

NOAA Technical Memorandum NMFS



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**MARINE MAMMAL DATA COLLECTED DURING A SURVEY IN
THE EASTERN TROPICAL PACIFIC OCEAN ABOARD
NOAA SHIPS *DAVID STARR JORDAN* AND *McARTHUR II*,
JULY 28 - DECEMBER 7, 2006**

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U.S. DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
National Marine Fisheries Service
Southwest Fisheries Science Center

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NOAA Technical Memorandum NMFS

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INTRODUCTION

In 1997 the U.S. Congress directed the Secretary of Commerce to determine whether the chasing and deployment of purse seine nets around dolphins during tuna fishing operations in the eastern tropical Pacific Ocean (ETP) was having a significant adverse impact on any depleted dolphin stock (International Dolphin Conservation Program Act, Public Law 105-42). A portion of this mandate directed the National Marine Fisheries Service to undertake three field surveys between 1998 and 2000 to estimate the current abundances of the populations of dolphins in the area affected by the fishery.

Among other results, analysis of data from the 1998-2000 cruises indicated that ETP dolphin populations were not recovering as expected (SWFSC 2002). Accordingly, the Southwest Fisheries Science Center (SWFSC) plans to carry out a cruise every three years to monitor the dolphin populations affected by the fishery. The 2006 *Stenella* Abundance Research project (STAR06) was the second of these continuing cruises.

This report summarizes the survey procedures and data for marine mammals during the STAR06 cruise. Ecosystem studies conducted during STAR06 will be summarized in a separate report. Marine mammal data on STAR cruises from 1998-2000 and 2003 were summarized in Kinzey et al. (1999, 2000a, 2001) and Jackson et al. (2004). These reports and additional details about the project are available at <http://swfsc.noaa.gov/PRD-star.aspx>.

The SWFSC has conducted research on the cetacean populations of the ETP since the mid-1970s. The line-transect field methodologies in current use were originally established for the five-year "Monitoring of Porpoise Stocks" (MOPS) program of surveys the SWFSC completed between 1986 and 1990. MOPS produced estimates of abundance over this five-year period for 24 stocks of cetaceans representing 19 species or genera (Wade and Gerrodette 1993). The MOPS program also produced annual estimates for the four species of dolphins (*Stenella attenuata*, *S. longirostris*, *S. coeruleoalba*, and *Delphinus delphis*) believed to be most affected by the fishery (Wade and Gerrodette 1992). A time-series of abundance estimates of northeastern offshore spotted and eastern spinner dolphins, including the STAR cruises through 2000, have been published by Gerrodette and Forcada (2005). Estimates of abundance of selected other species less affected by the fishery are reported in Gerrodette and Forcada (2002). Preliminary estimates of abundance in 2003 have been reported for northeastern offshore spotted and eastern spinner dolphins (Gerrodette et al. 2005). Additional information regarding the abundance of stocks of dolphins taken by the fishery is available through analysis of sighting data from the tuna vessels (Anganuzzi and Buckland 1994), although these data contain biases that vary in time (Lennert-Cody et al. 2001).

The STAR06 survey was conducted using the two NOAA ships *David Starr Jordan* (hereafter referred to as the *Jordan*) and *McArthur II* with cruise numbers assigned as follows:

Jordan, DS-06-05: SWFSC Cruise Number 1630

SURVEY OBJECTIVES

The primary objective of the study was to estimate abundances of the dolphin stocks affected by the ETP purse-seine fishery for yellowfin tuna (*Thunnus albacares*). The survey's design targeted the depleted stocks of eastern spinner dolphins (*Stenella longirostris orientalis*) and the northeastern offshore stock of spotted dolphins (*Stenella attenuata*). In addition to data suitable for line-transect analysis, behavioral, acoustic, photogrammetric, genetic, morphological, and individual whale identification data were collected on the region's cetaceans and are described in this report.

STUDY AREA

The study area extended from the U.S.-Mexico border, south to the territorial waters of Peru, bounded on the east by the continental shores of the Americas, and to the west by Hawaii (roughly from 30° north to 18° south out from the coastline to 153° west; see Fig. 1 and Appendix A). This area is the same as that covered during the 1998-2000 and 2003 surveys and approximately the same as that covered during the 1986-1990 MOPS surveys. Examination of dolphin sightings from research and fishing vessels indicated that this region encompasses the entire distribution of the dolphin stocks most affected by the fishery (Gerrodette et al. 1998). The study area was divided into three sampling strata that received different levels of survey effort: the core area, the outer area, and the coastal area (Fig. 1). The strata for the 2006 survey were the same as for the 2003 survey and only differed from the 1998-2000 surveys in that the western boundary of the core area was shifted to the west to include more of the range of the eastern spinner dolphin. The coordinates of the westernmost boundary point of the core area were 10° north and 125° west (Fig. 1).

ITINERARY

The survey began on July 28 and ended on December 7, 2006. It was composed of four legs on the *McArthur II* and six legs on the *Jordan*. Survey legs varied between 17 and 30 days in length, separated by 3 to 7 days in port. The itineraries for the ships are listed below.

NOAA Ship *David Starr Jordan*:

28 Jul	Depart San Diego, CA
30 Jul - 13 Aug	Leg 1
14 Aug - 16 Aug	Manzanillo, Mexico
17 Aug - 03 Sep	Leg 2
04 Sep - 07 Sep	Puntarenas, Costa Rica
08 Sep - 27 Sep	Leg 3
28 Sep - 02 Oct	Puerto Quetzal, Guatemala
03 Oct - 21 Oct	Leg 4
22 Oct - 24 Oct	Acapulco, Mexico
25 Oct - 18 Nov	Leg 5

19 Nov - 21 Nov	Manzanillo, Mexico
22 Nov - 06 Dec	Leg 6
07 Dec	Arrive San Diego, CA

NOAA Ship *McArthur II*:

28 Jul	Depart San Diego, CA
28 Jul - 25 Aug	Leg 1
26 Aug - 01 Sep	Honolulu, HI
02 Sep - 28 Sep	Leg 2
29 Sep - 04 Oct	Manta, Ecuador
05 Oct - 02 Nov	Leg 3I
03 Nov - 08 Nov	Manzanillo, Mexico
09 Nov - 06 Dec	Leg 4
07 Dec	Arrive San Diego, CA

SCIENTIFIC PERSONNEL

The scientific complement per leg included 12 to 15 scientists aboard the *Jordan* and 13 to 14 aboard the *McArthur II*. Appendix B lists the scientists and ship/legs on which they participated.

Two three-person teams of marine mammal observers were aboard each ship. Additionally, the *McArthur II* had one acoustician and 1 acoustic technician on legs 1-4. Data collected by birders and oceanographers aboard each vessel will be summarized in separate reports, as noted in the introduction.

EQUIPMENT AND PROCEDURES

Line-transect Survey

Line-transect procedures developed at SWFSC for estimating absolute abundances of cetaceans were followed during the survey (Kinzey et al. 2000b). The *McArthur II* and *Jordan*, 68.3 m and 52.1 m in length, respectively, maintained cruising speeds of approximately 18.5 km/hr (10 kt) along pre-determined tracklines (Figures 1-4) while actively searching for marine mammals ("on effort" mode). Observers conducted a visual watch for marine mammals during daylight hours (approximately 0600 to 1800) using two 25 X 150 power binoculars mounted on the port and starboard sides of the ship's flying bridge. For each marine mammal sighting, bearing (using an azimuth ring on the binocular mount to measure angle) and distance (using a reticle scale inscribed in the eyepiece) were recorded, along with the initial sighting cue and related information.

Six observers on each ship rotated through three watch positions: port binocular, center observer/data recorder, and starboard binocular. Observers shifted positions every 40 minutes. At least one identification specialist with previous experience in the ETP was on watch at all times.

Total binocular height above the water for the *Jordan* was 10.7 m, giving a maximum ship-to-horizon sighting distance of approximately 11.7 km (6.3 nm). On the *McArthur II*, total binocular height above the water was 15.2 m, giving a maximum ship-to-horizon sighting distance of approximately 13.9 km (7.5 nm). Two additional mounted 25 X 150 binoculars were available on both ships for periodic use during sightings (but not during searching mode).

Sighting data were collected by the three observers in the three watch positions on each ship. No information from other observers or binocular positions was relayed to this primary team during searching effort. The observer at the port binocular surveyed the area between the trackline and 90° left of the trackline. The observer at the starboard binocular surveyed the area between the trackline and 90° right of the trackline. Using unaided eye and a handheld 7X binocular, the center observer searched the entire 180° forward of the ship, with effort focused on the trackline and the area from the ship out to about 400 meters (the "blind" area for observers using the 25X binoculars).

The center observer also served as the data recorder and entered sighting, weather and effort information into a computer on the flying bridge using the SWFSC software program "WinCruz". The computer was linked to the ship's global positioning system to record time and position for every event entered by the recorder such as a sighting or effort change, or automatically every 10 minutes if no other event had been entered.

When a sighting was made, searching effort was typically suspended (i.e., "off effort") and the ship entered "closing" mode with variable speeds and courses in order to approach the mammals. Schools were approached if they were within 3 nm perpendicular to the trackline. Observers identified cetaceans to the level of species/stock when possible, and then made independent estimates of school size. If more than one taxon was present, percent composition of the school was estimated independently by each observer. Sightings of new schools made while in closing mode were recorded as off-effort sightings. While in closing mode, ancillary projects such as photo-identification and skin biopsy sampling might be conducted.

Upon completion of activities associated with the sighting, the ship returned to searching mode on a course toward the next waypoint (essentially parallel to the original trackline) unless the perpendicular distance from the original trackline was greater than 10 nm (18.5 km) from it, in which case the ship resumed searching on a 20° course back to the original trackline. If a school that had been previously recorded as an off-effort sighting during closing mode was resighted during searching, it was recorded as an on-effort sighting.

Acoustics

There were three main goals of the acoustics program for the STAR06 survey: (1) to gather additional information to determine whether acoustics can aid in the estimation of dolphin distribution and abundance; (2) to gather additional information on the range of acoustic detection of sperm whales (*Physeter macrocephalus*); and (3) to examine the

geographic variation of Bryde's (*Balaenoptera edeni*) and blue whale (*B. musculus*) vocalizations. Two procedures were used to gather these data: continuous monitoring and recording of dolphin and sperm whale vocalizations obtained from a towed hydrophone array on the *McArthur II*, and opportunistic deployment of sonobuoys for recording baleen whales from both the *McArthur II* and the *Jordan*. Additionally, opportunistic recordings of odontocetes were made on the *Jordan* using a bow-mounted hydrophone.

A two-element hydrophone array was towed 300 m behind the *McArthur II* during daylight hours. This array was built in-house, and the hydrophones have internal pre-amplification and sensitivity from 1 kHz to 40 kHz (± 5 dB). The array was monitored for cetacean vocalizations aurally and visually, using a spectrographic display, and clear cetacean sounds were recorded on a Tascam DA-38 multi-channel recorder at 48 k samples/sec. Real-time spectrographic displays of sounds were monitored using ISHMAEL (Mellinger 2001) software, which allows for localization of vocalizing animals via phone-pair (cross-correlation) algorithms. Successive angles to sound sources obtained using these methods were plotted to a mapping program, Whaltrak.

The sperm whale protocol differed from previous SWFSC acoustic surveys during which neither the visual nor the acoustic team announced the presence of sperm whales until they had passed abeam (or until the cruise leader had determined that both teams had detected the group). On STAR06 survey, the visual observers immediately informed the acoustic team when they had a sperm whale sighting. If that sighting was within 3 nm of the transect line, the visual observers would immediately go off-effort to approach the animals and obtain group size information. Therefore, the visual and acoustic detections of this species were not independent. However, the acoustic observers did not inform the visual observers of sperm whale or other cetacean detections until they had passed abeam. Visual observers frequently relayed information about delphinid sightings to the acoustic team to aid them in documenting delphinid whistle recordings.

Opportunistic deployments of Navy-surplus sonobuoys were made from both ships to record cetacean sounds not easily obtained using the hydrophone array. Sonobuoys (type 53, 57 or 77) were typically deployed within 500 m of Bryde's and blue whales. Sonobuoy signals were received using a 2-channel ICOM receiver and recorded to a Sony DAT recorder. Sounds were monitored aurally and visually using a scrolling spectrographic display.

A 3-element bow hydrophone was attached to the bow bubble of the *Jordan*, and allowed for recording vocalizations of odontocetes in close proximity to the bow of the ship (primarily bow-riding dolphins).

Photo-identification and Biopsy Studies

Digital photographs of cetacean schools and individuals were taken to assist with stock delineations and for studies utilizing identifiable individual whales to determine stock movement or, for some whale species such as blue whales, as an alternative means of

estimating population sizes. These studies were often conducted in conjunction with biopsy sampling using a hollow-tipped dart fired from a crossbow to obtain a small sample of skin for genetic analysis. Both photography and biopsy sampling were conducted either from the bow of the ship or from a small boat with outboard engine.

Aerial Photogrammetry

During Leg 5 for the *Jordan* (October 26-November 4) and Leg 4 for the *McArthur II* (November 9-18), each ship conducted coordinated operations with a NOAA Twin Otter aircraft operating out of airports along the west coast of Mexico (mainly Acapulco). On days with excellent weather (Beaufort 2 and below) the aircraft flew to the vessel area to collect vertical photographs of schools detected from the ship and also attempted to locate schools in the ship's immediate vicinity. Data from the images will be used to calibrate observer estimates of school size and to estimate calf production for populations sampled. During days of ship/aircraft operations, no line-transect sampling took place. The ship/aircraft coordinated operations used 11 of the 12 days allocated.

Behavior

Behavioral data collection emphasized dolphin schools and focused on behaviors that would indicate reactions to the vessel. The data included information on (1) group behavior, (2) school size and shape, (3) reactions to the research vessel, and (4) an estimate by the observer of whether the overall reaction of the school to the research vessel was evasive, non-evasive, both, or unknown. These data were collected using minor modifications to the additional data fields on the Marine Mammal Sighting Form that were initiated with the 1999 survey.

RESULTS

Line-transect Observations

A total of 22,237 km of trackline were surveyed by the two ships during 178 ship days of on-effort searching. The daily record of km surveyed by each ship is reported in Table 1. An average of 125 km (67 nm) of trackline was searched per ship per on-effort day. Figures 1 and 2 depict the locations of the combined tracklines. Tracklines completed individually by the *Jordan* and the *McArthur II* are depicted in Figures 3 and 4, respectively. The *McArthur II* surveyed the most offshore and southern portions of the study area, while the *Jordan's* tracklines were concentrated in the core area.

A total of 1,587 sightings of marine mammals were made during the survey: 1,007 from the *Jordan* and 580 from the *McArthur II*. Of this total, 1,135 sightings were on-effort, made during searching mode by the on-duty observers. The number of "pure" (single sighting category) and "mixed" (multiple category) schools are shown in Table 2. Eighty-six percent of all schools were pure schools. The total of 1,827 pure and mixed sightings in Table 2 exceeds the actual number of sightings by 240 because mixed sightings are counted separately in the table for each category recorded in the sighting.

Maps depicting the geographic positions for all marine mammal sightings are displayed in Figures 5-26.

The most common sighting categories were offshore spotted dolphin (*Stenella attenuata*) and unidentified small delphinid, found in about 11% and 10% of the total schools, respectively (Table 2). These two categories were followed closely in frequency by bottlenose dolphin (*Tursiops truncatus*), striped dolphin (*Stenella coeruleoalba*), short-beaked common dolphin (*Delphinus delphis*) and eastern spinner dolphin (*Stenella longirostris orientalis*). Offshore spotted and eastern spinner dolphins tended to be found in mixed schools while short-beaked common and striped dolphins were usually in pure schools.

The most commonly encountered species of large whales were blue whale (*Balaenoptera musculus*), sperm whale (*Physeter macrocephalus*) and Bryde's whale (*B. edeni*). In addition to the 22 confirmed sightings of Bryde's whale there were 21 sightings of whales that were either Bryde's or sei (*B. borealis*) whales that could not be identified to species.

The different kinds of mixed sighting-category schools recorded during the survey are shown in Table 3. Two hundred twenty-nine schools were mixed. The most common of these, 40% of all mixed schools, was comprised of the two target stocks, offshore spotted dolphin and eastern spinner dolphin. The second most common type of mixed school, 7% of all mixed schools, was comprised of short-fin pilot whale (*Globicephala macrorhynchus*) and bottlenose dolphin.

The overall sighting rate was 51.0 sightings per 1000 km (Table 4). Sighting rates were influenced by sea state and swell height (Table 4).

Acoustics

Recordings from the towed hydrophone array included vocalizations from short-beaked common dolphin (*Delphinus delphis*), spinner dolphin (*Stenella longirostris*), spotted dolphin (*S. attenuata*), striped dolphin (*S. coeruleoalba*), bottlenose dolphin (*Tursiops truncatus*), rough-toothed dolphin (*Steno bredanensis*), Fraser's dolphin (*Lagenodelphis hosei*), false killer whale (*Pseudorca crassidens*), pygmy killer whale (*Feresa attenuata*), pilot whale (*Globicephala* sp.), killer whales (*Orcinus orca*), minke whale (*Balaenoptera acutorostrata*), and sperm whale (*Physeter macrocephalus*, Table 5). All non-sighted acoustic detections, with the exception of sperm whales and minke whales, were "unidentified dolphins" if whistles were detected, and "unidentified cetaceans" if pulsed sounds were detected.

Recordings from the bow hydrophone on the *Jordan* included bottlenose dolphin, spotted dolphin, pygmy killer whales, rough-toothed dolphin, short-beaked common dolphin, spinner dolphin, killer whales, false killer whale, Risso's dolphin, striped dolphins, and minke whales (Table 6).

There were a total of 28 visual and/or acoustic detections of sperm whales while the acoustics team was on effort; eighteen of these were detected by the acoustics team only (Table 5). There were also nine acoustic detections of minke whales, none of which were sighted by the visual observation team.

A total of 77 sonobuoys were deployed from the ships, of which 33 were deployed from the *Jordan* (Table 7), and 44 were deployed from the *McArthur II* (Table 8). Sonobuoy recordings were made of blue whales, Bryde's whales, Bryde's/sei whales, Baird's beaked whales (*Berardius bairdii*), humpback whales (*Megaptera novaeangliae*), minke whales, bottlenose dolphins and pilot whales, and killer whales. Not all recordings contained vocalizations of the target species.

