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STENELLA ABUNDANCE RESEARCH LINE TRANSECT AND ECOSYSTEM (STAR-LITE) 2007 CRUISE REPORT

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NOAA-TM-NMFS-SWFSC-433

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

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***Stenella* Abundance Research Line Transect and Ecosystem
(STAR-LITE) 2007
Cruise Report**

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Annette E. Henry: Survey Coordinator
Lisa T. Ballance: Director, Protected Resources Division

Platform: NOAA Ship *McArthur II*

Cruise Number: M2-07-08, SWFSC Cruise Number 1634

Cruise Dates: 18 August - 29 November 2007

Study Area: A section of the high seas within the eastern tropical Pacific Ocean (ETP) approximately 200 nm southwest of Manzanillo, Mexico.

Sponsoring Institution: NOAA/NMFS, Southwest Fisheries Science Center (SWFSC), Protected Resources Division (PRD), 8604 La Jolla Shores Drive, La Jolla, CA 92037.

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CRUISE DESCRIPTION

The primary objective of the *Stenella* Abundance Research Line Transect and Ecosystem (STAR-LITE) cruise was to investigate spatial and temporal variability and line-transect methodologies in the eastern tropical Pacific Ocean. The project used a multidisciplinary approach. Data on cetacean distribution, school size and school composition were collected to determine cetacean density. Oceanographic data were collected to characterize habitat and its variation over time. Data on distribution and abundance of seabirds, flyingfish, and marine turtles collected will further characterize the ecosystem. Skin biopsies of cetaceans provide a database for investigations of stock structure and phylogenetic relationships. Photographs document geographic variation in dolphins and distribution of individual large whales. This project was related to a series of research cruises that have been repeated periodically in the ETP since the 1970s. Recently, a five-year series of cruises was conducted from 1986-1990 (Monitoring of Porpoise Stocks) and a three-year series was conducted from 1998 through 2000 (STAR: *Stenella* Abundance Research) with additional single-year cruises completed in 2003 and 2006. For additional information about STAR-LITE, please see: <http://swfsc.noaa.gov/prd-star-lite.aspx>; for additional information regarding STAR, please see: <http://swfsc.noaa.gov/prd-star.aspx>.

OPERATIONS

1.0 CETACEAN RESEARCH

Weather permitting, visual watches were conducted by observer teams on the flying bridge during daylight hours (from sunrise to sunset). The Commanding Officer ensured that the flying bridge work area was smoke-free at all times when observers were on watch.

1.1 Cetacean Survey - A daily watch for cetaceans was maintained on the flying bridge during daylight hours (approximately 0600 to 1800) by six mammal observers. Each observer worked in 2-hour rotations, staffing each of the following 3 stations on the flying bridge for 40 minutes: a port-side 25x150-binocular station, a center data recorder position, and a starboard 25x150 binocular station. Line-transect survey methods were used. At the beginning of each day, search effort started on the trackline. NOAA Ship *McArthur II* traveled at 10 knots (through the water) along the designated trackline. While on search effort, if the ship's speed through the water deviated from this by more than two knots, the bridge personnel notified the mammal team on watch or the Cruise Leader. Bridge personnel notified the marine mammal team of any course changes.

1.1.1 Logging of Data - A log of observation conditions, watch effort, sightings, and other required information was entered into a computer, hooked up to the ship's GPS (for course, speed and position information) and SCS (for weather and heading information). All science computers were connected to the same GPS as the ship and networked to the timeserver. An "independent observer" kept a separate watch during the cetacean survey operations while the visual team was off-effort during closing mode operations (see section 1.1.4) to ensure that all schools in visual range were recorded.

1.1.2 Breaking Trackline - On sighting a cetacean school or other feature of interest, the Cruise Leader or marine mammal observer team on watch requested that the vessel be maneuvered to approach the school or feature for investigation. As the ship approached a school, observers made independent estimates of school size. On selected occasions, biopsy and photographic operations may have commenced from the bow based on directions from the Cruise Leader or Senior Marine Mammal Observers. In some instances, the Cruise Leader requested the deployment of a small boat for biopsy, photographic, or other operations (see 3.0). It was occasionally necessary to divert the ship's course from the established trackline during regular effort due to glare or adverse sea conditions. Under these circumstances, the ship was diverted up to 30 degrees from the established course. This deviation was continued until the ship was 10nm from the trackline, at which point the ship turned back toward the trackline.

1.1.3 Resuming Effort - When the observers completed operations for the sighting, the ship resumed the same course and speed as prior to the sighting. If the pursuit of the sighting took the ship more than 10 nautical miles from the trackline, the observers were notified. The Cruise Leader or Senior Marine Mammal Observers occasionally requested that the ship take a heading back toward the trackline, rather than proceeding directly toward the next waypoint.

1.1.4 Passing/Closing Mode - On the first day at a new initial waypoint, the survey was conducted in passing mode and began 9 hours prior to sunset of that day with the ship traveling at 10kt from the initial waypoint down the trackline, surveying approximately 90nm. Just prior to sunset (approximately 20min before), the visual team went off-effort. The following day was conducted in closing mode, starting at the initial waypoint of the previous day. At sunset, the visual team went off-effort. This two-day procedure was repeated on the next trackline until all eight tracklines are surveyed in passing mode and then closing mode (Appendix 3). Under normal operations, transects were traversed in sequence, however the cruise leader occasionally requested the ship to transit to non-sequential waypoints in light of adverse weather or other operational considerations. Rarely, this led to some oceanographic operations being suspended. While in passing mode, the observers did not request any change in course to approach marine mammal sightings; the ship simply continued down the trackline. Small boat operations were infrequently requested, and only on closing-mode days (see 1.3).

