's dolphin - *Grampus griseus*				**2,537**
NAOPA	0.19985	1,693	31.70	
SOAR	0.01403	59	85.30	
South of SCI	0.16006	785	110.95	
Common bottlenose dolphin - *Tursiops truncatus*				**585**
NAOPA	0.06915	585	72.43	
SOAR	0	0		
South of SCI	0	0		
Common dolphins - *Delphinus* spp.				**30,034**
NAOPA	3.18990	27,028	36.20	
SOAR	0.58430	2,442	52.60	
South of SCI	0.11505	564	61.70	
California sea lion - *Zalophus californianus*				**2,534**
NAOPA	0.11240	952	43.00	
SOAR	0.31082	1,300	63.70	
South of SCI	0.05743	282	108.81	

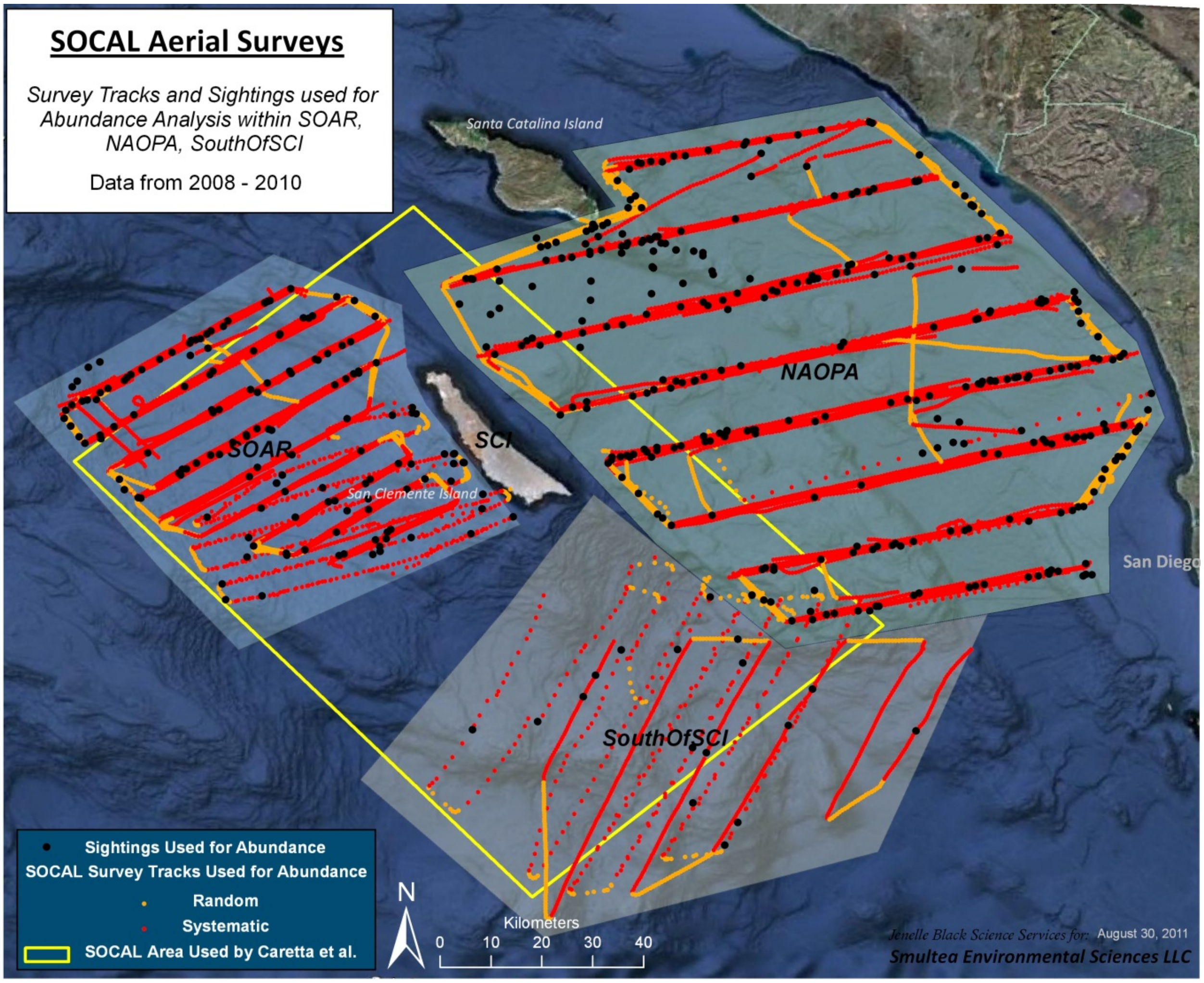

Figure 1. Survey tracks from surveys during 2008- 2010.

BEHAVIOR AND GROUP CHARACTERISTICS OF MARINE MAMMALS IN THE SOUTHERN CALIFORNIA BIGHT 2008-2010

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Introduction

The observed behavior of marine mammals in the Southern California Bight (SCB) has been little described and is limited to a few species and relatively small sample sizes. Since 2008, the U.S. Navy has been tasked by the National Marine Fisheries Service to monitor the distribution, occurrence and behavior of marine mammals within the Southern California Range Complex (SOCAL) off San Diego and San Clemente Island, California (DoN 2009). The initial primary goal has been to gather current baseline data that can be used comparatively to quantify potential effects of Navy major training events involving mid-frequency active sonar (MFAS) and underwater detonations. Numerous behavioral and group social parameters have been used to quantify and compare the reactions of various marine mammal species to anthropogenic and other stimuli such as underwater sound, vessels, predators, etc. (e.g., see review in Richardson et al. 1991). In such studies, baseline variables were compared to the same variables collected under stimulus-exposed conditions. Significant changes in a number of behavioral variables have been associated with such stimuli for whales. Examples include changes in dive and surface times, respiration rates, swim speeds, and headings among bowhead whales (*Balaena mysticetus*) (e.g., Richardson et al. 1985), gray whales (*Eschrichtius robustus*) (Malme et al. 1986), humpback whales (*Megaptera novaeangliae*)(Baker et al. 1985; Bauer 1986, Frankel and Clark 2002), and sperm whales (*Physeter macrocephalus*) (Madsen et al. 2002; Smultea et al. 2008). Among delphinids, reactions have included changes in dive and surface times, group size and cohesion, heading/orientation, swim speed, including bottlenose dolphins (*Tursiops truncatus*) (Smultea and Würsig 1992; Constantine et al. 2004), dusky dolphins (*Lagenorhynchus obscurus*) (Vaughn et al. 2010), and common dolphins (*Delphinus* spp.) (Stockin et al. 2009).

Of particular relevance to SOCAL are recent studies there and elsewhere focused on the behavioral responses of a number of cetacean species to playbacks of reduced sound levels of MFAS. The latter studies have been designed to facilitate collection of before, during and after behavioral, dive and vocalization data. Techniques have included vessel-based visual observations, passive acoustic recordings, photo-identification, and tagging of animals with satellite, time-depth-recorder, and acoustic sensors. However, vessels from which visual observations are made contribute to underwater noise and potential confounding disturbance to focal animals. In addition, the high expense of such studies, the difficulty in obtaining statistically sufficient sample sizes, and the general lack of baseline "undisturbed" regional behavioral data from SCB species limits the interpretation of the results. Despite the limitation, those studies currently represent the most integrated and comprehensive study focused on the behavioral responses to MFAS. Preliminary results indicate that responses or lack thereof appear to be related to the behavioral context when the noise exposure occurs, i.e., the level of individual response is related to what the individual is doing as has been shown for other cetaceans and stimuli (reviewed in Richardson et al. 1991). Although these studies have provided valuable insight, there is still a critical need for additional behavioral response studies, particularly with larger sample sizes and from other species (NRC 2003; Southall et al. 2008). Additionally, to interpret these results, it is also essential to understand what constitutes “normal” or “typical” behavior in the absence of the noise of interest which is difficult, if not impossible to obtain from vessel-based visual observations.

In this paper, we report selected results of aerial surveys conducted in the SCB on behalf of the Navy to gather baseline behavioral ecology parameters for marine mammals with which to provide a comparison database for animals exposed to MFAS. Variables of interest were selected based on results of other studies identifying certain quantifiable parameters shown to be demonstratively sensitive to underwater noise for some marine mammal species (e.g., Richardson et al. 1985, 1995; Malme et al 1986; Smultea and Würsig 1992; Gailey et al. 2007). The goal was to gather robust sample sizes of the selected behavioral and group characteristic variables to describe the typical behavior of Federally-listed and selected priority species as feasible. We also developed hypotheses linked with these variables to be used for future and ongoing identification and interpretation of potential reactions of marine mammals to MFAS and underwater detonations.

Methods

Eight aerial surveys were conducted from 2008-2010 in October and November 2008; June, July and November 2009; and May, July and September 2010 (Table 1). The observation platform was a high-wing, twin-engine, fixed-wing Partenavia P68 or Observer (OBS) aircraft. Survey methods were consistent with current accepted Distance Sampling theory (Buckland et al. 2001) and followed general protocol used for surveys SOCAL (e.g., Carretta et al. 2000). Survey lines consisted of generally E-W-oriented lines perpendicular to bathymetric contours (Figure 1). Surveys were flown at a speed of 100 knots from an altitude of approximately 357 m (1,000 ft). Previous studies indicate that bowhead whales (e.g., Richardson et al. 1985a,b; Patenaude et al. 2002), adult humpback whales (e.g., Smultea et al. 1995), and bottlenose dolphins (Smultea and Würsig 1995) show little or no detectable reaction to small fixed-wing aircraft circling at these altitudes and radial distances (also see review in Richardson et al. 1985 a,b; 1995). Preliminary data support these results (SES unpublished data). These parameters are well outside the Snell’s Cone theoretical range of air-to-water sound transmission angle associated with over-flying aircraft (Urick 1972, 1983; Richardson et al. 1995). Thus, staying outside these parameters was anticipated to avoid the potential for the aircraft to affect the behavior of the observed animals.

The survey team consisted of a pilot and three marine mammal biologists experienced in line-transect survey methodology; identification of Pacific marine mammals; and marine mammal observations from aircraft. Two observers were in the back seats of the aircraft, while the third sat in the front right co-pilot seat, serving as the recorder and photographer.

The general survey approach was to: (1) follow survey lines until a sighting was made; (2) record basic sighting information per established protocol; and (3) circle the sighting to photo-document and confirm species and group size and take digital photographs as needed; or (4) increase altitude to ~365-455 m and radial distance ~0.5-1.0 km to conduct a detailed focal behavioral follow involving videography. Geographical Positioning System (GPS) locations were automatically recorded at 10-sec intervals on a handheld, WAAS-enabled Garmin 495 aviation

GPS as well as by the aircraft WAAS GPS. A Suunto handheld clinometer was used to measure declination angles to a sighting when it was perpendicular to the aircraft. Steiner 7 x 25 or Swarovski 10 x 32 binoculars were used as needed to identify species, group size, and behaviors.

Data were recorded using a Palm Pilot TX, Apple iTouch, or an Acer netbook laptop computer. Data recording software consisted of SpectatorGo or custom-designed Excel datasheets. Recorded variables included environmental data (Beaufort sea state, glare, visibility conditions); leg effort type (e.g., systematic line transect, connector (i.e., shorter) lines connecting systematic lines, random, transect, circling); species; estimated group size; and number of calves observed. Modified scan sampling and zero-one sampling approaches (Altmann 1974; Smultea 1994, 2008; Mann 2000) were used to record: (1) behavioral state; (2) minimum and maximum dispersal distance between nearest individuals within a subgroup (i.e., spacing estimated in body lengths [BL]); and (3) heading (in degrees magnetic) (see Table 2).

Photographs to confirm species identifications were taken using a digital camera with Image Stabilized (IS) zoom lenses (a Canon 40D with 100-400 mm ET-83C lens, a 20D with 70-200 mm 2.8 lens and 1.4x converter; or a D60 with 100-400mm lens). For focal follow behavioral sessions, a Canon Vixia HF10 or Sony HDR-XR550 12.0 megapixels high-definition (HD) digital video camera with a built-in optical image stabilizer and 12x optical zoom lens were used to record behaviors. Software vATS was used to convert video camera lapsed time to real-time. The microphone of the video camera was connected to the audio system of the aircraft so that all vocal input (i.e., behavioral verbal descriptions) was recorded into the video camera data stream.

Sighting rates (number of sightings per unit effort) were calculated for on-effort periods involving "point-to-point" effort (i.e., systematic, connector and transit leg types) (Smultea et al. 2009, Jefferson et al. 2011). Statistical analyses were conducted using Excel or SPSS software. Video analyses involved reviewing video and transcribing observed behaviors and recorded audio from the video onto a customized Excel spreadsheet (Smultea and Bacon 2011); the latter results are not includedhere.

Results

A total of 1,284 groups of marine mammals and an estimated 177, 770 individuals were sighted during approximately 37,798 km of all observation effort across eight aerial surveys from Fall 2008 through Fall 2010 (Table 1). Of these totals, 24,736 km consisted of point-to-point observation effort during which 924 sightings of approximately 85,502 individuals occurred. Sixteen marine mammal species were identified-- 13 cetacean and 3 pinniped (Table 1). Group size and initial behavioral state, heading, and minimum and maximum dispersal distance (within subgroups) data were recorded for most sightings when such information could be determined. Sighting rates, mean group sizes, and means and/or frequency distributions of headings, mean maximum dispersal distance, and behavior states are presented in Tables 2-4 and Figures 2-43; these parameters were also summarized by time of year and diurnal differences.

The following discussion is organized by species or species groups in descending order of group sighting frequency and is limited to the following seven most commonly sighted species each with a minimum of 20 sightings: common dolphin, California sea lion, Risso's dolphin, fin whale, blue whale, bottlenose dolphin, and Pacific white-sided dolphin. Sample sizes of the remaining species were considered too small to warrant summarization and interpretation of trends. Each subsection consists of a brief overview of natural history important to understanding the context of the study results. Results are then discussed in the context of what is known and of relevance for the species, and what those results may indicate relative to the animal's behavioral ecology. In general, the social behavior of the species discussed is not well documented and/or what is available has been collected outside the SCB with few exceptions.

Common Dolphin *Delphinus* spp.

Two species of common dolphin – short-beaked (*D. delphis*) and long-beaked (*D. capensis*) – occur in the SCB (Heyning and Perrin 1994; Chivers et al. 2010; Carretta et al. 2011). Common dolphins are the most abundant cetaceans off California (e.g., Dohl et al. 1981; Forney et al. 1995; Carretta et al. 2011; Jefferson et al. 2011). Historically, this abundance has changed both seasonally and inter-annually with varying oceanographic conditions, with abundance increasing off California during the warm-water months (Dohl et al. 1986; Barlow 1995; Forney et al. 1995; Forney and Barlow 1998; Forney 2000; Carretta et al. 2011). In response to oceanographic events, movements may be north-south and/or inshore-offshore (Barlow 1995; Forney and Barlow 1998). Short-beaked common dolphin abundance off California has increased dramatically since the late 1970s, suggesting a large-scale shift in distribution in the eastern North Pacific (Forney et al. 1995; Forney and Barlow 1998; Jefferson et al. 2011). The northward extent of this distribution appears to vary interannually and with changing oceanographic conditions (Forney and Barlow 1998).

Delphinus is often found associated with offshore bathymetric features, such as escarpments and submarine canyons (e.g., Dohl et al. 1986). However, common dolphins of both species have also frequently been found close to the SCB mainland (Smultea et al. 2009, 2010, 2011a). Perrin (2002) report that long-beaked common dolphins appear to be restricted to waters relatively close to shore, preferring shallower and warmer water than the short-beaked common dolphin (Perrin 2002). However, habitat partitioning among the two species is not clear-cut and is not typical for areas outside California and Baja California (Pinela et al. 2011). In fact, mixed aggregations of short- and long-beaked common dolphins have been reported within the SCB (G. Campbell and

T. Jefferson, pers. comm., 2011), and considerable geographical overlap has been observed in the SCB (Smultea et al. 2009, 2010, 2011a).

Common dolphins are typically sighted in schools of hundreds to over 1,000 individuals (Evans 1994; Jefferson et al. 2008). Nineteen species of fish and two species of cephalopods have been found within the stomachs of *Delphinus* from California waters, most of which are associated with the vertically migrating deep-scattering layer (Evans 1994). Off San Clemente Island, a distinct diurnal movement pattern has been recently reported, with common dolphins moving offshore into deeper waters in the late afternoon and evening, and returning inshore at dawn (Henderson 2010). This movement combined with the low rate of observed daytime foraging, analyses of vocalizations, and stomach content analyses suggest that common dolphins in this region are primarily engaged in night-time feeding (Henderson 2010).

We observed a total of 307 common dolphin groups consisting of an estimated 79,254 individuals (Table 2). Individuals were seen during all survey months from May-November. Consistent with past SCB studies, common dolphin sighting rates were relatively high in summer (11.4 groups/1,000 km) and fall (13.7 groups/1,000 km) (Figure 2). Sighting rate increased across the day from 8.8 in the morning to 15.9 groups/1,000 km in the late afternoon. Overall, mean group size was 258 ± 39.7 individuals. Although mean group size was higher in the morning (302 ± 119.0) vs. mid-afternoon (251 ± 50.4) and late afternoon (240 ± 64.6), this difference was not significant given the high degree of variability in group size. There was also no significant change observed in group size by season. We observed a mean maximum dispersal between individual common dolphins within subgroups of 5 ± 0.7 BL, with no significant changes by time of day or season.

Common dolphins were predominantly (37% of 110 groups) observed to "surface-active mill" followed by travel (34%) and surface-active travel (21%) based on initially observed behavior state. This species was the most surface-active of all marine mammal species observed, with 58% of all groups observed in a surface-active behavior state. Overall, mean heading of common dolphins groups was southerly (188º ± 15.8) as represented primarily by summer observations; no significant differences were found in headings by survey period or time of day (Figure 6). The latter result does not support observations reported by Henderson (2010) suggesting that common dolphins headed predominantly westward in the late afternoon and evening and predominantly eastward at dawn (based on 61 common dolphin groups observed on 97 days from a stationary vessel near San Clemente Island in 2006-2008).

In summary, common dolphins were observed in very social, large, relatively consistent group sizes of around 250 - 300 animals, with a trend for larger group sizes in fall vs. spring/summer. Despite large group aggregations, individuals appeared to be consistently very cohesive within subgroups based on a relatively small mean maximum dispersal distance and associated low variability around this distance. Overall, common dolphins were more likely to be headed in a southerly direction, although there were no significant diurnal differences in headings unlike reported for this species near San Clemente Island.

<u>California sea lion *Zalophus californianus*</u>

The California sea lion ranges along the west coast of Mexico to southern British Columbia, from about 19 degrees N latitude northward to 50 degrees N latitude. This is the most commonly observed pinniped in the SCB although its relative abundance is related to time of year. During the breeding season (May-July), nearly the entire population occurs south of 34 degrees N latitude. Breeding California sea lions occur in large numbers at and near colonies at the southern California Channel Islands (principally San Nicolas and San Miguel islands) from late May through August (Stewart et al. 1993). Most rookery sites in the Channel Islands are used as haul-out areas during the non-breeding season (Stewart and Yochem 2000). Sea lions seen near the mainland coast in southern California may be from the colony at the Coronado Islands in northern Baja California or perhaps even colonies farther south. Non-breeding sea lions from U.S. colonies occur farther north along the California coast throughout summer, and may remain there or move even farther north, during fall and winter. California sea lions are least abundant in the SCB during fall and winter when adult and subabdult males, many juveniles, and some adult females forage off northern and central California, Oregon, Washington, and British Columbia (Stewart et al. 1993). Adult females and pups generally remain year-round south of Monterey Bay, California, feeding in coastal waters in the summer and moving offshore in the winter (Melin and DeLong 2000; Melin et al. 2008).

The California sea lion is a coastal animal rarely venturing seaward off the continental slope (Antonelis and Fiscus 1980). Most individuals stay within 50 km of the rookery islands during the breeding season (Bonnell et al. 1978), primarily in productive upwelling areas around the islands or near Point Conception (Stewart et al. 1993). Bearzi et al. (2008) reported frequent sightings near canyons.

Life history of the California sea lion is strongly tied to the dynamics of the California Current System (CCS) (e.g., Block et al. 2010). During periods of strong negative upwelling in the CCS (e.g., El Nino-Southern Oscillation [ENSO] events), regional productivity declines and lactating female California sea lions travel farther from the colony, move farther offshore and dive deeper, presumably in response to movement of their prey deeper in the water column or to more productive areas (Melin et al. 2008). As a result, changes in distributions, pup production, female survivorship, and foraging behaviors of sea lions occur during El Niño years when there are substantial declines in their local abundance and distribution (e.g., Ono et al. 1987; DeLong et al. 1991). The unprecedented mortality of California sea lion pups born at San Miguel Island, California, and the record number of emaciated weaned pups that stranded along the central California coast in 2009 were associated with anomalous oceanographic conditions along the central California coast between May and August 2009 (Melin et al. 2010).

California sea lions are highly gregarious and often haul out in large numbers. Thus, most information on the occurrence and distribution of California sea lions in the SCB is based on observed densities at terrestrial haul -outs, though Bearzi et al. (2008) reported densities at sea nearshore off Santa Monica, California. General unquantified observations indicate that they are usually solitary while at sea, but tend to form large groups near food-rich areas (Antonelis and Fiscus 1980). California sea lions often “raft” at the water surface alone or in groups. They engage in cooperative foraging behavior with common dolphins (*Delphinus* spp.) along the ridges and canyons of the SCB per vessel-based observations of 140 sightings made at sea in Santa Monica Bay from 1997- 2001 (Bearzi 2006).

When in the SCB, this species forages mostly at depths of 150 to 300 feet, primarily in offshore upwelling areas, though they may also occasionally forage on demersal prey in nearshore kelp beds. During the breeding season, females are primarily coastal foragers and shallow divers

(Melin and DeLong 2000). During the non-breeding season, Melin and DeLong (2000) reported that tagged females forage over the slope or offshore.

The California sea lion diet is temporally dynamic, with animals feeding on seasonally abundant schooling or aggregating prey. Northern anchovy (*Engraulis mordax*), Pacific sardine (*Sardinops sagax*), Pacific whiting (*Merluccius productus*), Pacific mackerel (*Scomber japonicus*), jack mackerel (*Trachurus symmetricus*), shortbelly rockfish (*Sebastes jordani*), and market squid (*Loligo opalescens*) are their main prey in southern California (Lowry and Carretta 1999; Lowry et al. 1990, 1991). Diet of sea lions becomes more variable during El Niño oceanographic events due to decreased abundance and availability of their preferred prey. Migrating sea lions, especially subadult and adult males, may forage closer to the mainland coast, often associating with recreational and commercial fishing vessels, feeding on fish used for chum and depredating (i.e., taking) the fish (i.e., yellowtail, barracuda, or bonita) that have been caught (Hanan et al. 1989).

We observed a total of 298 California sea lion groups of an estimated 857 individuals (Table 2). Consistent with past SCB studies, they were seen during all survey months from May-November with highest at-sea sighting rates in fall (14.82 groups/1,000 km) vs. summer (9.37 groups/1,000 km) (Figure 8). Morning and mid-afternoon sighting rates (13.4 and 13.6 groups/1,000 km, respectively) were nearly double those observed in the late afternoon (6.9 groups/1,000 km) (Figure 8). This pattern could indicate that California sea lions tended to haul-out more in late afternoon and were thus not seen during line-transect surveys.

Consistent with other reports, California sea lions tended to occur alone or in small groups while at sea, with little variation in group size. Overall, mean group size was 3 ± 0.7 individuals. Although mean group size was somewhat lower in summer (2 ± 0.7) vs. fall (3 ± 0.9), this difference was not significant (X^2=1.42, df=1, p=0.23). Mean maximum dispersal distance between individuals within subgroups was 6 ± 3.8 BL, indicating that synchronized groups tended to remain close to one another while at sea, presumably socializing. Dispersal distance was not found to differ significantly by time of day or season.

California sea lions were most frequently (60% of 99 groups) observed "traveling" (swimming) in point-to-point movement based on initially observed behavior state, followed by milling (33%), with very little surface-active behavior seen (8%). Overall, mean heading of California sea lion groups was to the SSW (210º ± 25.3) as represented primarily by fall observations; no significant differences were found in headings by survey period or time of day (Figure 12).