Photo-identification

Four hundred forty-eight cetacean schools were photographed (Table 9). One hundred thirty of these contained various stocks of spotted and spinner dolphins, or both. Photographs of potentially individually identifiable whales that will be submitted to existing ID catalogs were obtained from 35 sightings of blue whales, 12 sightings of killer whales, 9 sightings of sperm whales, and 6 sightings of humpback whales.

Aerial Photogrammetry

A total of 75 schools were photographed, of which 43 were used to calibrate observer estimates of school size (Table 10). Thirty-four mixed spotted/spinner, 14 common dolphin, 7 spinner and 4 spotted dolphin schools were photographed in the combined calibration and other aerial photogrammetric studies (Table 11).

Biopsy Sampling

Skin biopsy samples were obtained from 532 individual cetaceans representing 18 species or stocks (Table 12). For spotted dolphin, biopsies from the northeast stock, spotted schools unidentified to stock, and the coastal stock totaled 123, 8, and 28 samples, respectively. For spinner dolphin, the eastern stock and unidentified stock were represented by 78 and 25 samples, respectively. No samples were obtained from the hybrid or "whitebelly" form of spinner dolphin. Figures 27-34 show where skin biopsy samples were collected.

Behavior

Behavioral data regarding cetacean responses to the survey ships were collected for 1,244 sightings, separately by species/stock (Table 13), or 68% of all sightings. Most notably, these data were collected for 95% of the target species sightings.

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For further information about these data contact the following: marine mammal sightings, Tim Gerrodette; acoustics, Jay Barlow; aerial photogrammetry, Wayne Perryman; biopsy sampling, Barb Taylor; digital photographs, Alan Jackson; and behavior, Sarah Mesnick.

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Table 1. Kilometers of survey effort during STAR06, per ship per day.

Date	McArthur II	Jordan	Date	McArthur II	Jordan
29 Jul 06	0.0	36.3	27 Sep 06	38.4	177.7
30 Jul 06	57.8	174.2	28 Sep 06	0.0	130.1
31 Jul 06	104.8	96.1	3 Oct 06	30.3	0.0
1 Aug 06	127.1	244.4	4 Oct 06	118.3	0.0
2 Aug 06	90.5	211.0	5 Oct 06	91.0	53.4
3 Aug 06	134.9	228.0	6 Oct 06	78.0	176.7
4 Aug 06	155.5	183.6	7 Oct 06	96.6	150.6
5 Aug 06	150.9	188.8	8 Oct 06	144.6	176.6
6 Aug 06	192.4	153.9	9 Oct 06	113.9	170.3
7 Aug 06	196.3	138.7	10 Oct 06	141.4	175.6
8 Aug 06	120.7	104.5	11 Oct 06	78.4	200.3
9 Aug 06	118.2	211.4	12 Oct 06	48.6	190.6
10 Aug 06	100.0	221.0	13 Oct 06	0.0	144.4
11 Aug 06	144.8	181.3	14 Oct 06	106.9	139.1
12 Aug 06	131.5	167.6	15 Oct 06	0.0	132.5
13 Aug 06	123.9	162.5	16 Oct 06	0.0	141.6
15 Aug 06	0.0	124.7	17 Oct 06	0.0	97.1
16 Aug 06	0.0	171.9	18 Oct 06	9.7	151.5
17 Aug 06	90.8	23.9	19 Oct 06	120.5	181.5
18 Aug 06	165.0	93.8	20 Oct 06	164.4	140.2
19 Aug 06	143.6	162.1	21 Oct 06	150.6	89.8
20 Aug 06	153.4	160.7	22 Oct 06	0.0	124.4
21 Aug 06	153.8	0.0	23 Oct 06	0.0	157.2
22 Aug 06	90.7	0.0	24 Oct 06	0.0	194.0
23 Aug 06	19.5	0.0	25 Oct 06	73.2	206.2
24 Aug 06	201.2	0.0	26 Oct 06	0.0	173.6
25 Aug 06	145.7	0.0	27 Oct 06	0.0	164.0
26 Aug 06	90.5	0.0	28 Oct 06	0.0	135.2
27 Aug 06	42.2	0.0	29 Oct 06	0.0	167.1
28 Aug 06	112.7	0.0	30 Oct 06	0.0	141.0
29 Aug 06	133.6	0.0	31 Oct 06	0.0	127.2
30 Aug 06	73.4	0.0	1 Nov 06	0.0	174.7
31 Aug 06	89.6	0.0	2 Nov 06	0.0	186.9
1 Sep 06	65.8	0.0	5 Nov 06	80.1	0.0
2 Sep 06	75.8	0.0	6 Nov 06	105.8	0.0
3 Sep 06	93.4	0.0	7 Nov 06	3.8	0.0
5 Sep 06	0.0	108.4	11 Nov 06	183.1	0.0
6 Sep 06	0.0	162.5	12 Nov 06	81.3	0.0
7 Sep 06	0.0	125.4	13 Nov 06	139.4	0.0
8 Sep 06	99.4	229.0	14 Nov 06	80.6	0.0
9 Sep 06	123.2	100.2	19 Nov 06	0.0	72.9
10 Sep 06	63.0	146.3	20 Nov 06	0.0	52.4
11 Sep 06	30.0	196.7	21 Nov 06	0.0	87.1
12 Sep 06	104.8	0.0	22 Nov 06	6.9	49.5
13 Sep 06	38.1	190.1	23 Nov 06	0.0	168.1
14 Sep 06	145.6	102.4	24 Nov 06	0.0	162.1
15 Sep 06	37.3	172.4	25 Nov 06	43.3	148.9
16 Sep 06	67.8	163.9	26 Nov 06	43.3	89.1
17 Sep 06	143.2	191.1	27 Nov 06	110.2	68.6
18 Sep 06	109.0	193.8	28 Nov 06	92.4	153.1
19 Sep 06	127.0	167.3	29 Nov 06	141.5	143.7
20 Sep 06	115.4	106.6	30 Nov 06	38.5	0.0
21 Sep 06	114.6	138.7	1 Dec 06	156.2	159.3
22 Sep 06	123.5	118.2	2 Dec 06	139.7	170.3
23 Sep 06	78.9	146.7	3 Dec 06	82.4	163.6
24 Sep 06	76.7	95.6	4 Dec 06	68.9	183.8
25 Sep 06	86.5	124.2	5 Dec 06	0.0	113.0
26 Sep 06	79.2	123.2	6 Dec 06	0.0	81.8
			Total	8855.4	13381.9

Table 2. Summary of STAR06 marine mammal sightings. Mixed schools are counted once for each sighting category that occurs in them. School size is the mean of the best estimates of total school size for pure schools, and subgroup size of the sighting category in the case of mixed schools.

Code	Sighting Category	Pure Schools	Mixed Schools	Total Sightings	School Size
002	<i>Stenella attenuata</i> (offshore)	84	125	209	95.2
177	unid. small delphinid	166	20	186	23.4
018	<i>Tursiops truncatus</i>	92	57	149	24.2
013	<i>Stenella coeruleoalba</i>	137	2	139	51.8
017	<i>Delphinus delphis</i>	123	5	128	216.6
010	<i>Stenella longirostris orientalis</i>	23	92	115	123.8
077	unid. dolphin	64	12	76	25.2
015	<i>Steno bredanensis</i>	59	17	76	9.9
036	<i>Globicephala macrorhynchus</i>	30	27	57	18.0
075	<i>Balaenoptera musculus</i>	54	3	57	1.9
021	<i>Grampus griseus</i>	35	13	48	18.5
277	unid. medium delphinid	36	7	43	7.8
070	<i>Balaenoptera</i> sp.	36	2	38	1.4
049	ziphiid whale	34	1	35	1.7
079	unid. large whale	32	1	33	1.1
003	<i>Stenella longirostris</i> (unid. subsp.)	10	22	32	166.0
048	<i>Kogia sima</i>	31	0	31	1.6
051	<i>Mesoplodon</i> sp.	30	0	30	2.4
046	<i>Physeter macrocephalus</i>	22	2	24	6.1
072	<i>Balaenoptera edeni</i>	18	4	22	1.5
090	<i>Stenella attenuata</i> (unid. subsp.)	12	9	21	47.8
099	<i>Balaenoptera borealis/edeni</i>	21	0	21	1.3
034	<i>Globicephala</i> sp.	12	8	20	31.6
006	<i>Stenella attenuata graffmani</i>	15	4	19	167.7
078	unid. small whale	17	1	18	1.5
037	<i>Orcinus orca</i>	15	2	17	8.1
011	<i>Stenella longirostris</i> (whitebelly)	4	13	17	389.0
033	<i>Pseudorca crassidens</i>	10	6	16	11.8
001	<i>Mesoplodon peruvianus</i>	16	0	16	2.0
061	<i>Ziphius cavirostris</i>	16	0	16	1.8
PU	unid. pinniped	13	0	13	1.7
101	<i>Stenella longirostris</i> (southwestern)	5	8	13	292.4
076	<i>Megaptera novaeangliae</i>	11	0	11	1.5
032	<i>Feresa attenuata</i>	9	0	9	24.6
074	<i>Balaenoptera physalus</i>	8	0	8	1.2
ZC	<i>Zalophus californianus</i>	8	0	8	1.4
377	unid. large delphinid	8	0	8	3.3
063	<i>Berardius bairdii</i>	8	0	8	8.3
AT	<i>Arctocephalus townsendi</i>	8	0	8	1.4
UA	unid. fur seal	6	0	6	1.5
098	unid. whale	4	1	5	1.1
080	<i>Kogia</i> sp.	3	0	3	1.0
088	<i>Stenella longirostris centroamericana</i>	3	0	3	204.2
047	<i>Kogia breviceps</i>	3	0	3	1.3
MA	<i>Mirounga angustirostris</i>	2	0	2	1.0
UO	unid. sea lion	2	0	2	1.0
026	<i>Lagenodelphis hosei</i>	1	1	2	72.5
031	<i>Peponocephala electra</i>	0	2	2	395.5
065	<i>Indopacetus pacificus</i>	0	1	1	3.3
071	<i>Balaenoptera acutorostrata</i>	1	0	1	1.0
096	unid. cetacean	1	0	1	1.0
103	<i>Stenella longirostris orient/centroam</i>	0	1	1	187.6

Table 3. Marine mammal schools of mixed species composition during STAR06. Scientific names for each sighting code are listed in Appendix C.

Species 1 code name	Species 2 code name	Species 3 code name	Species 4 code name	Number of schools
002 OFFSH_SPOT	010 EAST_SPINR			91
036 SHRT_PILOT	018 TURSIOPS			15
011 WBEL_SPINR	002 OFFSH_SPOT			12
003 UNID_SPINR	177 UNID_S_DEL			10
003 UNID_SPINR	002 OFFSH_SPOT			9
034 GLOBI_SPP	018 TURSIOPS			8
021 GRAMPUS	018 TURSIOPS			7
015 STENO	018 TURSIOPS			7
101 SW_SPINNER	002 OFFSH_SPOT			6
177 UNID_S_DEL	002 OFFSH_SPOT			5
018 TURSIOPS	077 UNID_DOLPH			5
090 UNID_SPOT	177 UNID_S_DEL			4
090 UNID_SPOT	003 UNID_SPINR			3
018 TURSIOPS	015 STENO	036 SHRT_PILOT		3
036 SHRT_PILOT	033 FALSE_KLLR			3
021 GRAMPUS	015 STENO			2
018 TURSIOPS	277 UNID_M_DEL			2
006 COAST_SPOT	077 UNID_DOLPH			2
018 TURSIOPS	033 FALSE_KLLR			2
017 SHRTB_COMM	101 SW_SPINNER			2
018 TURSIOPS	006 COAST_SPOT	077 UNID_DOLPH		1
018 TURSIOPS	006 COAST_SPOT			1
072 BRYDES_WHL	015 STENO			1
021 GRAMPUS	015 STENO	277 UNID_M_DEL		1
046 SPERM_WHAL	018 TURSIOPS	036 SHRT_PILOT		1
098 UNID_WHALE	036 SHRT_PILOT			1
015 STENO	090 UNID_SPOT			1
075 BLUE_WHALE	018 TURSIOPS			1
021 GRAMPUS	077 UNID_DOLPH			1
021 GRAMPUS	070 UNID_RORQL			1
078 UNID_SM_WH	277 UNID_M_DEL			1
036 SHRT_PILOT	277 UNID_M_DEL			1
017 SHRTB_COMM	077 UNID_DOLPH			1
075 BLUE_WHALE	015 STENO			1
013 STRIPED	277 UNID_M_DEL			1
177 UNID_S_DEL	010 EAST_SPINR			1
077 UNID_DOLPH	090 UNID_SPOT			1
011 WBEL_SPINR	002 OFFSH_SPOT	072 BRYDES_WHL		1
037 KILLER_WHA	033 FALSE_KLLR			1
017 SHRTB_COMM	013 STRIPED			1
036 SHRT_PILOT	065 INDOPAC_PA	018 TURSIOPS		1
072 BRYDES_WHL	049 ZIPHIID_WH			1
031 MELON_HEAD	015 STENO	036 SHRT_PILOT		1
031 MELON_HEAD	026 FRASERS			1
046 SPERM_WHAL	079 UNID_LG_WH			1
075 BLUE_WHALE	070 UNID_RORQL			1
072 BRYDES_WHL	077 UNID_DOLPH			1
002 OFFSH_SPOT	018 TURSIOPS			1
017 SHRTB_COMM	103 E/CA_SPIN			1
021 GRAMPUS	018 TURSIOPS	277 UNID_M_DEL		1
037 KILLER_WHA	036 SHRT_PILOT	018 TURSIOPS		1

Table 4. Effort and sighting rates during STAR06, by sea state and swell height.

	Kilometers of effort	No. of sightings	Sightings per 1000 km
Total	22237.3	1135	51.04
By sea state (Beaufort)			
0	100.1	33	329.55
1	375.4	78	207.80
2	1729.8	221	127.76
3	3212.2	261	81.25
4	9375.5	336	35.84
5	6952.1	199	28.62
6	492.1	7	14.23
7	0.0	0	0.00
By swell height (ft)			
0	27.0	11	407.24
1	644.0	83	128.89
2	1101.8	163	147.95
3	2203.5	184	83.50
4	5553.5	321	57.80
5	5468.3	179	32.73
6	4577.4	140	30.59
7	1631.7	36	22.06
8	857.1	15	17.50
9	85.9	0	0.00
10	18.7	0	0.00
12	68.4	3	43.87

Table 5. Acoustic detection of cetaceans obtained using the towed hydrophone array on the *McArthur II* during STAR06 (including non-sighted unidentified dolphins, unidentified cetaceans, sperm whales, and minke whales).

Species	Number of Acoustic Detections
Unidentified dolphins (non-sighted)	479
Unidentified cetacean (non-sighted)	37
Unidentified dolphins (sighted)	32
<i>Physeter macrocephalus</i> (non-sighted)	18
<i>Physeter macrocephalus</i> (sighted)	10
<i>Balaenoptera acutorostrata</i> (non-sighted)	9
<i>Stenella coruleoalba</i>	35
<i>Globicephala</i> sp.	22
<i>Delphinus delphis</i>	21
<i>Stenella attenuata</i>	18
<i>Stenella longirostris</i>	13
<i>Tursiops truncatus</i>	8
<i>Pseudorca crassidens</i>	6
<i>Steno bredanensis</i>	6
<i>Orcinus orca</i>	2
<i>Feresa attenuata</i>	1
<i>Lagenodelphis hosei</i>	1
<i>S. attenuata, S. longirostris</i>	33
<i>T. truncatus, G. macrorhynchus</i>	11
<i>D. delphis, S. longirostris</i>	2
<i>P. crassidens, G. macrorhynchus</i>	2
<i>T. truncatus, P. crassidens</i>	2
<i>L. hosei, Peponocephala electra</i>	1
<i>S. bredanensis, P. electra, G. macrorhynchus</i>	1
<i>S. bredanensis, T. truncatus, G. macrorhynchus</i>	1
<i>T. truncatus, G. macrorhynchus, Indopacetus pacificus</i>	1
<i>T. truncatus, G. macrorhynchus, O. orca</i>	1
<i>T. truncatus, Unidentified dolphins</i>	1
Total	774

Table 6. Acoustic detection of cetaceans obtained from the bow hydrophone on the *David Starr Jordan* during STAR06.

Species	Number of Acoustic Detections
<i>Tursiops truncatus</i>	11
<i>Stenella attenuata</i>	11
<i>Steno bredanensis</i>	5
<i>Delphinus delphis</i>	4
<i>Stenella longirostris</i>	4
<i>S. attenuata, S. longirostris</i>	3
<i>Orcinus orca</i>	3
<i>Feresa attenuata</i>	2
<i>Pseudorca crassidens</i>	2
<i>Grampus griseus</i>	1
<i>G. macrorhynchus, P. macrocephalus, T. truncatus</i>	1
<i>T. truncatus</i> , Unidentified dolphins	1
<i>T. truncatus, S. bredanensis</i>	1
<i>Stenella coruleoalba</i>	1
<i>T. truncatus, G. macrorhynchus</i>	1
<i>Balaenoptera acutorostrata</i>	1
Total	52

Table 7. Acoustic recordings of cetaceans obtained using sonobuoys on the *David Starr Jordan* during STAR06, listed in decreasing order of recordings obtained. Not all recordings contain vocalizations from the target species.

Species	Number of Acoustic Detections
Opportunistic sonobuoys	13
<i>Orcinus orca</i>	7
<i>Balaenoptera musculus</i>	6
<i>B. borealis/edeni</i>	3
<i>Berardius bairdii</i>	1
<i>B. edeni</i>	1
<i>B. acutorostrata</i>	1
<i>Tursiops truncatus, Globicephala macrorhynchus</i>	1
Total	33

Table 8. Acoustic recordings of cetaceans obtained using sonobuoys on the *McArthur II* during STAR06, listed in decreasing order of recordings obtained. Not all recordings contain vocalizations from the target species.

Species	Number of Acoustic Detections
<i>Balaenoptera musculus</i>	18
<i>B. edeni</i>	15
<i>B. borealis/edeni</i>	5
Opportunistic sonobouys	3
Unidentified rorqual	2
<i>Megaptera novaeangliae</i>	1
Total	44

Table 9. Cetacean schools photographed by handheld digital cameras and total number of images taken during STAR06, listed by number of schools photographed.