1.2 Biopsy Sampling - Biopsy samples for genetic analyses of cetaceans were collected on an opportunistic basis on closing-mode days. Necessary permits were present on the vessel. The animals sampled were 1) approached by the research vessel during normal survey operations, 2) approached the vessel on their own, or 3) approached by a small boat. Samples were collected from animals within 10-30 m of the bow of the ship using a dart fired from a crossbow.

1.3 Photography - Photographs of cetaceans were taken on an opportunistic basis. These will be used to study social behavior and movement patterns of identified individuals, and to study geographic variation. Necessary permits were present on the vessel. The animals to be photographed 1) were approached by the research vessel during normal survey operations; 2) approached the vessel on their own; or 3) were approached by a small boat.

1.4 Acoustics - There were two main goals of the acoustics program during the STAR-LITE survey: (1) to compare acoustic and visual dolphin detections during passing mode; and (2) to test a new hydrophone design with two nodes that allow instantaneous localization of dolphin whistles. In order to address these goals, a hydrophone array was deployed on-board NOAA Ship *McArthur II* for all legs during passing-mode days within the study area. A full-time acoustician was employed for legs 1 and 2 to collect data that are more comprehensive. The array was deployed and recordings were made with the help of other scientists for legs 3 and 4.

A towed hydrophone array was deployed 300 m behind the *McArthur II* during daylight hours on passing-mode survey days. The initial hydrophone array configuration consisted of two hydrophone nodes separated by 1000 m; each node consisted of three hydrophones with 4 m separation between all but the last two hydrophones (11.9 m separation, Table 4a). Hydrophones 1-5 were built in-house and have internal pre-amplification and sensitivity from 1 kHz to 40 kHz (± 5 dB). Hydrophone 6 was built by Seiche Instruments, Inc. This hydrophone had a frequency sensitivity from 1 kHz to 150 kHz. Modifications were made to this array configuration due to technical problems; all array configurations are shown in Table 4a.

The array was monitored for cetacean vocalizations aurally and visually. Using a spectrographic display, 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 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. Locations and detection information were input into an Access database. High-frequency recordings were made to hard drive using a MOTU Traveler digital audio interface with Raven software on a desktop computer. Three or four channels were recorded to hard disk at 96 k-samples/sec in 5-minute bins.

Recordings from the towed hydrophone array included vocalizations from spinner dolphins (*Stenella longirostris*), spotted dolphins (*S. attenuata*), striped dolphins (*S. coeruleoalba*), rough-toothed dolphins (*Steno bredanensis*), and Risso's dolphins (*Grampus griseus*). All non-sighted acoustic detections were "unidentified dolphins" (Table 4b).

There were a total of 398 detections of cetaceans made while both the acoustic and visual teams were on effort. Of these, 117 were made by both visual and acoustic teams (Table 4b). There were a total of 149 detections made only by the acoustic team, and 132 detections made only by the visual team. Many of the detections made only by the visual team were of species known to vocalize outside the range of the acoustics equipment (*Kogia sima*, beaked whales, and unidentified whales and cetaceans). There were a total of 105 detections made by the visual team only that were sightings of species known to vocalize within the acoustic detection range.

Several hydrophone failures appeared to be caused by the extreme cable tension for these long arrays. The array with 1000m between hydrophones 3 and 4 proved to be unworkable at tow speeds of 8-10 kts. The array with 500m between hydrophones 3 and 4 worked and collected valuable data for a relatively short period before it broke as well. Long arrays, such as these are practical only in when the ship is in passing mode and is not turning to chase dolphin groups, and the 1000m array would only be practical at tow speeds of approximately 5-6 kts

1.4.1 Sonobuoys - Sonobuoys were infrequently deployed periodically from NOAA Ship *McArthur II* on an opportunistic basis, at the discretion of the Cruise Leader.

1.5 Salvage of Cetaceans – No cetacean body parts were salvaged.

2.0 ECOSYSTEM STUDIES

2.1 Oceanography - Oceanographic sampling was conducted by two Oceanographers, the ship's Survey Technician, and other scientists as designated by the Cruise Leader. A chronological record of oceanographic and net tow stations was kept by the ship (Marine Operations Log) with dates and times in GMT. The ship provided an electronic copy of this log (with the cruise Weather Log and SCS data) to the Chief Scientist upon completion of the cruise.

2.1.1 Thermosalinograph Sampling - Ship personnel provided and maintained a calibrated thermosalinograph (TSG) for continuous measurement of surface water temperature and salinity. The SCS served as the main data collecting system for the TSG. The Oceanographer provided the ship's Operations Officer and Electronics Technician with detailed SCS acquisition information. The SCS data acquisition was stopped and restarted weekly by the Electronics Technician so data files could be backed up and checked for errors. All SCS and raw data were provided to the SWFSC Oceanographer following each leg of the cruise.

2.1.2 XBT Drops - There were four XBT drops per day at specific locations along the trackline; each drop was determined by ship position. The Cruise Leader or a member of the oceanographic team notified the bridge prior to launching. An additional XBT drop was conducted at the evening CTD station following closing-mode operations twice each leg. This additional XBT drop will allow assessment of the accuracy of the XBT data.

2.1.3 Surface Water Samples - A surface water sample for chlorophyll *a* analysis and a bucket temperature was collected immediately following each the XBT drop (four drops per day). These samples were taken by a member of the scientific party.

2.1.4 Argo Buoy Deployments – Four Argo buoys were deployed by the oceanographers with assistance from scientific personnel. The buoys will help fill in the coverage gap in the eastern tropical Pacific Ocean. Argo is a major contributor to the WCRPs Climate Variability and Predictability Experiment (CLIVAR) and to the Global Ocean Data Assimilation Experiment (GODAE). The Argo array is part of the Global Climate Observing System/Global Ocean Observing System GCOS/GOOS.

The Cruise Leader notified and consulted with the Command regarding the times and locations of the buoy deployments. The buoys were deployed off the stern by a member of the scientific party after notifying the Deck Officer.