Risso's dolphin *Grampus griseus*

Risso's dolphins in the SCB belong to the California/Oregon/Washington stock inhabiting shelf, slope and offshore waters within the SCB, and ranging into more northern slope and offshore waters into Washington (Carretta et al. 2011). Historical, year-round aerial surveys in the region indicate that this stock occurs most commonly off California during the colder water months then appears to generally shift northward primarily into Oregon and Washington waters during the warmer-water periods in late spring and summer (Green et al. 1992; Carretta et al. 2011). However, the abundance and distribution of this species appears vary with changes in seasonal and inter-annual oceanographic conditions (Forney and Barlow 1998).

Based on surveys between 1991 and 2008, Barlow and Forney (2007) and Barlow (2010) report abundance estimates ranging from approximately 4,000 to 11,000 animals in California waters, with no apparent consistent trend in abundance. However, In the SCB, Risso's dolphins appear to have been increasing in abundance over the last few decades (e.g., Leatherwood et al. 1980; Shane 1995; Forney et al. 1995; Carretta et al. 2000; Smultea et al. 2009, 2010, 2011 a,b; Jefferson et al. 2011), before which they were considered relatively rare. Their influx was correlated with the apparent near abandonment of SCB waters by short-finned pilot whales in the early 1980s in association with a severe ENSO and drop in squid abundance (Barlow 1995; Shane 1995). Within the SCB, Risso's dolphins have been consistently associated with shelf-edge habitats and other steep underwater topographical features from the mainland coast to waters west of San Clemete Island (SCI) (Carretta et al. 2000; Carretta et al. 2011; Forney and Barlow 1998; Smultea et al. 2009, 2010, 2011 a,b), usually over water depths of 400-1000 m (Baird 2008).

The social, feeding, and diving behavior of Risso's dolphins are little described. Reported typical group sizes for Risso's dolphins off California range from about 10-50 individuals (Forney and Barlow 1993, Baird 2008). In areas outside the SCB, stable groups of adults have been reported within larger aggregations. Limited data from a school killed in a drive fishery in Japan, it has been hypothesized that mature males travel between groups.

We observed 148 Risso's dolphin groups comprised of an estimated 2473 individuals during SCB aerial surveys from 2008-2010 (Table 2). Consistent with past SCB studies, Risso's dolphins were seen during all survey months from May-November. However, sighting rates (corrected for effort) were much higher in summer (9.96 groups/1000 km) vs. fall (2.33 groups/1000 km) (Figure 14). In contrast, Carretta et al. (2000) reported that Risso's dolphins were more abundant in fall than in summer. Risso's dolphin sighting rates tended to increase across the day: 4.46 groups/1,000 km in the morning, 6.31 groups/1,000 km in the mid-afternoon and 7.26 groups/1,000 km in the late afternoon (Figure 14). This could suggest diurnal inshore-offshore movement of the species such that they may have been farther offshore or out of our SCB study area in the morning periods. Overall, mean group size was 19 ± 3.3 individuals (n = 148) and was significantly lower in summer (16 ± 3.0, n = 118) than in fall (29 ± 10.3, n = 30) (Kruskal: X^2= 6.27, df=1, p=0.012). There was no significant difference in group size by time of day (Kruskal: X^2= 0.53, df=2, p=0.766). Overall, mean maximum dispersal distance between individuals was 6 ± 1.4 BL, n = 23). This dispersal distance decreased significantly across the day, with the largest maximum dispersal in the morning (10 ± 4.8 BL, n = 23) and the shortest maximum inter-individual distance during late afternoon (3 ± 0.77, n = 31) (Kruskal: X^2= 20.148, df=2, p<0.000).

Risso's dolphins were nearly always (80% of 114 groups) observed "traveling" in slow, point-to-point movement based on initially observed behavior state. Surface-active behavior was rarely observed (3% or 4 of 114 groups), unlike for common dolphins (Table 2). Similarly, Shane (1995) reported that 84% of 234 records of Risso's dolphin behavior off Santa Catalina Island consisted of a travel behavioral state (note however, that the latter data includes multiple recordings from the same group(s) followed from a small research vessel using instantaneous samples collected at 5-min intervals; the total number of separate groups was not indicated). Similarly, in Monterey Bay, California, Kruse (1989) reported that traveling was the most common behavioral state recorded for Risso's dolphins. Shane (1995) found that Risso's dolphins were engaged in feeding in only 1% of the 234 samples (diving repeatedly in the same location and surfacing facing in different directions); she hypothesized that feeding was rarely observed among Risso's dolphins because they were believed to feed primarily nocturnally, supported by tagging data from a single Risso's dolphin reported by Mate (1989).

However, the observed predominant slow travel behavior appears to contrast unquantified behavior observed among Risso's dolphins off Monterey Bay approximately 837 km north of the SCB (K. Forney and T. Jefferson, pers. comm., 2011). The latter dolphins are frequently surface-active such as porpoising, leaping, breaching, etc. Another interesting contrast for our recent Risso's dolphins observations compared to studies in the region from the 1980s and from Monterey Bay is that we rarely observed Risso's associated with other marine mammal species. Of our total 148 Risso's dolphin sightings, only 5 were associated with another species, most of which were California sea lions and common dolphins (3% of Risso's mixed species sightings); only 0.6% were with bottlenose dolphins. In contrast, Shane (1994) reported that Risso's commonly associated with bottlenose dolphins near Santa Catalina Island during 1983-1991. In Monterey Bay, Risso's dolphins appear to also associate more frequently with other marine mammals species than we observed in the SCB. Kruse (1989) reported that Risso's dolphins sightings from 1985 to 1987 were associated with another species, primarily northern right whale dolphins but also bottlenose dolphins. Extensive aerial surveys of the SCB conducted by the SWFSC during the 1980s and 1990s also may have had higher rates of mixed species associations for Risso's dolphins, particularly with bottlenose dolphins (Karin Forney, pers. comm., 2011). Interestingly, Risso's dolphins were associated with bottlenose dolphins during 1 of 66 Risso's sightings during approximately 24,854 km of aerial survey effort off the SCB from February-May 2011 (HDR, unpublished data).

Overall, mean heading of Risso's dolphin groups was to the SSW (195º ± 19.5) as represented primarily by summer observations. A slight temporal trend suggested more easterly movement in the morning vs. more westerly in the afternoon, but this difference was not significant (Figure 18). There were also no significant differences found in headings by survey period (Figure 18). Focal follows of this species for periods of up to one hour indicate that SCB Risso's dolphins are observable at or near the surface for extended periods of time engaged predominantly in very slow, synchronized travel in tight formations (SES, unpublished data). These observations suggest that during daylight periods, Risso's dolphins appear to rest/socialize, as suggested previously by Shane (1995) for Risso's dolphins observed near Santa Catalina Island in the 1980s during winter. The predominance of DSL prey species in stomach content analyses along with the diurnal resting behavior indicates that SCB Risso's dolphins are nocturnal feeders. Similar behavioral patterns have been documented for nocturnal-feeding/diurnal-resting Hawaiian spinner dolphins (e.g., Norris et al. 1994).

In summary, Risso's dolphins were most common during late spring/early summer, in contrast to SCB studies in 1998-1999 when they were most common during fall and winter (Carretta et al. 2000). Group size was consistently relatively small (about 20-30 individuals) compared to common dolphins, with largest group sizes during the fall cool-water season and during the morning. Group cohesiveness tended to be consistently tight based on dispersal distance of individuals within subgroups, with closer inter-individual spacing during the afternoon than the morning. Risso's dolphins predominantly traveled slowly and surface-active behavior was rarely observed, in contrast to behavior reported for this species to the north in Monterey Bay. Risso's dolphins were also less frequently associated with other species than reported for Monterey Bay. Differences in the behavior of Risso's dolphins in the SCB vs. farther north may be related to differences in prey abundance, distribution and behavior. Further examination of oceanographic and prey influences may reveal reasons for the observed geographical differences in behavior of Risso's dolphins.

Fin whale *Balaenoptera physalus*

Fin whales in the SCB belong to the California/Oregon/Washington stock within the eastern North Pacific population that ranges from Alaska to Mexico (Carretta et al. 2011). Historical surveys indicate that these whales occur year-round in southern/central California, with peak feeding numbers in summer and fall (Dohl et al. 1981; Forney et al. 1995; Barlow 1997; Carretta et al. 2000). They also feed during summer in Oregon (Green et al. 1992; McDonald 1994), and during summer/autumn in the Shelikof Strait/Gulf of Alaska (Brueggeman et al. 1990). Vocalizing fin whales have been recorded year-round off northern California, Oregon and Washington, principally between September and February (Moore et al. 1998). However, visually observed fin whale numbers appear to decline in winter/spring off California (Dohl et al. 1981; Forney et al. 1995; Smultea et al. 2009, 2010; Jefferson et al. 2011) and Oregon (Green et al. 1992), suggesting that they seasonally move outside these areas (Carretta et al. 2011). There are no reliable estimates on the current and historical abundance of fin whales in the entire northeast Pacific (NOAA 2011). The last estimate of 3,279 fin whales for the California/Oregon/Washington stock was based on ship surveys conducted in summer/autumn of 1996 (Barlow and Taylor 2001) and 2001 (Barlow 2003). Jefferson et al. (2011) recently estimated that 1.22 animals/100 km^2 inhabit the SCB during summer and fall using data from the same eight aerial surveys reported herein from 2008-2010.

Fin whales are typically associated with continental shelf waters (Jefferson et al. 2008). Within the SCB, recent studies indicate that fin whales concentrate primarily in waters west of SCI within the Navy's Southern California Anti-Submarine Warfare Range (SOAR), particularly along steep underwater ridges (Carretta et al. 2000; Smultea et al. 2009, 2010; Jefferson et al. 2011; Schorr et al. 2010). In particular, during June, we have commonly observed fin whales across San Nicolas Basin/SOAR between SCI and Tanner Bank (Smultea et al. 2009). However, they are also commonly found feeding within 10 km of San Diego, oftentimes with blue whales (Smultea et al. 2009, 2010, 2011b). Satellite-tagging of a few fin whales indicates that they travel between California, Oregon and Washington over periods of several days (Schorr et al. 2010). Schorr et al. (2010) suggested that fin whales may move relatively quickly between likely feeding areas, but remain more localized within those feeding areas for periods of time.

During the summer, fin whales lunge feed on krill, small schooling fish (e.g., herring, capelin, and sand lance), and squid but fast during the winter after migrating to warmer waters (NOAA 2011). We have observed and documented (with video) fin whales lunge feeding on swarms of red krill with frequent reddish –colored defecations within the SCB, including apparent inter-specific feeding competition with blue whales (SES and HDR unpublished data, Smultea et al. 2011b).

Specific breeding and calving areas of fin whales are unknown, but whaling data indicate that this activity occurs during mid-winter in more southern tropical and sub-tropical waters (Jefferson et al. 2008; NOAA 2011). Accordingly, the social and mating systems of fin whales are not well described or quantified. Available data indicate that long-term associations between individuals are rare, similar to most other baleen whales (NOAA 2011). Schorr et al. (2010) reported that fin whales off California to Washington are often observed in loose large aggregations; however, data from a small number of tagged individuals indicate that associations are ephemeral in nature. In the SCB, we have observed and documented (with video) socializing and touching among fin whales in what appear to be courting behaviors based on similarity with courting behaviors reported for humpback, gray, and bowhead whales (SES and HDR, unpublished data). We have also observed fin whale calves in the SCB (Smultea et al. 2009).

On the North Atlantic feeding grounds, fin whales typically occur in social groups of 2-7 individuals where they are frequently seen feeding in large groups or aggregations in association with humpback whales, minke whales, and Atlantic white-sided dolphins (Jefferson et al. 2008). In the SCB, we have commonly seen them interspersed with aggregations of blue whales but only rarely with other marine mammal species (SES and HDR unpublished data). One focal follow involved a mother-calf fin whale following and interacting (e.g., rolling, touching) with over 1,000 northern right whale dolphins documented for over 40 min with video in June 2009. The mother-calf pair remained at the tail end of the dolphin group. The dolphins appeared to interact with the fin whale mother and calf by swimming between and around them, while the fin calf often rolled on its mother's back/rostrum, meandering while slowly traveling.

During our 2008-2010 SCB aerial surveys, we observed a total of 51 fin whale groups comprised of an estimated 86 individuals (Table 2). Individuals were seen during all survey months with the highest sighting rate in May-June (Figure 20). The May-June sighting rate was 2-3 times higher than the July-September and October-November sightings rates; this difference was significant (X^2=13.73, df=2, p=0.001). Carretta et al. (2000) also reported seeing the fin whale year-round in our study area in 1998-1999, with highest abundance during warm-water (May-October) vs. cold-water (November-April) seasons. We did not find any significant diurnal differences in sighting rates (X^2=1.30, df=2, p=0.523).

Similar to blue whales, fin whales were nearly always (92% of 51 groups) observed "traveling", followed by milling (4%) and surface-active travel (4%). Like blue whales, this traveling probably involved feeding based on frequent reddish defecations and occasional lunge-feeding seen during the longer focal follow behavioral sessions (SES/HDR unpublished data). Overall, mean heading of fin whale groups was to the SSW (189 º ± 33) as represented primarily (36 of 51 groups) by summer observations. No significant differences were found in headings by survey period or time of day (Figure 24). Fin whales were headed more southwesterly in the mornings (212º ± 71.0) and more southeasterly in the afternoons (173º ± 43.9) though this trend was not significant (Kruskal:X^2=0.009, df=1, p=0.922). There were also no significant trends in heading by season (Kruskal: X2=0.550, df=1, p=0.458). Rather, headings were variable. Surprisingly few individuals headed south or north during the expected fall migration period (Figure 24).

Overall, mean group size of fin whales was 2 ± 0.2 individuals (n=51). This mean was nearly three times higher than that reported by Carretta et al. (2000) for fin whales in 1998-99 in the same region and season (warm-water season)(mean 1.3, n = 15). We observed smaller fin whale group sizes during late afternoon (mean 1 ± 0.3) than earlier in the day (2 ± 0.3), though this difference was not significant (Kruskal: X^2=5.308, df=2, p=0.070). No significant difference was found for group size in fall (mean 2 ± 0.6) vs. summer (mean 2 ± 0.2) (Kruskal: X^2=2.236, df=1, p=0.135). Carretta et al. (2000) reported a smaller mean group size of 1.0 fin whales (n=6) during the cool-water season; we did not survey the cool-water season. Tershy (1992) reported a median group size of 2.0 among traveling fin whales (n=197 sightings) in the central Gulf of California during year-round observations.

Mean maximum dispersal between individual fin whales within a group was 8 ± 4.6 BL, considerably less than the distance between blue whales in synchronized groups (16 ± 8.7 BL) (Table 2). Dispersal distance ranged from ~0.5 to 50 BL among fin whale groups, although socializing involving individuals touching was never observed during the May-November study period. Fin whales were occasionally (n = 2 events) seen in loose feeding aggregations with blue whales. In one focal behavioral session, video was taken of two fin whales suddenly increasing speed and turning sharply in front of several blue whales with one of the fin whales then gulping a reddish prey concentration of presumed krill.

Blue whale *Balaenoptera musculus*

Blues whales in the SCB belong to the Eastern North Pacific stock ranging from Alaska to the Costa Rica Dome. Southern and central California coastal waters are important feeding areas for this population in the summer and fall where their numbers appear to have increased from 1979-1996 (Carretta et al. 2011). Since 1996, blue whale numbers have fluctuated and declined off California, attributed to changes in the portion of the population feeding there in summer and fall (Calambokidis et al. 2009). In winter and spring, these whales migrate to biologically productive waters off Baja California, the Gulf of California, and the Costa Rica Dome, where at least small numbers are seen year-round (Reilly and Thayer 1990, Carretta et al. 2011). The population is believed to feed throughout the year. Breeding and calving areas are unknown but whaling data indicate this activity occurs during winter in more southern tropical and sub-tropical waters (Jefferson et al. 2008).

A total of 49 blue whale sightings of 84 individuals occurred (Table 2). Consistent with past DCB studies, blue whale sighting rates were highest in summer/fall. Individuals were seen during all survey months from May-November. However, sighting rates were significantly higher in summer (n=48 groups) vs. fall (1 group) (X^2=11.52, df = 3, p=0.001); (Figure 26). Overall, mean group size was 2 ± 0.4 individuals and was smaller in May-June (1.X whale per sighting) vs. July-December (2.X whales per sighting), although the difference was not significant (Kruskal: X2=0.859, df=1, p=0.354). Blue whale sighting rates were significantly lower in the morning than during the afternoon (X^2=9.94, p=0.007) (Figure 26).

Blue whales were nearly always (85% of 49 groups) observed "traveling" in point-to-point movement based on initially observed behavior (necessarily limited to a period within a surfacing bout), followed by milling (11%) and surface-active travel (4%) (Table 2). Overall, mean heading of blue whale groups was to the SSW (203º ± 35) as represented primarily by summer observations; no significant differences were found in headings by survey period or time of day (Figure 28). Travel also involved feeding on some occasions based on data from extended focal follows (SES/HDR unpublished data). Similar to fin whales, heading among blue whales was nearly always consistent and synchronized between individuals within a surfacing bout, but often changed between dives; the latter behavior combined with occasionally observed lunge feeding, reddish-colored defecation and swarms (presumed to be krill) indicate that blue whales are feeding in concentrated areas (SES/HDR unpublished data). Mean maximum dispersal between individuals was 16 ± 8.7 BL. We are not aware of other publications that systematically reported dispersal distances within groups of blue whales or any other baleen whales except mother-calf southern right whales (e.g., Tabor and Thomas 1982).

Common Bottlenose Dolphin *Tursiops truncatus*

Bottlenose dolphin distribution off California extends from at least Ensenada, Baja California, Mexico to as far north as 41 degrees N off California, ranging into Oregon and Washington waters during warm-water periods (Carretta et al. 2011). The bottlenose dolphin is a year-round resident to SCB waters. Three ecotypes are considered to occur in the SCB: coastal, island-associated, and oceanic (K. Forney, NMFS-SWFSC pers. comm. in DoN 2008).

Detailed long-term studies on bottlenose dolphins in the SCB have focused primarily on coastal communities along the San Diego coastline (within 1 km of coastline; Defran and Weller 1999). Pacific Coast bottlenose dolphins travel rapidly and extensively along the coastline in search of optimal feeding opportunities (e.g., Defran et al. 1999; Hwang 2011). Oceanographic events influence distribution; for example, there has been a change in residency patterns along Southern California and a northward range extension into central California after the 1982-83 El Niño (Hanson and Defran 1993; Wells et al. 1990). Since the 1982-83 El Niño, which increased water temperatures off California, bottlenose dolphins are sighted regularly in central California, as far north as San Francisco. Hwang (2011) suggested that irregular upwelling patterns off California might explain the apparent lack of a pattern in dolphin movements. In some parts of the SCB, such as Santa Monica Bay, the species occasionally aggregates offshore near areas of bottom relief, such as submarine canyons and escarpments (Bearzi 2005).

Bottlenose dolphins occur year-round offshore around the islands of San Clemente, Santa Catalina, and San Nicolas (Bonnell and Dailey 1993; Shane 1994; Carretta et al. 2000). The relatively large population of bottlenose dolphins occurring offshore, as noted by Bonnell and Dailey (1993), appears to center around Santa Catalina Island during most of the year. Most bottlenose dolphins were sighted during the winter months in the area. During the summer; the island-associated population is widely distributed through the Channel Islands (Bonnell and Dailey 1993). NMFS-conducted marine mammal aerial surveys off San Clemente Island during 1998-1999 determined that bottlenose dolphins were seen year-round, but were also the least abundant of marine mammal species seen in the area (Carretta et al. 2000). The species is ubiquitous in the SCB, found in waters close to shore and further offshore, across a wide range of bottom depths (e.g., Shane 1994). Stomach content analyses indicate that a large percentage of SCB bottlenose dolphin prey includes surf perches (*Embiotocidae*) or croakers (*Scianidae*) (e.g., Hanson and Defran 1993; Bearzi 2005).

Past studies reported that bottlenose dolphins in waters off California often associate with Risso's dolphins, short-finned pilot whales, both common dolphin species, California sea lions, and gray whales (Norris and Prescott 1961; Shane 1994; Bearzi 2005). However, only one of the 25 bottlenose dolphin sightings reported herein were associated with other species.

A total of 25 bottlenose dolphin sightings of 553 individuals occurred (Table 2). Consistent with past SCB studies, individuals were seen during all survey months from May-November. Sighting rates were slightly higher in summer vs. fall (1.27 and 0.78 groups/1,000 km), respectively), but this difference was not significant (Figure 32). Overall, mean group size was 22 ± 7.6 individuals and was slightly higher in summer (24 ± 8.3) vs. fall (19 ± 14.7) although the difference was not significant. Mean maximum dispersal between individuals within a subgroup was 5 ± 2.8, with no significant diurnal or season trends noted based on the limited sample size.

Bottlenose dolphins were mostly observed "traveling" (54% and group n = 13) in point-to-point movement based on initially observed behavior, followed by surface-active travel (21%). Overall, mean heading of bottlenose dolphin groups was to the SSW (198º ± 19.5) as represented primarily by summer observations (Figure 36), with no significant diurnal or season trends based on the limited sample size.

Pacific white-sided dolphin *Lagenorhynchus obliquidens*

The Pacific white-sided dolphin is found only in temperate waters (Leatherwood et al. 1984). Surveys suggest a seasonal north-south distributional shift of the species in the eastern North Pacific as water temperatures change. There is a year-round occurrence of the white-sided dolphin in California waters (Bonnell and Dailey 1993). This species occurs primarily off California during the cool-water months, shifting northward into Oregon and Washington as water temperatures increase during late spring and summer (Barlow 1995; Forney et al. 1995). Soldevilla et al. (2010) documented a fall–winter peak in seasonal occurrence in the SCB based on acoustic detections. Dohl et al. (1981) also noted a winter-spring shift in the population from offshore to inshore waters in the SCB. The Pacific white-sided dolphin is most common in waters over the continental shelf and slope.

Bonnell and Dailey (1993) reviewed white-sided dolphin occurrence based on aerial surveys conducted by Dohl et al. (1981) in the late 1970s in the SCB. Peak numbers, exceeding 10,000 animals, occurred from about September through November. During these months, abundance increases first in northern waters of the SCB, especially in the western Santa Barbara Channel, over the San Miguel Island shelf, and along the Santa Rosa-San Nicolas Ridge. By October and November, these dolphins are fairly widespread in the area at slightly lower densities. By November, sightings in central and eastern waters of the SCB begin to increase, indicating a general dispersal southward. By winter, numbers sharply decline in California waters. During January in the SCB, sightings were recorded only in offshore waters over the Santa Rosa Cortes Ridge, suggesting that the reduction in numbers in the area results from an offshore shift in the species distribution. In the spring, distribution in the SCB shifts to inshore waters, where Pacific white-sided dolphin sightings are typically clustered within 30 km of shore. A few sightings were recorded close inshore through June and July.

Two forms of the white-sided dolphin – northern and southern – occur along the U.S. West Coast; both forms occur in the SCB (Carretta et al. 2011). The NMFS has noted that it is not currently possible to distinguish animals without genetic or morphometric analyses (Carretta et al. 2011). Two types of white-sided dolphins in the SCB are distinguished by vocalizations (see Soldevilla et al. 2011). Predictive models (using acoustic data from both types) for the white-sided dolphins in the SCB suggest that habitat features important to the species include both the importance of ecological succession between abiotic variables and dolphin occurrence, as well as an association with prey-aggregating features, such as fronts and eddies (Soldevilla et al. 2011).

Pacific white-sided dolphins in the eastern North Pacific feed primarily on epipelagic fishes and cephalopods (e.g., Schwartz et al. 1992; Heise 1997).

A total of 20 Pacific white-sided dolphin sightings of approximately 602 individuals occurred (Table 2). Given this relatively small sample size, interpretation of results is limited and potential diurnal and seasonal patterns cannot be assessed. However, as little is known about the behavioral ecology and social behavior of this species, results discussed herein contribute to a rare data base for the species. Consistent with past SCB studies, individuals were seen during all survey months from May-November, with sighting rates notably higher in fall vs. summer (0.25 vs. 1.32 groups/1,000 km, respectively (Figure 38). Overall, mean group size was 30 ± 20.6 individuals. Mean maximum dispersal between individuals within a subgroup was 10 ± 5.3 BL.