Sighting Category	Schools	Images
<i>Tursiops truncatus</i>	54	1139
<i>Stenella attenuata</i> (offshore)	53	1922
<i>Delphinus delphis</i>	49	1232
<i>Globicephala macrorhynchus</i>	43	1656
<i>Stenella longirostris orientalis</i>	39	1618
<i>Balaenoptera musculus</i>	35	3745
<i>Stenella coeruleoalba</i>	31	427
<i>Steno bredanensis</i>	20	488
<i>Balaenoptera edeni</i>	13	469
<i>Orcinus orca</i>	12	1815
<i>Grampus griseus</i>	11	276
<i>Stenella attenuata graffmani</i>	11	221
<i>Pseudorca crassidens</i>	10	642
<i>Physeter macrocephalus</i>	9	213
<i>Stenella longirostris</i> (unid. subsp.)	9	447
<i>Megaptera novaeangliae</i>	6	147
<i>Balaenoptera borealis/edeni</i>	6	272
<i>Stenella longirostris</i> (whitebelly)	6	55
<i>Feresa attenuata</i>	6	628
<i>Stenella longirostris</i> (southwestern)	5	370
<i>Berardius bairdii</i>	3	63
<i>Stenella attenuata</i> (unid. subsp.)	3	64
<i>Stenella longirostris centroamericana</i>	3	357
<i>Balaenoptera physalus</i>	2	36
Ziphiid whale	2	96
<i>Peponocephala electra</i>	2	77
<i>Lagenodelphis hosei</i>	2	72
<i>Kogia sima</i>	1	26
<i>Stenella longirostris orientalis/centroamericana</i>	1	73
<i>Balaenoptera acutorostrata</i>	1	16
Totals	448	18,662

Table 10. Aerial photogrammetry effort, total number of schools, and number of calibration schools, obtained per leg during STAR06.

Leg #	DSJ Leg 5	Mac Leg 4	Totals
Days Flown	11	8	19
Days Lost	1	4	5
% Days Flown	92%	67%	79%
Flight Hours	56.3	44.0	100.3
Avg. Flight Hrs./Days Flown	5.12	5.50	5.28
Number of Schools Photographed	40	35	75
Number of Schools for Calibration	28	15	43
% Calibration	70%	43%	57%

Table 11. Numbers of aerially photographed cetacean schools per leg during STAR06.

Leg #	DSJ Leg 5	Mac Leg 4	Totals
<i>Stenella attenuata</i>	0	4	4
<i>Stenella longirostris</i>	3	4	7
Mixed <i>S. attenuata</i> & <i>S. longirostris</i>	25	9	34
<i>Stenella coeruleoalba</i>	0	0	0
<i>Delphinus delphis</i>	4	10	14
Other Small Cetaceans	3	4	7
Unid. Small Cetaceans	0	1	1
<i>Balaenoptera edeni</i>	1	0	1
Beaked Whales	4	3	7

Table 12. Summary of cetacean skin biopsy samples obtained during STAR06.

Species/Stock	DSJ	Mac	Total
<i>Stenella attenuata</i>	110	13	123
<i>Tursiops truncatus</i>	58	29	87
<i>Globicephala macrorhynchus</i>	62	20	82
<i>Stenella longirostris orientalis</i>	74	4	78
<i>Stenella attenuata graffmani</i>	27	1	28
<i>Stenella longirostris</i> subsp.	25	0	25
<i>Orcinus orca</i>	22	0	22
<i>Delphinus delphis</i>	19	2	21
<i>Balaenoptera musculus</i>	9	9	18
<i>Steno bredanensis</i>	13	0	13
<i>Physeter macrocephalus</i>	9	1	10
<i>Stenella attenuata</i> subsp.	0	8	8
<i>Balaenoptera edeni</i>	4	1	5
<i>Megaptera novaeangliae</i>	2	1	3
<i>Pseudorca crassidens</i>	1	3	4
<i>Stenella coeruleoalba</i>	2	0	2
Unid	2	0	2
<i>Feresa attenuata</i>	1	0	1
Total	440	92	532

Table 13. Number of cetacean schools for which behavior observations were recorded during STAR06.

Sighting category	Total
<i>Balaenoptera edeni</i>	5
<i>Balaenoptera musculus</i>	14
<i>Berardius bairdii</i>	3
<i>Delphinus delphis</i>	124
<i>Feresa attenuata</i>	9
<i>Globicephala macrorhynchus</i>	48
<i>Globicephala</i> sp.	18
<i>Grampus griseus</i>	44
<i>Indopacetus pacificus</i>	1
<i>Kogia sima</i>	5
<i>Lagenodelphis hosei</i>	2
<i>Megaptera novaeangliae</i>	1
<i>Mesoplodon</i> sp.	4
<i>Orcinus orca</i>	17
<i>Peponocephala electra</i>	2
<i>Physeter macrocephalus</i>	4
<i>Pseudorca crassidens</i>	13
Rorqual identified as a Sei or Bryde's whale	2
<i>Stenella attenuata</i> (offshore)	200
<i>Stenella attenuata</i> (unid. subsp.)	14
<i>Stenella attenuata graffmani</i>	17
<i>Stenella coeruleoalba</i>	139
<i>Stenella longirostris</i> (southwestern)	13
<i>Stenella longirostris</i> (unid. subsp.)	23
<i>Stenella longirostris</i> (whitebelly)	18
<i>Stenella longirostris centroamericana</i>	3
<i>Stenella longirostris orientalis</i>	108
<i>Stenella longirostris orientalis/centroamericana</i>	1
<i>Steno bredanensis</i>	71
<i>Tursiops truncatus</i>	147
Unidentified dolphin or porpoise	39
Unidentified large delphinid	3
Unidentified large whale	2
Unidentified medium delphinid	25
Unidentified small delphinid	89
Unidentified small whale	3
Ziphiid whale	9
<i>Ziphius cavirostris</i>	4
Total	1,244

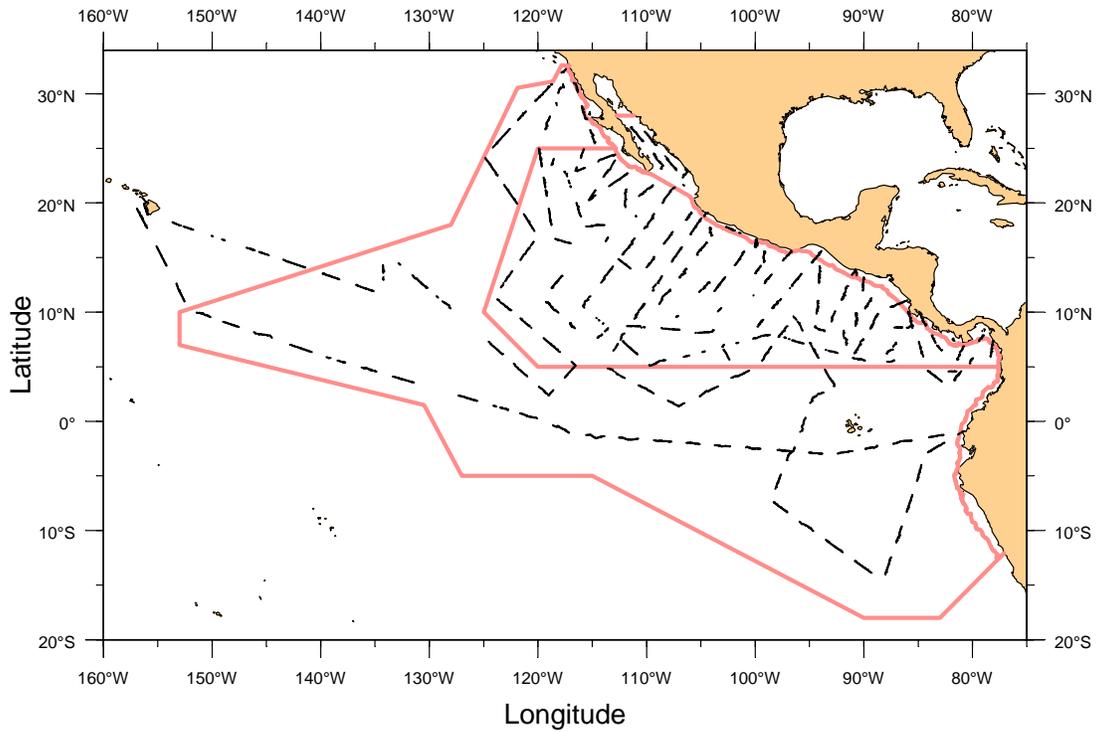


Figure 1. STAR06 survey tracklines and sampling strata boundaries for both NOAA ships *David Starr Jordan* and *McArthur II*.

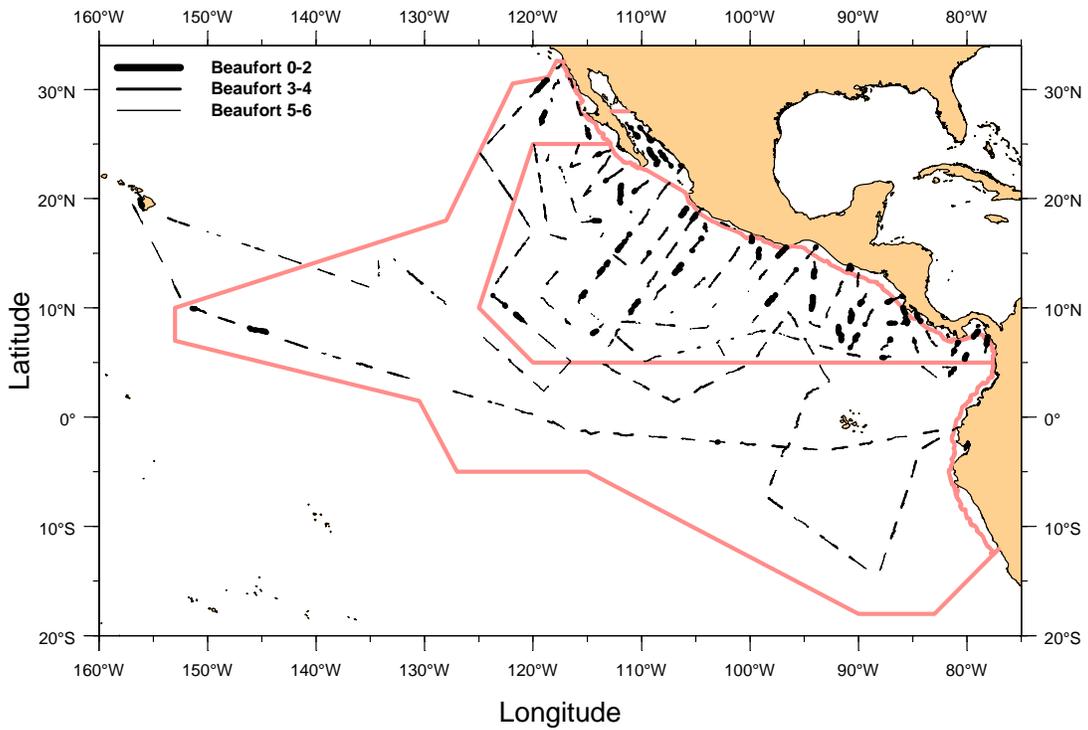


Figure 2. STAR06 survey tracklines by sea state (Beaufort scale).

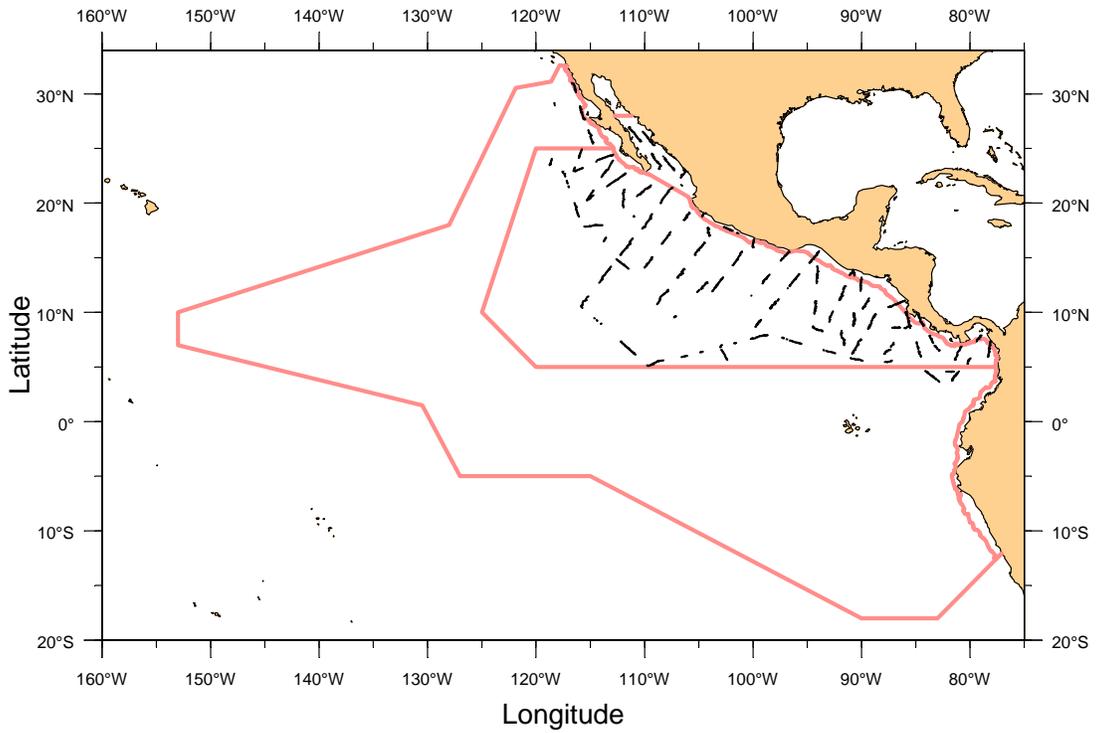


Figure 3. STAR06 survey tracklines for NOAA Ship *David Starr Jordan*.

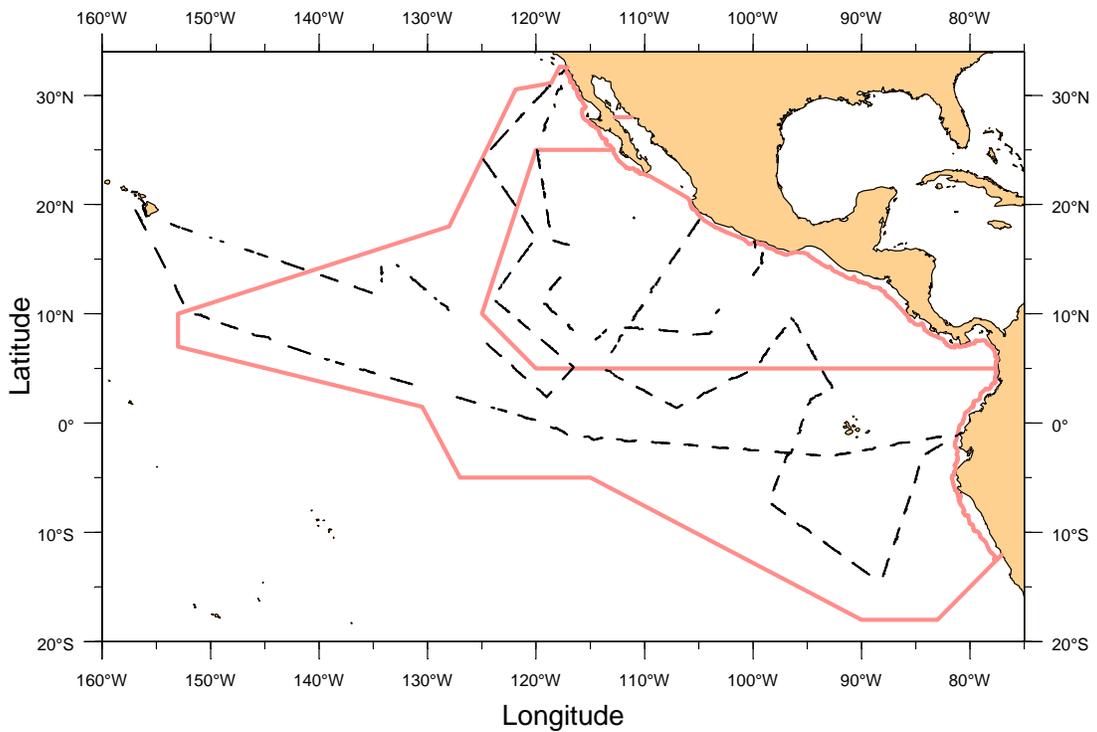


Figure 4. STAR06 survey tracklines for NOAA Ship *McArthur II*.

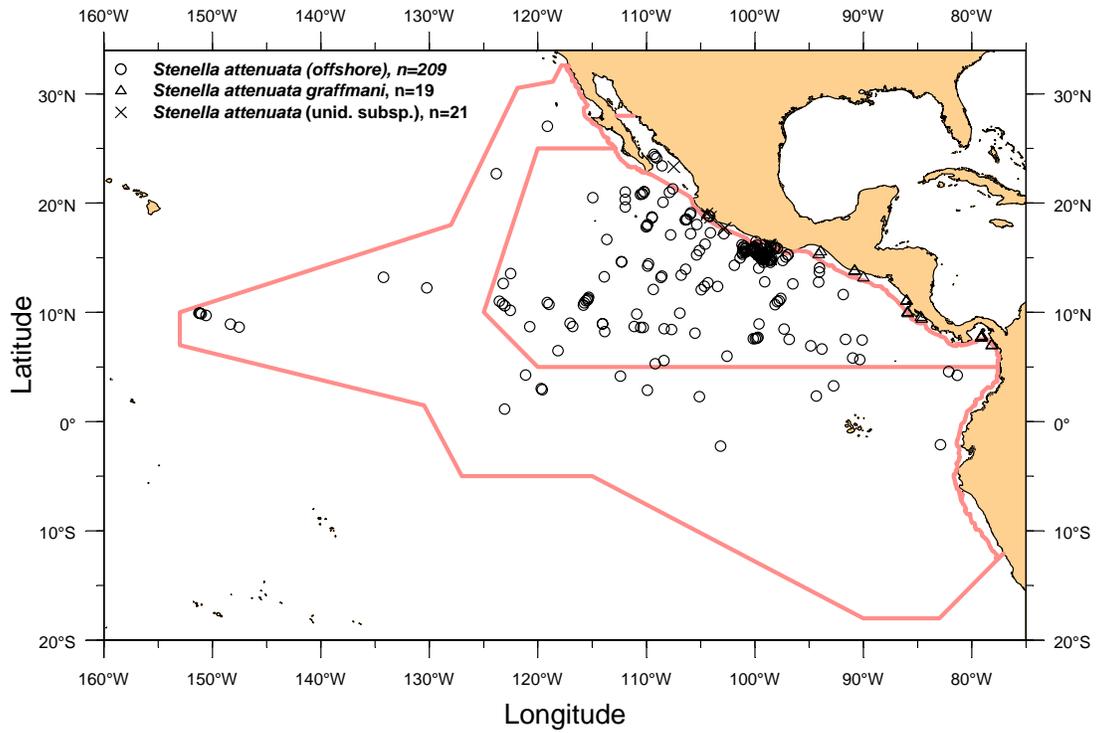


Figure 5. Spotted dolphin sightings, STAR06.