2.1.5 CTD - The main SeaBird CTD system was provided by the ship and maintained by the Survey Technician. The collection of CTD data, samples, and their processing were conducted by the scientific party and Survey Technician. Morning and evening CTDs were conducted by the Survey Technician. The crew of the vessel operated all deck equipment and were responsible for the termination (and any necessary reterminations) of the CTD cable pigtail to the conducting cable of the winch. To ensure longevity of the CTD and bottles, the CTD was rinsed completely with fresh water after every cast, and the CTD and rosette were then covered and secured on the fantail.

2.1.5.1 Deck Pressure Tests for Each Leg – A deck pressure test was conducted at the beginning of each leg. The test was performed by the Oceanographers and the ship's Survey Technician before leaving the dock; the CTD was in its normal at-sea position on the ship.

2.1.5.2 Initial CTD Cast for Each Leg - An additional CTD cast was performed on the first morning of oceanographic operations for each leg of the cruise. This cast

was used to test the agreement among salinity samples collected from all CTD bottles. For this cast, a maximum depth of 700m was needed; all bottles were fired at this depth. The rate of CTD ascent and descent for this cast was 60m per minute. The Oceanographer took salinity samples from all bottles before the regular CTD cast was conducted.

2.1.5.3 CTD Stations - Weather permitting, two CTD casts were conducted each night: an evening cast and an early dawn cast (see Appendix 3). CTD data and seawater samples were collected using a SeaBird 9/11+CTD with rosette and Niskin bottles fitted with silicone tubing and o-rings (supplied by the scientific party). All casts were to 1000m, with the descent rate at 30m/min for the first 100m of the cast, then 60m/min after that, including the upcast between bottles. Bottle samples were collected from 12 standard depths on all stations (0, 20, 40, 60, 80, 100, 120, 140, 170, 200, 500, 1000 m). Samples for chlorophyll were collected from all depths ≤ 250 m and processed on board. The 265ml chlorophyll samples were filtered onto GF/F filters, placed in 10ml of 90% acetone, refrigerated for 24 hours, and then analyzed on a Turner Designs model 10AU field fluorometer. Both the Survey Technician and Oceanographers participated in sample collection. Analysis of chlorophyll samples were done by the Oceanographers. Salinity samples (from all 12 Niskin bottles) were taken from casts selected by the Oceanographer. Analyses were done by the Oceanographers. Cast times were subject to change since sunrise and sunset varied during the cruise.

2.1.5.4 Morning cast - The morning cast began approximately at sunrise. The exact starting time was determined the evening before, by the Operations Officer or Deck Officer. Samples for chlorophyll were collected as detailed above.

2.1.5.5 Evening Cast - An evening CTD cast was conducted no sooner than one hour after sunset. The exact time was determined by the Deck Officer (by 1800 local ship time that day). Samples for chlorophyll and salinity were collected as detailed above.

2.1.5.6 "CTD Yo-Yo Casts" - On four closing mode nights, one night per leg, CTD yo-yo casts were done. The casts consisted of approximately 10 consecutive CTD casts over a period of 2.5 hr. The casts occurred to a depth of 200m at a rate of 30m/min. No bottle samples were taken; each cast took approximately 15 min.

2.1.5.7 CTD Cast to Measure XBT Variability - Four additional CTD casts were conducted one night per leg. These casts were evenly spaced between the regular evening and morning CTD. The casts occurred to a depth of 200m at a rate of 30m/min and took approximately 15 min to complete.

2.2 Prey Fishes and Squids

2.2.1 Acoustic Backscatter - The scientific EK-60 depth sounder operated at 38, 120, and 200 KHz and interfaced to a data acquisition system to estimate micronekton biomass between 0 and 500m. The vessel's Abyss IES-10 echo sounder normally remained off while underway in deep waters. None of the ship's navigational depth sounders (ES60 or ABYSS)

interfered with the EK-60 scientific sounder. Use of the scientific EK-60 was continuous or at the discretion of the Cruise Leader.

2.2.2 Dipnetting - Dipnetting for surface fauna was conducted by scientific personnel concurrent with the evening CTD station. This station began no sooner than one full hour after sunset and required one full hour of time to complete. One or more deck lights were necessary to illuminate the water surface in the area of dipnet sampling. Samples were preserved, labeled, and stored in the scientific freezer.

2.2.3 Bongo Tow - An oblique Bongo tow (45 minute station time) was conducted for fifteen minutes immediately following the evening CTD station and dipnetting, to a depth of 200m (wire out 300m on starboard hydro winch). The Bongo has 505-micron mesh on the starboard side, and 333-micron mesh on the port side. The samples were preserved in formalin or frozen, labeled, and stored in containers provided by the SWFSC for post-cruise analysis by the Fisheries Resources Division at the SWFSC in San Diego.

2.2.4 Manta Tow - A surface manta net tow was conducted for fifteen minutes immediately following the evening bongo tow. The manta tow was conducted in the dark; hence, the deck lights were off for the duration of the tow. The net was deployed from the starboard hydro winch. Samples were preserved in formalin, labeled, and stored in containers provided by the SWFSC. Station time for the manta tow was 30 minutes.

2.3 Seabird Research - Weather permitting, visual surveys for seabirds were conducted by seabird observers from the flying bridge during all daylight hours (sunrise to sunset). The Commanding Officer ensured that the flying bridge work area was smoke-free at all times when observers were on watch.

2.3.1 Seabird Survey - Visual surveys of seabirds were conducted from the flying bridge during daylight hours by two seabird observers. A log of visibility conditions, effort, sightings, and other required information was entered into a computer interfaced with the ship's GPS (for course, speed, and position information) and SCS (for weather and heading information). All science computers were connected to the same ship's GPS. Seabird observers used both handheld and 25x150 binoculars.