Pacific white-sided dolphins were primarily observed traveling (54% of 13 groups) based on initially observed behavior, followed by milling (26%), and surface-active travel or milling (27%). Overall, mean heading of Pacific white-sided dolphin groups was southerly (175º ± 63.5), with considerable variation (Figure 42).

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TABLES

Table 1. Summary of Aerial Surveys conducted during 2008 – 2010 in the SOCAL Complex Range.

	Survey								
	October	**November**	**June**	**July**	**November**	**May**	**July**	**September**	**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	23-28 Sept 2010	**8 surveys: May, June, July, Sept, Oct, Nov**
No. Days Flown	5	4	6	9	6	6	7	6	**49**
Major Training Exercise (MTE) Before, During or After Survey?	Before/During	After	After	After	During/After	During	During/After	During/After	**During, before or after**
Total Flight Hr (Wheels up/down)	28	21	30	34	28	29	18	19	**207**
Total Observation Effort (km) *(excl. poor weather, over land)*	4563 km	3838 km	6140 km	6500 km	4823 km	4891 km	3125 km	3918 km	**37,798**
	(2464 nm)	(2072 nm)	(3315 nm)	(3510 nm)	(2604 nm)	(2641 nm)	(1688 nm)	(2116 nm)	**20,410**
No. Navy-directed Survey Changes (appox)	9	7	12	10	3	1	0	0	**42**
No. Coastline Surveys for Strandings (San Clemente Isld)	0	2	1	0	1	1	0	0	**5**
No. Groups Seen	115	185	161	240	93	152	86	252	**1,284**
Estim. No. Individuals	12,587	5732	9489	22,719	12,826	5,453	11,090	37,874	**117,770**

	Survey								
	October	**November**	**June**	**July**	**November**	**May**	**July**	**September**	**Total**
Mean Group Size	109.4	31	58.9	94.7	137.9	35.9	131.3	150.3	**85.6**
No. Dead Sightings	0	3 *(2 CA sea lions, 1 blue whale)*	0	2 *(2 prob. CA sea lions)*	0	0	0	0	**5**
No. Species	9	9	11	10	10	9	5	9	**16***
No. Focal Groups Circled 5-9 min	22	20	24	37	14	10	6	6	**139**
No. Extended Focal Groups Circled >10 min	5	7	7	8	10	20	13	10	**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*)	45 min (*Bryde's Whale*)	**144 min. total of longest focal**
No. Photos Taken	1050	1280	1099	2301	2203	1350	2900	741	**12,183**
Estimated Usable Video (min)	53	41	83	50	90	334	373	142.41	**1024**

*Note: Sixteen species were seen during the eight surveys. Not all species were seen during each survey.

Table 2. Overall Group Characteristics of Marine Mammals from 2008-2010 in the SOCAL Complex Range

Species	Scientific Name	No. of Groups	No. of Individuals	Mean of Greatest Group Size	Sighting Rate Indiv/1000 km	Mean Group Heading	Initial Group Behavior States	Mean of Greatest Group Dispersal
Common dolphin sp.	*Delphinus* sp.	307	79,254	258 ± 39.7	12	188º ± 15.8	37% SA Mill, 34% Travel, 21% SA travel, 8% Mill	5 ± 0.7
California sea lion	*Zalophus californianus*	298	857	6 ± 5.9	12	210º ± 25.3	60% Travel, 33% Mill, 4% SA mill, 4% SA travel	6 ± 3.8
Risso's dolphin	*Grampus griseus*	148	2743	37 ± 37.5	6	195º ± 19.5	80% Travel, 17% Mill, 2% SA Mill, 1% SA travel	6 ± 1.4
Fin whale	*Balaenoptera physalus*	51	86	3 ± 3.3	2.1	189º ± 33	92% Travel, 4% Mill, 4% SA travel	8 ± 4.6
Blue whale	*Balaenoptera musculus*	49	84	2 ± 0.4	2	203º ± 35	85% Travel, 11% Mill, 4% SA travel	16 ± 8.7
Bottlenose dolphin	*Tursiops truncatus*	25	553	22 ± 7.6	1	198º ± 52.1	54% Travel, 21% SA travel, 13% Mill, 13% SA mill	5 ± 2.8
Pacific white-sided dolphin	*Lagenorhynchus obliquidens*	20	602	30 ± 20.6	0.8	175º ± 63.4	47% Travel, 26% Mill, 16% SA travel, 11% SA Mill	10 ± 5.3
Humpback whale	*Megaptera novaeangliae*	5	9	2 ± 0.8	0.2	198º ± 52.1	100 % Travel	1 ± 0
Northern elephant seal	*Mirounga angustirostris*	5	24	8 ± 7.2	0.2	130 ± 184.1	75% Travel, 25% Mill	2 ± 1
Minke whale	*Balaenoptera acutorostrata*	4	6	2 ± 1.0	0.2	31º ± 60.3	75% Travel, 25% SA travel	10 ± 0

Species	Scientific Name	No. of Groups	No. of Individuals	Mean of Greatest Group Size	Sighting Rate Indiv/1000 km	Mean Group Heading	Initial Group Behavior States	Mean of Greatest Group Dispersal
Cuvier's beaked whale	*Ziphius cavirostris*	4	12	3 ± 1.9	0.2	145º ± 132.9	100 % Travel	2 ± 0.7
Northern right whale dolphin	*Lissodelphis borealis*	3	1,200	400 ± 312.4	0.1	223º ± 136.9	100% SA Travel	8 ± 4.1
Bryde's whale	*Balaenoptera edeni/brydei*	2	2	1 ± 0	0.1	145º ± 112.9	100 % Travel	0
Killer whale	*Orcinus orca*	2	67	34 ± 44	0.1	235º ± 194.3	100 % Travel	22 ± 36.9
Sei/Bryde's whale	*Balaenoptera borealis/edeni/brydei*	1	3	3 ± 0	0.04	120º ± 0	100 % Travel	8 ± 0
	Total:	**924**	**85,502**					

Table 3. Sighings of marine mammals from 2008-2010 in the SOCAL Complex Range in desecening order. Note: Sightings did not occur during January-March.

Species	Total Sightings	No. Summer Sightings	Summer Sighting Rate (Indiv/1000 km)	No. Fall Sightings	Fall Sighting Rate (Indiv/1000 km)	No. Apr-June Sightings	Apr-June Sighting Rate (Indiv/1000 km)	No. July-Sept Sightings	July-Sept Sighting Rate Indiv/1000 km	No. Oct-Dec Sightings	Oct-Dec Sighting Rate Indiv/1000 km
Common dolphin sp.	307	131	7	176	32	35	6	220	27	52	6
California sea lion	298	108	6	190	35	85	14	95	12	118	13
Risso's dolphin	148	118	6.1	30	1.1	75	12	49	6	24	2.7
Fin whale	51	36	1.8	17	2.9	25	4	10	1.2	16	1.8
Blue whale	49	48	2.5	1	0.2	12	1.9	36	4.4	1	0.1
Bottlenose dolphin	25	15	0.8	10	1.8	12	1.9	7	0.9	6	0.7
Pacific white-sided dolphin	20	3	0.2	17	3.1	2	0.3	1	0.1	17	1.9
Humpback whale	5	2	0.1	3	0.6	2	0.3	0	0	3	0.3
Northern elephant seal	5	1	0.1	6	0.7	1	0.2	3	0.4	1	0.1
Minke whale	4	2	0.1	2	0.4	1	0.2	2	0.2	1	0.1
Cuvier's beaked whale	4	1	0.1	3	0.6	0	0	2	0.2	2	0.2
Northern right whale dolphin	3	3	0	0	0	3	0.5	0	0	0	0
Bryde's whale	2	0	0	2	0.4	0	0	1	0	1	0.1
Killer whale	2	0	0	2	0.4	0	0	0	0	2	0.2
Sei/Bryde's whale	1	0	0	1	0.2	0	0	1	0.1	0	0
Total	**924**	**468**		**460**		**253**		**427**		**244**	

Table 4. Marine Mammal Sightings from 2008-2010 during each period of the day.

Species	Overall Number of Sightings	Sightings during the morning (6-12)	Morning Sighting Rate Indiv/1000 km	Sightings during the early afternoon (12-16)	Early Afternoon Sighting Rate Indiv/1000 km	Sightings during the late afternoon (16-20)	Late Afternoon Sighting Rate Indiv/1000 km
Common dolphin sp.	307	60	9	168	13	79	16
California sea lion	298	92	13	173	13	33	7
Risso's dolphin	148	31	4.5	81	6.3	36	7.3
Fin whale	51	15	2.2	29	2.3	7	1.4
Blue whale	49	4	0.6	31	2.4	14	2.8
Bottlenose dolphin	25	6	0.9	16	1.3	3	0.6
Pacific white-sided dolphin	20	3	0.4	16	1.3	1	0.2
Humpback whale	5	0	0	5	0.4	0	0
Northern elephant seal	5	1	0.1	3	0.2	1	0.2
Minke whale	4	2	0.3	2	0.2	0	0
Cuvier's beaked whale	4	2	0.3	2	0.2	0	0
Northern right whale dolphin	3	0	0	2	0.2	1	0.2
Bryde's whale	2	0	0	2	0.2	0	0
Killer whale	2	1	0.1	1	0.1	0	0
Sei/Bryde's whale	1	1	0.1	0	0	0	0
Total	**924**	**218**		**531**		**175**	

FIGURES

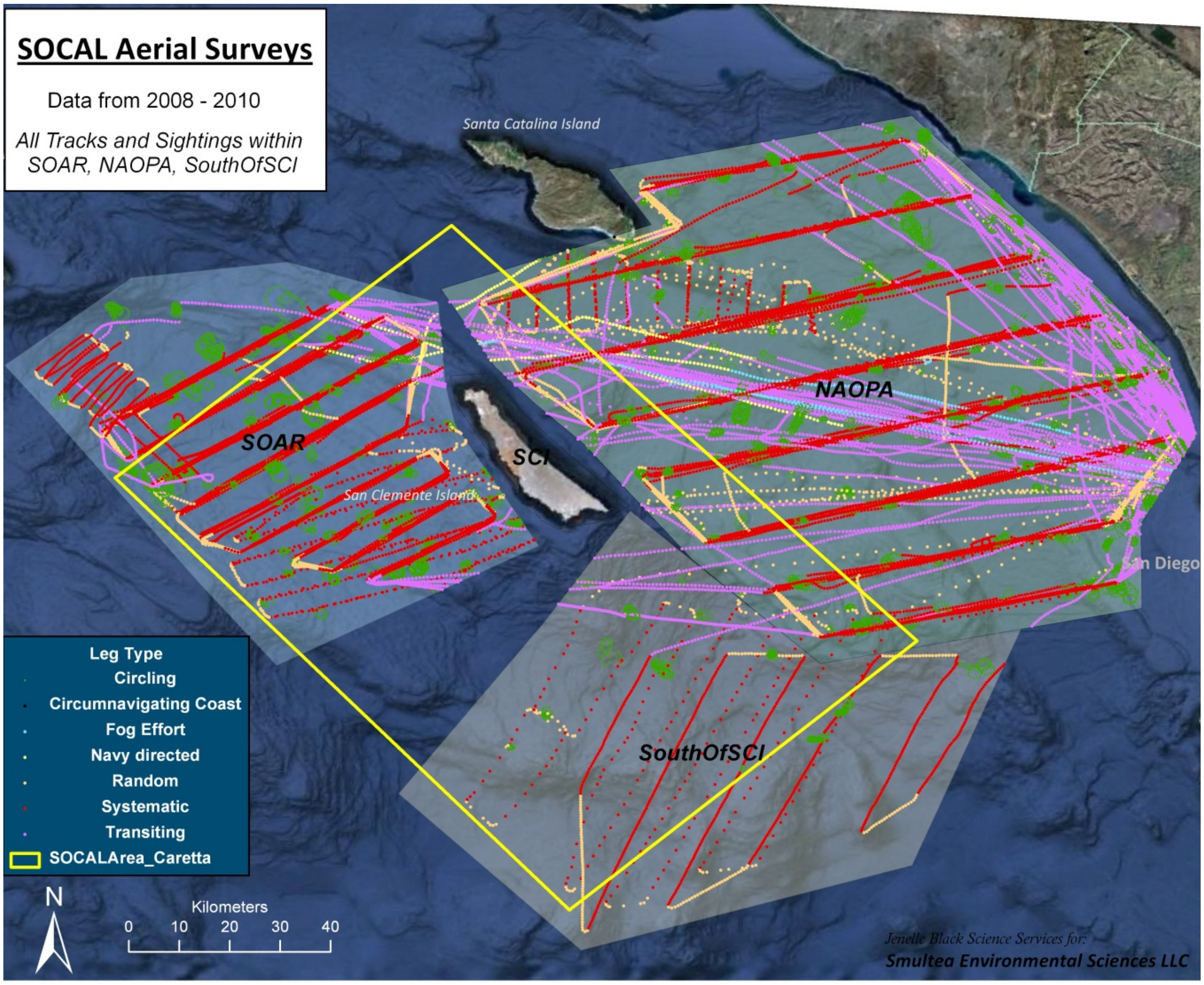

Figure 1. Survey tracks of all effort during 2008-2010 aerial surveys conducted during 2008-2010 in the SOCAL Complex Range.

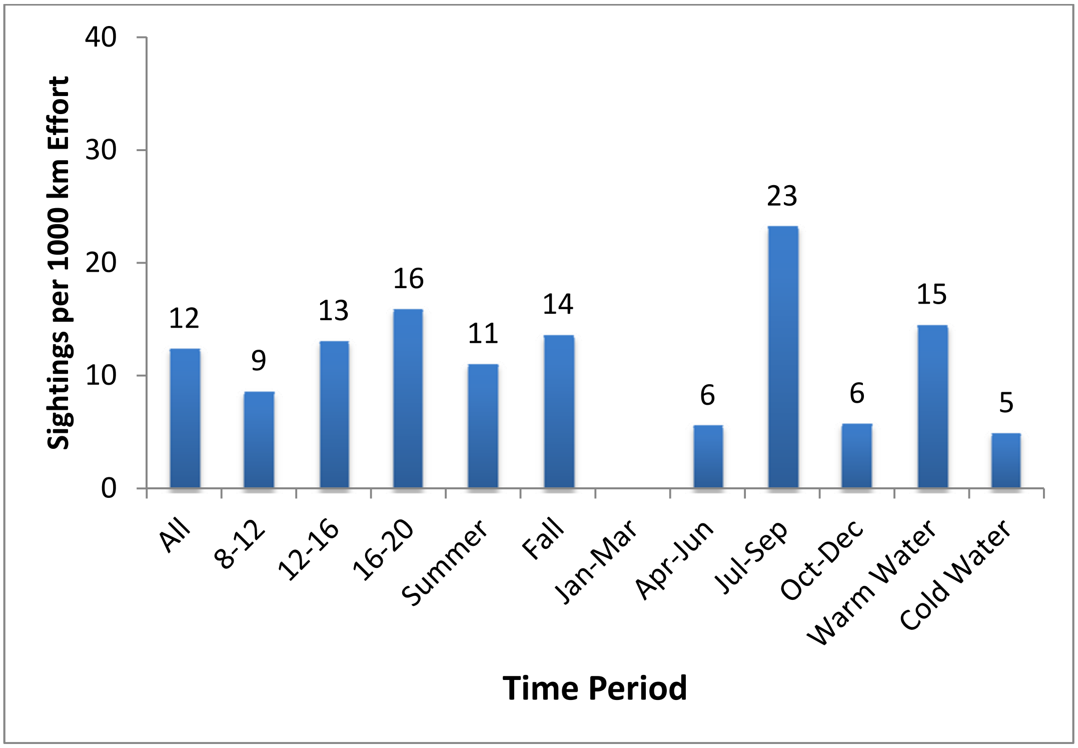

Figure 2. Common Dolphin Delphinus species sightings per 1,000 km of effort based on time of day, season, quarter, and water temperature.

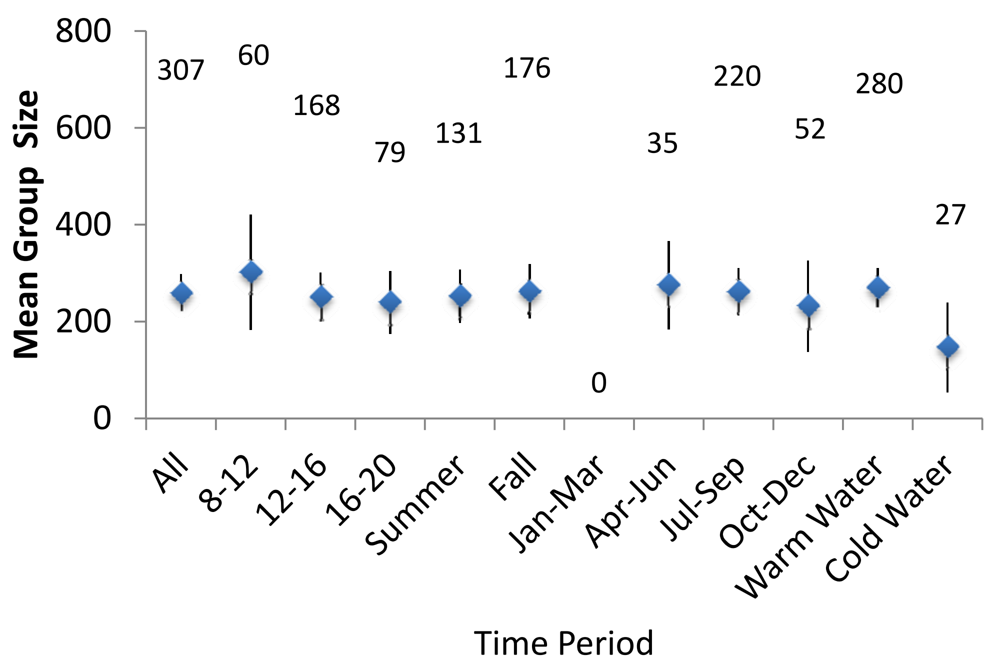

Figure 3. Common Dolphin Delphinus species mean group size by time of day, season, quarter, and by water temperature. Numbers refer to the total sightings for which data was collected.

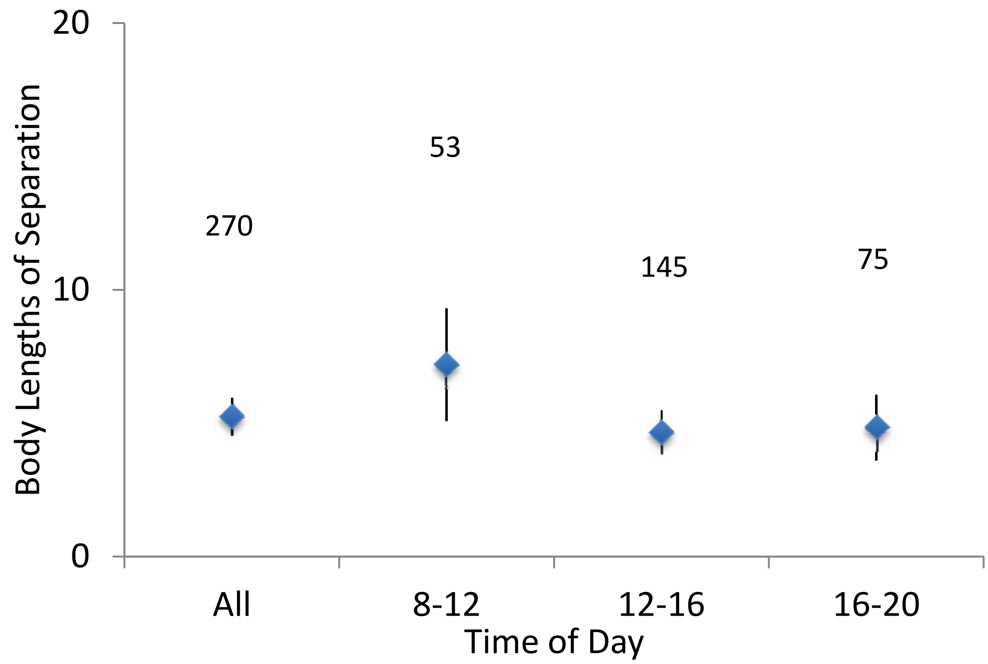

Figure 4. Common Dolphin Delphinus species mean of all maximum dispersions recorded for a sighting by time of day. Numbers refer to the total sightings for which data was collected.

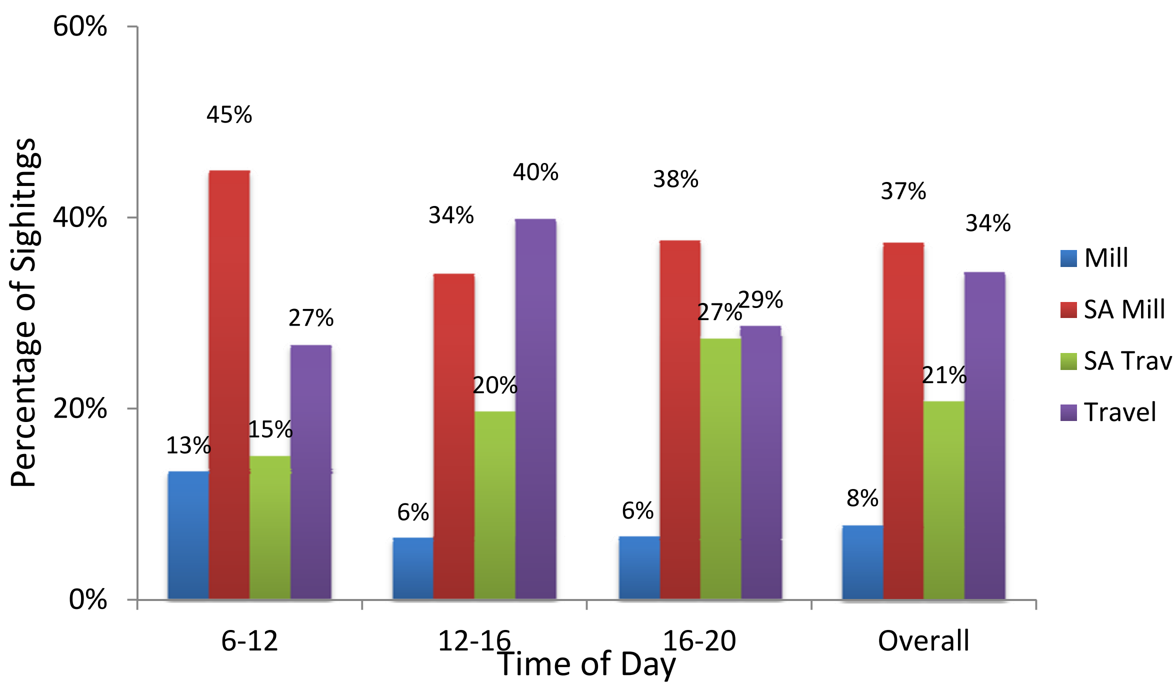

Figure 5. Common Dolphin Delphinus species initial behavior observed by time of day.