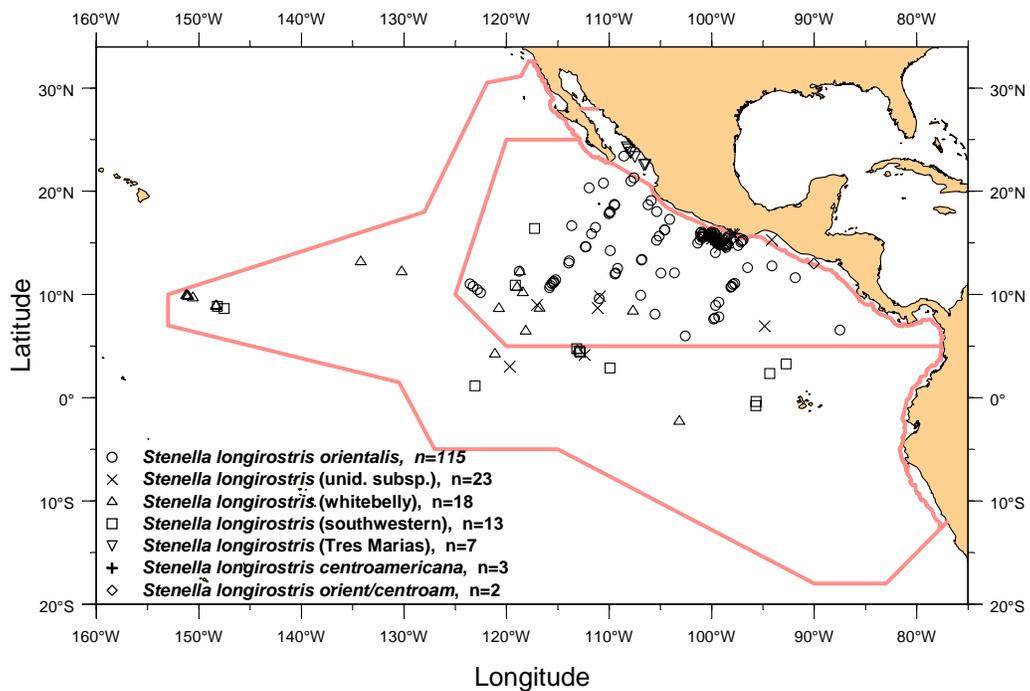


Figure 6. Spinner dolphin sightings, STAR06.

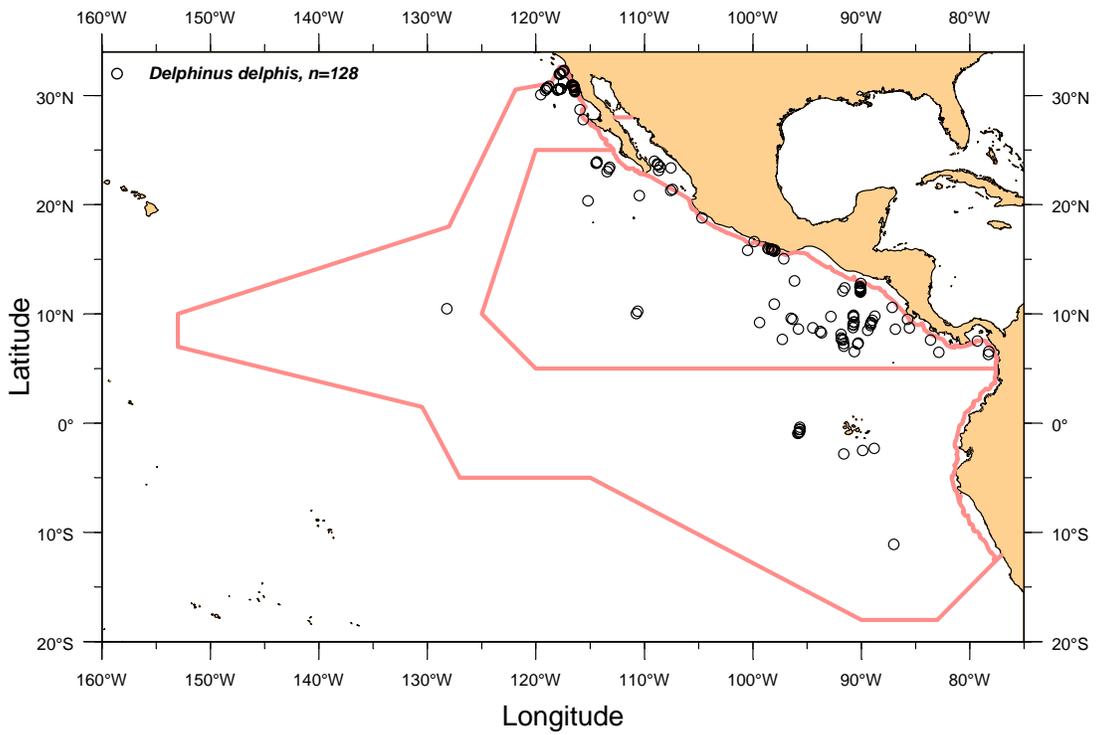


Figure 7. Common dolphin sightings, STAR06.

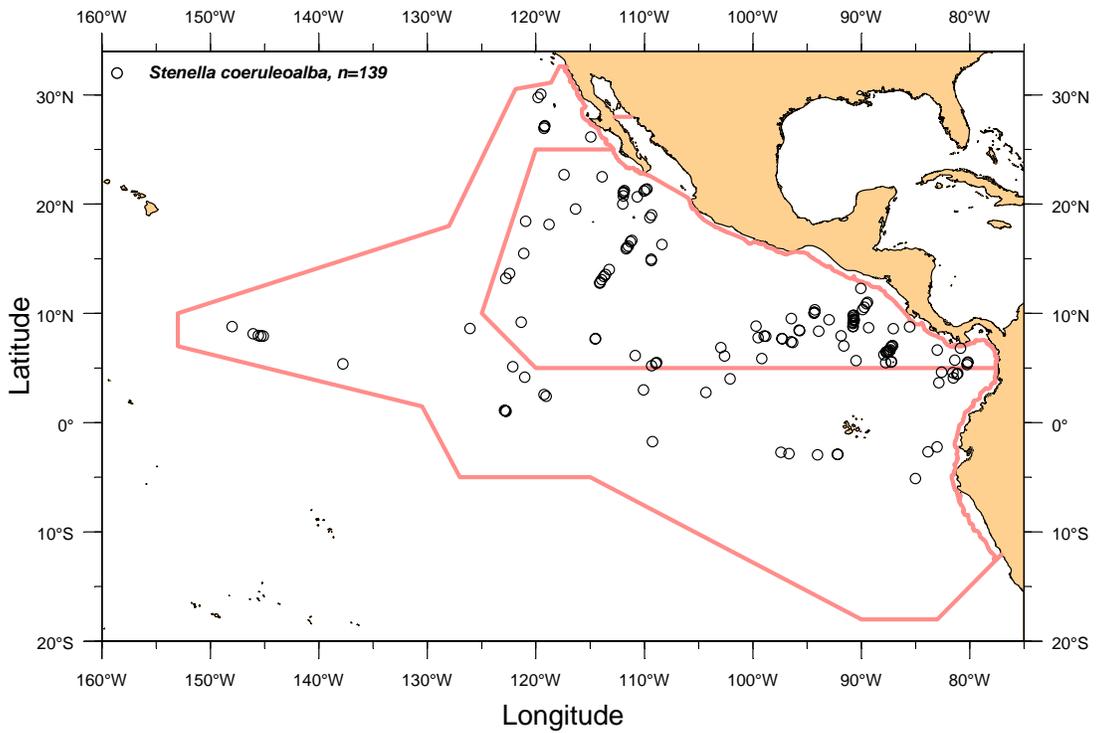


Figure 8. Striped dolphin sightings, STAR06.

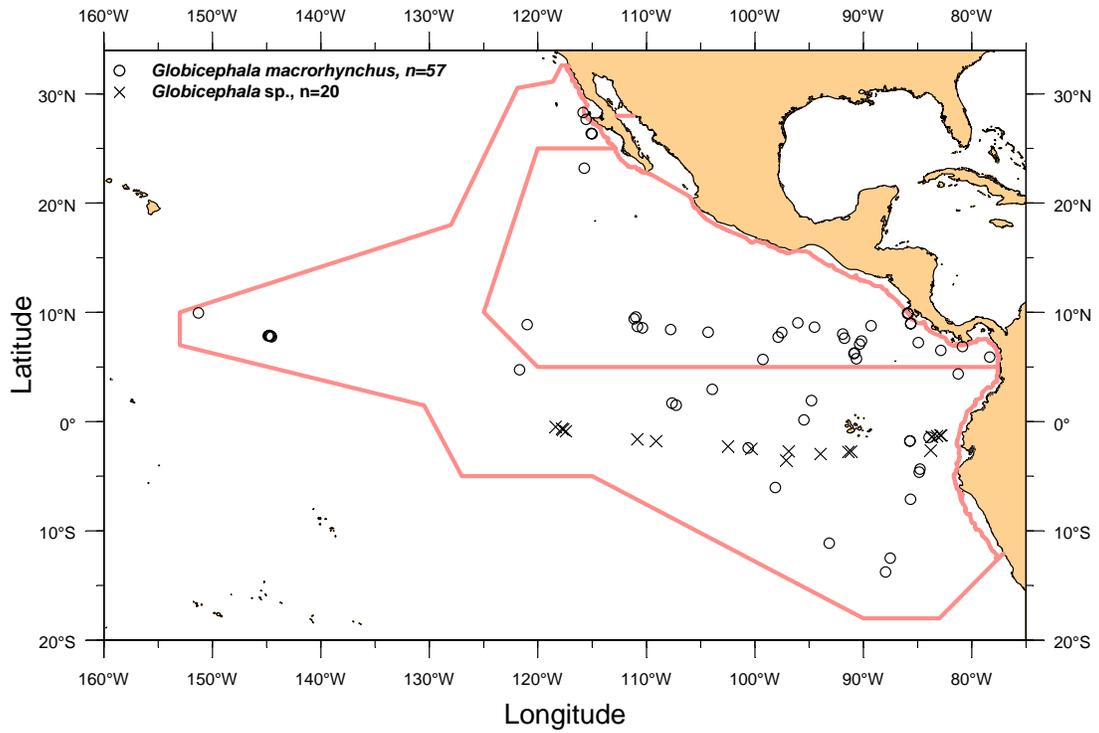


Figure 9. Pilot whale sightings, STAR06.

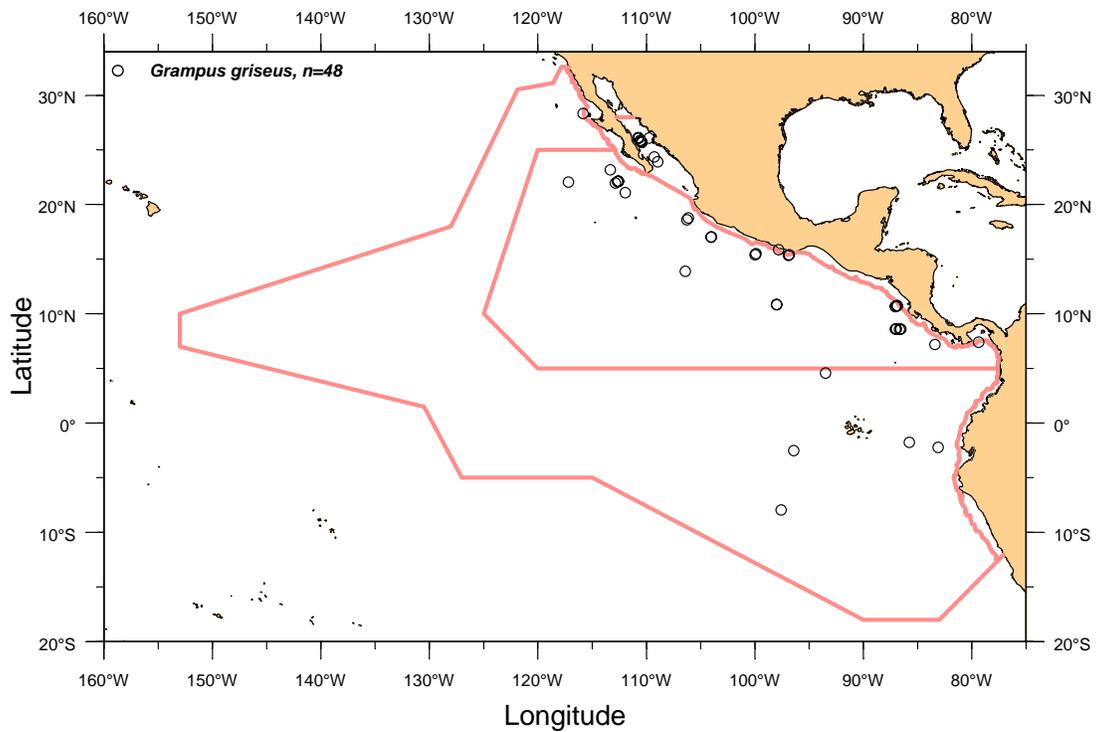


Figure 10. Risso's dolphin sightings, STAR06.

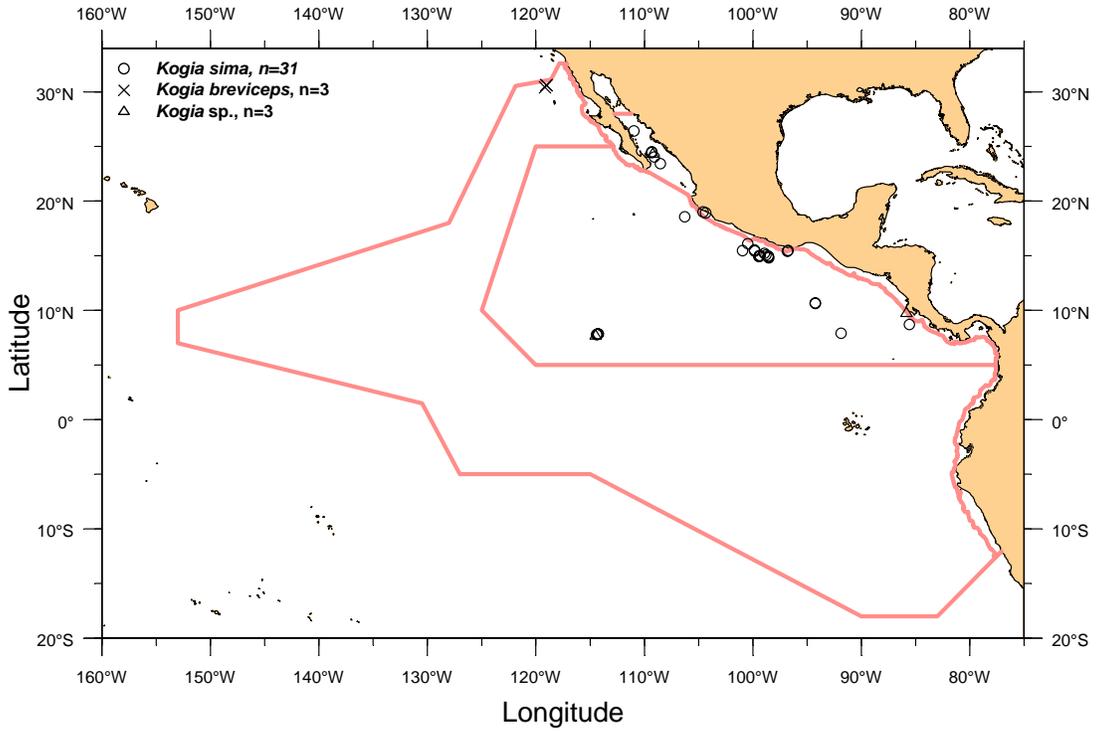


Figure 11. Dwarf and pygmy sperm whale and unidentified *Kogia* sp. sightings, STAR06.

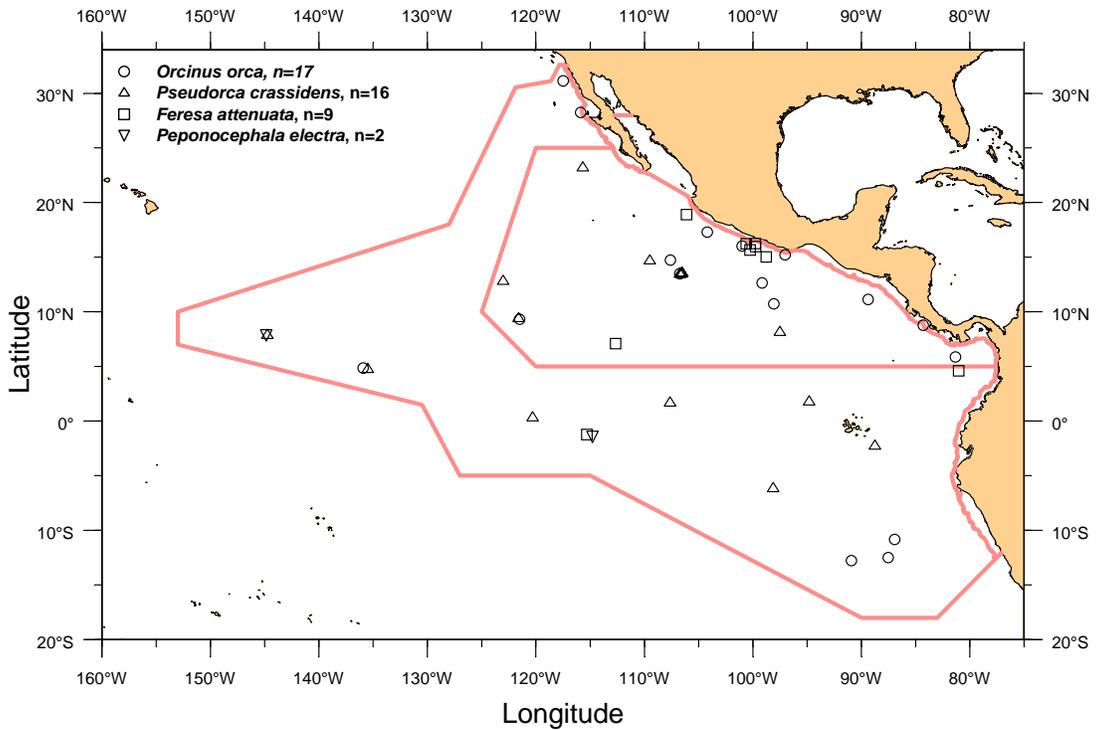


Figure 12. Killer, false killer, pygmy killer and melon-headed whales, STAR06.