2.4 Marine Turtle Research - A visual survey for marine turtles was conducted by the mammal and seabird observers on the flying bridge during all daylight hours. Data were recorded in both mammal and seabird databases. On Leg 4, scientists disentangled a female olive ridley turtle (*Lepidochelys olivacea*) from netting and released it.

3.0 SMALL BOAT WORK

A small boat was necessary for biopsy sampling, photography, and other ancillary work. Deployment was requested by the Cruise Leader on an opportunistic basis, provided that the Commanding Officer concurred that operating conditions were safe.

4.0 TRANSIT AT NIGHT

After a day in passing mode (see 1.1.4), the ship returned at night along the line just surveyed, conducting net tow and evening and morning CTD operations along the way. At sunrise, the ship reversed direction and re-surveyed the same transect in closing mode. The starting point for the effort in closing mode generally began at the same location as on the previous day. After a day in closing mode, the ship usually moved only a short distance to the next waypoint. On occasion, the Cruise Leader decided to move at night farther along the trackline or to another section of trackline that may have been missed due to weather. The Cruise Leader consulted with the Operations Officer each evening to determine night transit. The Cruise Leader determined the nightly transit length on a daily basis.

Table 1. Cruise itinerary for NOAA Ship *McArthur II* during STAR-LITE 2007

Date	Event
8/18	Ship loading and gear preparation at 10 th Avenue Terminal
8/20	Leg 1: Depart San Diego, CA
9/14	Arrive Manzanillo, Mexico
9/18	Leg 2: Depart Manzanillo, Mexico
10/6	Arrive Manzanillo, Mexico
10/12	Leg 3: Depart Manzanillo, Mexico
10/31	Arrive Manzanillo, Mexico
11/4	Leg 4: Depart Manzanillo, Mexico
11/29	Arrive San Diego, CA

Table 2. Participating scientists aboard NOAA Ship *McArthur II* during STAR-LITE 2007

Name	Affiliation	Nationality	Position	Legs
Tim Gerrodette	SWFSC	USA	Cruise Leader	1
Susan Chivers	SWFSC	USA	Cruise Leader	2
Lisa Ballance	SWFSC	USA	Cruise Leader	3
Eric Archer	SWFSC	USA	Cruise Leader	4
Jim Cotton	SWFSC	USA	Senior Mammal Observer	1,2
Robert Pitman	SWFSC	USA	Senior Mammal Observer	3
Richard Rowlett	SWFSC	USA	Senior Mammal Observer	1-4
Juan Carlos Salinas	AFL	Mexico	Biopsy/Mammal Observer	1-4
Suzanne Yin	SWFSC	USA	Mammal Observer	1-4
Adam Ü	SWFSC	USA	Mammal Observer	1-4
Ernesto Vazquez	AFL	Mexico	Mammal Observer	1-4
Dawn Breese	AFL	USA	Mammal Observer	4
Michael Force	AFL	Canada	Senior Seabird Observer	1-4
Sophie Webb	SWFSC	USA	Seabird Observer	1-4
Candice Hall	AFL	South Africa/Britain	Oceanographer	1-4
Ryan Driscoll	AFL	USA	Oceanographic Tech	1-4
Shannon Rankin	SWFSC	USA	Acoustician	1,2
Elizabeth Zele	AFL	USA	Acoustic Tech	1,2
Jay Barlow	SWFSC	USA	Visiting Scientist	1
Eric Lewallen	University of Toronto	USA	Visiting Scientist	1,2
Victoria Pease	AFL	USA	Visiting Scientist	2
Fionna Matheson	NOAA Corps/SWFSC	USA	Visiting Scientist	2
Megan Ferguson	AFL	USA	Visiting Scientist	3
Annette Henry	SWFSC	USA	Visiting Scientist	3
Nick Kellar	SWFSC	USA	Visiting Scientist	3
Lisa Schwarz	Montana State Univ	USA	Visiting Scientist	4
Xiujiang Zhao	Chinese Academy of Sciences	China	Visiting Scientist	4
Siri Hakala	AFL	USA	Visiting Scientist	4
Heather Judkins	ARMADA/NOAA	USA	Teacher-at-sea	4

Table 3. Summary of cetacean sightings during STAR-LITE 2007 aboard NOAA Ship *McArthur*

II. Behavioural data were collected on each delphinid sighting.

Species or Taxon	Leg 1	Leg 2	Leg 3	Leg 4	Total
<i>Balaenoptera borealis/edeni</i>	1	0	0	0	1
<i>Balaenoptera musculus</i>	0	0	0	5	5
<i>Balaenoptera</i> sp.	0	1	0	1	2
<i>Delphinus delphis</i>	0	0	0	3	3
<i>Feresa attenuata</i>	0	6	1	1	8
<i>Grampus griseus</i>	0	4	1	11	16
<i>Kogia sima</i>	6	10	3	4	23
<i>Mesoplodon peruvianus</i>	1	5	1	4	11
<i>Mesoplodon</i> sp.	5	9	3	6	23
<i>Orcinus orca</i>	0	2	2	0	4
<i>Physeter macrocephalus</i>	0	0	1	0	1
<i>Pseudorca crassidens</i>	1	0	2	2	5
<i>Stenella attenuata</i> (offshore)	76	117	55	71	319
<i>Stenella coeruleoalba</i>	12	9	4	11	36
<i>Stenella longirostris</i> (unid. subsp.)	1	4	1	3	9
<i>Stenella longirostris orientalis</i>	24	49	39	41	153
<i>Steno bredanensis</i>	15	7	0	10	32
<i>Tursiops truncatus</i>	9	11	4	5	29
Unid. cetacean	0	12	3	1	16
Unid. dolphin	5	14	5	11	35
Unid. large whale	0	0	0	1	1
Unid. medium delphinid	5	6	3	4	18
Unid. small delphinid	77	89	37	46	249
Unid. small whale	4	0	3	1	8
Ziphiid whale	1	1	3	5	10
<i>Ziphius cavirostris</i>	5	4	0	5	14
Total	248	360	171	252	1031

Table 4. Detections of cetaceans by (1) both the visual and acoustic teams, (2) only the acoustic team, and (3) only the visual team. All detections made only by the acoustic team were of unidentified dolphins. Detections made only by the visual team in parenthesis are species known to vocalize beyond the acoustic detection and monitoring range.