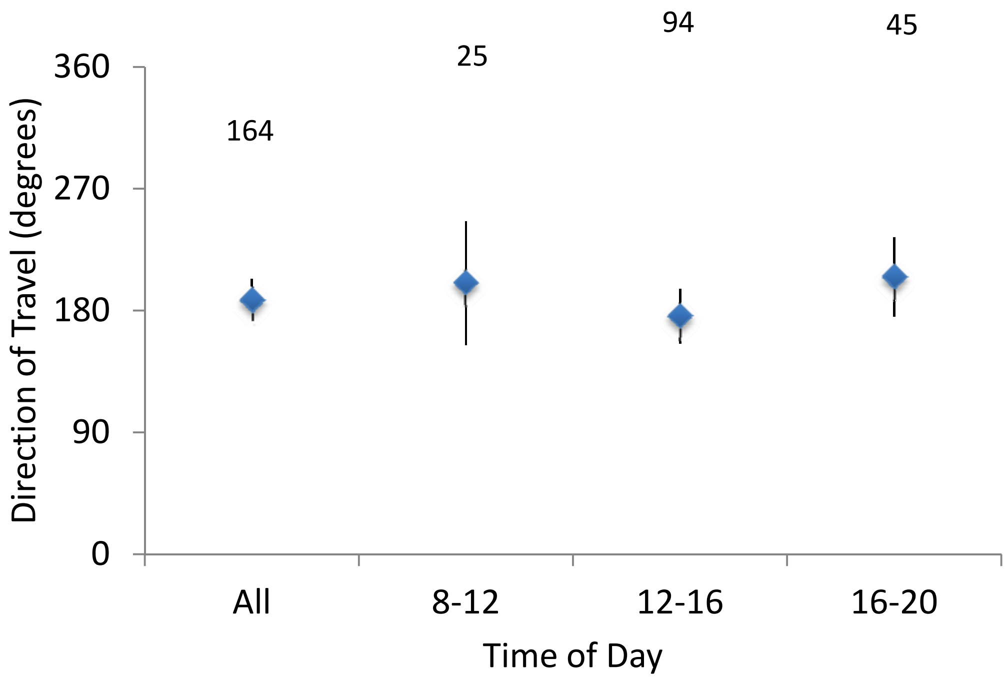

Figure 6. Common Dolphin Delphinus species mean group heading by time of day. Numbers refer to the total sightings for which data was collected.

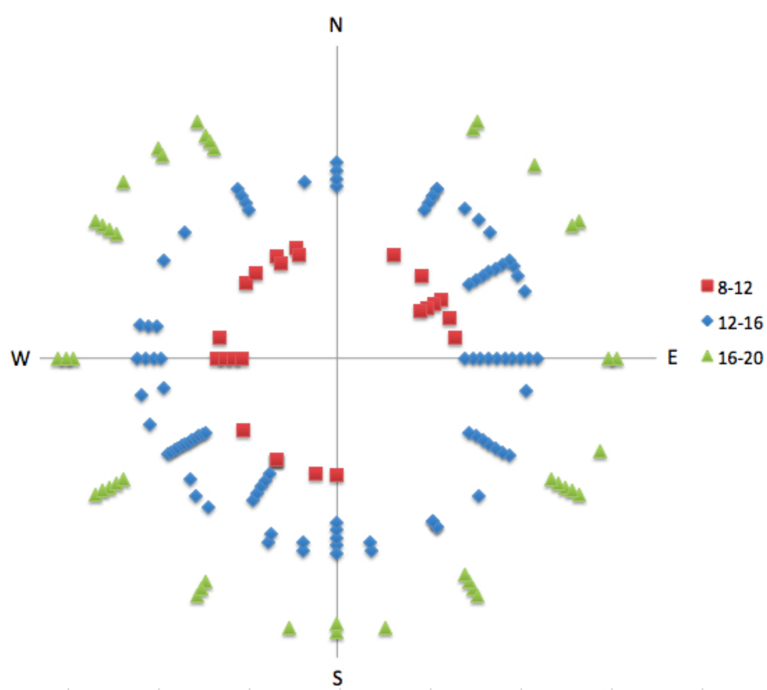

Figure 7. Common Dolphin Delphinus species mean group heading (degrees magnetic) by time of day.

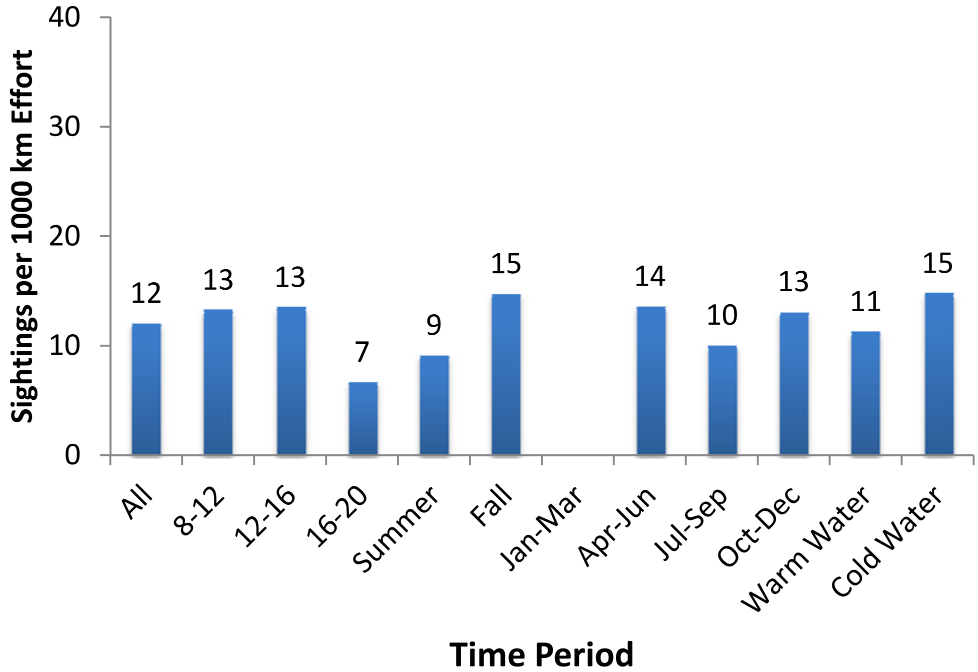

Figure 8. California Sea Lion Zalophus californianus sightings per 1,000 km of effort based on time of day, season, quarter, and water temperature.

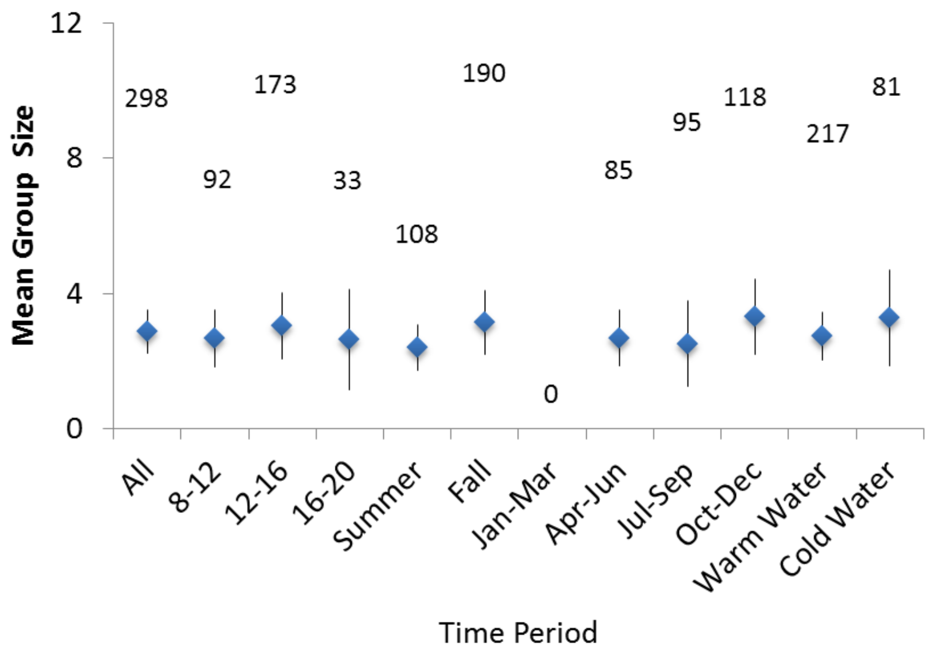

Figure 9. California Sea Lion Zalophus californianus mean group size by time of day, season, quarter, and by water temperature. Numbers refer to the total sightings for which data was collected.

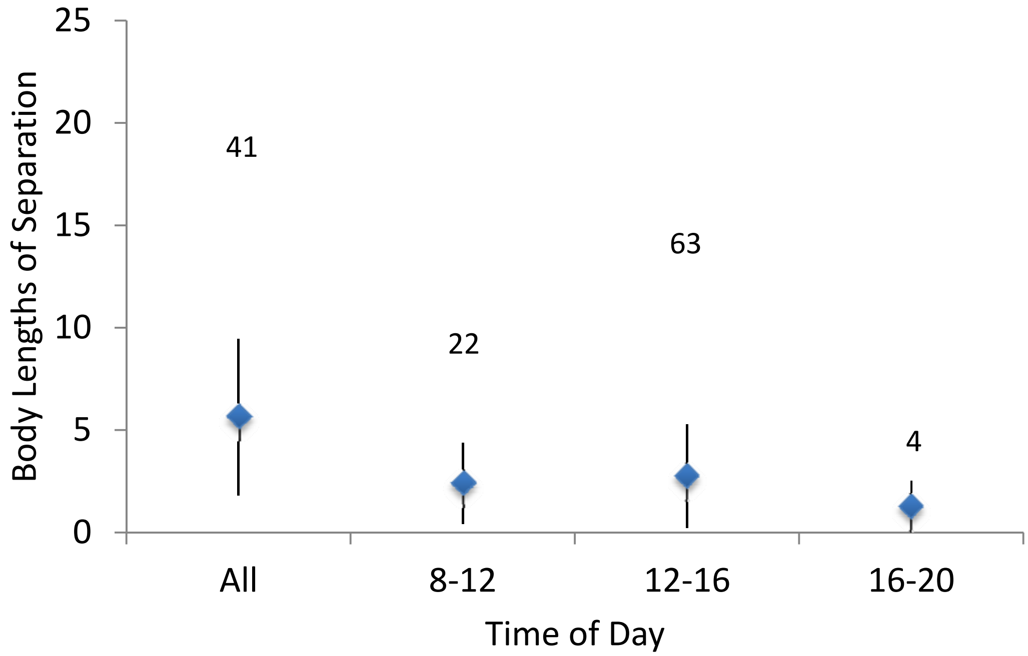

Figure 10. California Sea Lion Zalophus californianus mean of all maximum dispersions recorded for a sighting by time of day. Numbers refer to the total sightings for which data was collected.

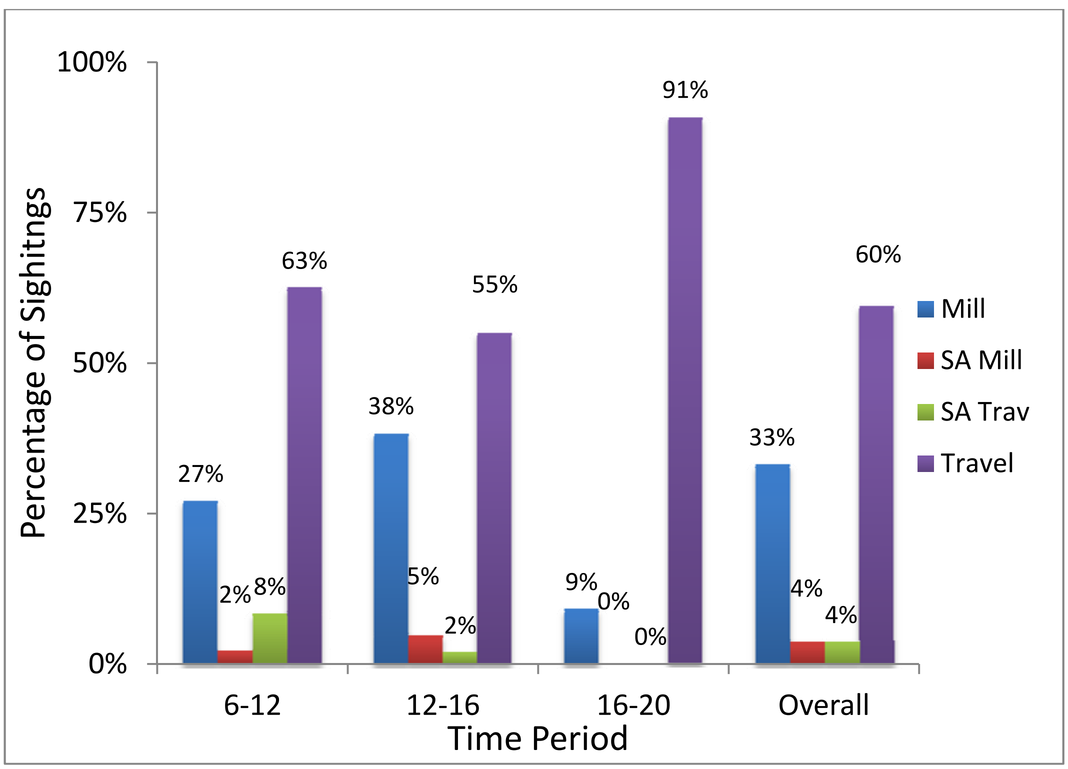

Figure 11. California Sea Lion Zalophus californianus initial behavior observed by time of day. Note: SA=surface active.

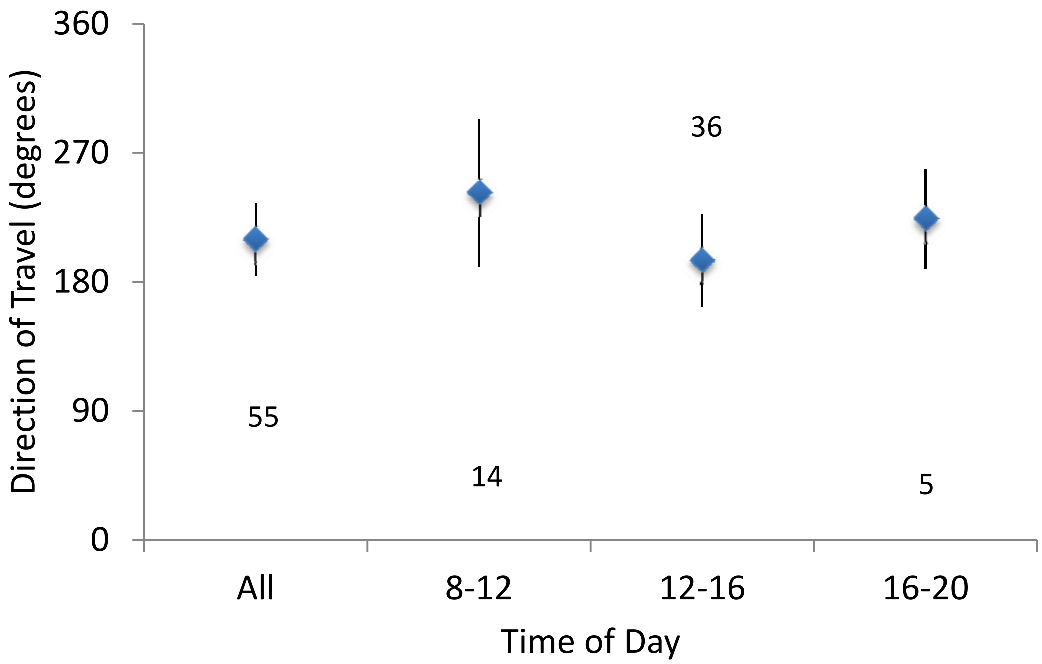

Figure 12. California Sea Lion Zalophus californianus mean group heading by time of day. Numbers refer to the total sightings for which data was collected.

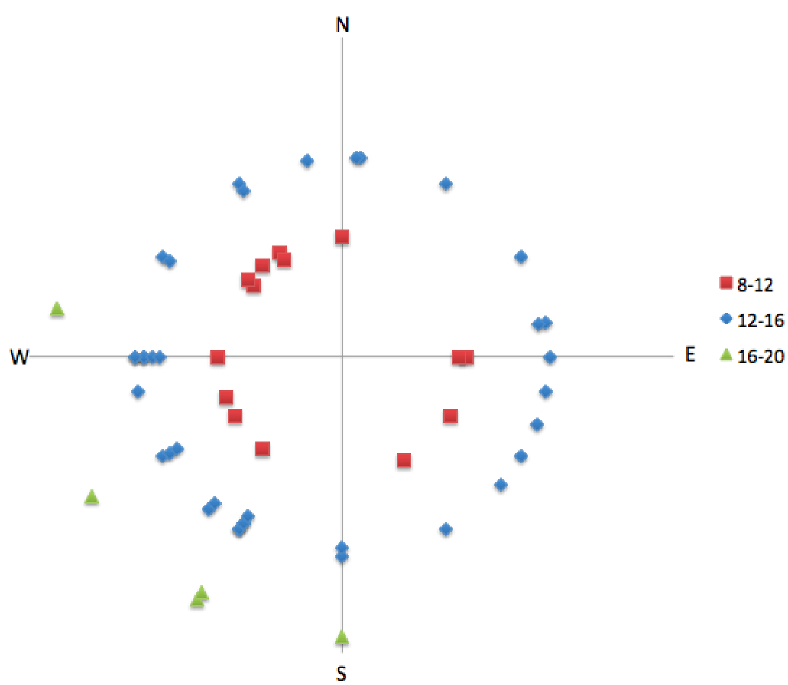

Figure 13. California Sea Lion Zalophus californianus mean group heading (degrees magnetic) by time of day.

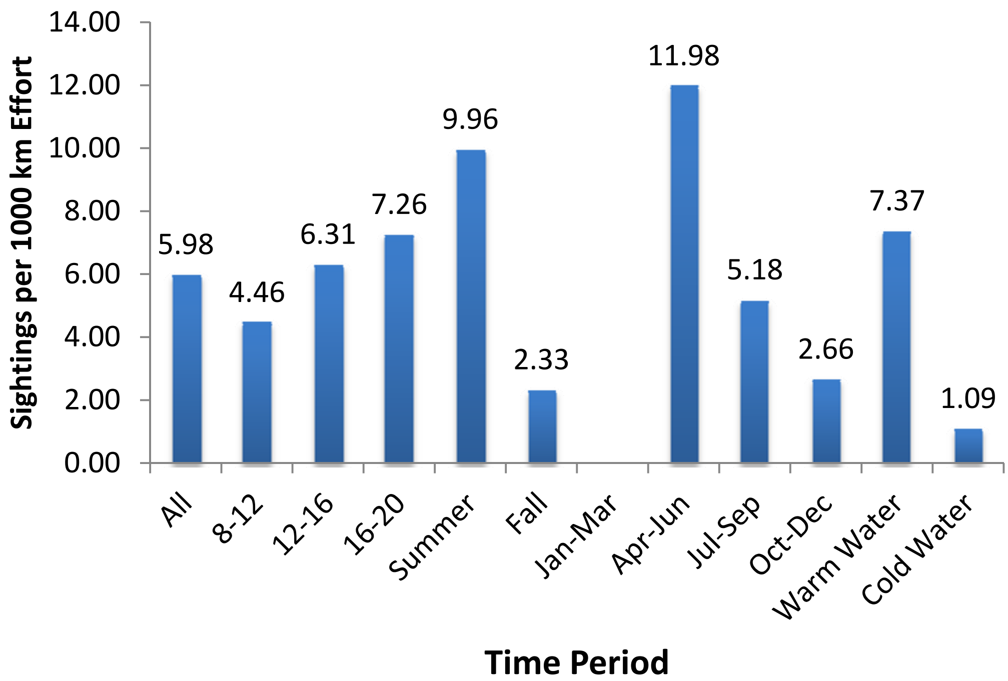

Figure 14. Risso's Dolphin Grampus griseus sightings per 1,000 km of effort based on time of day, season, quarter, and water temperature.

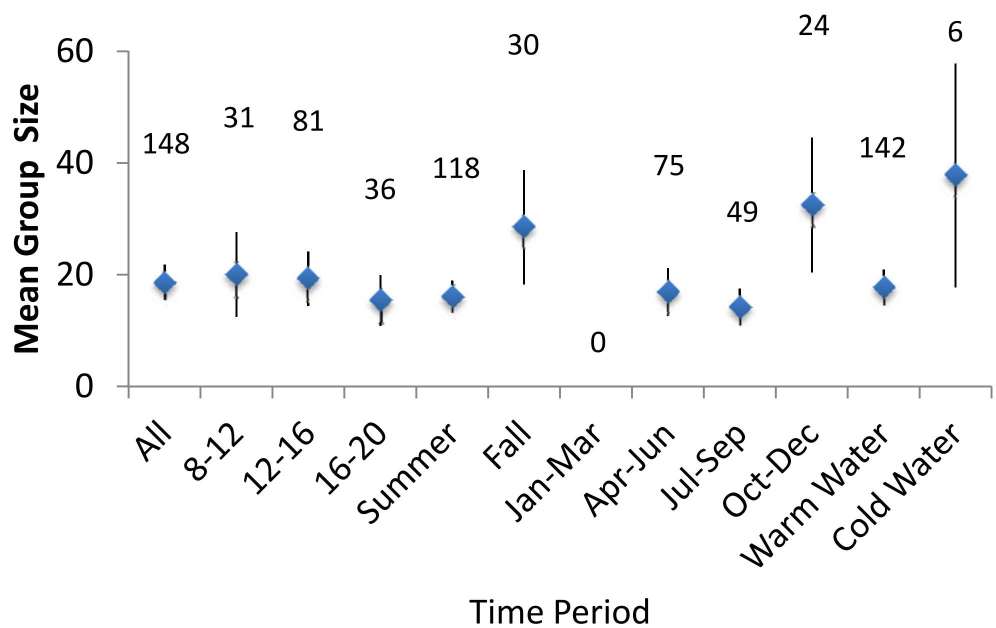

Figure 15. Risso's Dolphin Grampus griseus mean group size by time of day, season, quarter, and by water temperature. Numbers refer to the total sightings for which data was collected.

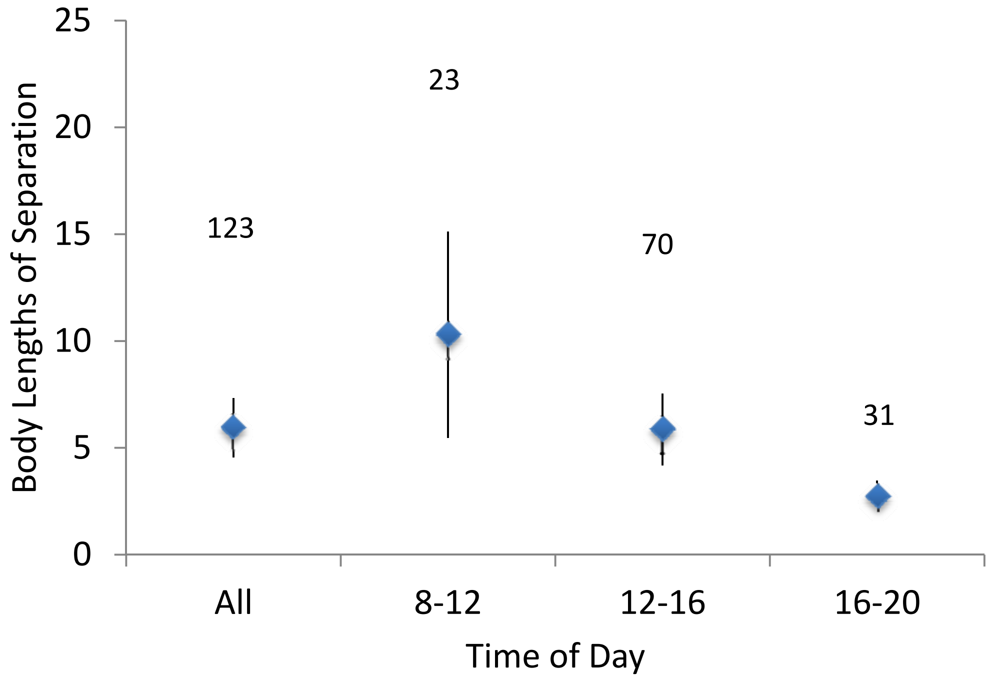

Figure 16. Risso's Dolphin Grampus griseus mean of all maximum dispersions recorded for a sighting by time of day. Numbers refer to the total sightings for which data was collected.