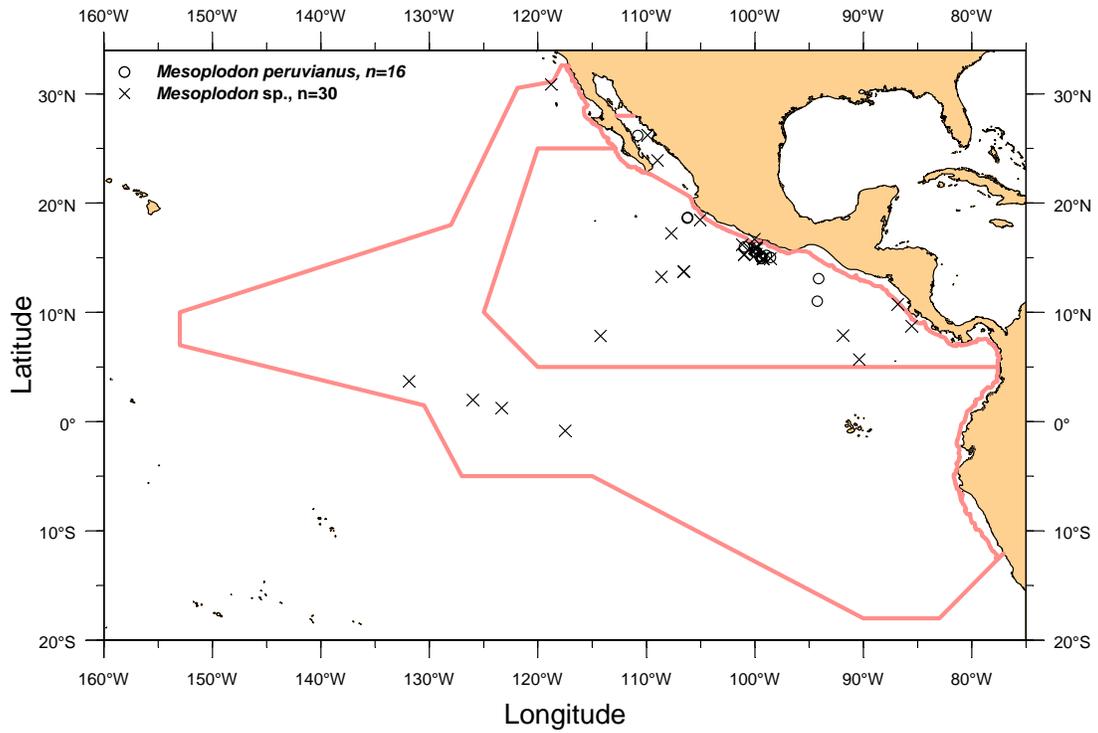


Figure 13. Beaked whales of the genus *Mesoplodon* sightings, STAR06.

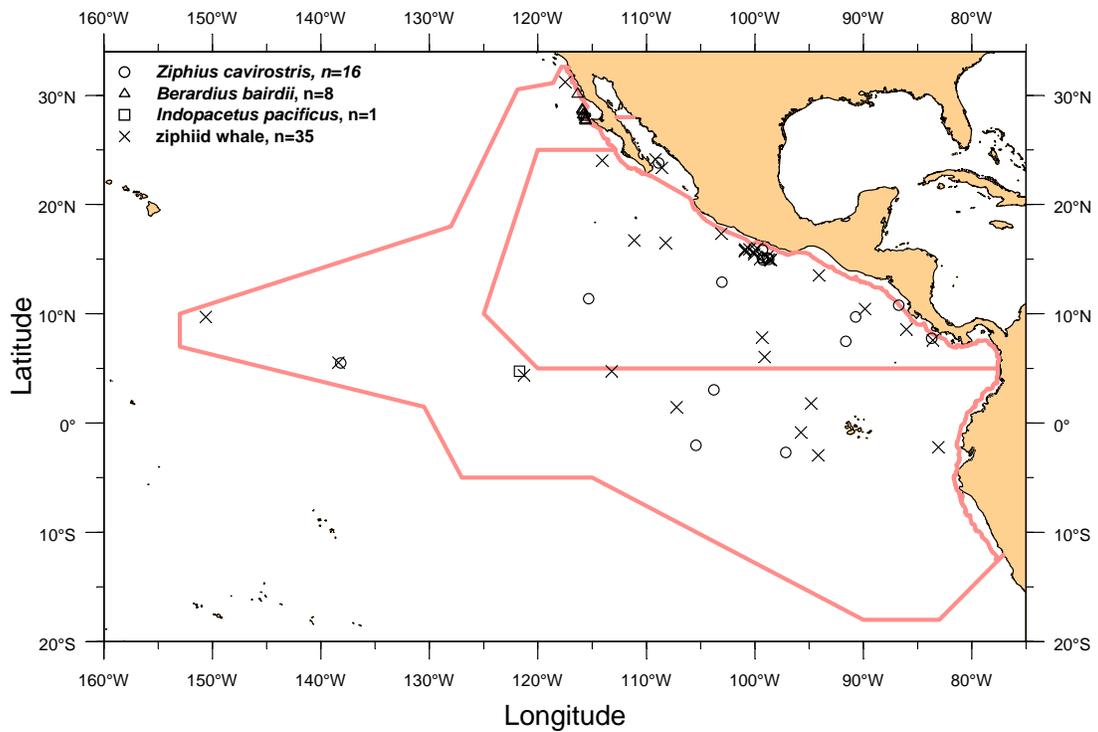


Figure 14. Cuvier's, Baird's, Longman's and unidentified ziphiid beaked whale sightings, STAR06.

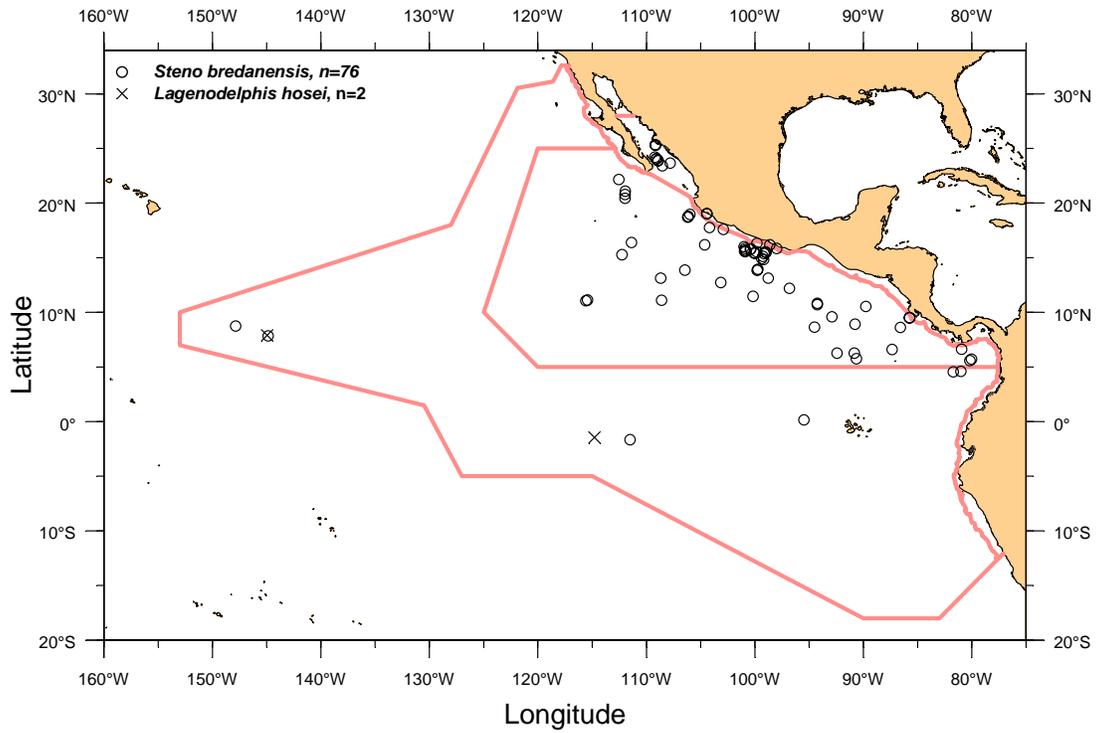


Figure 15. Rough-toothed and Fraser's dolphin sightings, STAR06.

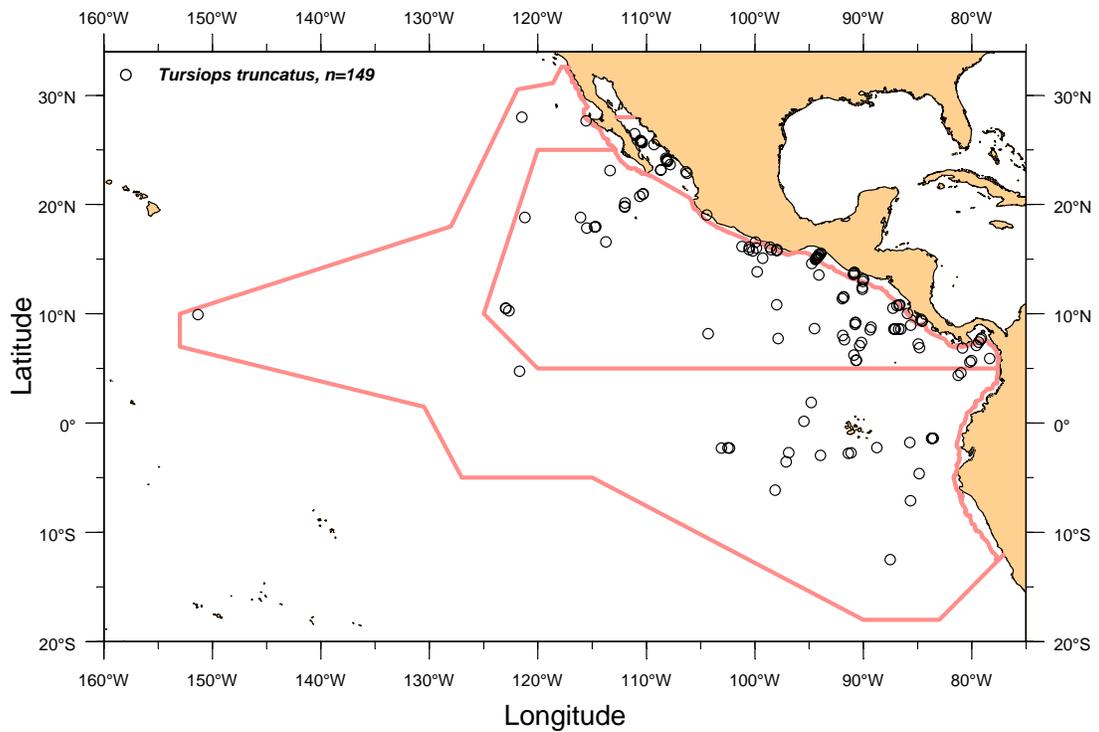


Figure 16. Bottlenose dolphin sightings, STAR06.

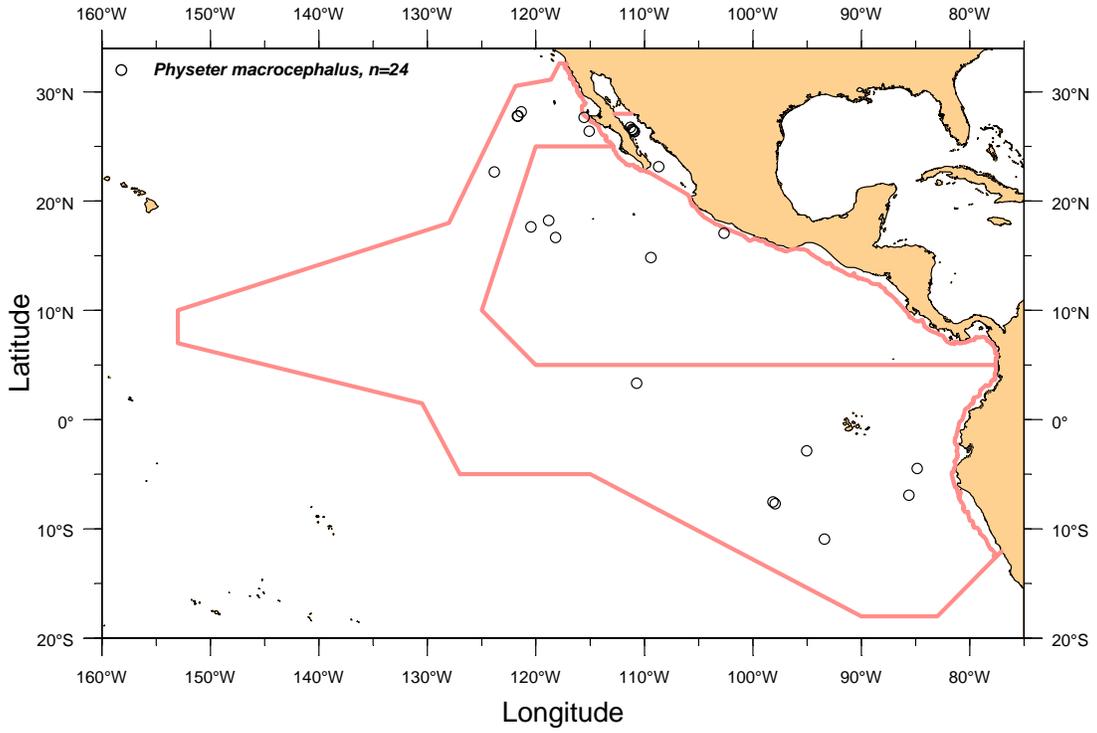


Figure 17. Sperm whale sightings, STAR06.

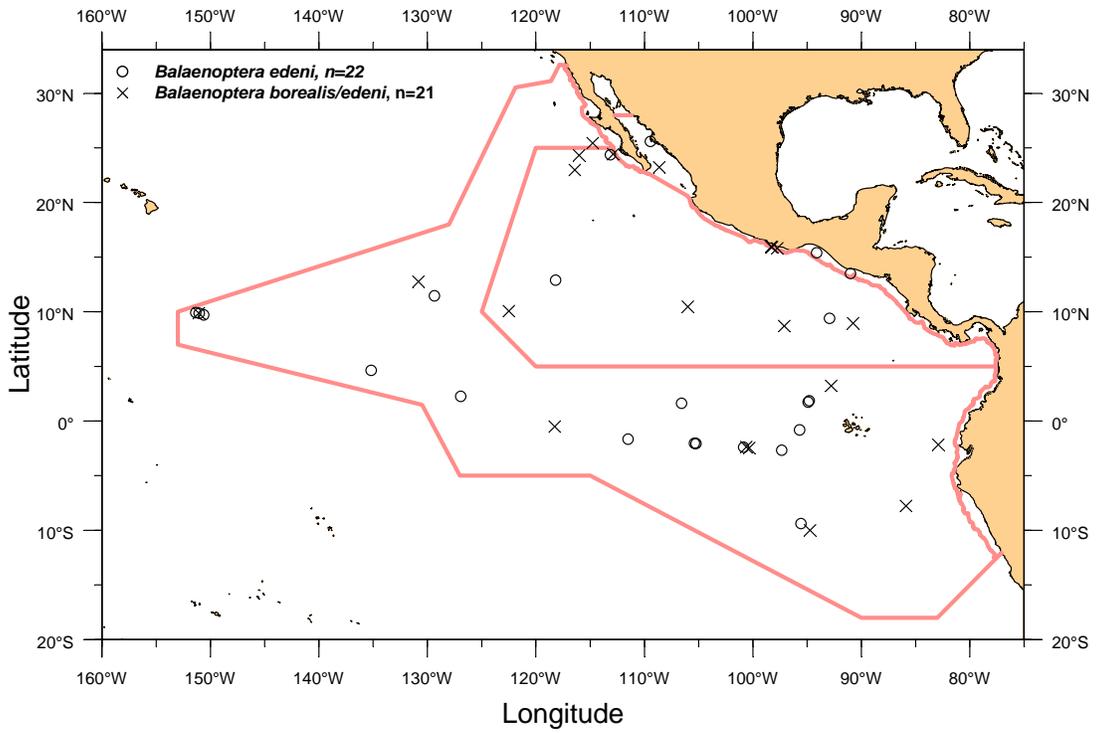


Figure 18. Bryde's and unidentified Sei/Bryde's whale sightings, STAR06.

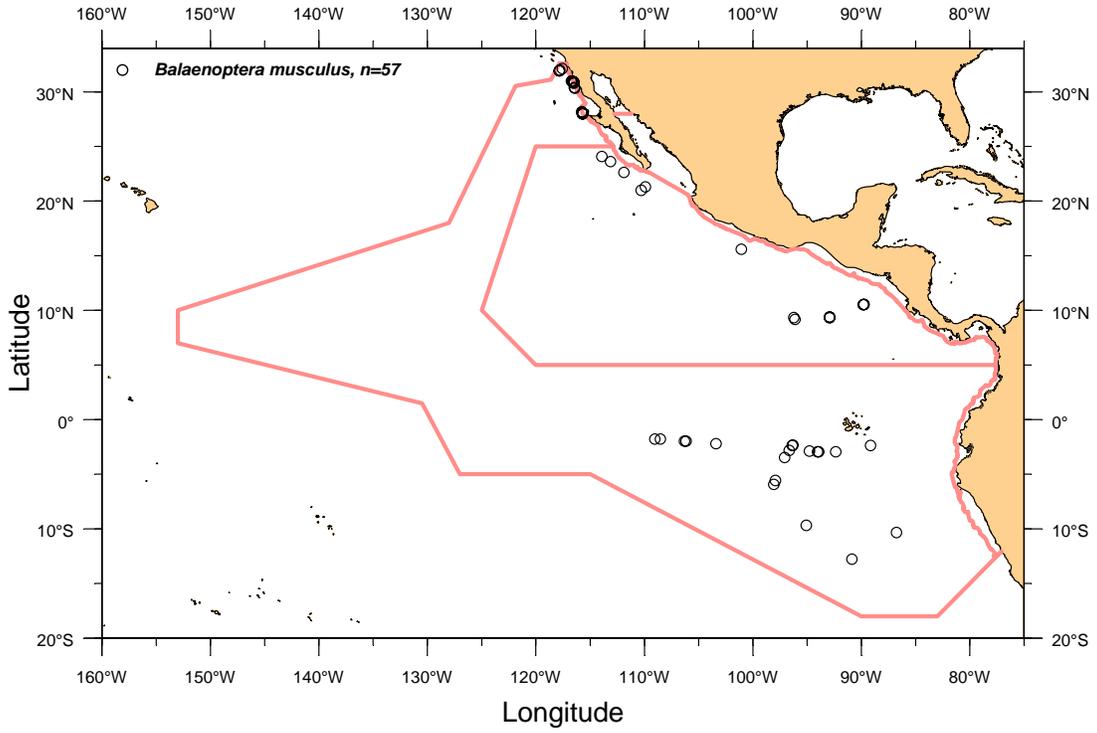


Figure 19. Blue whale sightings, STAR06.