Species or Taxon	Acoustic & Visual	Acoustic (only)	Visual (only)	Total
<i>Stenella attenuata</i>	45	-	20	65
<i>Stenella longirostris</i>	2	-	2	4
<i>Stenella coeruleoalba</i>	2	-	4	6
<i>S. attenuata, S. longirostris</i> (mixed)	8	-	-	8
<i>Steno bredanensis</i>	11	-	5	16
<i>Grampus griseus</i>	1	-	1	2
<i>Orcinus orca</i>	-	-	1	1
<i>Kogia sima</i>	-	-	(7)	7
Beaked whales	-	-	(14)	14
Unidentified dolphins	48	149	72	269
Unidentified whales	-	-	(3)	3
Unidentified cetaceans	-	-	(3)	3
Total	117	149	132 (27)	398

Table 5. Cetacean biopsy samples collected during STAR-LITE 2007 aboard NOAA Ship *McArthur II*.

Species or Taxon	Leg 1	Leg 2	Leg 3	Leg 4	Total
<i>Pseudorca crassidens</i>	1	0	2	1	4
<i>Stenella attenuata</i>	2	0	2	1	5
<i>Tursiops truncatus</i>	1	1	0	2	4
Total	4	1	4	4	13

Table 6. Number of cetacean schools or individuals photographed during STAR-LITE 2007 aboard NOAA Ship *McArthur II*.

Species or Taxon	Leg 1	Leg 2	Leg 3	Leg 4	Total
<i>Balaenoptera musculus</i>	0	0	0	736	736
<i>Feresa attenuata</i>	0	304	23	0	327
<i>Grampus griseus</i>	0	42	0	151	193
<i>Pseudorca crassidens</i>	26	0	63	44	133
<i>Stenella attenuata</i> (offshore)	207	19	111	154	491
<i>Stenella coeruleoalba</i>	20	0	0	60	80
<i>Stenella longirostris orientalis</i>	15	23	112	53	203
<i>Steno bredanensis</i>	0	0	0	316	316
<i>Tursiops truncatus</i>	7	67	2	0	76
Total	275	455	311	1514	2,555

Table 7. Summary of seabird sightings during STAR-LITE 2007 aboard NOAA Ship *McArthur II*.

Common Name	Taxon	Leg 1	Leg 2	Leg 3	Leg 4	Total
Albatrosses	Diomedidae	0	0	0	0	0
Fulmars	<i>Fulmarus</i>	0	0	0	0	0
Shearwaters	<i>Puffinus</i>	823	532	95	169	1619
Petrels	<i>Procellaria, Pterodroma, Pseudobulweria</i>	1014	1009	234	55	2312
Storm Petrels	Oceanitidae	131	183	299	479	1092
Tropicbirds	Phaethontidae	16	14	19	24	73
Pelecans	Pelecanidae	0	0	0	0	0
Boobies	Sulidae	275	518	344	407	1544
Cormorants	Phalacrocoracidae	0	0	0	0	0
Frigatebirds	Fregatidae	2	0	1	10	13
Phalaropes	Phalaropodidae	49	56	17	227	
Skuas and Jaegers	Cathartidae, Stercorariidae	20	36	30	44	130
Gulls	<i>Larus</i>	0	0	3	3	6
Terns	<i>Sterna, Gygis, Chlidonias, Anous</i>	140	27	22	157	346
Auks	Alcidae	0	0	0	0	0
Total		2470	2375	1064	1575	7135

Table 8. Dipnet samples collected during STAR-LITE 2007 aboard NOAA Ship *McArthur II*.

Species or Taxon	Leg 1	Leg 2	Leg 3	Leg 4	Total
No. of Stations	14	16	14	19	63
Two-winged flyingfish (<i>Exocoetus</i> sp.)	63	98	59	127	347
Four-winged flyingfish (<i>Cheilopogon, Hirundichthys, Prognichthys</i>)	53	35	48	44	180
Short-winged flyingfish (<i>Oxyporhamphus</i>)	39	35	20	57	151
Lantern fish (Myctophidae)	6	1	1	5	13
Unidentified fish	0	3	1	17	21
Total	161	172	129	250	712

Table 9. Number of stomachs preserved from dipnet samples collected during STAR-LITE 2007 aboard NOAA Ship *McArthur II*.

Species or Taxon	Leg 1	Leg 2	Leg 3	Leg 4	Total
Two-winged flyingfish (<i>Exocoetus</i> sp.)	40	73	29	95	237
Four-winged flyingfish (<i>Cheilopogon, Hirundichthys, Prognichthys</i>)	32	24	28	31	115
Short-winged flyingfish (<i>Oxyporhamphus</i>)	1	0	12	22	35
Total	73	97	69	148	387

Table 10. Summary of environmental data collected during STAR-LITE 2007 aboard NOAA Ship *McArthur II*.

Operation	Leg 1	Leg 2	Leg 3	Leg 4	Total
CTD Casts	42	33	23	42	140
XBT	63	64	61	81	269
Surface Chlorophyll	65	63	61	76	265
Bongo Net Tows	15	12	9	18	54
Manta Net Tows	15	11	9	18	53

Table 11. Disposition of data collected aboard NOAA Ship *McArthur II* during STAR-LITE 2007 for analysis and further distribution.