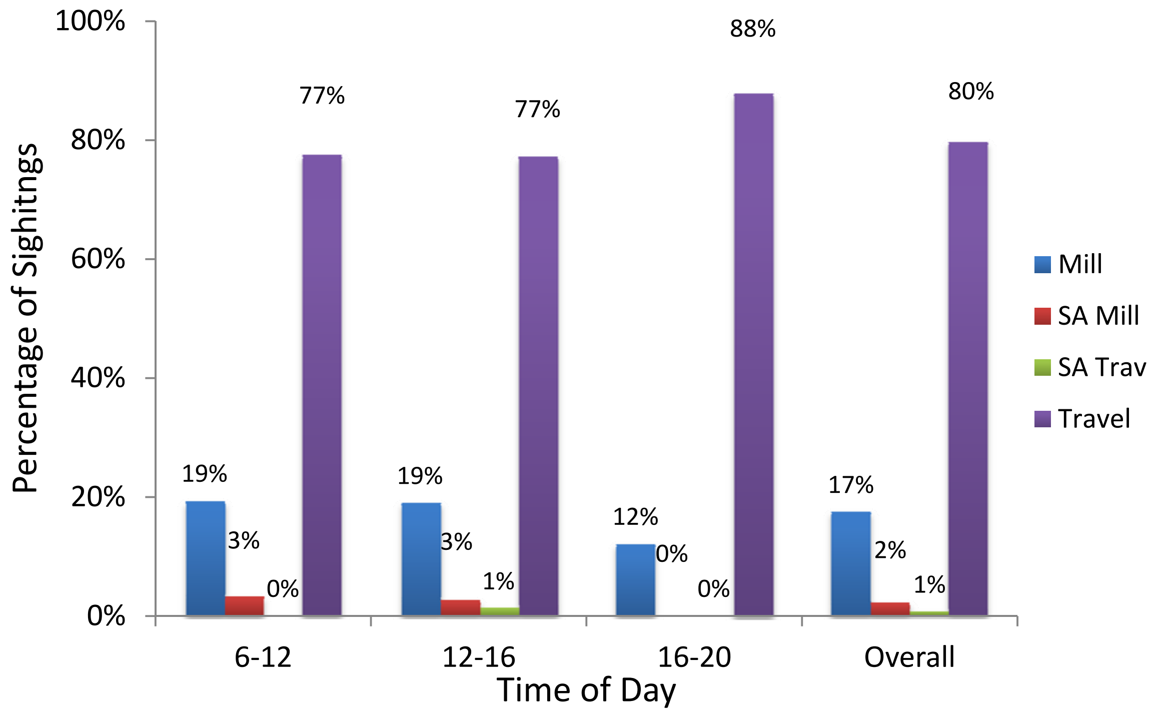

Figure 17. Risso's Dolphin Grampus griseus initial behavior observed by time of day. Note: SA=surface active.

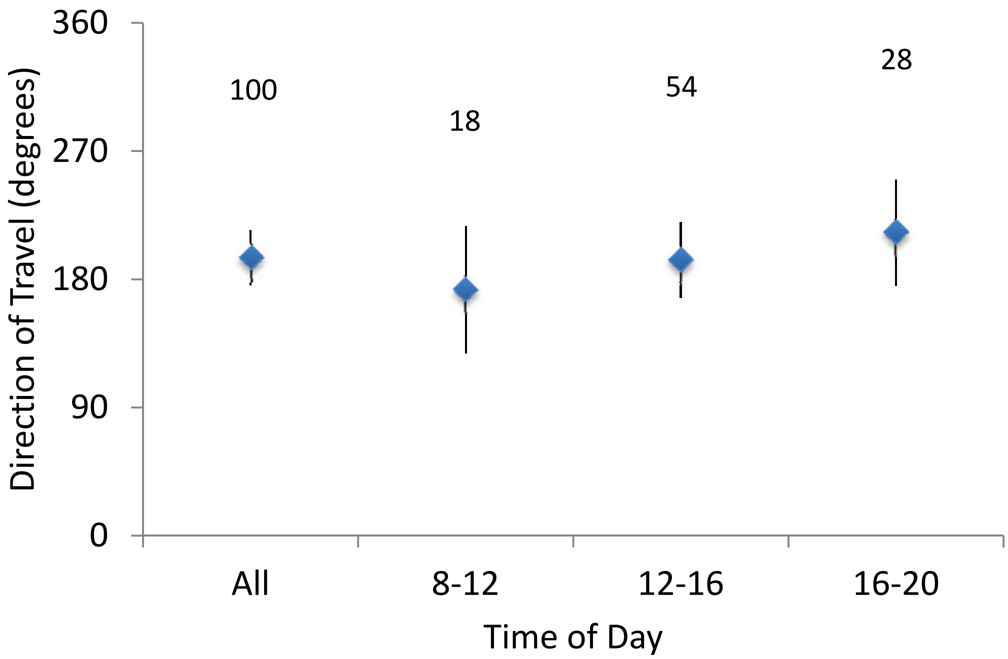

Figure 18. Risso's Dolphin Grampus griseus mean group heading by time of day. Numbers refer to the total sightings for which data was collected.

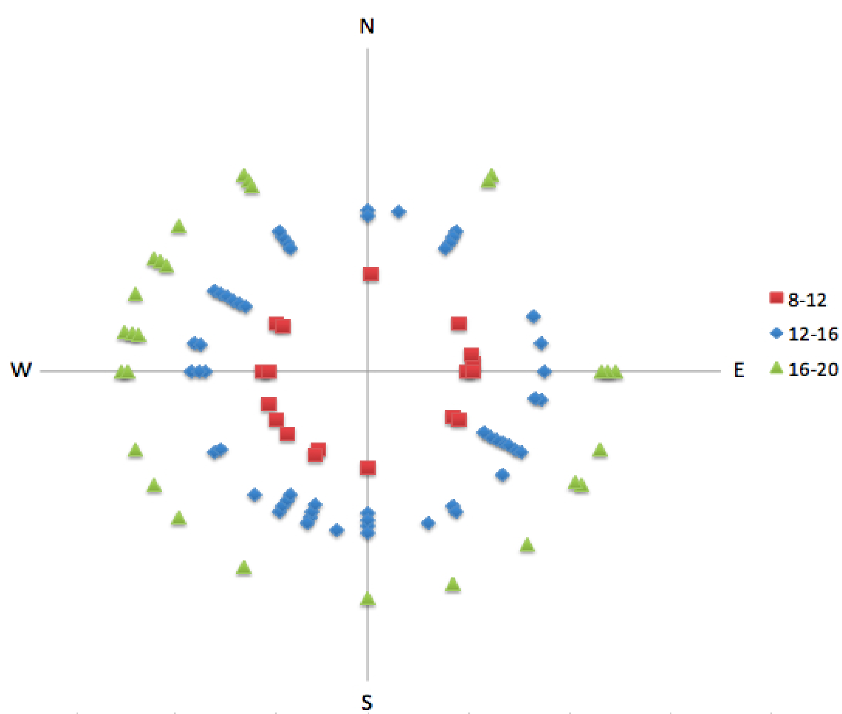

Figure 19. Risso's Dolphin Grampus griseus mean group heading (degrees magnetic) by time of day.

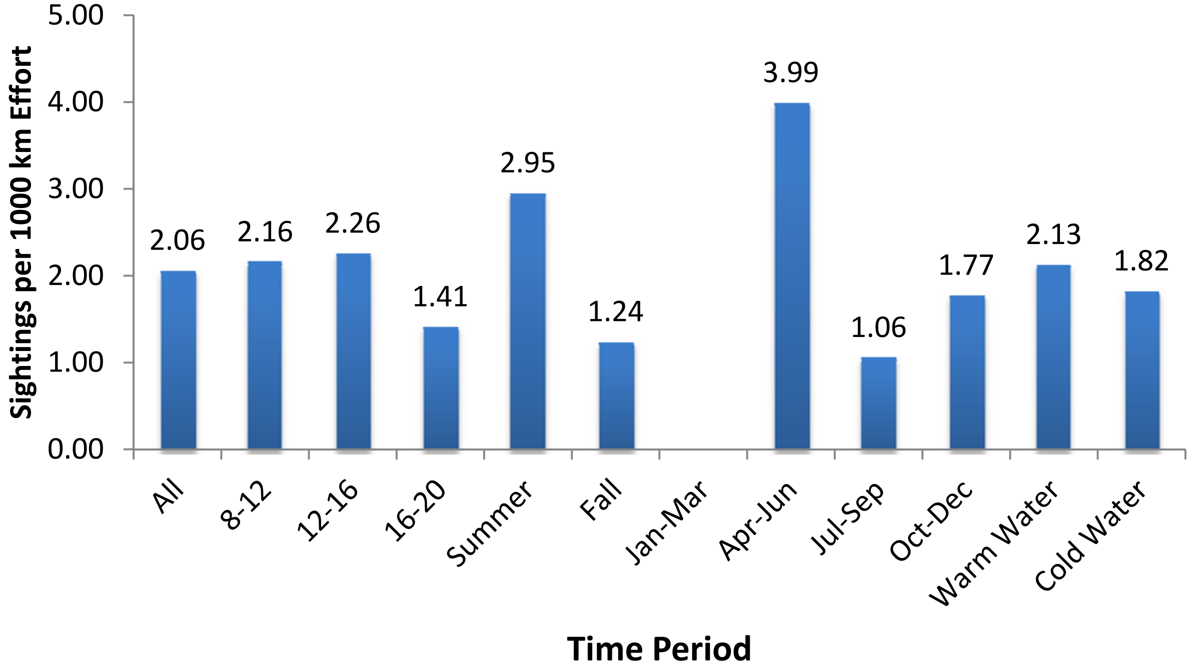

Figure 20. Fin Whale Balaenoptera physalus sightings per 1,000 km of effort based on time of day, season, quarter, and water temperature.

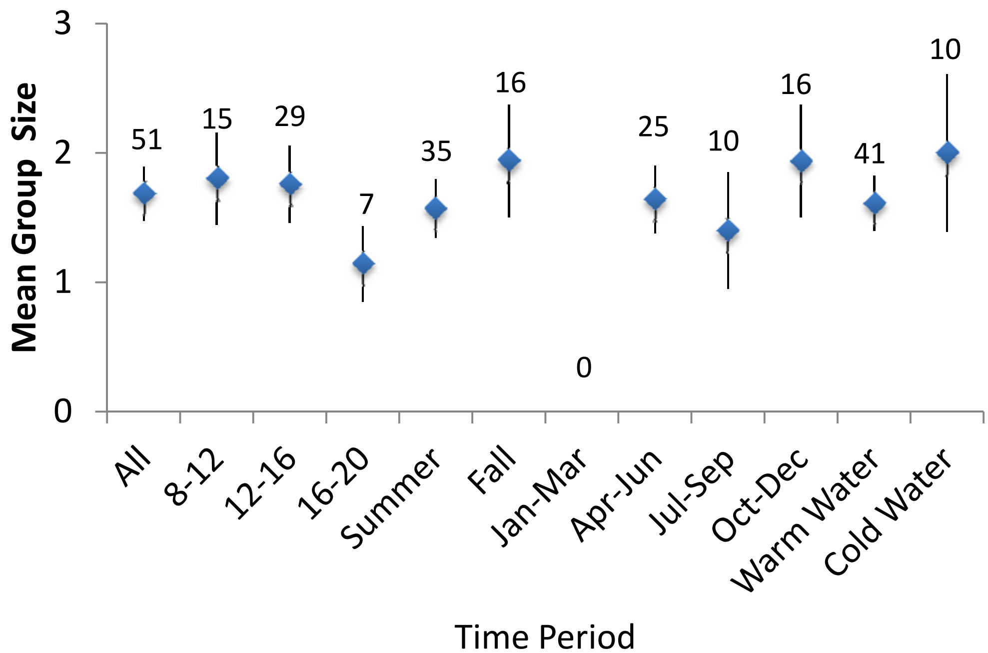

Figure 21. Fin Whale Balaenoptera physalus mean group size by time of day, season, quarter, and by water temperature. Numbers refer to the total sightings for which data was collected.

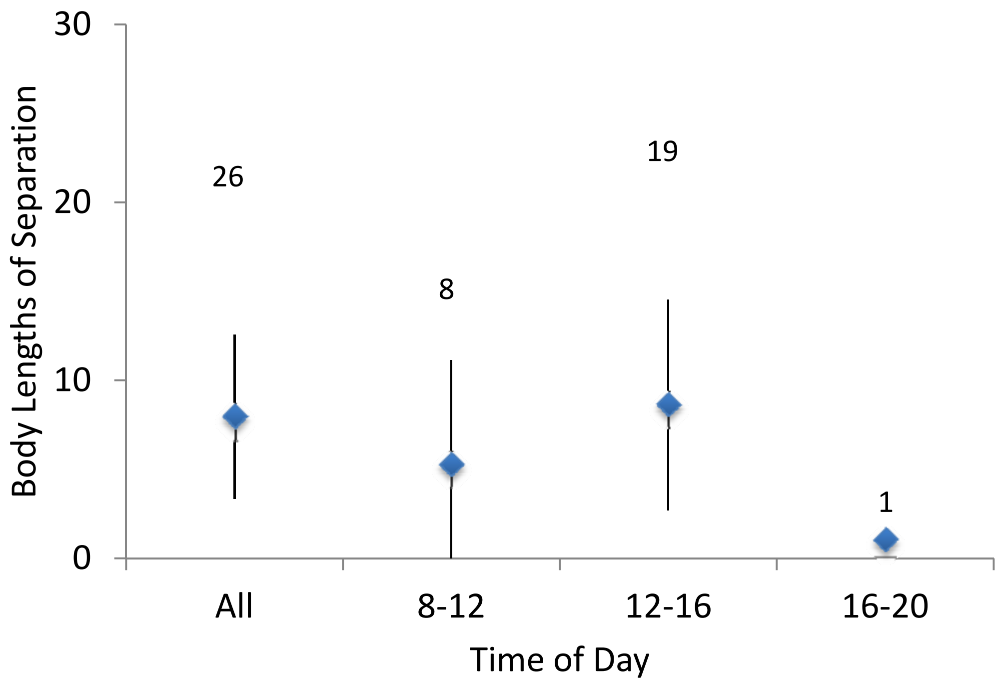

Figure 22. Fin Whale Balaenoptera physalus mean of all maximum dispersions recorded for a sighting by time of day. Numbers refer to the total sightings for which data was collected.

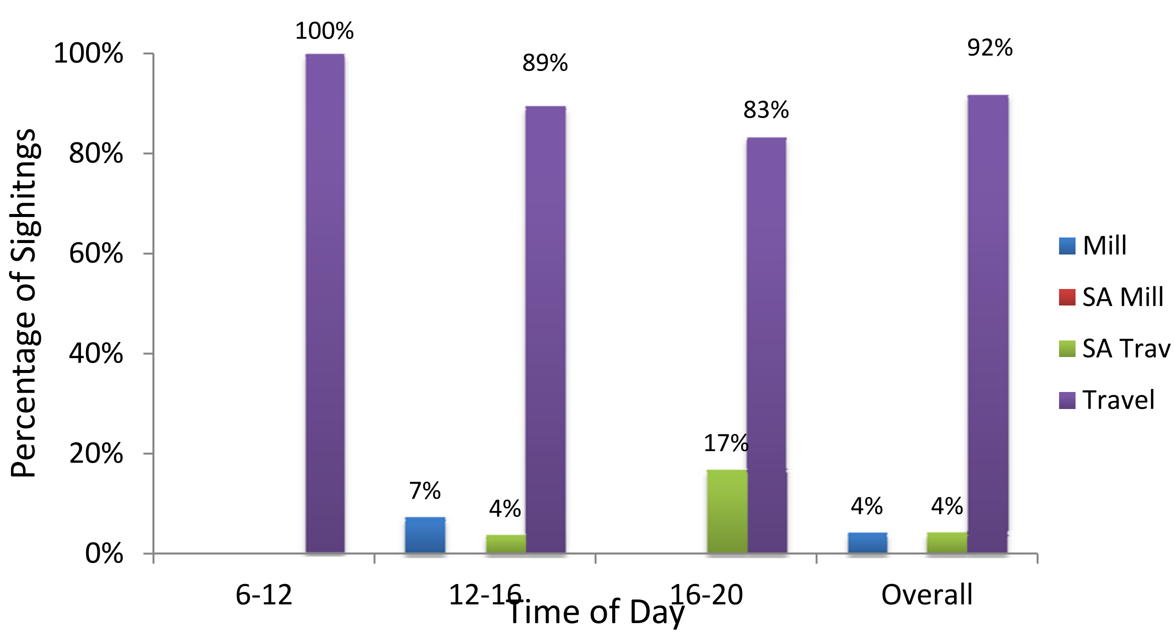

Figure 23. Fin Whale Balaenoptera physalus initial behavior observed by time of day. Note: SA=surface active.

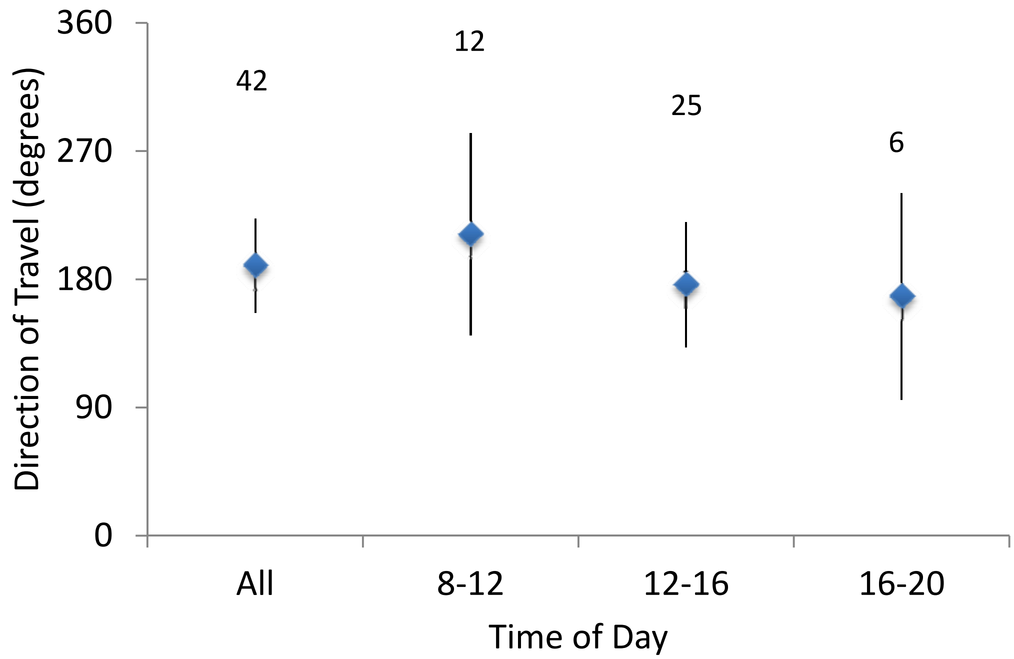

Figure 24. Fin Whale Balaenoptera physalus mean group heading by time of day. Numbers refer to the total sightings for which data was collected.

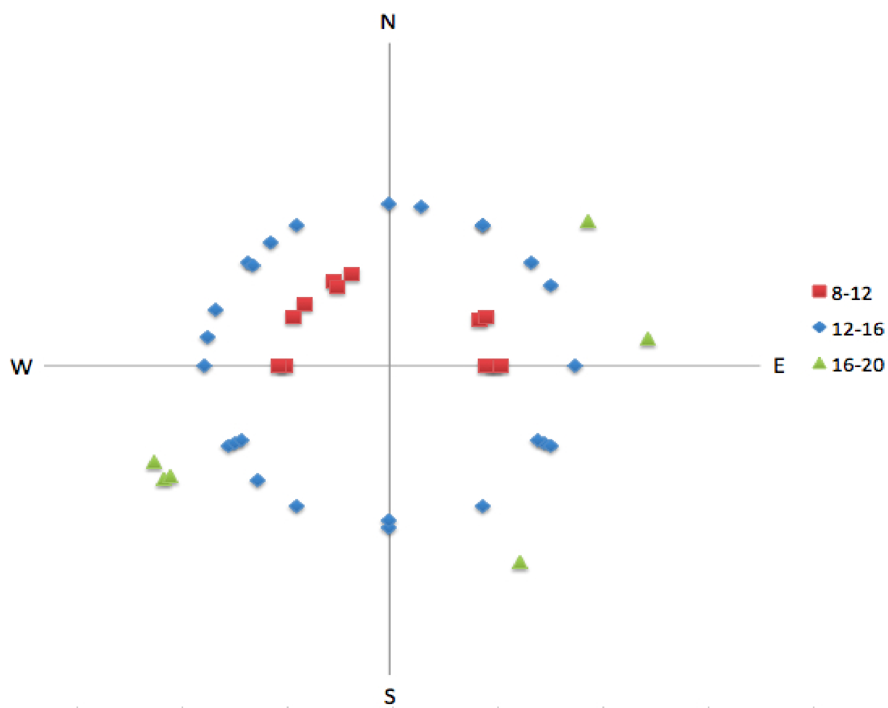

Figure 25. Fin Whale Balaenoptera physalus mean group heading (degrees magnetic) by time of day.

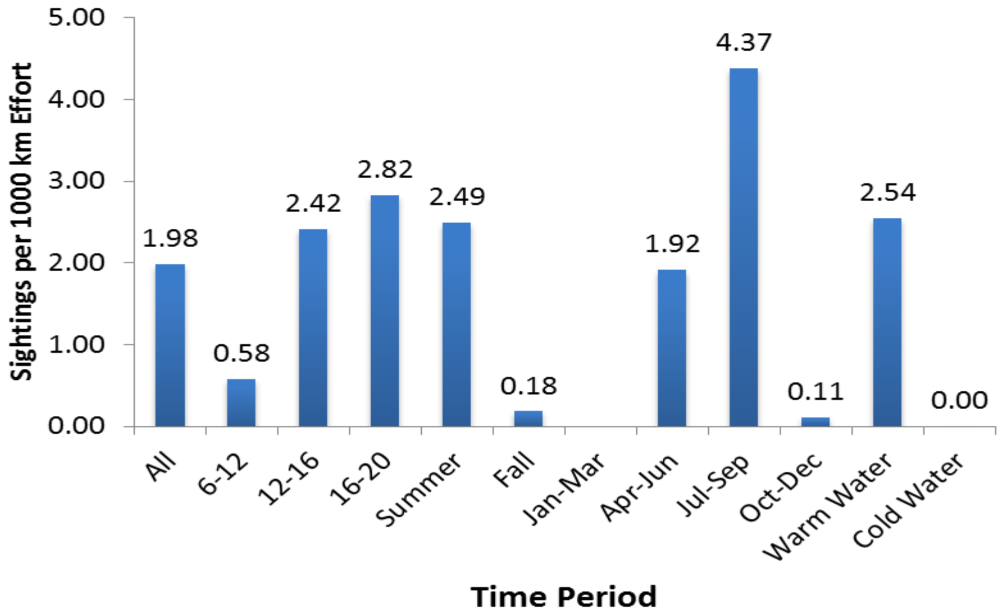

Figure 26. Blue Whale Balaeanoptera musculus sightings per 1,000 km of effort based on time of day, season, quarter, and water temperature.

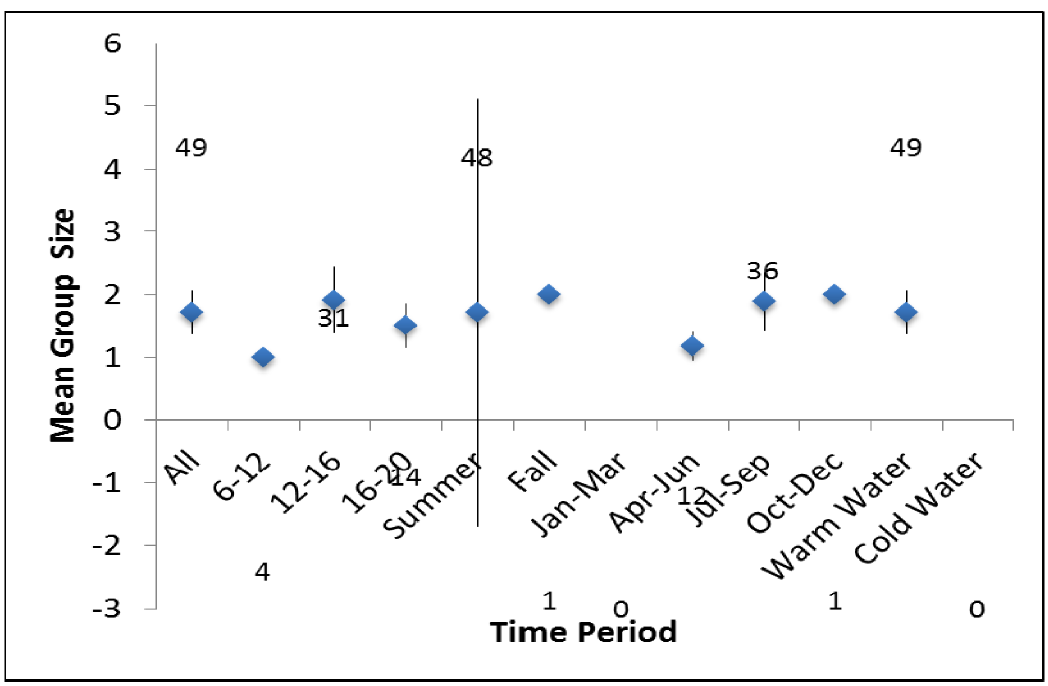

Figure 27. Blue Whale Baleanoptera musculus mean group size by time of day, season, quarter, and by water temperature. Numbers refer to the total sightings for which data was collected.