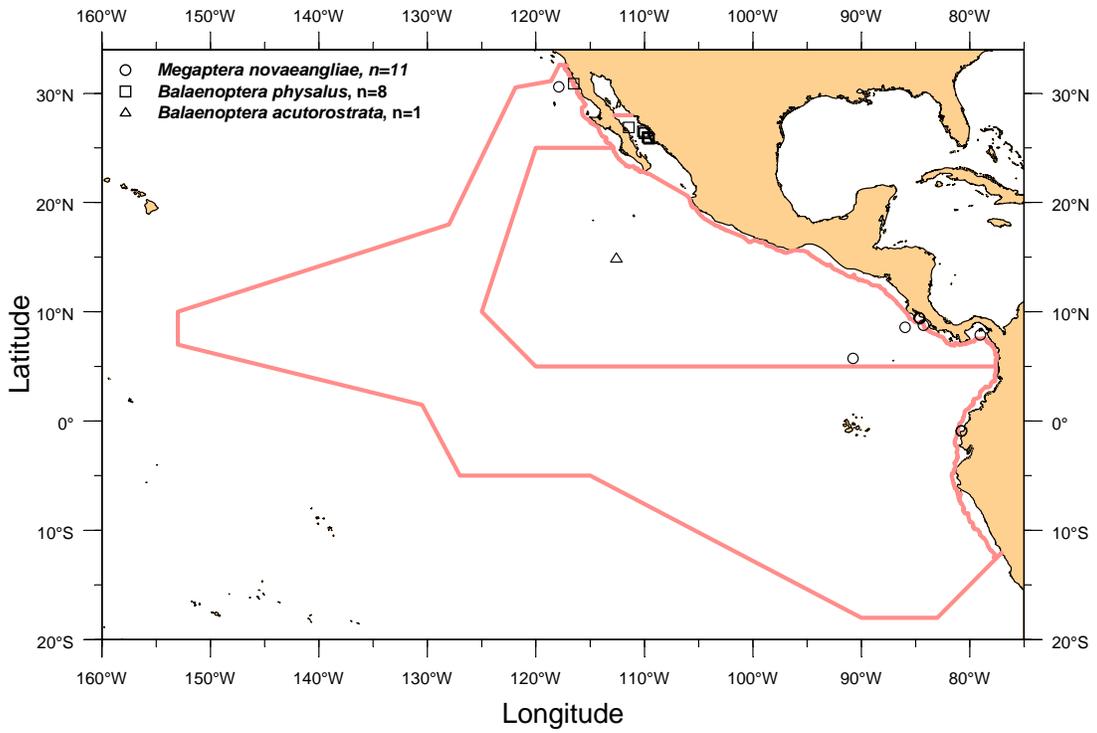


Figure 20. Humpback, fin and minke whale sightings, STAR06.

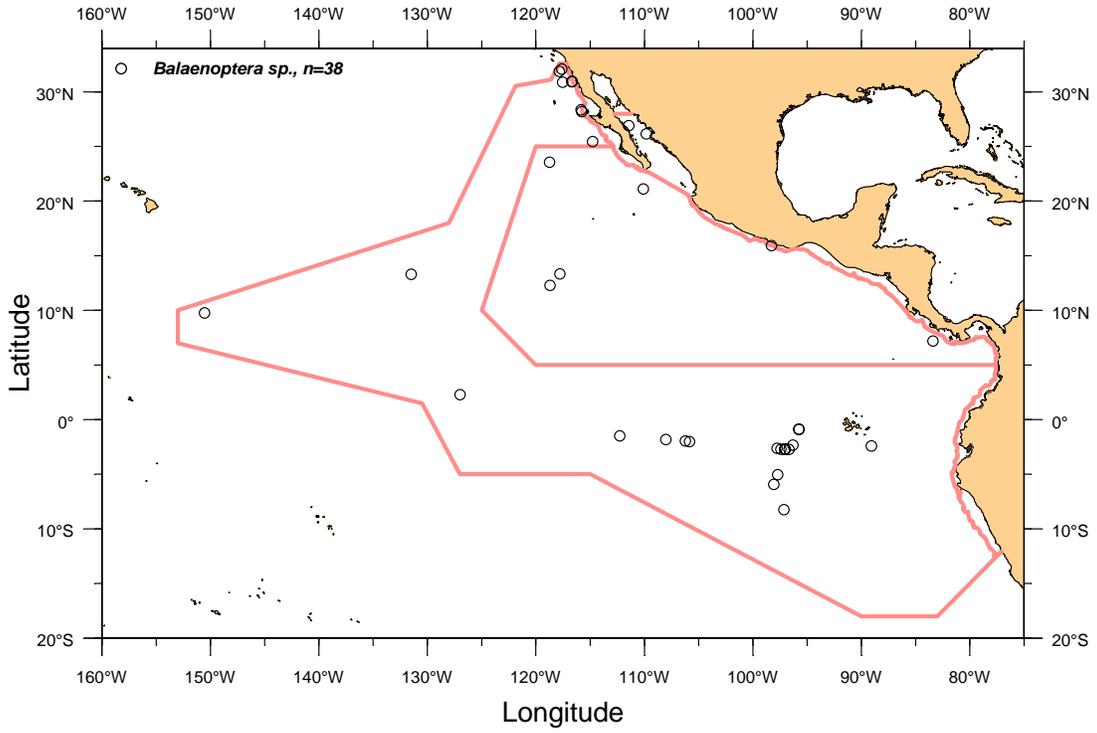


Figure 21. Baleen whale sightings not identified to species, STAR06.

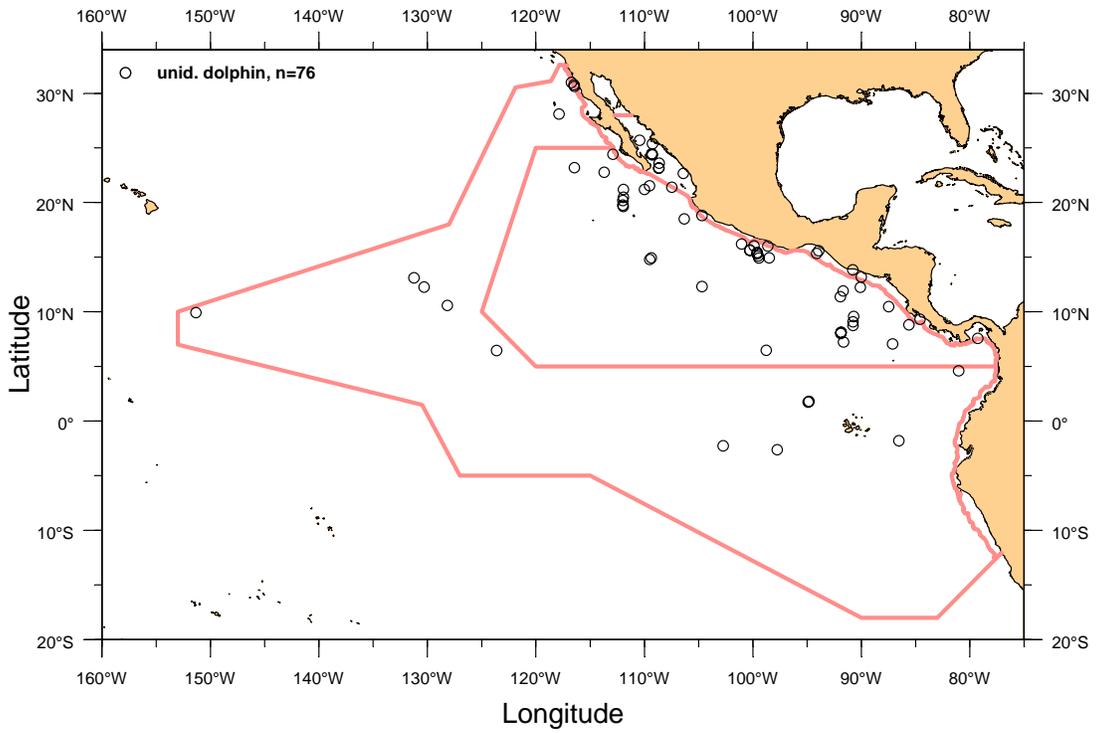


Figure 22. Unidentified dolphin sightings, STAR06.

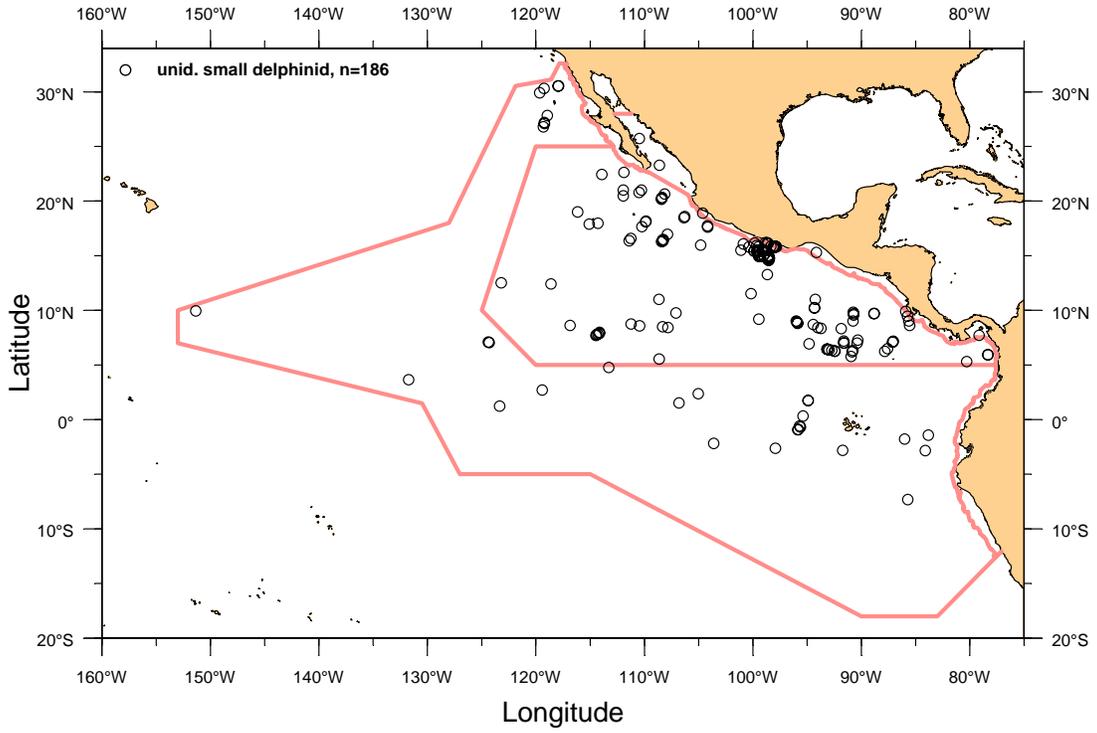


Figure 23. Unidentified small delphinid sightings, STAR06.

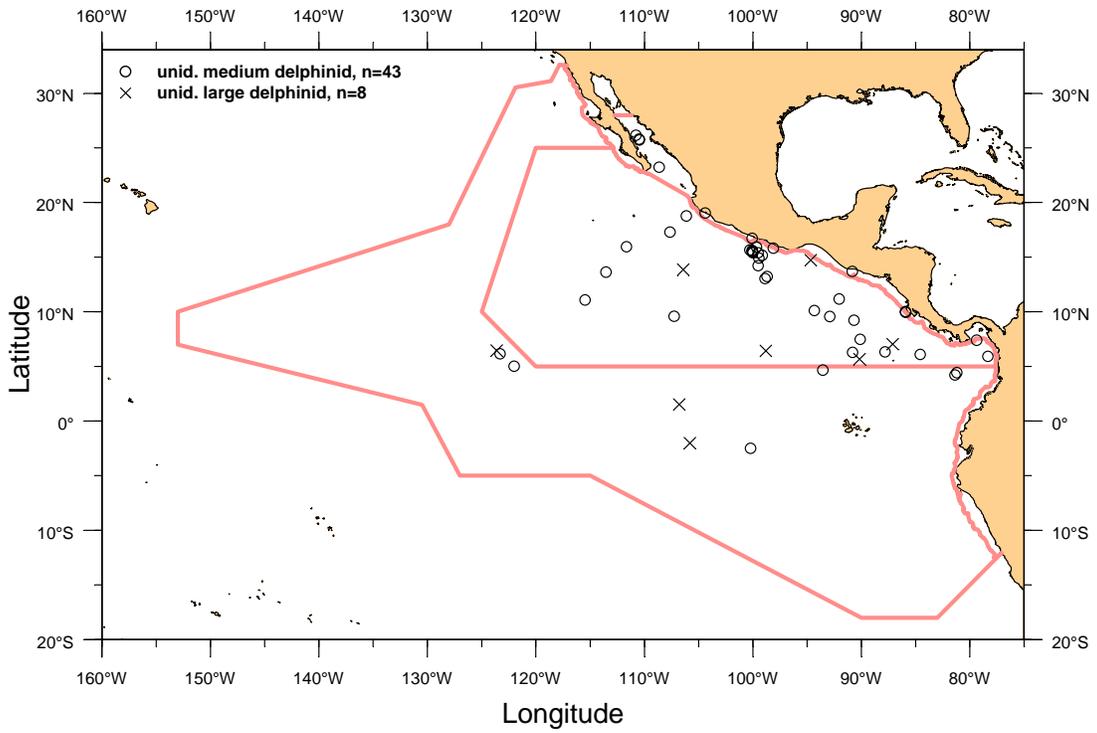


Figure 24. Unidentified medium- and large-sized delphinid sightings, STAR06.

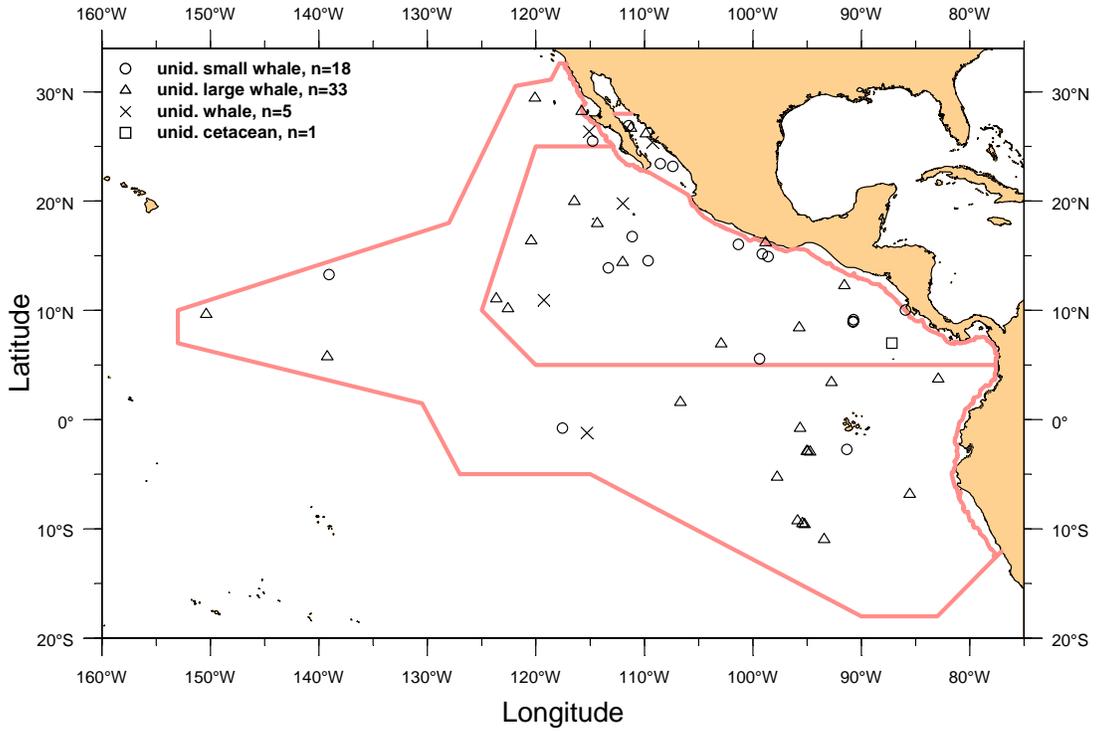


Figure 25. Unidentified whale sightings, STAR06.

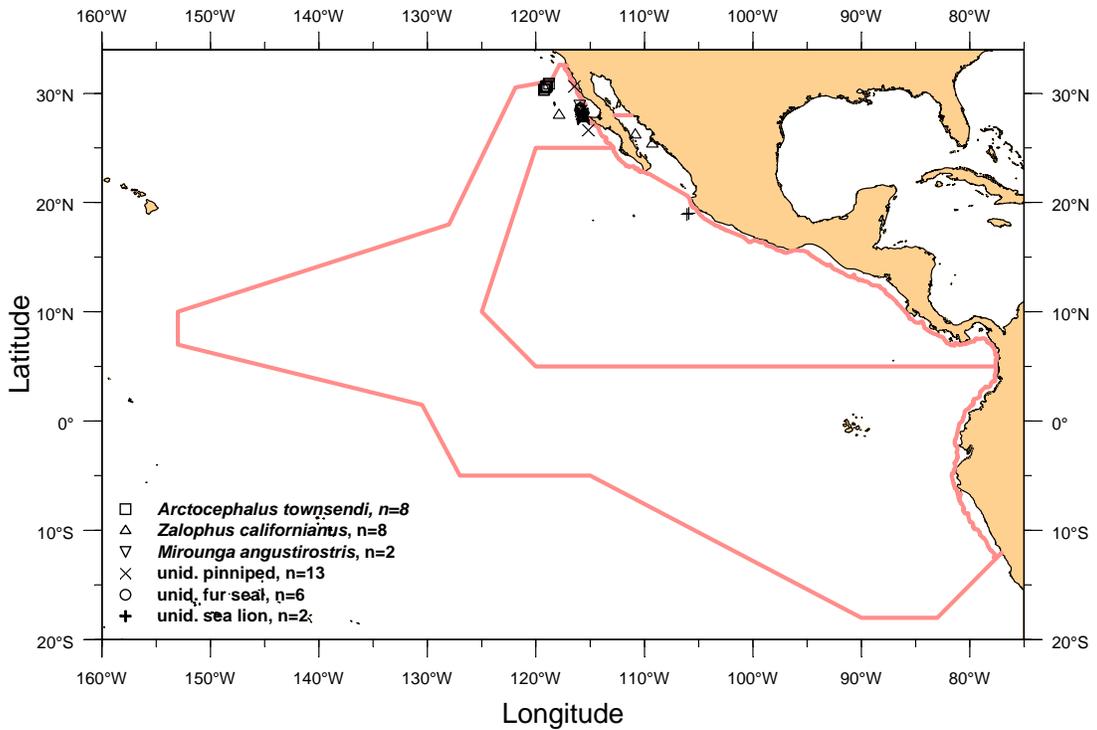


Figure 26. Sea lions, seals and unidentified pinniped sightings, STAR06.