Data	PI	Affiliation	Contact
Marine mammal sightings	Dr. Tim Gerrodette	NOAA Fisheries - SWFSC	tim.gerrodette@noaa.gov 858-546-7131
Passive acoustics	Dr. Jay Barlow	NOAA Fisheries - SWFSC	jay.barlow@noaa.gov 858-546-7178
Biopsies	Dr. Barbara Taylor	NOAA Fisheries - SWFSC	barbara.taylor@noaa.gov 858-546-5620
Seabird sightings	Dr. Lisa Ballance	NOAA Fisheries - SWFSC	lisa.ballance@noaa.gov 858-546-7173
Acoustic backscatter	Dr. David Demer	NOAA Fisheries - SWFSC	david.demer@noaa.gov 858-546-5603
Oceanographic	Dr. Paul Fiedler	NOAA Fisheries - SWFSC	paul.fiedler@noaa.gov 858-546-7016
Net samples	Dr. George Watters	NOAA Fisheries - SWFSC	george.watters@noaa.gov 858-546-7198

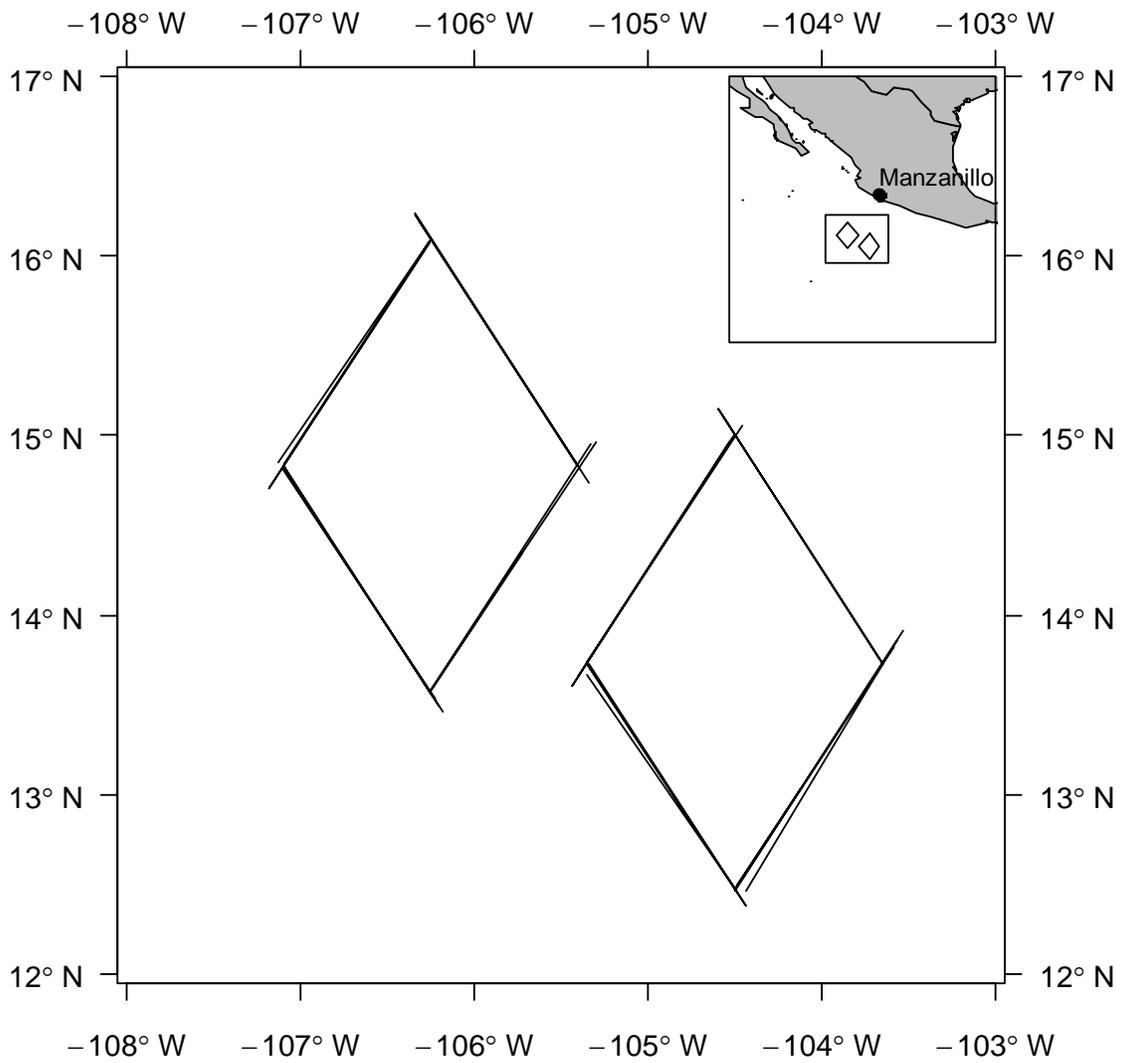


Figure 1. Transect lines covered in passing mode for STAR-LITE 2007 aboard NOAA Ship *McArthur II*. Both diamond patterns were repeated on each of the four legs as weather permitted. Inset shows location of study area.