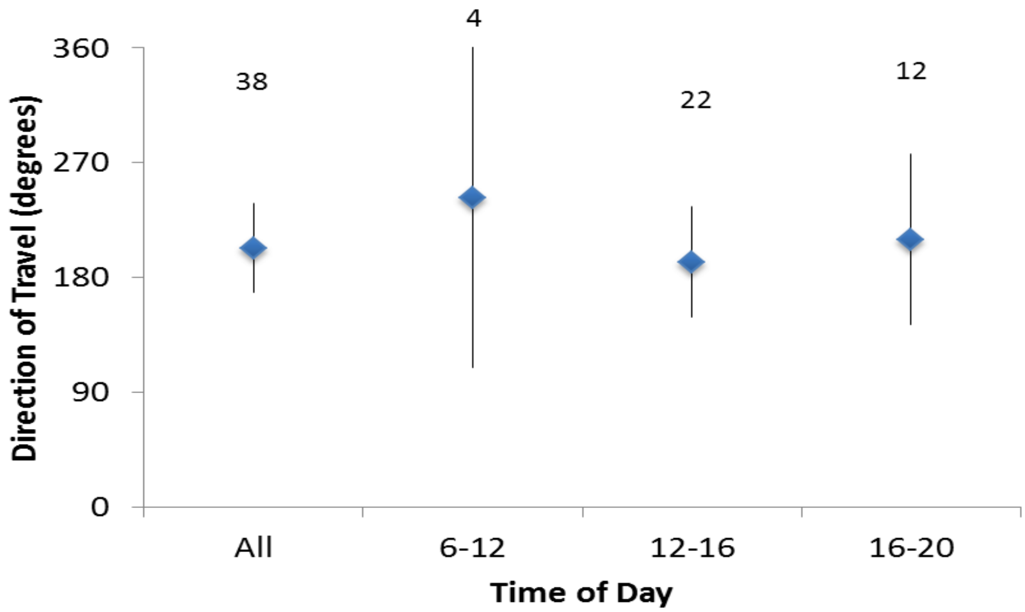

Figure 28. Blue Whale Baleanoptera musculus mean group heading by time of day. Numbers refer to the total sightings for which data was collected.

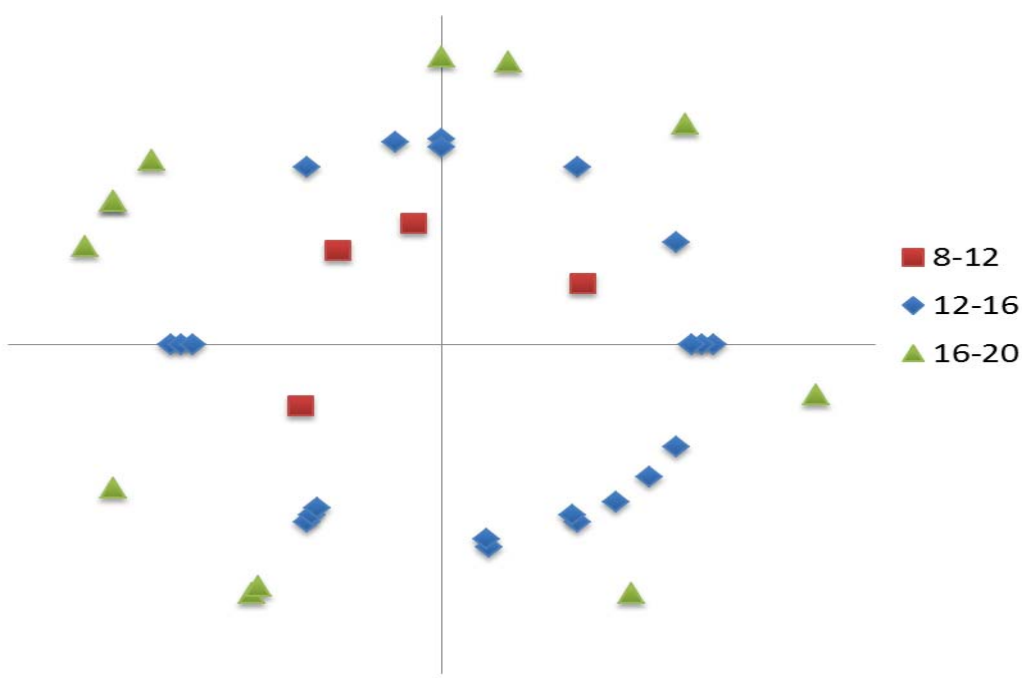

Figure 29. Blue Whale Baleanoptera musculus mean group heading (degrees magnetic) by time of day.

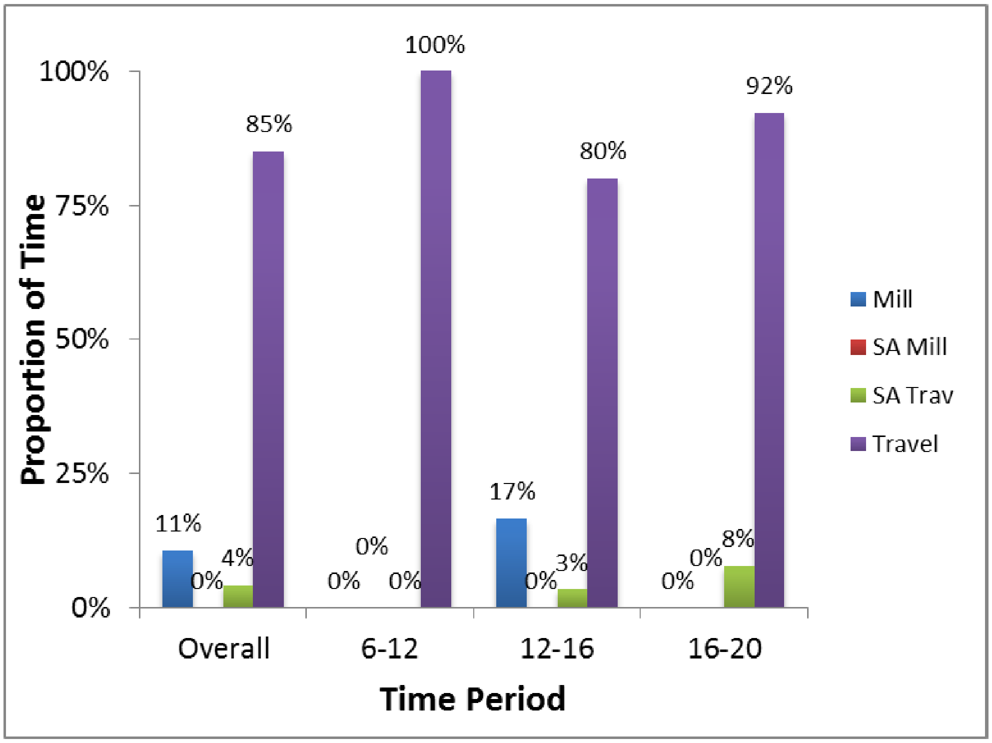

Figure 30. Blue Whale Baleanoptera musculus initial behavior observed by time of day. Note: SA=surface active.

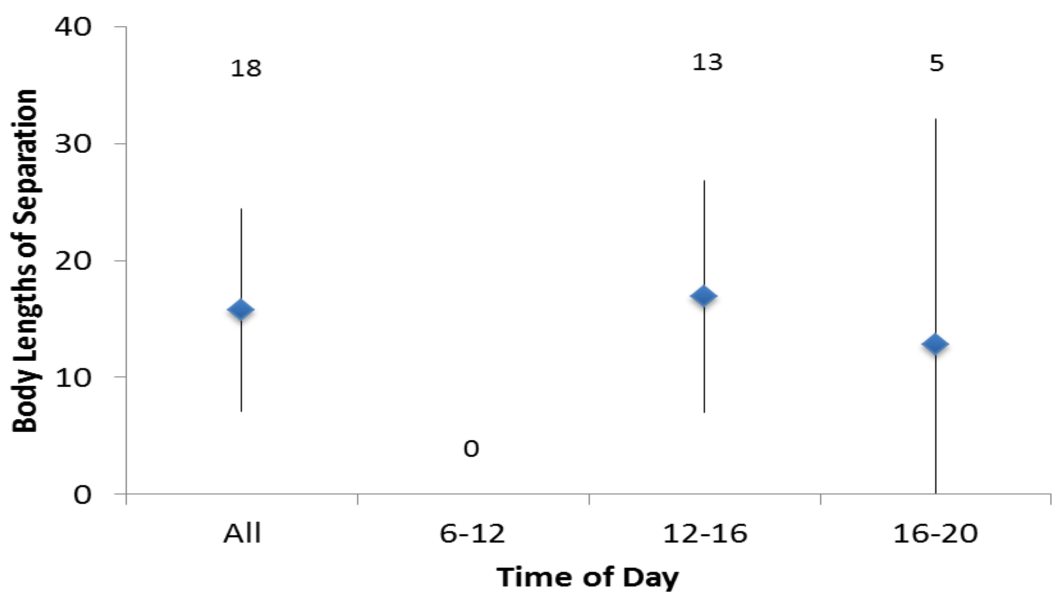

Figure 31. Blue Whale Baleanoptera musculus mean of all maximum dispersions recorded for a sighting by time of day. Numbers refer to the total sightings for which data was collected.

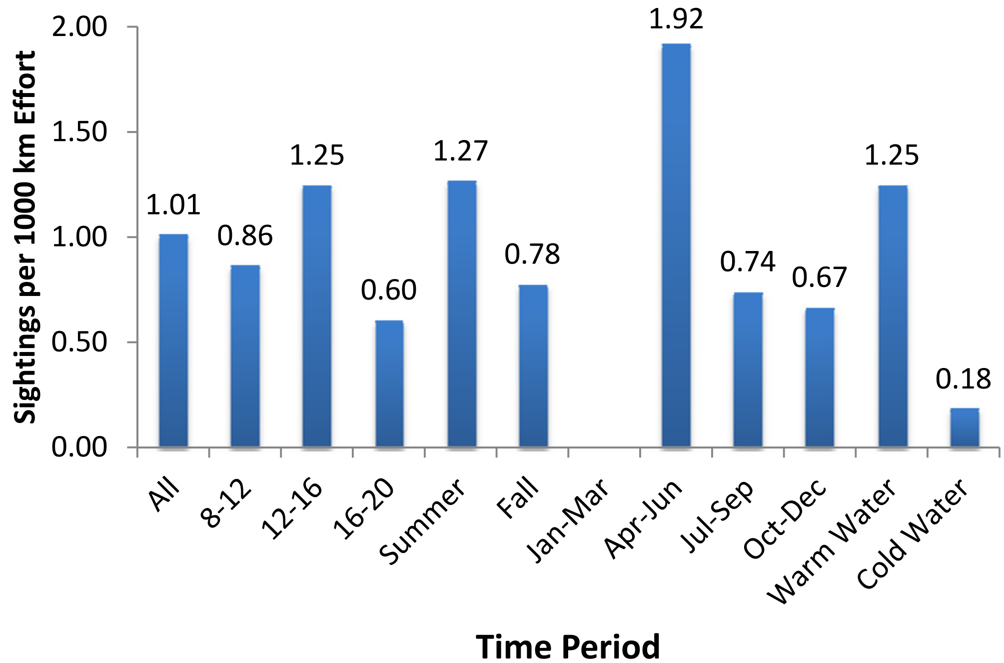

Figure 32. Bottlenose Dolphin Tursiops truncatus sightings per 1,000 km of effort based on time of day, season, quarter, and water temperature.

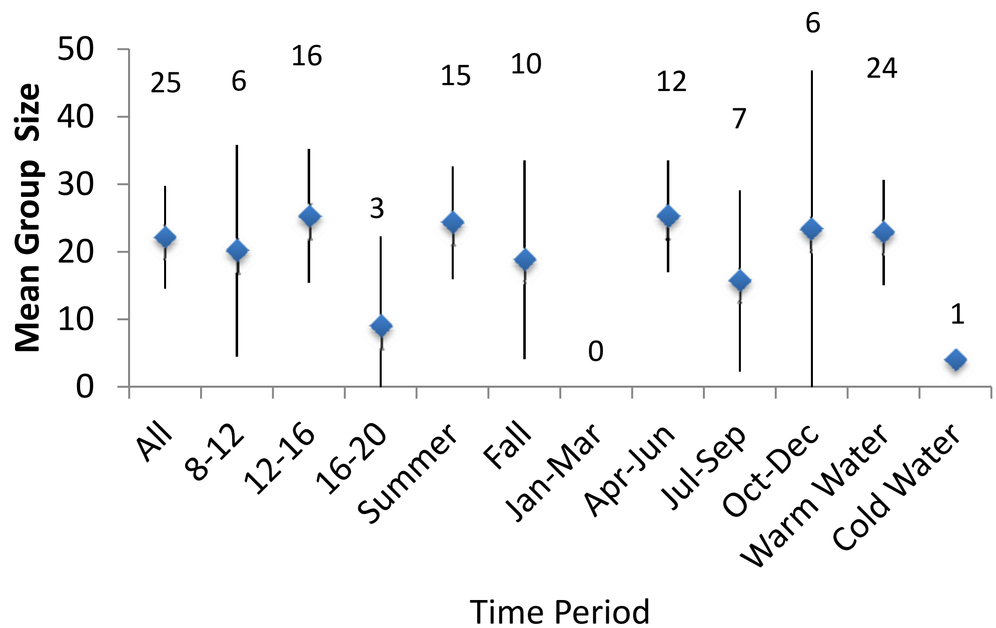

Figure 33. Bottlenose Dolphin Tursiops truncatus mean group size by time of day, season, quarter, and by water temperature. Numbers refer to the total sightings for which data was collected.

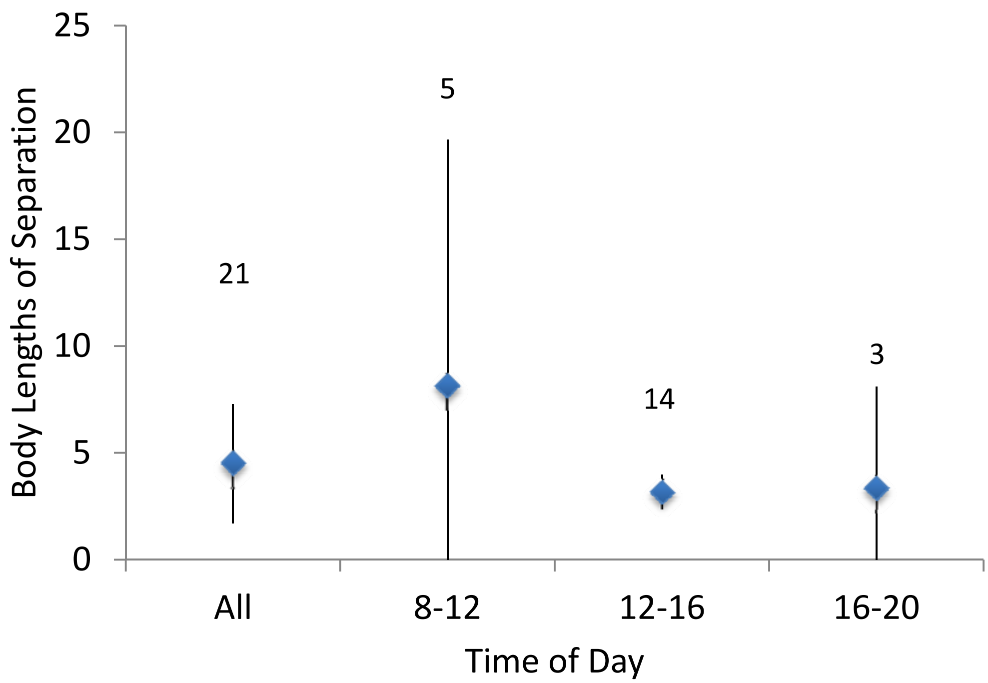

Figure 34. Bottlenose Dolphin Tursiops truncatus mean of all maximum dispersions recorded for a sighting by time of day. Numbers refer to the total sightings for which data was collected.

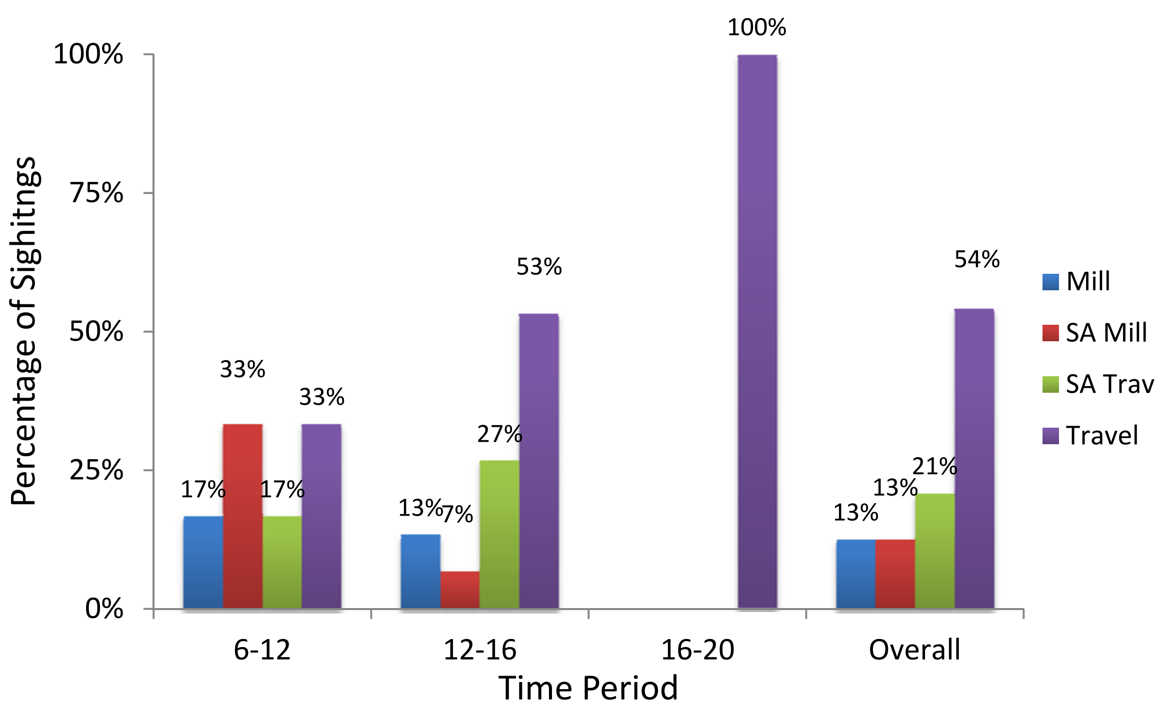

Figure 35. Bottlenose Dolphin Tursiops truncatus initial behavior observed by time of day. Note: SA=surface active.

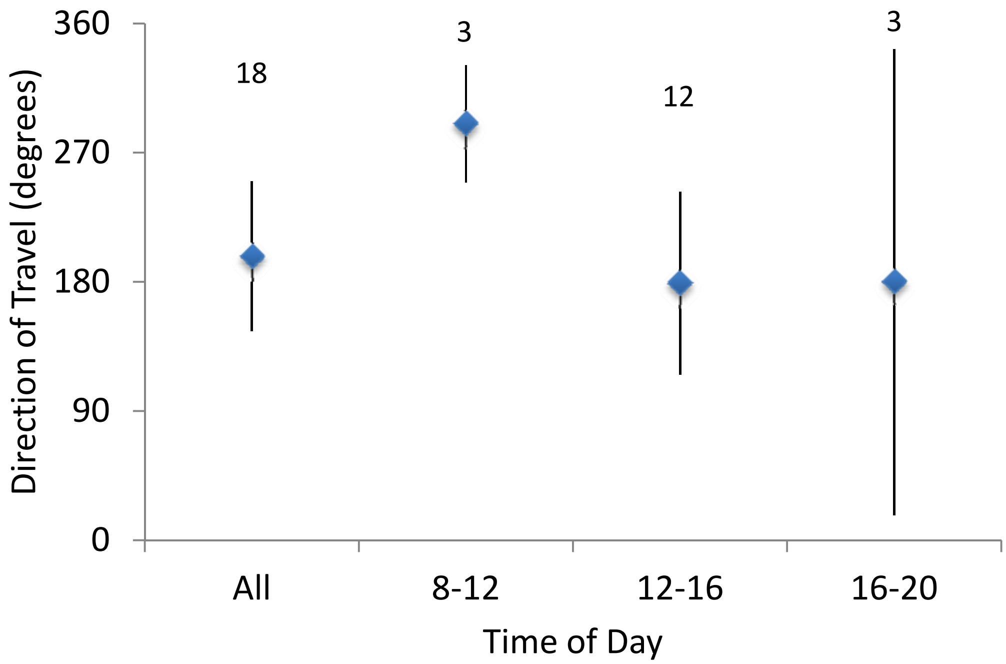

Figure 36. Bottlenose Dolphin Tursiops truncatus mean group heading by time of day. Numbers refer to the total sightings for which data was collected.

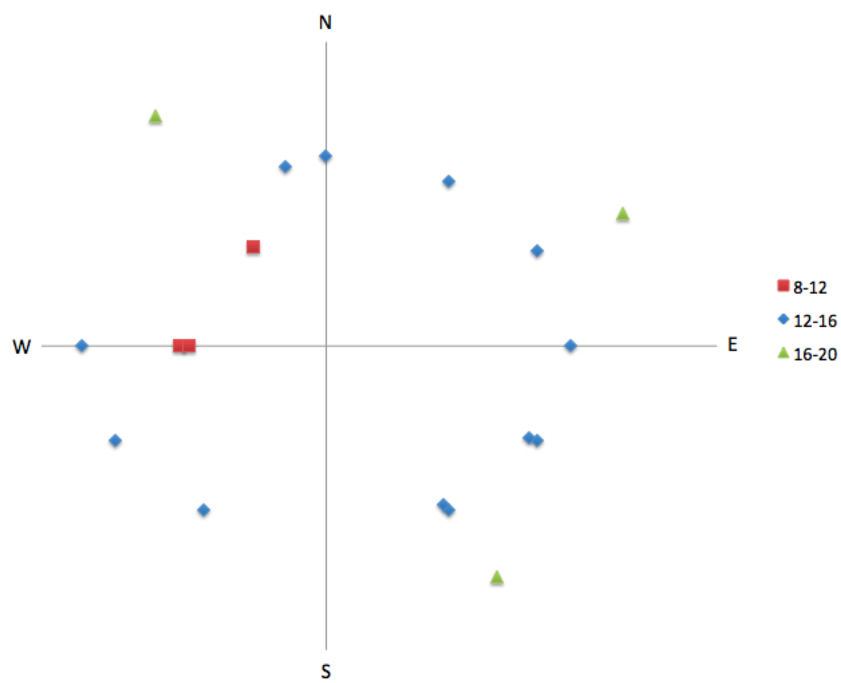

Figure 37. Bottlenose Dolphin Tursiops truncatus mean group heading (degrees magnetic) by time of day.