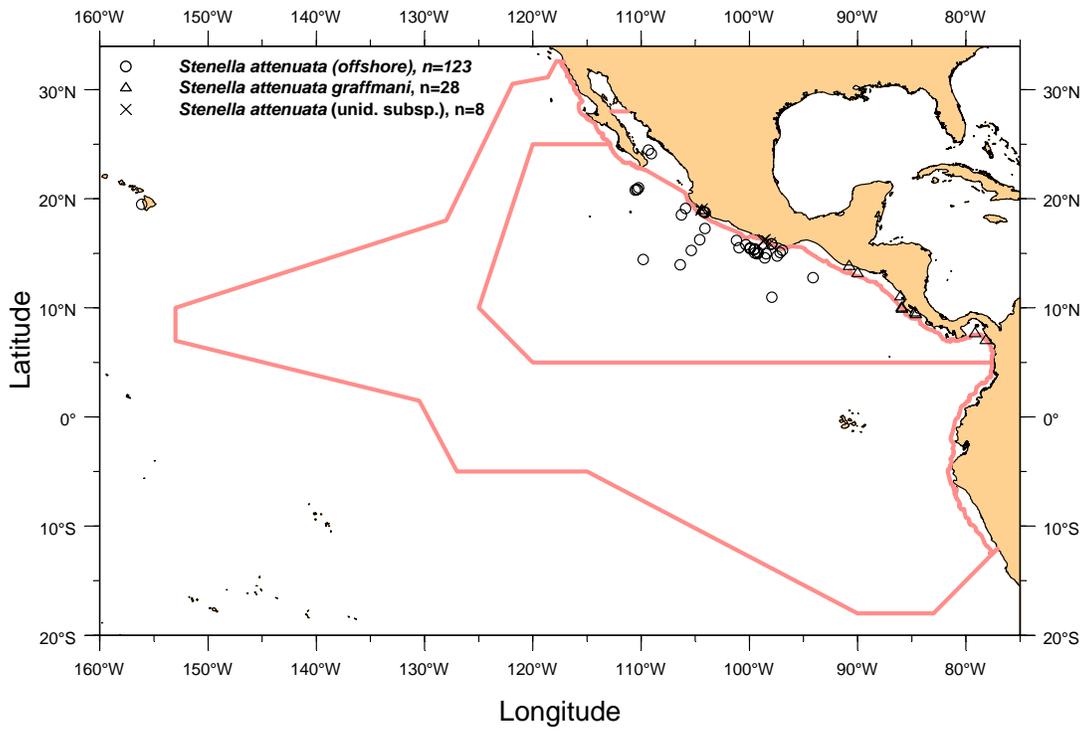


Figure 27. Spotted dolphin biopsy samples, STAR06.

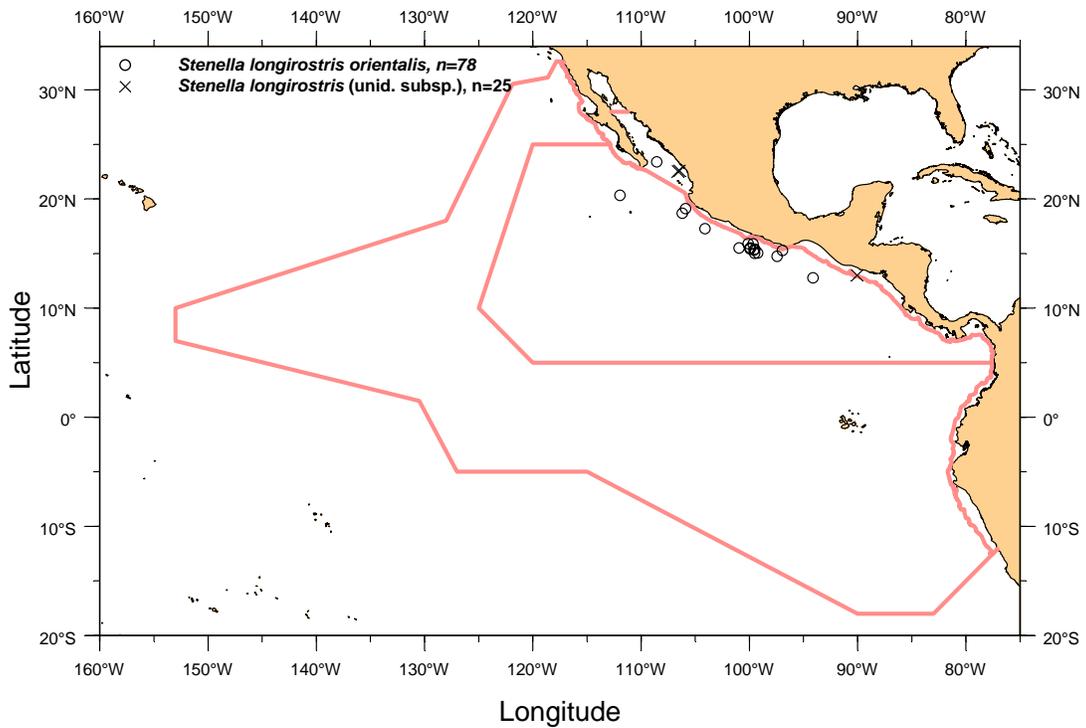


Figure 28. Spinner dolphin biopsy samples, STAR06.

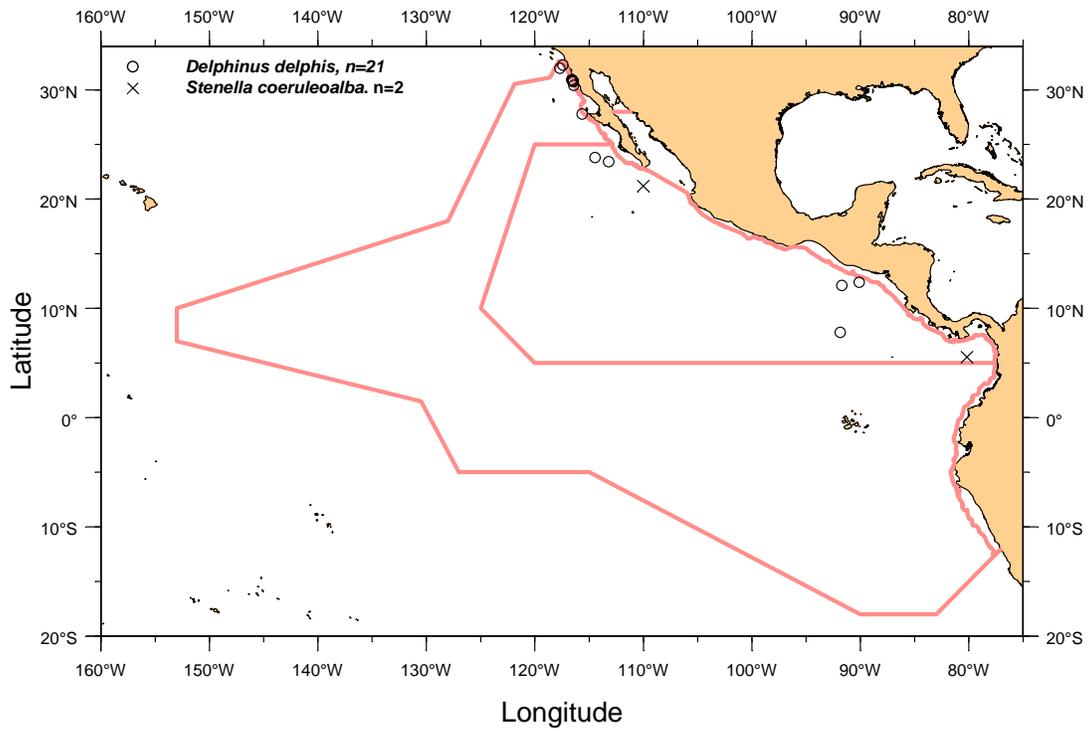


Figure 29. Common and striped dolphin biopsy samples, STAR06.

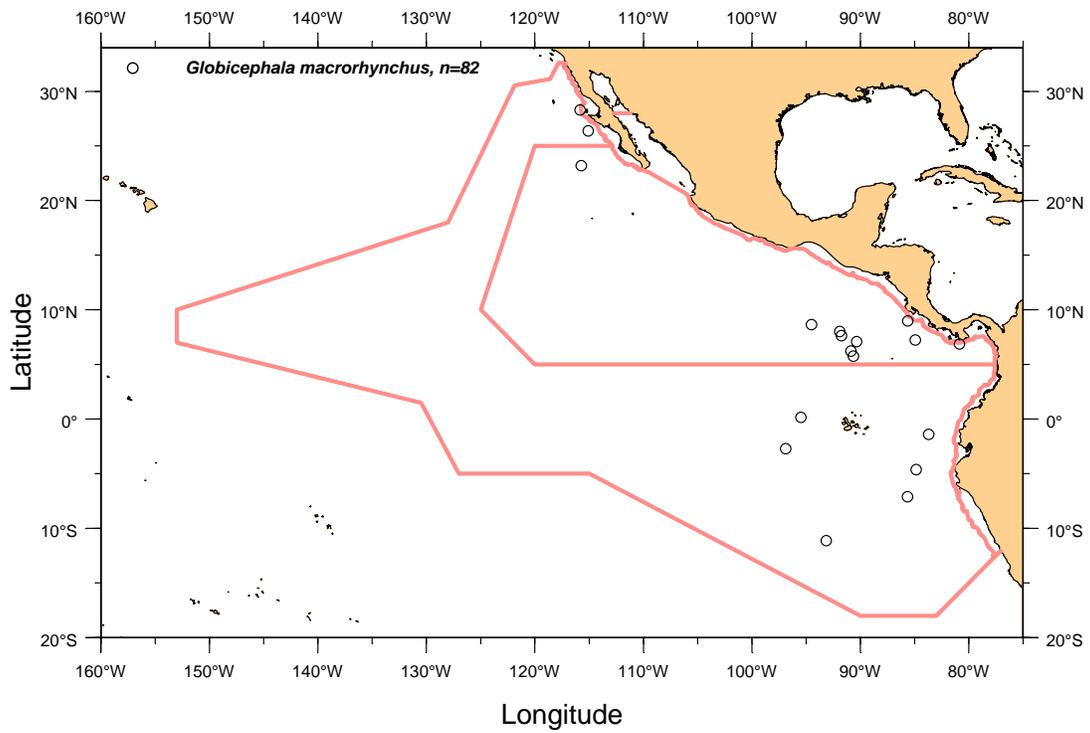


Figure 30. Pilot whale biopsy samples, STAR06.

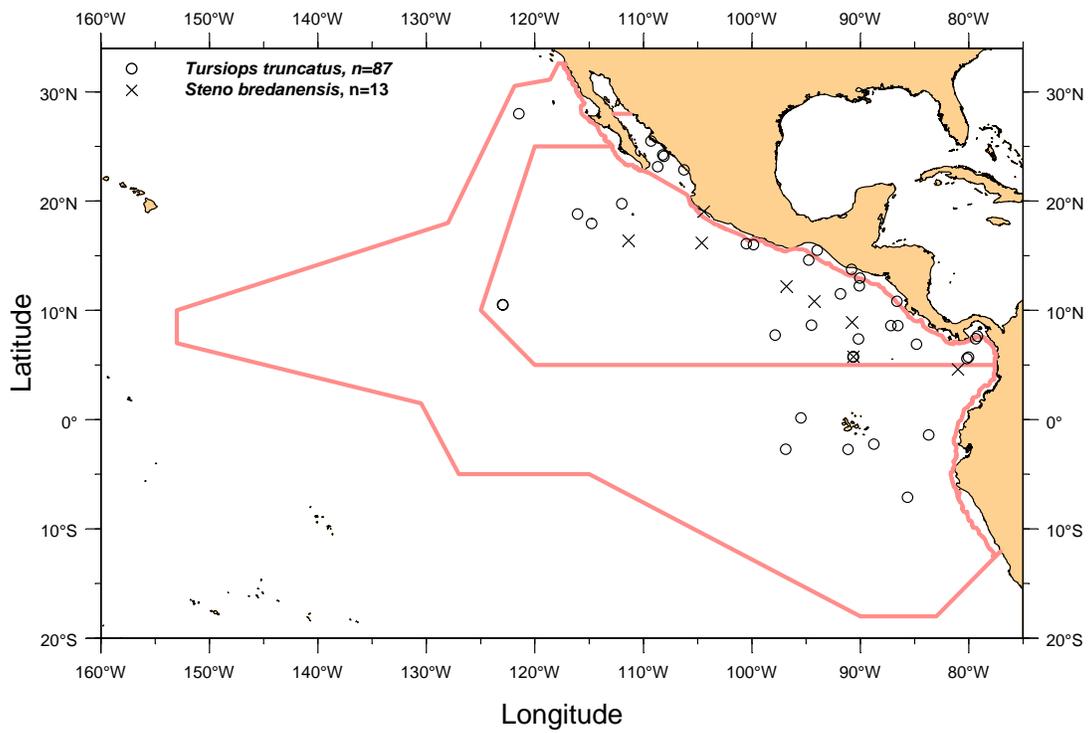


Figure 31. Bottlenose and rough-toothed dolphin biopsy samples, STAR06.

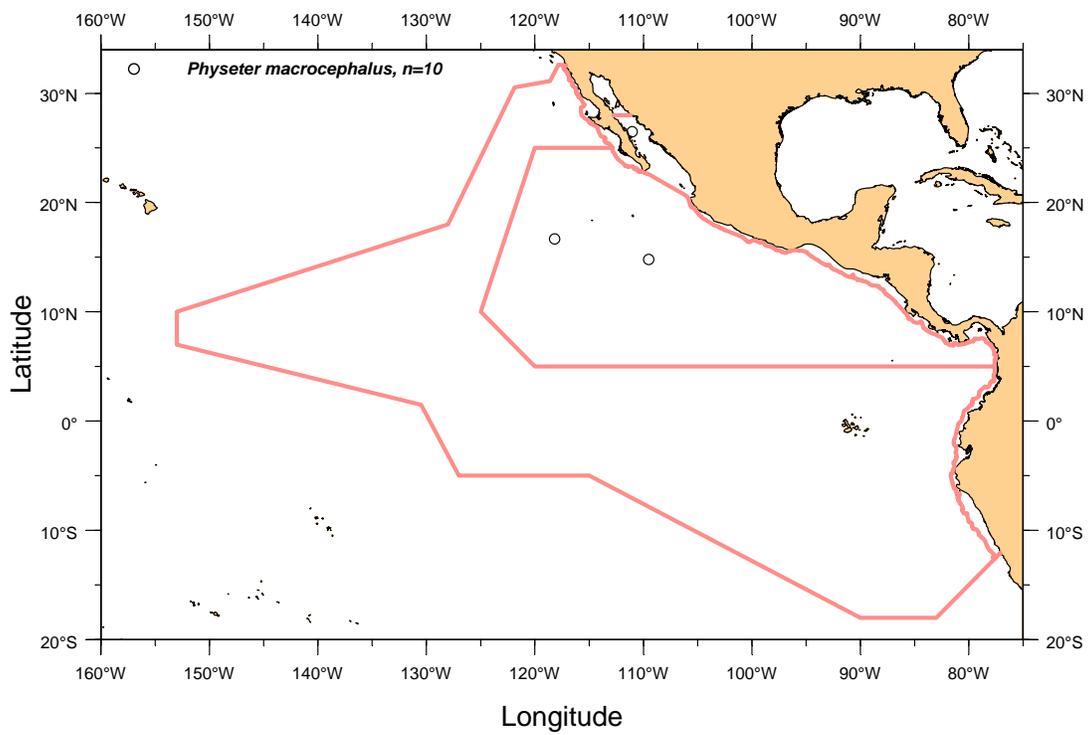


Figure 32. Sperm whale biopsy samples, STAR06.

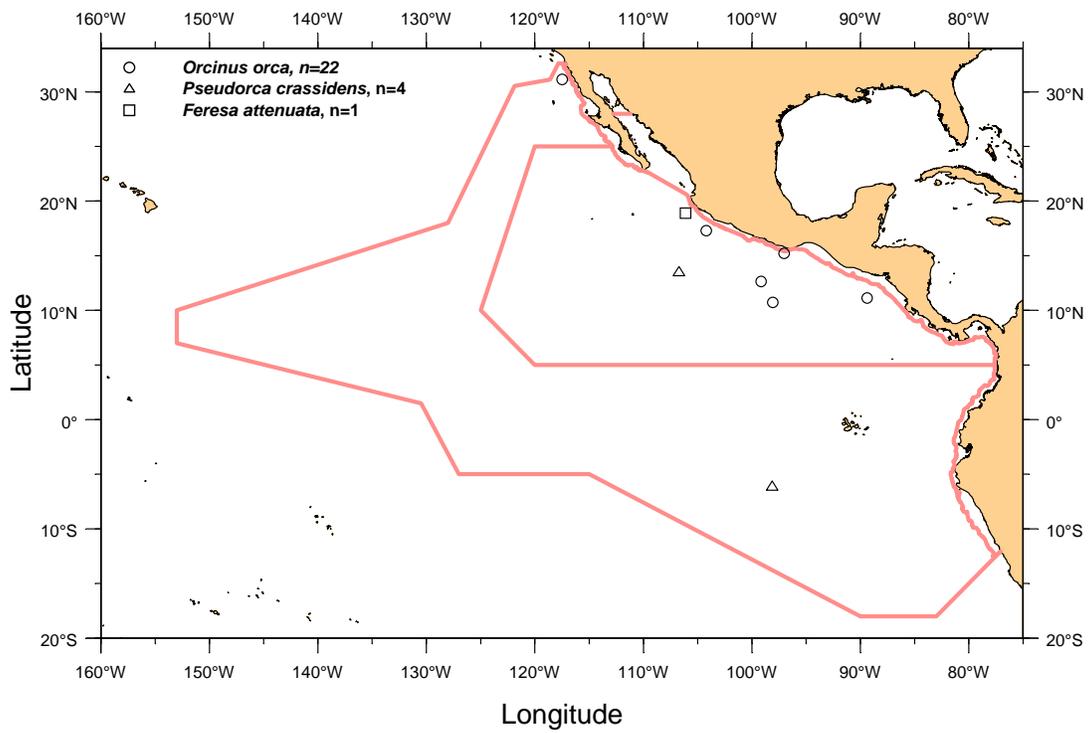


Figure 33. Killer, false killer and pygmy killer whale biopsy samples, STAR06.