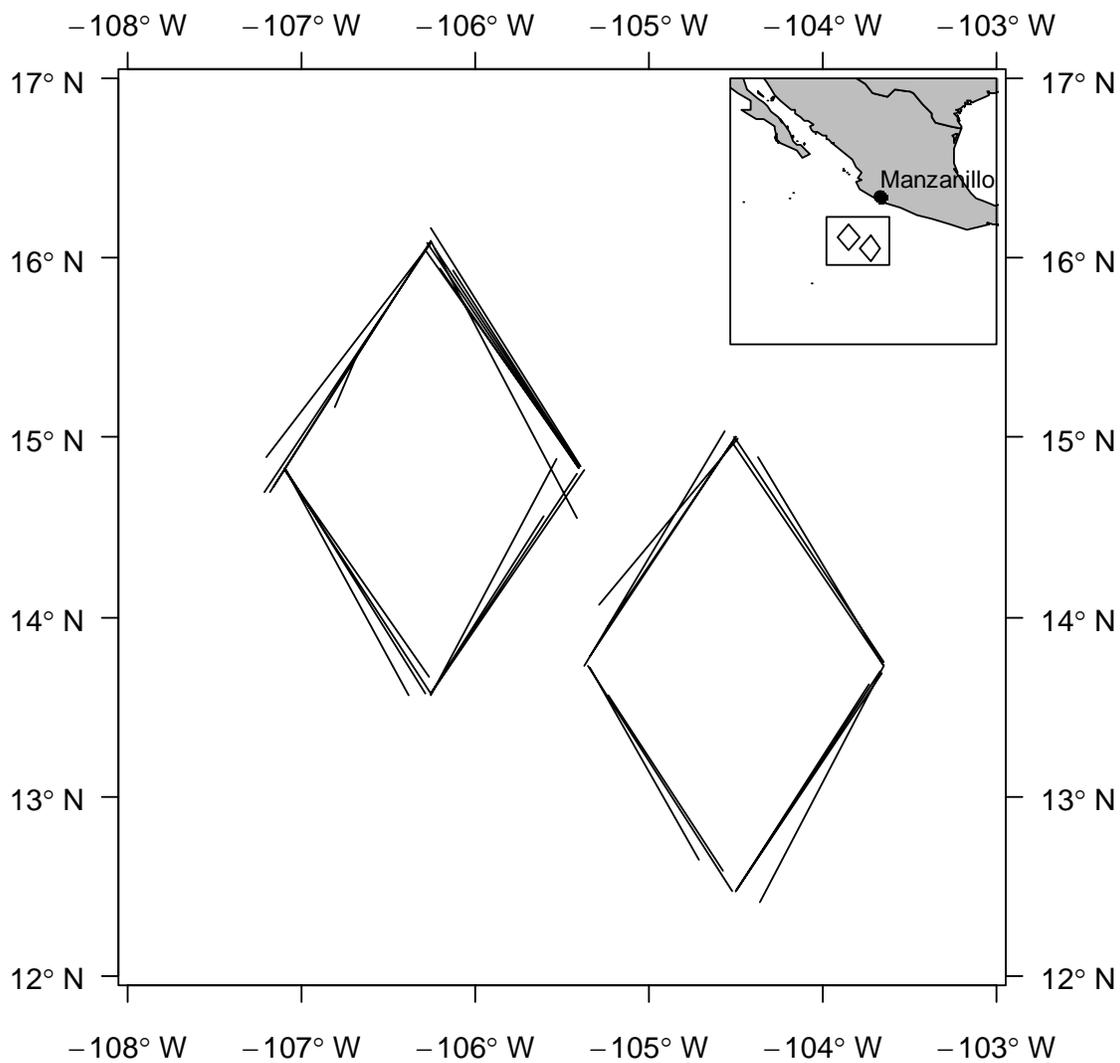


Figure 2. Transect lines linking beginning and end points of days covered in closing mode for STAR-LITE 2007 aboard NOAA Ship *McArthur II*. Both diamond patterns were repeated on each of the four legs as weather permitted. Inset shows location of study area.