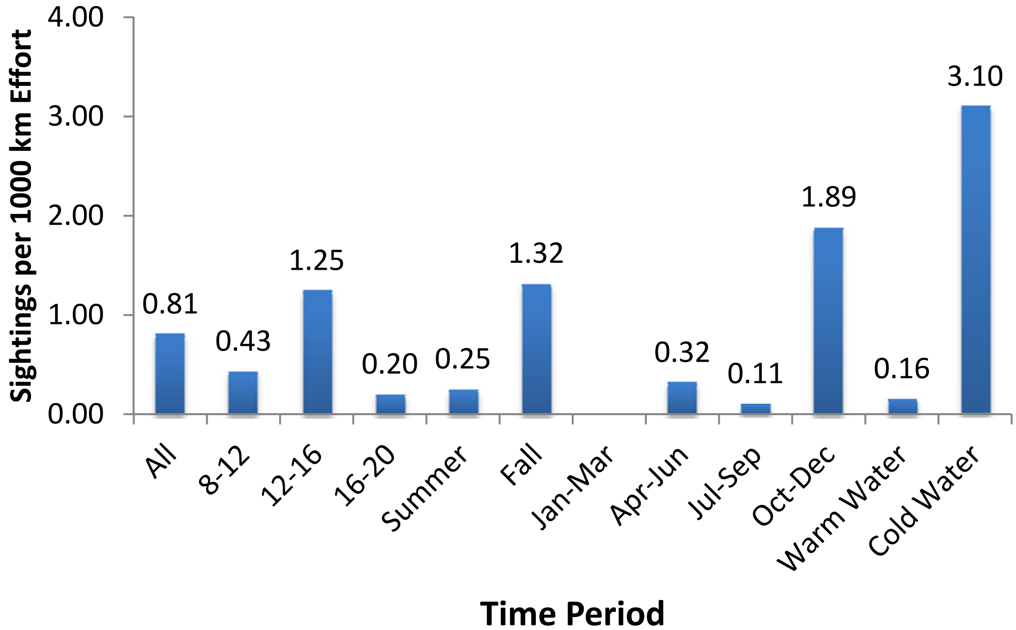

Figure 38. Pacific White Sided Dolphin Lagenorhynchus obliquidens sightings per 1,000 km of effort based on time of day, season, quarter, and water temperature.

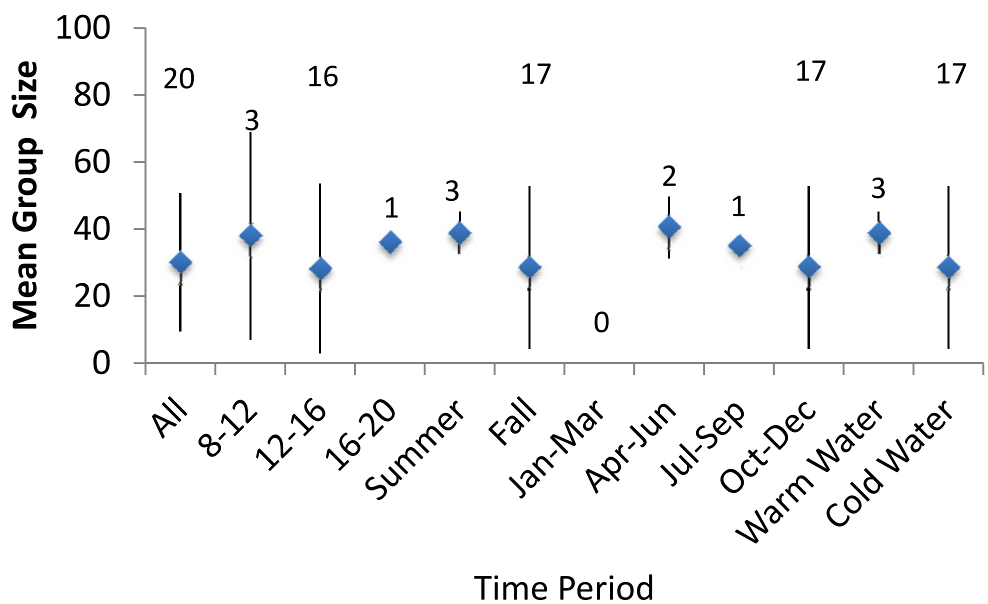

Figure 39. Pacific White Sided Dolphin Lagenorhynchus obliquidens mean group size by time of day, season, quarter, and by water temperature. Numbers refer to the total sightings for which data was collected.

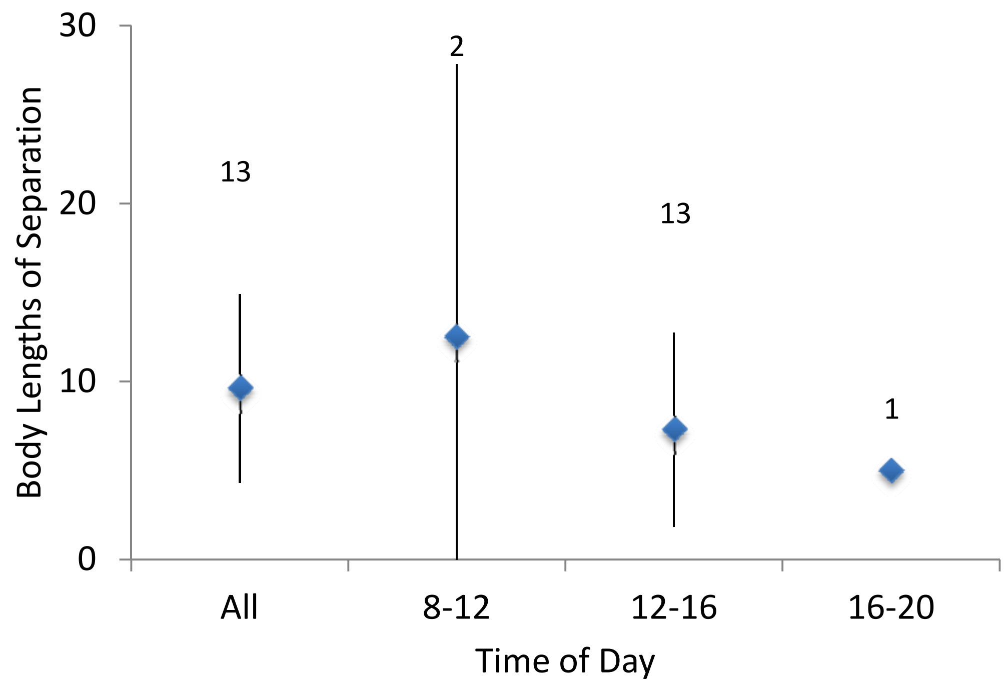

Figure 40. Pacific White Sided Dolphin Lagenorhynchus obliquidens mean of all maximum dispersions recorded for a sighting by time of day. Numbers refer to the total sightings for which data was collected.

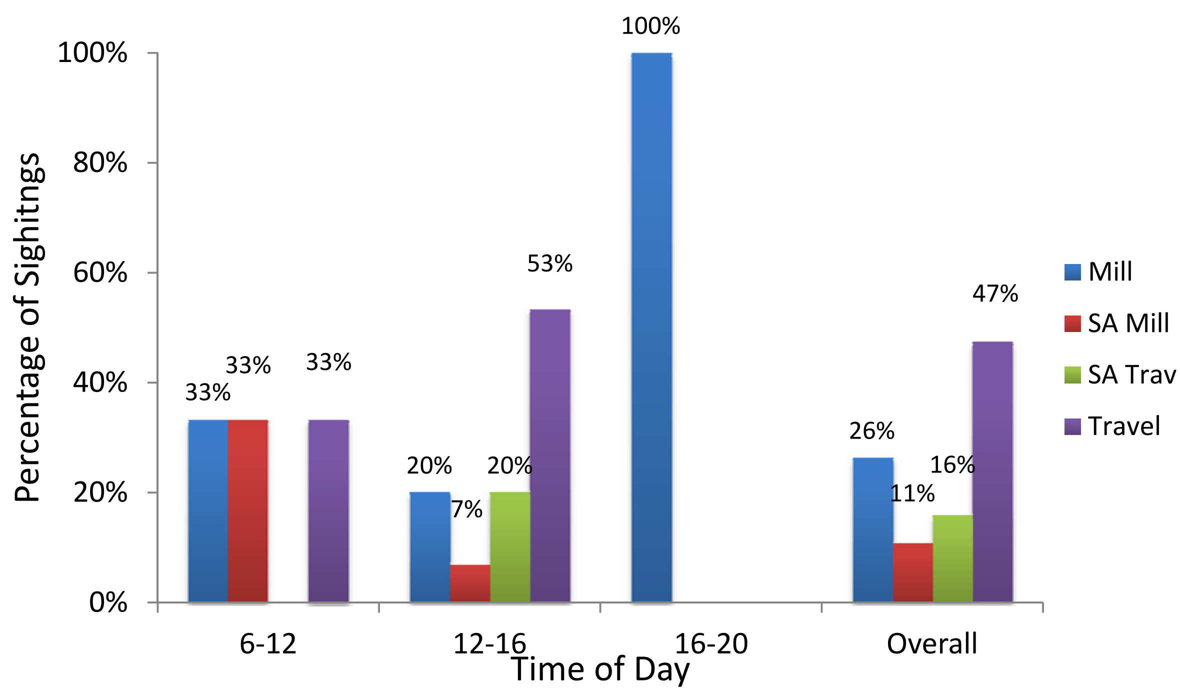

Figure 41. Pacific White Sided Dolphin Lagenorhynchus obliquidens initial behavior observed by time of day. Note: SA=surface active.

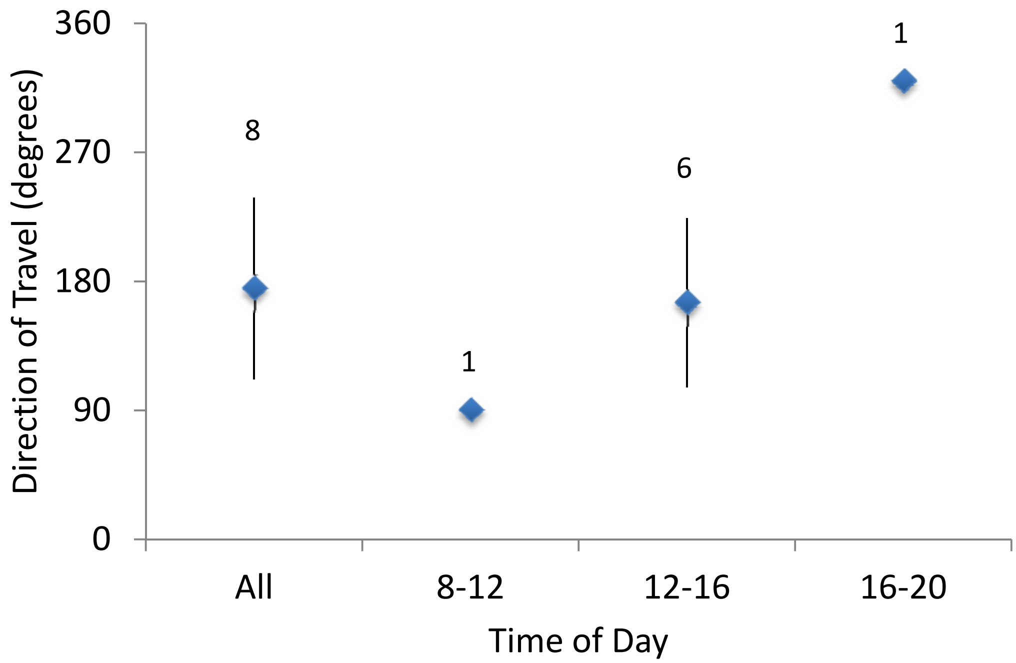

Figure 42. Pacific White Sided Dolphin Lagenorhynchus obliquidens mean group heading by time of day. Numbers refer to the total sightings for which data was collected.

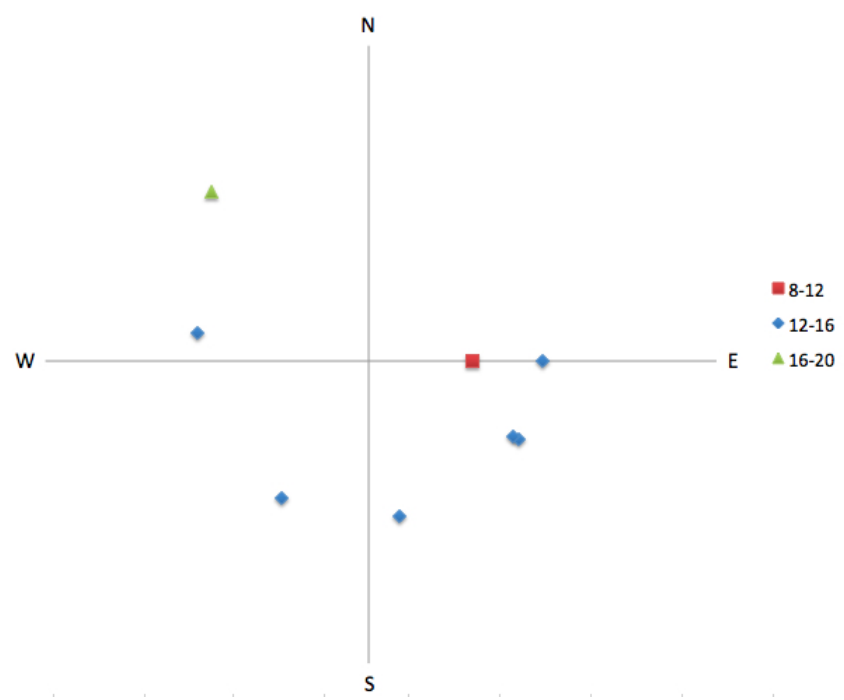

Figure 43. Pacific White Sided Dolphin Lagenorhynchus obliquidens mean group heading (degrees magnetic) by time of day.

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MARINE MAMMAL AND SEA TURTLE MONITORING VIDEO DURING NAVY TRAINING EVENTS

Contract No. N62742-10-P-1818

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Introduction

This report summarizes Contract N62742-10-P-1818 issued to Smultea Environmental Sciences (SES) in summer 2010 as described in the scope of work (SOW). The purpose of this contract was to review, catalog, inventory, transcribe and summarize HD video that had been collected during aircraft-based monitoring of marine mammals on behalf of the US Navy in the Southern California (SOCAL) Range Comlex and Hawaiin Range Complex (HRC) complexes during the period August 2008 through July 2009 by SES and Marine Mammal Reasearch Consultants (MMRC). As described elsewhere (e.g., Smultea et al. 2009, 2010), video data were collected to provide a detailed, reviewable media to document and describe the detailed behavior of cetaceans, focusing on priority species of marine mammals (e.g., federally listed species, Rissos's dolphins).

The primary goal of Navy funded behavioral monitoring of marine mammals is to provide a baseline to describe what constitutes typical behavior of marine mammals as observed at and just below the water surface (i.e., ~20-50 m below the surface). The latter data are to be used to assess potential effects of exposure to mid-frequency active sonar (MFAS). Past studies have shown that an aircraft circling cetaceans outside the received sound range of the aircraft (i.e., Snell's Cone) allows collection of undisturbed data that are not confounded (i.e., disturbed) by the platform of observation. In contrast, vessel surveys introduce noise into the water that has been shown to affect the behavior of some species and individual marine mammals (e.g., reviewed in Richardson et al. 1995; Southall et al. 2007; NRC 2003).

The occurrence, distribution, abundance, and vocalizations of marine mammals have been studied in the SOCAL and HRC complexes for several decades from aircraft, vessels, shore, and remote censusing techniques. Primary methods have included photo-identification, tagging, vessel and aerial-based line- transect surveys, passive acoustic monitoring and shore-based theodolite tracking (e.g., Tyack 1982; Baker and Herman 1984; Baker et al. 1985; Silber 1986; Mobley and Herman 1985; Frankel et al. 1995; Forney and Barlow 1998; Carretta et al. 2000). More recently, within the last decade, small-vessel-based satellite tagging and photo-identification efforts have revealed considerable information on dive, respiration, group characteristics, occurrence, distribution, range, and residency of many more obscure species in the HRC and SOCAL Range such as beaked whales and pelagic delphinids (e.g., Falcone et al. 2009; Schorr et al. 2010; Baird et al. 2011). However, very few social behavioral data have been collected, particularly in a systematic manner, with the exception of the humpback whale in the HRC. For example, much remains to be learned about basic behavioral budgets, level and rates of socializing/touching, short-term movements, inter-individual interactions, and group composition and size relative to vocalization patterns, among other variables. This information is critical to better understanding the context and factors influencing behavior, including vocal behavior. Furthermore, virtually nothing has been published on the social or basic behavior of some of even the most common species occurring there, especially in the SOCAL Range Complex, including blue and fin whales and Risso's dolphins.

Numerous studies have shown that some behavioral variables are affected by anthropogenic and other disturbance. Resulting responses have been successfully quantified and measured using behavioral parameters including dive and surface time, respiration rates, orientation/headings, and behavioral state among others (reviewed in Richardson et al. 1995). Using video to collect, analyze and interpret behavior has been shown to be an effective and useful tool to record and quantify these parameters for bowhead and humpback whales and bottlenose dolphins (e.g., Würsig et al. 1985, 1989; Richardson et al. 1985; Smultea and Würsig 1991). This approach has not been heretofore applied to other species until the recent aircraft-based behavioral monitoring in the SOCAL Range Complex and HRC. Video provides a media that can be reviewed repeatedly to obtain detailed, accurate behavioral data and identify behaviors missed in-situ during field work. Post-field comparisons of behavioral data collected in-situ with the same data collected, viewed and transcribed from video have shown that behaviors are missed in-situ or incorrectly identified but can be corrected during review of the video.

This report summarizes the methods used to collect, summarize, inventory, and transcribe video of seven species of marine mammals in the SOCAL Range Complex and HRC, as requested in the associated SOW. It also includes a discussion of the technical and other issues encountered during this process and how they have been addressed and/or improved upon. Given the relatively limited projects and species to which videography has been used to describe cetacean behavior, the technique is still relatively novel, it's utility of videography has not been fully explored beyond the extensive such studies done on bowhead whales relative to the seismic industry in the Beaufort Sea (e.g., Würsig et al. 1985; Richardson et al. 1985, 1995), bottlenose dolphins relative to an oil spill in the Gulf of Mexico (Smultea and Würsig 1991), and unpublished baseline data on humpback whales in Hawaii (e.g., Smultea et al. 1994).

Methods

Video was collected during four aerial surveys in SOCAL Range Complex and two aerial surveys in the HRC conducted from August 2008 through July 2009. Table 1 summarizes these videos including the dates they were taken and other associated information. Behavioral video collection protocol is described in Smultea et al. (2009, 2010, etc), as this report is more focused on how video was processed during the post-field period.

Video was collected using an HD Canon Vixia HF10 video camera with 12x optical zoom lens and a built-in optical internal stabilizer. This video camera was equipped with a flip-out LCD viewing screen as well as a short ocular viewing lens. Video were collected from altitudes of 366-457 m (1,200-1,500 ft) and a radial distance of ~1 km (0.5 nm) to the maximum extent practicable to remain well outside Snell's sound cone (Figure 1) below an aircraft. For example, at an altitude of 457 m (1,500 ft), Snell's sound cone radius is ~100 m during calm Beaufort sea state conditions over deep water (see Table 2 for the radial width of Snell's theoretical sound cone at various altitudes). When low ceilings precluded this, we flew at the highest altitude possible. Altitudes below 305 m (1,000 ft) were considered impractical for collecting data due to the difficulty in keeping the focal group in view as well as the risk of potential disturbance to them.

Videos were first reviewed in their entirety to identify and log periods when animals were in view, video general content, species, group size, and quality. Video quality was rated on a subjective scale to rate its utility with respect to the ability to identify and see individual behaviors, behavior states, etc. Factors that affected video quality included the occurrence of glare or the aircraft body periodically obscuring view of the animals (e.g., when the pilot turned sharply, the engine cowling or wing sometimes temporarily obstructed the view from the video camera); shaking of the video due to air turbulence or other factors; whether the animals were in view or focus, etc. Table 3 provides definitions of video quality that were applied.

Videos were reviewed a second time in their entirety to transcribe detailed behaviors. In this process, the video was paused, rewound, forwarded, and/or reviewed multiple times, as needed to identify and note pre-selected variables of interest based on visual and/or audio recorded data on the video. Data were entered into a customized Excel transcription spreadsheet. Prior to video transcription, an ethogram was developed to standardize transcription of behaviors. This ethogram was based on other studies and sources that had previously defined cetacean behaviors (e.g., Shane 1990; Baker and Herman 1984; Bauer 1986; Helweg 1989; Smultea 1991; Mann 1999, 2000; Perrin et al. 2009). Variables noted are provided in Tables 4 and 5. During transcription, unusual or previously undefined (in standard published ethograms) were identified and added to the original ethogram.

Scan sampling (Altmann 1974) was applied to systematically record the following variables at 30-sec intervals, as determined from viewing the video and/or hearing the video's audio: behavior state, heading (degrees magnetic), and minimum and maximum dispersal between nearest individuals within a subgroup (subgroup was defined as individuals behaving in a synchronized manner within 20 body lengths (BL) of one another). For whales, all-occurrence behavioral event sampling (Altmann 1974) was applied. Thus, all individual events/behaviors were recorded as possible/viewable/audible from audio, including respirations (blows), typical behaviors associated with dives and surfacing (e.g., first observed blow, no blow rise, peduncle arch, fluke up/down), conspicuous and previously defined (or sometimes novel) other behaviors (e.g., breach, tail slap, head rise, etc.), and any periods a behavior may have been missed. Individual respirations could not be reliably seen from most video for dolphins, especially larger group sizes of delphinids and their fluidity and the associated difficulty in keeping them all within view and/or altitude (457 m) relative to their body size. Thus, they were not recorded. However, such data could be discerned in a subset of these videos for a subset of individuals under ideal conditions (e.g., Beaufort sea state <3, calm air/no turbulence, no or minimum glare, etc.), especially for small groups of delphinids (e.g., <5-10 individuals) or individually discernible individuals within a group (e.g., a mother-calf pair).

Results

The video and metadata associated with this contract were provided to the NAVFAC Hawaii in May 2011 and included (1) two copies of all video, (2) an inventory list identifying all video taken, its contents, time, date, etc.; (3) an Excel spreadsheet for each cetacean sighting videotaped with transcription of behaviors based on video content and auditory video comment that included times and frequencies of individual behaviors, behavior states, headings, minimum and maximum nearest-neighbor dispersal distances between individuals, and general comments; and (4) the behavior ethogram.

Video was collected from a total of 30 focal groups of 7 species: 23 groups and 6 species in SOCAL Range Complex and 7 groups and 2 species in the HRC. Considerably more video was collected in the SOCAL Range Complex due to the higher density of animals and the overall much better Beaufort sea state conditions (e.g., mean Beaufort ~2-3 in SOCAL vs. Beaufort 4-5 in the HRC). A total of 181 min of video was collected in SOCAL vs. 52 min from the HRC. Video was of higher subjective quality in SOCAL vs. the HRC, generally due to the higher predominance of whitecaps in the HRC that often obscured detailed behavior of the focal group and the higher degree of turbulence associated with stronger wind speeds leading to shakier/less stable video.

Discussion

The first few aerial surveys were considered the feasibility phase of the aerial monitoring as described in the SOCAL Range Complex (DoN 2009) and HRC monitoring plans (DoN 2008). This phase was used to assess the utility of using video to collect behavioral data in the SOCAL and HRC complexes relative to the species and environmental conditions occurring there, as well as the aircraft platforms available within the limited budgets. It was found that more detailed behavior could be collected from certain species than others with video. For example, blue, fin, humpback, and minke whales could generally be reliably tracked for extended periods with the video. Risso's dolphins could also be reliably tracked in the SOCAL Range Complex given their whitish, light body color that could be tracked further below the water surface than darker species coupled with their tendencies to occur in relatively small group sizes (<20-25) and rest or travel slowly at or near the surface for extended periods (Risso's are considered a priority species in the Navy's SOCAL monitoring plan [DoN 2009]).

Equipment and methods used to collect video behavioral data were also modified during the feasibility phase of the aerial monitoring to improve the quality of the video. This included limiting video data collection to periods ideally with Beaufort sea states <4, from altitudes of 366-457 m (1,200-1,500 ft), and with minimal air turbulence. A chest monopod was also adopted after the first few surveys to increase the stabilization of the video camera and reduce the shaking of recoded video. Video could not be taken through the bubble windows due to distortion, and taking video through the flat Plexiglas windows decreased the clarity and resolution of the video; thus, video was collected through the one opening port in the plane's window from the front co-pilot seat.