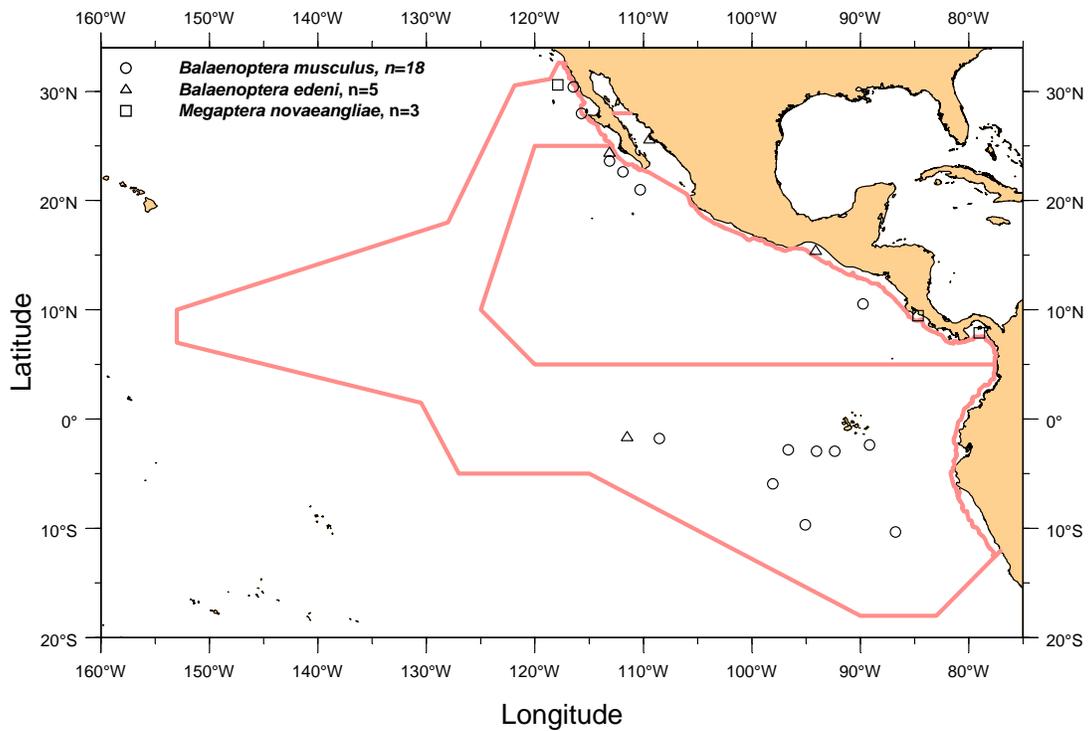


Figure 34. Blue, Bryde's and humpback whale biopsy samples, STAR06.

Appendix A. Study area boundary points for STAR06 survey. The eastern boundary is defined by the coastline of the Americas.

32° 32.12' N, 117° 7.34' W
32° 35.37' N, 117° 27.82' W
32° 37.61' N, 117° 49.52' W
31° 7.97' N, 118° 36.30' W
30° 32.52' N, 121° 52.00' W
18° 0.00' N, 128° 0.00' W
10° 0.00' N, 153° 0.00' W
7° 0.00' N, 153° 0.00' W
1° 30.00' N, 130° 30.00' W
5° 0.00' S, 127° 0.00' W
5° 0.00' S, 115° 0.00' W
18° 0.00' S, 90° 0.00' W
18° 0.00' S, 83° 0.00' W
12° 0.00' S, 77° 0.00' W

Strata Boundaries: The coastal stratum is inshore of the 1000 meter depth contour. The core stratum is defined by the following points:

25° 0.00' N, 112° 51.60' W
25° 0.00' N, 120° 0.00' W
10° 0.00' N, 125° 0.00' W
5° 0.00' N, 120° 0.00' W
5° 0.00' N, 77° 38.04' W

Appendix B. Participating scientists and the ship legs on which they sailed during STAR06.

Name	Obs Num	Position	Affiliation ¹	<i>McArthur II</i> Leg Number				<i>D. S. Jordan</i> Leg Number						
				1	2	3	4	1	2	3	4	5	6	
Lisa Ballance	120	Cruise Leader	SWFSC		X						X	X		
Jay Barlow	015	Cruise Leader	SWFSC				X							
Susan Chivers	029	Cruise Leader	SWFSC					X						
Tim Gerrodette	084	Cruise Leader/Visiting Sci	SWFSC							X				
Sarah Mesnick	159	Cruise Leader	SWFSC											X
Robert Pitman	004	Cruise Leader	SWFSC					X	X	X	X			
Jessica Redfern	240	Cruise Leader	SWFSC	X										
Juan Carlos Salinas	126	Senior Mammal Observer	AFL					X	X	X	X	X	X	X
James Cotton	007	Senior Mammal Observer	SWFSC	X	X	X	X							
Cornelia Oedekoven	208	Senior Mammal Observer	AFL					X	X	X	X	X	X	X
Richard Rowlett	073	Senior Mammal Observer	SWFSC	X	X	X	X							
Gary Friedrichsen	001	Mammal ID Specialist	SWFSC					X	X	X	X	X	X	X
Isabel Beasley	196	Mammal Observer	AFL	X	X	X	X							
Howard Goldstein	277	Mammal Observer	SWFSC	X	X	X	X							
Erin LaBrecque	200	Mammal Observer	SWFSC	X	X	X	X							
Laura Morse	149	Mammal Observer	SWFSC					X	X	X	X	X	X	X
Adam Ü	280	Mammal Observer	SWFSC					X	X	X	X	X	X	X
Ernesto Vasquez	125	Mammal Observer	AFL					X	X	X	X	X		
Suzanne Yin	197	Mammal Observer	SWFSC	X	X	X	X							
Shannon Rankin	184	Acoustician	SWFSC	X	X	X	X							

¹ AFL—Aquatic Farms Ltd
 ARMADA—Armada Project
 BOI—Blue Ocean Institute
 CWS—Canadian Wildlife Service
 HMS—Hopkins Marine Station
 IATTC—Inter-American Tropical Tuna Commission
 NEFSC—Northeast Fisheries Science Center, NOAA
 NMSU—New Mexico State University
 SIO—Scripps Institution of Oceanography, University of California, San Diego

Appendix B. Participating scientists (continued).

Name	Obs Num	Position	Affiliation	<i>McArthur II</i> Leg Number				<i>D. S. Jordan</i> Leg Number							
				1	2	3	4	1	2	3	4	5	6		
Elizabeth Zele	242	Acoustic Technician	AFL	X	X	X	X								
Michael Force	098	Senior Bird Observer	AFL	X	X	X	X								
Richard Pagen	231	Senior Bird Observer	SWFSC					X	X	X	X	X	X	X	
Chris Cutler	228	Bird Observer	SWFSC					X	X	X	X	X	X	X	
Sophie Webb	229	Bird Observer	SWFSC	X	X	X	X								
Candice Hall		Oceanographer	AFL					X	X	X	X	X	X	X	
Melinda Kelley		Oceanographer	SWFSC	X	X	X	X								
Lindsey Peavey	287	Turtle Handler	Volunteer					X	X	X	X	X	X	X	
Tony Gaston		Visiting Scientist	CWS												X
Nicholas Kellar	173	Visiting Scientist	SWFSC												X
Jessica Kondel		Visiting Scientist	NOAA Fisheries												X
Iliana Ruiz-Cooley		Visiting Scientist	NMSU					X	X						
Jeremy Rusin	202	Visiting Scientist	SWFSC												X
Carl Safina		Visiting Scientist	BOI									X			
Danna Schulman		Visiting Scientist	HMS				X								
Marisa Trego		Visiting Scientist	AFL												X
Sophie Van Parijs	286	Visiting Scientist	NEFSC					X							
L. Ignacio Vilchis	248	Graduate Student	SIO							X	X	X			
Dave Bratten	284	Official Observer	IATTC-U.S.					X							
Juan Francisco Córdova Soriano		Official Foreign Observer	Govt of El Salvador							X					
Ignacio García-Godos Naveda		Official Foreign Observer	Govt of Peru			X									
Juan Manuel Gutierrez		Official Foreign Observer	Govt of México												X
Manuel Inclan		Official Foreign Observer	Govt of México						X						
Kruger Loor		Official Foreign Observer	IATTC-Ecuador				X								
Mateo Lopez-Victoria		Official Foreign Observer	Govt of Colombia								X				
Christian Naranjo		Official Foreign Observer	Govt of Ecuador							X					
Anna Núñez Pereligina		Official Foreign Observer	Govt of Panamá								X				
Maria Elena Tapia		Official Foreign Observer	Govt of Ecuador				X								
Mark Harris		Teacher-at-Sea	ARMADA						X						
Cyndy Martin	281	Teacher-at-Sea	ARMADA	X											

Appendix C. SWFSC species, stocks and other sighting-categories of marine mammals, 2006.

Code	Genus/Taxa	Species/Stock	Common Names
001	Mesoplodon	peruvianus	Pygmy beaked whale
002	Stenella	attenuata (offshore)	Offshore pantropical spotted dolphin
003	Stenella	longirostris (unid. subsp.)	Unidentified spinner dolphin
004	Stenella	clymene	Clymene dolphin, short-snouted spinner dolphin
005	Delphinus	sp.	Unidentified common dolphin
006	Stenella	attenuata graffmani	Coastal spotted dolphin
007	Sotalia	fluviatilis	Tucuxi, Guiana dolphin
008	Orcaella	brevirostris	Irrawaddy dolphin, Lumbalumba
009	Phocoena	dioptrica	Spectacled porpoise
010	Stenella	longirostris orientalis	Eastern spinner dolphin
011	Stenella	longirostris hybrid	Whitebelly spinner dolphin
012	Lagenorhynchus	albirostris	White-beaked dolphin
013	Stenella	coeruleoalba	Striped dolphin, streaker porpoise, euphrosyne dolphin
014	Lagenorhynchus	acutus	Atlantic white-sided dolphin
015	Steno	bredanensis	Rough-toothed dolphin, Steno
016	Delphinus	capensis	Baja neritic common dolphin, long-beaked common dolphin
017	Delphinus	delphis	Offshore common dolphin, short-beaked common dolphin
018	Tursiops	truncatus	Bottlenose dolphin
019	Cephalorhynchus	heavisidii	Heaviside's dolphin
020	Cephalorhynchus	hectori	Hector's dolphin, pied dolphin, white front dolphin
021	Grampus	griseus	Risso's dolphin, gray grampus
022	Lagenorhynchus	obliquidens	Pacific white-sided dolphin
023	Lagenorhynchus	australis	Peale's dolphin, blackchin dolphin
024	Lagenorhynchus	cruciger	Hourglass dolphin
025	Lagenorhynchus	obscurus	Dusky dolphin
026	Lagenodelphis	hosei	Fraser's dolphin, Sarawak dolphin
027	Lissodelphis	borealis	Northern right whale dolphin
028	Lissodelphis	peronii	Southern right whale dolphin
029	Cephalorhynchus	eutropia	Black dolphin, Chilean dolphin
030	Cephalorhynchus	commersonii	Commerson's dolphin, piebald dolphin
031	Peponocephala	electra	Melon-headed whale
032	Feresa	attenuata	Pygmy killer whale
033	Pseudorca	crassidens	False killer whale
034	Globicephala	sp.	Unidentified pilot whale
035	Globicephala	melas	Long-finned pilot whale, Atlantic pilot whale
036	Globicephala	macrorhynchus	Short-finned pilot whale
037	Orcinus	orca	Killer whale
038	Sousa	chinensis	Indo-Pacific hump-backed dolphin
039	Sousa	teuszii	Atlantic hump-backed dolphin
040	Phocoena	phocoena	Harbor porpoise
041	Phocoena	sinus	Vaquita, Gulf of California harbor porpoise
042	Phocoena	spinipinnis	Burmeister's porpoise, black porpoise
043	Neophocaena	phocaenoides	Black finless porpoise
044	Phocoenoides	dalli	Dall's porpoise

Appendix C. SWFSC species, stocks and other sighting-categories of marine mammals (continued).

Code	Genus/Taxa	Species/Stock	Common Names
045	Delphinapterus	leucas	Beluga, white whale
046	Physeter	macrocephalus	Sperm whale
047	Kogia	breviceps	Pygmy sperm whale
048	Kogia	sima	Dwarf sperm whale
049	Ziphiid		Unidentified beaked whale
050	Hyperoodon	planifrons	Southern bottlenose whale
051	Mesoplodon	sp.	Unidentified Mesoplodon
052	Mesoplodon	carlhubbsi	Hubb's beaked whale, archbeak whale
053	Mesoplodon	hectori	Hector's beaked whale
054	Mesoplodon	bowdoini	Andrew's beaked whale, deepcrest whale
055	Mesoplodon	europaeus	Gervais' beaked whale, Antillean beaked whale
056	Mesoplodon	bidens	Sowerby's beaked whale
057	Mesoplodon	ginkgodens	Ginkgo-toothed beaked whale
058	Mesoplodon	grayi	Gray's beaked whale
059	Mesoplodon	densirostris	Blaineville's beaked whale, dense-beaked whale
060	Mesoplodon	layardii	Strap-toothed whale
061	Ziphius	cavirostris	Cuvier's beaked whale, goose-beaked whale
062	Berardius	arnuxii	Arnoux's beaked whale, southern giant bottlenose whale
063	Berardius	bairdii	Baird's beaked whale, northern giant bottlenose whale
064	Tasmacetus	shepherdi	Shepherd's beaked whale
065	Indopacetus	pacificus	Longman's beaked whale
066	Eubalaena	japonica	North Pacific right whale
067	Balaena	mysticetus	Bowhead whale
068	Caperea	marginata	Pygmy right whale
069	Eschrichtius	robustus	Gray whale
070	Balaenoptera	sp.	Unidentified rorqual
071	Balaenoptera	acutorostrata	Common minke whale
072	Balaenoptera	edeni	Bryde's whale
073	Balaenoptera	borealis	Sei whale
074	Balaenoptera	physalus	Fin whale
075	Balaenoptera	musculus	Blue whale
076	Megaptera	novaeangliae	Humpback whale
077	unid. Dolphin		Unidentified dolphin or porpoise
078	unid. Small whale		Unidentified small whale
079	unid. Large whale		Unidentified large whale
080	Kogia	sima/breviceps	Unidentified Kogia (dwarf or pygmy sperm whale)
081	Mesoplodon	stejnegeri	Steinger's beaked whale, sabertooth, Bering Sea beaked whale
082	Mesoplodon	mirus	True's beaked whale
083	Mesoplodon	sp. A	Unnamed beaked whale
084	Hyperoodon	ampullatus	Northern bottlenose whale, North Atlantic bottlenose whale
085	Monodon	monoceros	Narwhal, sea unicorn
086	Eubalaena	australis	Southern right whale
087	Pontoporia	blainvillei	Franciscana, La Plata dolphin
088	Stenella	longirostris centroamericana	Central American spinner dolphin, Costa Rican spinner dolphin

Appendix C. SWFSC species, stocks and other sighting-categories of marine mammals (continued).

Code	Genus/Taxa	Species/Stock	Common Names
089	Stenella	attenuata/plagidon	Unidentified spotted dolphin in Atlantic
090	Stenella	attenuata (unid. subsp.)	Unidentified pantropical spotted dolphin, spotter porpoise
091	Stenella	frontalis	Atlantic spotted dolphin
092	Platanista	gangetica gangetica	Ganges river dolphin
093	Platanista	gangetica minor	Indus river dolphin
094	Inia	geoffrensis	Boto, Amazon river dolphin
095	Lipotes	vexillifer	Baiji, Chinese river dolphin, whitefin dolphin
096	unid. cetacean		Unidentified cetacean
097	unid. object		Unidentified object, possible marine mammal
098	unid. whale		Unidentified whale
099	Balaenoptera	borealis/edeni	Rorqual identified as a Sei or Bryde's whale
100	Stenella	longirostris	Tres Marias spinner dolphin
101	Stenella	longirostris	Southwestern spinner dolphin
102	Stenella	longirostris	Gray's spinner dolphin, pantropical spinner dolphin
103	Stenella	longirostris	Undetermined eastern or Central American spinner dolphin
177	unid. small delph.		Unidentified Delphinus/Lagenorhynchus/Lissodelphis/Stenella
277	unid. medium delph.		Unidentified Feresa/Grampus/Steno/Tursiops
377	unid. large delph.		Unidentified Pseudorca/Orca/Globicephala
477	Phocoena/Phocoenoides		Unidentified porpoise (Phocoena or Phocoenoides)
AA	Arctocephalus	australis	South American fur seal
AG	Arctocephalus	galapagoensis	Galapagos fur seal
AT	Arctocephalus	townsendi	Guadalupe fur seal
CU	Callorhinus	ursinus	Northern fur seal
EJ	Eumetopias	jubatus	Steller sea lion
MA	Mirounga	angustirostris	Northern elephant seal
OB	Otaria	byronia	South American sea lion
PU	unid.	pinniped	Unidentified Pinniped
PV	Phoca	vitulina	Harbor seal
UA	unid. fur seal		Unidentified fur seal
UO	unid. sea lion		Unidentified sea lion
US	unid. seal		Unidentified seal
ZC	Zalophus	californianus	California sea lion

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- 418 Diet of the striped dolphin, *Stenella coeruleoalba*, in the eastern tropical Pacific ocean.
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