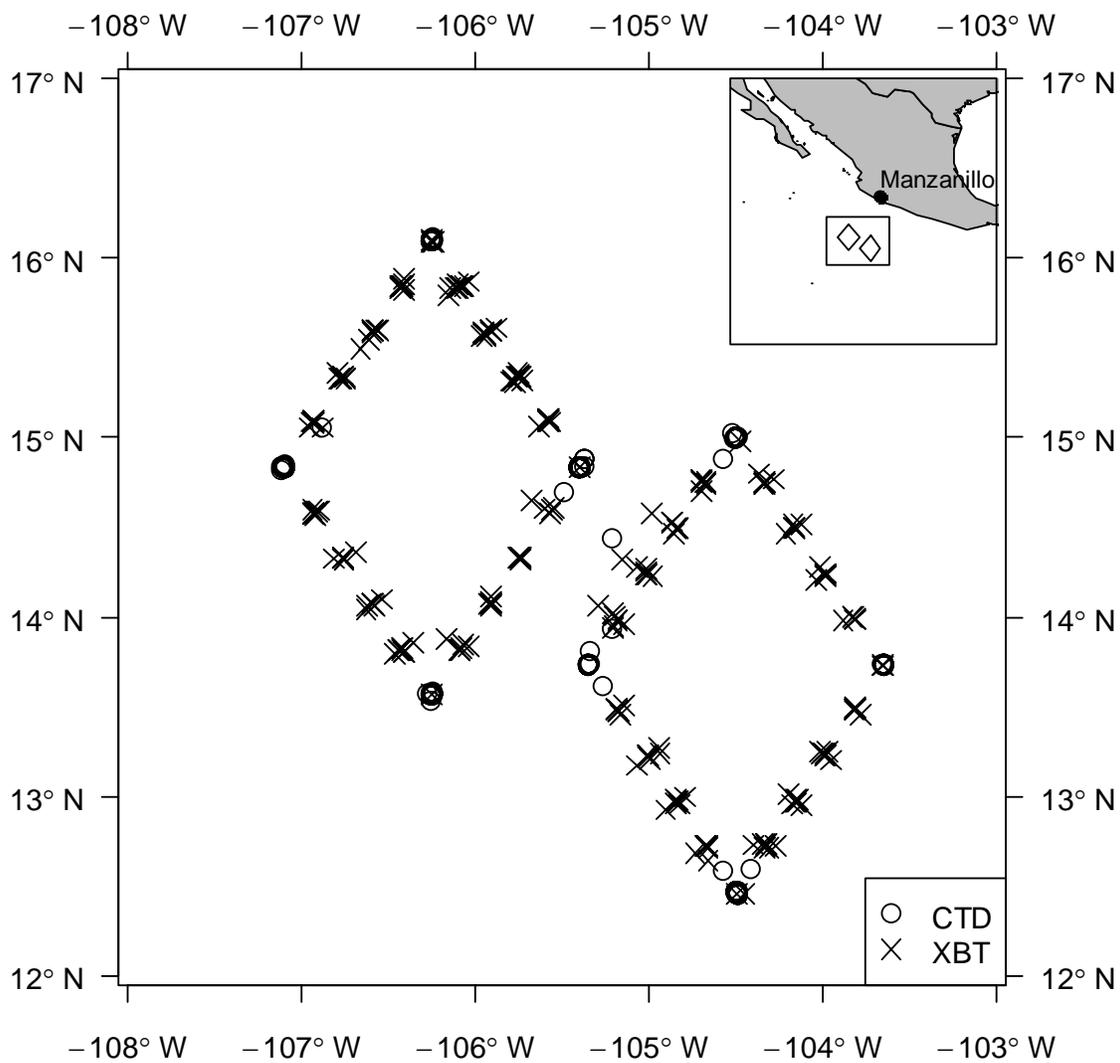


Figure 3. Locations of CTD (circles), and XBT (crosses) samples taken during STAR-LITE 2007 aboard NOAA Ship *McArthur II*. Both diamond patterns were repeated on each of the four legs as weather permitted. Inset shows location of study area.

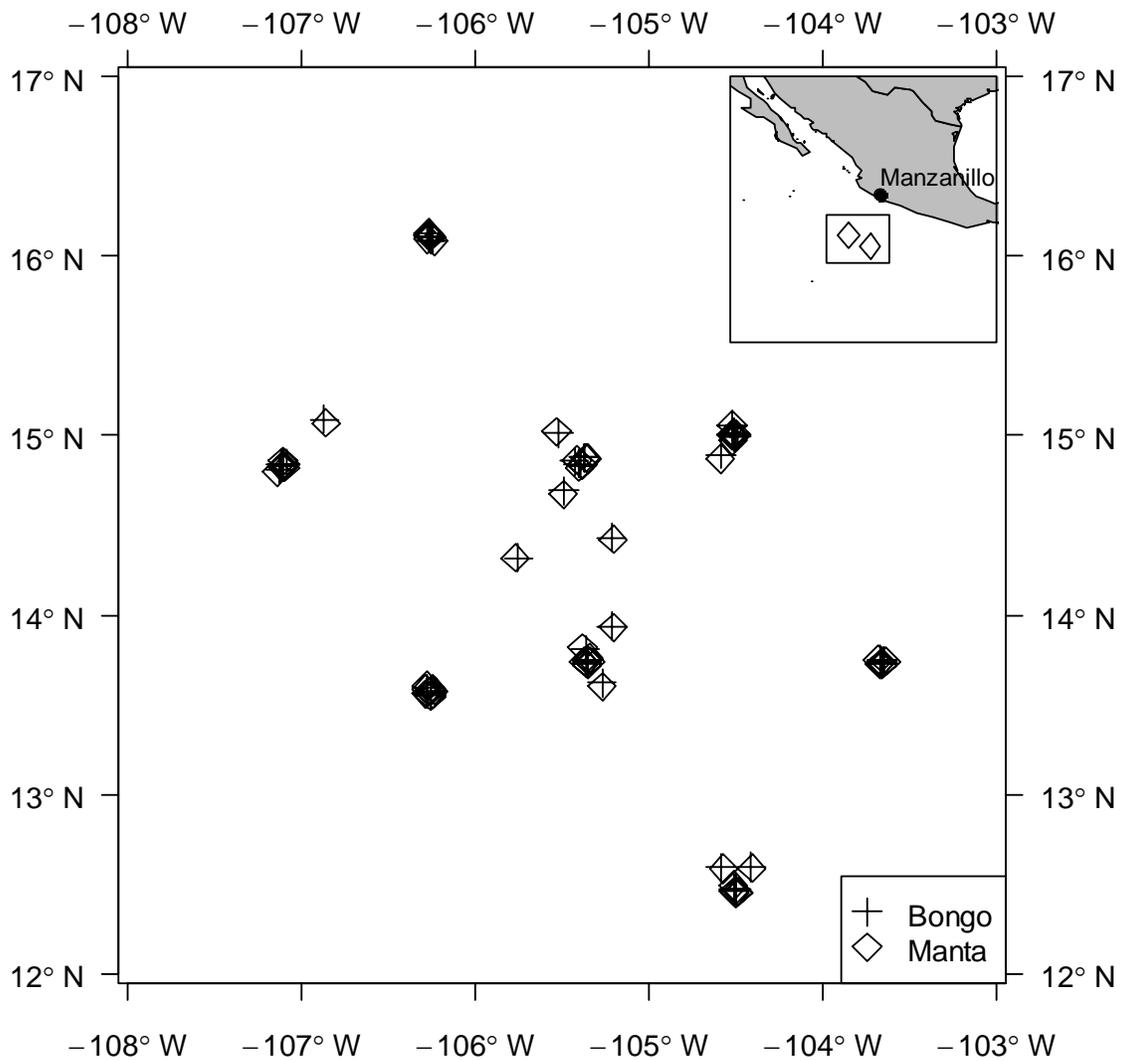


Figure 4. Locations of Bongo (pluses), and Manta (diamonds) net tows made during STAR-LITE 2007 aboard NOAA Ship *McArthur II*. Both diamond patterns were repeated on each of the four legs as weather permitted. Inset shows location of study area.

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