There were a number of issues/problems encountered during post-processing of video. These issues along with how they were addressed are summarized in Table 6. The primary issues are briefly discussed below but described in detail in the table. The foremost issue was that the Canon video camera did not display real time after video had been recorded, i.e., when viewing it after it had been downloaded from the video camera. We contacted Canon but this feature was not available. The only measure of time on the downloaded video was a counter that counted video in seconds beginning with 0 whenever the video was started and restarted. This made transcription of video into real time a time-intensive process. However, in February 2011, specialized independent software was found on the internet in response to numerous complaints from video users that the video camera did not display time and date in other video viewing software. After purchase of this software, all video was then converted and displayed the real-time original time rather than the counter time. In addition, this display could be edited and the video could have titles inserted, etc. This made transcription of video much faster and less prone to potential error when converting counter time to real time. The video has an internal GPS and clock that automatically updates itself whenever it is turned on, so the time on the video matches the GPS time.

Another issue was that sometimes when video was copied, downloaded, or uploaded, resolution was lost or degraded in the process. This could be avoided by ensuring that the original resolution of the HD video was retained during the process. See Table 6 for additional issues and resolutions.

One ongoing issue is that it is very difficult to have no shaking on the video. The shaking was greatly reduced when we began using a monopod chest pod to help steady the video camera. However, in windy conditions resulting in air turbulence, shakiness persists due to the vibration of the aircraft itself. The shaking is annoying to transcribe, but these effects can be minimized by freezing video frames when viewing them to obtain the data of interest.

Conclusion

Video was successfully used to collect detailed behavioral data on species for which little or no socio-behavioral data have been collected. This method developed in the 1980s to document detailed behavioral variables of bowheads in a format that could be repeatedly reviewed was successfully applied to numerous novel species in the SOCAL monitoring. Techniques, approaches and methods were fine-tuned and modified over the course of the first six aerial surveys discussed herein. These modifications have improved the quality and utility of the video. However, further research into the feasibility of using more expensive and high-tech equipment to further minimize shaking of video is desirable (e.g., a gyroscope, etc.).

While video behavioral data were transcribed and inventoried for this project and contract, they remain to be quantitatively summarized with summary statistics. The latter is necessary to identify the variance around the mean of various variables of interest to determine what sample size would be required to enable recognition of a significant change from normal behavior, such as a potential response to exposure to mid-frequency active sonar.

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Table 1. Overall inventory library of marine mammal video taken during aerial monitoring conducted on behalf of the Navy in the HRC and SOCAL range complexes March 2008-July 2009.

Note: no video taken of sea turtles; sea turtles seen only in HRC

Survey Area	Survey Name	Survey Date	Video Taken	Species Videotaped	Total Video	SES Recommend Detailed Transcription?	Comments
HRC							
HRC	RIMPAC	24-30 March 2008	no	none	0	na	no video taken
HRC	RIMPAC	13-17 July 2008	no	none	0	na	no video taken
HRC	SCC OPS	18-21 August 2008	yes	spinner dolphins	0:07:15	yes	first time video taken from plane
HRC	SCC OPS	15-19 February 2009	yes	humpback whales	0:45:00	yes	see SCC OPS HI Feb 09 tab
HRC	SCC OPS	26-30 August 2009	no	none	0	na	no video of marine mammals, only a few sightings seen briefly
SOCAL							
SOCAL	JTFX	17-21 October 2008	yes	Risso's dolphin, common dolphin sp., fin whale, unidentified dolphin	0:35:22	yes	
SOCAL	Post-JTFX	15-18 Nov 2008	yes	humpback whale, blue whale, fin whale	0:58:57	yes	excellent video of whale behavior during low Beaufort above and below surface, possible courtship behavior, socializing

Survey Area	Survey Name	Survey Date	Video Taken	Species Videotaped	Total Video	SES Recommend Detailed Transcription?	Comments
SOCAL	JTFX	05-11 Jun 2009	yes	fin whale mother/calf with N. right whale dolphins, blue whale, humpback whale	1:27:21	yes	rare video of interspecific interactions between N right whale dolphins and mother/calf fin whale; very little known about social beh. of these species
SOCAL	Post-JTFX	20-28 July 2009	yes	Risso's dolphin, common dolphin sp., blue whale, unidentified whale	0	na	video backed up to 3 HDs but all 3 HDs malfunctioned/ failed; no video available; sent HD to data retrieval service: estimated $1200 to assess if data can be retrieved/not guaranteed

Table 2. Radial distance from aircraft of Snell's theoretical sound cone at various altitudes.

Aircraft Altitude (feet)	Clinometer Angle (degrees)	Radial distance (feet)	Radial distance (meters)
500	77	115	36
600	77	138	43
700	77	161	50
800	77	185	57
900	77	208	65
1000	77	231	72
1100	77	254	79
1200	77	277	86
1300	77	300	93
1400	77	323	100
1500	77	346	108
1600	77	369	115

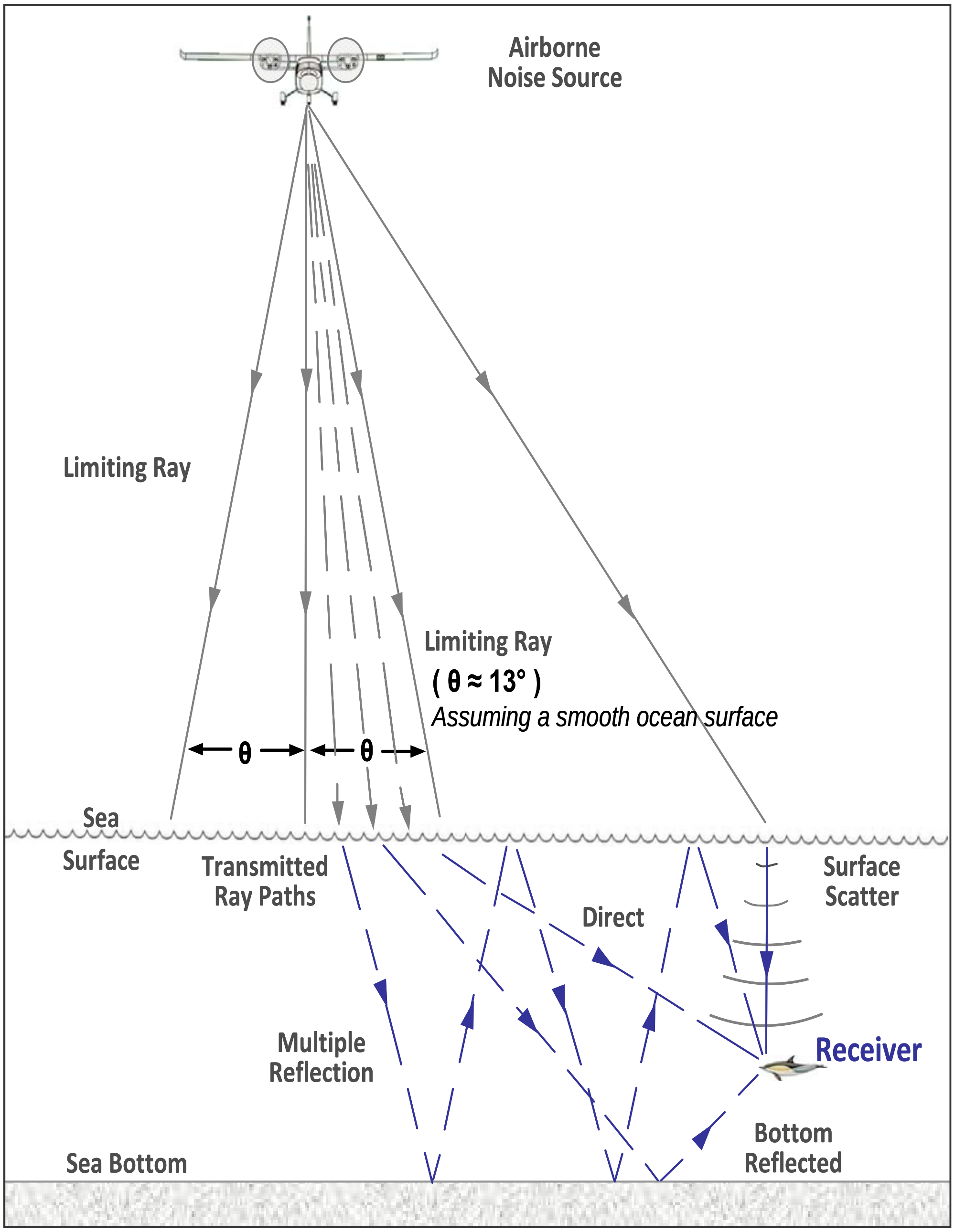

Figure 1. Diagram illustrating the theoretical 36-degree inverted sound cone (radius 13 degrees) within which the noise ray of an overflying aircraft is limited at the sea surface under calm, flat sea conditions. Also illustrated are ways in which the transmission of sound rays though the water surface can be influenced by water-depth reflection. Increasing disturbance of surface waters (i.e., increasing Beaufort sea state) can increase the size of the radius beyond the theoretical 26-degree sound cone. (Diagram from Richardson et al. 1995).

Table 3. Definitions used in assessing the utility and quality of video taken during marine mammal monitoring conducted on behalf of the Navy in the SOCAL and HRC range complexes October 2008-July 2009.

Video Quality	Definition
Poor	Behavior and audio indiscernible. E.g., animal never seen in video or behavior cannot be determined because animal too far away, video shaky/out of focus/moving too much, Beaufort sea state too rough (i.e., can't determine dispersal distance between individuals, blows and (for whales), individual surface-active behaviors, and/or orientation of animal), and/or audio cannot be understood due to interference/static noise or was not recorded.
Fair	Some behavior and most audio discernible. E.g., animal seen in video and behavior, orientation, and dispersal can be determined but in view on video for only a short period of time (<30 sec per video clip). Most audio can be understood.
Good	Most behavior and audio discernible. Most periods animal at or near surface are captured on video and most audio is understandable. Animal seen in video for a longer length of time (e.g., >30 sec per video clip) and can determine behavior. Nearly all individual behavioral events, blows (for whales), behavior state, orientation, and dispersal distances can be determined via combined video and/or audio.
Excellent	Behavior easily discernible all times animal in view below/above surface and audio discernible. E.g., animal(s) seen throughout entire video when visible at or below the water surface and all audio can be understood. All behavioral events and blows (for whales), behavior state, heading, and dispersal distance can be determined. Video footage is relatively steady and focused. Usually occurs when Beaufort sea state is less than 3.

Table 4. Behavior state and individual behavioral event definitions.

BEHAVIOR STATE (>50% of group's activity--note once per min; also note if unknown when animals not in view during that minute)	CODE	DEFINITION (e.g. Perrin et al. 2009, Shane 1990, etc.)
REST/SLOW TRAVEL	RE	>50% of group exhibiting little or no forward movement (<1 km/hr) remaining at the surface in the same location or drifting/traveling slowly with no wake
TRAVEL	TR	Slow travel = travels w/ no wake or white water. Medium travel = travel with wake but no white water. Fast travel = travel with wake and white water
MILL	MI	>50% of group swimming with no obvious consistent orientation (non-directional) characterized by asynchronous headings, circling, changes in speed, and no surface activity. Includes feeding.
SURFACE-ACTIVE MILL	SM	While milling, occurrence of aerial behavior that creates a conspicuous splash (includes all head, tail, pectoral fin, and leaping behavior events—see below) Includes feeding.

BEHAVIOR STATE (>50% of group's activity--note once per min; also note if unknown when animals not in view during that minute)	CODE	DEFINITION (e.g. Perrin et al. 2009, Shane 1990, etc.)
SURFACE ACTIVE TRAVEL	ST	While traveling, occurrence of aerial behavior that creates a conspicuous splash (include all head, tail, pectoral fin, and leaping behavior events—see below)
PROBABLE FORAGING	PF	Apparent searching for prey; the process of finding, catching, and eating food (Perrin et al. 2009)
UNKNOWN	UN	Not able to determine behavior state. (e.g., animals out of sight, too far to determine, on a dive, etc.)
OTHER	OT	Describe in notes
Individual Behavior Event		
Logging	LG	Lying at the surface with body exposed with no directed forward movement
Breach	BR	A behavior in which a marine mammal leaps out of the water (Perrin et al. 2009)
Porpoise	PO	The behavior of marine mammals leaping at least partially clear of the water surface during rapid swimming (Perrin et al. 2009)
Stern-ride	SR	The action or behavior pattern of riding on the pressure wave at the stern or abreast of a ship
Spin	SP	Leap clear of water and spin (dolphins only)
Bow ride	BO	The action or behavior pattern of riding on the pressure wave in front of the bow of a ship (Perrin et al. 2009) or the stern or abreast of a ship
Head Slap/Lunge	HS	Leap out of water w/ forward thrust or side at >40º and slap ventral surface on water creating large splash
Foraging	FO	Seen chasing fish or prey and/or zigzag pursuit swimming
Sprint	ST	Brief increase in speed often associated with foraging /feeding
Social	SO	Two or more animals in physical contact
Roll over	RO	Animal completely rolling over
Zigzag	ZZ	Swimming in a zigzag pattern
Tail Slap	TS	A behavior in which a marine mammal slams its flukes down on the water, usually repeatedly (Perrin 2009)
Pectoral Fin Slap	PS	Slap water surface with pectoral fin - ventral or dorsal up
Inverted Swim	IS	Animal swimming with ventral side up, dorsal side down - inverted
Unknown	UN	
Other Behavior	OB	Behavior not listed above: describe in notes

BEHAVIOR STATE (>50% of group's activity--note once per min; also note if unknown when animals not in view during that minute)	CODE	DEFINITION (e.g. Perrin et al. 2009, Shane 1990, etc.)
Missed Behavior	OMB	Did not see/missed a behavior
Whales Only		
Blow	BL	Visible respiration-cloud of vapor and sea water mixed with air that is exhaled by cetaceans (Perrin et al. 2009)
No Blow Rise	NB	Surface with no visible blow/respiration
Missed Blow	MB	A blow/surfacing is suspected to have been missed/not seen
First Blow	FB	First blow of surface sequence (where surface sequence consists of closely spaced blows usually followed by a dive)
Peduncle Arch	PA	Arching of peduncle (posterior portion of the body bearing the tail or flukes) without lifting tail/flukes
Fluke up	FU	Arching of back followed by lifting tail flukes into air (fluke facing up) usually before an extended dive
Fluke down	FD	Arching of back followed by lifting tail flukes into air (fluke facing down) usually before an extended dive
Un ID Large Splash	US	Large splash associated with an unidentified/unseen behavior
Vertical	VU	Vertical in water with head up
Vertical down	VD	Vertical in water with head down

Table 5. Codes and definitions developed and used during transcriptions of marine mammal behavior from video.

Behavior State Code	Definition
Codes When Behavior State Not Visible	
NVSS	Not visible due to animals being sub-surface
VSSNB	Visible sub-surface but no behavior discernable
NVGL	Not visible due to animals in glare
NVPL	Not visible due to animals under plane e.g. out of view under belly of plane or under wing
NVOF	Not visible due to camera out of focus or camera not centered on group
Group Shape	
C	Circular
L	Longer than wider oval
W	Wider than longer oval
T	Triangle
IT	Inverted triangle
LA	Line abreast (single file line horizontally)
LAL	Line abreast (single file line vertically)
V	V-shaped
IV	Inverted V-shape
U	U-shaped
IU	Inverted U-shape
IR	Irregular Shape
O	Other

Table 6. Issues and problems encountered and how they were addressed during development and application of using video to collect marine mammal behavioral data in the Navy's HRC and SOCAL range complexes 2008-2010.

Video Issue	Description of Problem	Resolution	Recommendations	Comments
Format	The video is in the format of the video camera (ex. Canon video recorders produce in a unique proprietary format). Format is incompatible with video playback software except the software that comes with the video camera.	A software program was purchased to change file format. Although the video can be viewed by many programs after conversion, the result is a significant investment of additional resources. Conversion is slow and utilizes enough RAM to make the system(s) used for the conversion inoperable until the task is completed.	Recorders have unique formats in order to compress files while recording. Each recorder has the software distributed with the hardware. All video should be recorded using one format (brand and model of recorder) and software should be distributed to all staff needing access to viewing videos.	There may be a requirement to purchase additional licenses for users. It will be important to note that if file conversion is continued, WAV is the preferred format. Other formats may compromise audio.
Access to files	File sizes are large. Uploading to FTP is time-consuming as is subsequent downloading.	Task was divided among users. Some files were distributed on portable, external hard drives mailed to staff. Egnyte (storage space on a server) was purchased to make access to files possible from any geographical location with internet access. This is a time-consuming process (see comments)	Files can be uploaded overnight on several machines. Task should be divided for efficiency. Bandwidth is the limiting factor for transferring files to shared data bases (for users over distance). Speeding up this process is costly. Important to upload and download in the same high-resolution as original video or resolution can be lost in the uploading, downloading, and copying process	It is not likely that purchasing more bandwidth to upload files will make good fiscal sense as long as analyzing data is not a 24-our operation. It may make sense to acquire an intern needing experience to perform data transfer, if a dedicated computer is available. Otherwise, a dedicated computer is needed and needs to be checked intermittently to ensure copying. uploading and downloading process are not interrupted.

Video Issue	Description of Problem	Resolution	Recommendations	Comments
Potential loss of video resolution	Video resolution can be degraded during uploading, downloading, and/or copying process. It can also appear to be reduced when viewing it from an external HD rather than from a high-powered computer.	Be sure and maintain HD quality and resolution when copying, downloading and uploading. View video from a high-powered laptop rather than an external HD as the latter modes cause video to appear grainy and shaky when in fact it is not.	See column three	
File names/dates /times	Identification of video segments was initially problematic. Dates and times did not always match with the signature from the video recorder. Time stamp on video was lost when opened in any software other than the original video camera format (e.g., Canon or Sony).l	a. Considerable effort and time was needed to decipher date/time stamps of video by back tracking to clips that could be identified and then using the video counter numbers and translating them to time, from a known start time. b. On 3 April 2011 we found (online) software developed by an independent person to display the time and date on video downloaded via the USB cable to the computer/external hard drives as long as the video is downloaded in the original proprietary format (e.g., Cannon). The issue that date and time are not displayed on downloaded video when not using the Cannon or Sony proprietary software AND the AV cable has been a problem for many users of the Sony video as indicated by customer complaints online. This independent software (vATS, http://dts8888.com/vATS/vats.htm) is available for purchase online for 40$ and allows display of time and date for video downloaded with USB cable, again as long as the video is downloaded in the original Sony format. It can then be opened and edited on most readily available software (e.g., windows media player, Adobe Premiere, etc.).	Run the original video through the independent software designed to allow transfer of original time and date into formats other than the original, proprietary video camera format. Alternatively, a single, dedicated stop watch can be started at the first video segment. The start time should be recorded from a GPS unit or cell phone (updated by satellite) when the stop watch is activated. At the start and end of each video segment the stop watch can be videotaped. Times can be deduced by adding the running time on the stop watch to the initial start time.	Application of the independent software that can read and display the original video camera date and time has solved previous issues. All video have subsequently been run through this program and original times and dates are now displayed on the video.

Video Issue	Description of Problem	Resolution	Recommendations	Comments
Still shots	Video is often blurred when a still shot is desired.	Alternating to a program allowing frame by frame capture.	Software specific to the video recording unit may have this option. Alternating to another program is time-consuming and should be available on software specific to the video unit of an upgrade.	
Frame by frame viewing	Frame-by-frame viewing is desirable to analyze behaviors but is not possible on all video-viewing software. This enables the viewer to examine the position of all individuals and the external environment	Using a video viewing program that has an option to view frame by frame (e.g. QuickTime Player).	Software specific to the video recorder is likely to allow frame-by-frame viewing. It may be necessary to purchase an upgrade depending on the model/brand of video recorder. However, using the original format program of the video camera means no one can see the video except people who have the proprietary software that comes with the video camera.	Frame-by-frame is valuable for analyzing behaviors in video clips. Cetaceans often react quickly to conspecifics, prey, and other stimuli. Identifying probable source for a specific action/reaction is facilitated by advancing video frame-by-frame.
Instability of recorder during video capture	Video is difficult to analyze due to shaking during recording.	An internal-stabilizer during video clips reduced some of the shaking during recordings. Using a chest monopod with the video camera attached to it with the base braced against the videographer's chest helped to reduce shakiness. However, shakiness due to air turbulence is difficult to remedy.	Chest stabilizers should be available during all surveys for all videographers	Need to investigate the cost of a more expensive and better gyrostabilizer for the camera as done by National Geographic. Consult Dr. Bernd Würsig.

Video Issue	Description of Problem	Resolution	Recommendations	Comments
Species Identification	Distance, activity or angle sometimes makes it difficult to confirm species identification during analysis for small delphinids.	Consulted with the crew on the survey for identification or made a presumptive ID. Reviewers can reference the master data sheets (electronic format in Egnyte) to determine the species.	Voice recording is obstructed by the noise of the aircraft. A means of recording an ID on the video should be visual. A piece of paper with a print out of common species names in bold print can be posted on the aircraft near the window or other location close to the videographer. ID can be established by video recording the name of the species during the clip. More than one species can be indicated by video recording more than one ID from the paper for several seconds.	Separate voice recorders were not clear enough to understand the voice of the person speaking. The separate voice recordings need to be matched up after the survey. Video recording the species ID from a piece of paper ensures correct ID matched to the correct clip without additional investment in time retrieving separate audio files.
	Voices on video or voice recorders sometimes obstructed by the aircraft noise.			
Clips extended past behaviors	Videographer continues to film after whales dive or aircraft leaves the area (either by filming the water or setting the recorder down inside the aircraft) extends the length of the video and the length of time invested in analysis while the reviewer anticipates more video of animals.	Since summer 2010 we have been stopping the video recordings when animals are not in view to minimize the size of the video file and the analysis time.	Refer to last entry : "aircraft noise: general"	Initially all video between animal surfacing was recorded as a back up to capture vocal notes by the observers for additional information.

Video Issue	Description of Problem	Resolution	Recommendations	Comments
Aircraft noise: general	Electrical interference (i.e., impedance) from aircraft sound system with video recording system caused static and high-pitched noise that interfered with ability to decipher audio on video. Wind noise from window opened to collect video sometimes interfered with ability to understand audio on video.	Aircraft noise mismatched impedance noise interference with vocals recorded through aircraft headset jacks have been replaced by placing a mini microphone in one side of an observer's aircraft headset that is then connected directly to adapter splitter into the video microphone port/jack and the voice recorder port/jack. This has resulted in crisp clear vocal recordings with no extra noise or impedance interference. This was started in Feb 2011 after trying a number of impedance-canceling cables with minimal improvement.	Resolved for electrical interference. To minimize or avoid noise interference from open window, put mini-microphone in ear of someone other than the video recorder.	Prior to this a specialized impedance cable had been purchased to try and filter out the aircraft interference noise. That reduced the noise but did not eliminate it. This problem has been solved.
Video lost when Mac and PC hardware and software used same external HD.	The 3 versions of the July 2009 video became inaccessible. Video from this survey was first downloaded to an Apple computer. It was then copied onto two external HD that we were told were interchangeable between Apple and PC computers. They were originally viewed and transcribed for the first initial view for summarizing general content and length from the external HD on a Mac. When the external HD was later opened by two separate users independently using a PC, the HD became unreadable.	One of the external HDs was brought to two different computer repair stores in Anchorage and they said they could not retrieve the data. The second external HD was taken to 3 different computer repair stores in the Seattle area and they also were not able to retrieve the video. More research was done on expert data retrieval services. One external HD was then sent to such a service but the retrieval fee was 1600$ initially so further investigation was ceased due to cost and no guarantee of retrieval. Another smaller expert data retrieval company was then contacted and the two HDs were sent to this company. They quoted a minimum cost of 900$ possibly more. The HDs are currently being examined by this group. However, they take about 1 one month to conduct the assessment.	Do not interchange use of Apple and PC computers when copying and viewing data. Make 4 copies of the video including an online offsite copy.	All videos have since been uploaded to an offsite online data storage site and copied to 3 external HDs located in different regions. We are using only PCs and PC software for video analyses, review and transcription.