UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NATIONAL MARINE FISHERIES SERVICE
Southwest Fisheries Center
8604 La Jolla Shores Drive
La Jolla, California 92037

21 March 2007

FINAL CRUISE REPORT

Ship Name: NOAA Ship *McArthur II*

Cruise Numbers: OMAO AR-06-10, SWFSC Marine Mammal Cruise Number: 1631

Cruise Dates: 28 July through 07 December 2006

Project: *Stenella* Abundance Research Project (STAR)

Sponsor: NOAA Fisheries, Southwest Fisheries Science Center (SWFSC) Protected Resources Division (PRD)

Chief Scientist: Dr. Lisa T. Ballance, SWFSC (858) 546-7173, Lisa.Ballance@noaa.gov

Clearance Countries:
Mexico, Guatemala, El Salvador, Honduras, Nicaragua, Costa Rica, Panama, Ecuador, Colombia, Peru, and France (Clipperton Island)

Foreign Participants:
Instituto Nacional de la Pesca (INP), Mexico; Instituto Nacional de Ecología (INE), Mexico; Universidad del Valle de Guatemala (Dra. Lucía Gutiérrez), Guatemala; Institut français de recherche pour l'exploitation de la mer (IFREMER), France; Ministerio de Ambiente y Energía (MINAE), Costa Rica; Instituto del Mar del Peru (IMARPE), Peru

Itinerary:
28 JUL-EK 60 Calibration

LEG 1: 29 JUL - Depart San Diego, CA	26 AUG - Arrive Honolulu, HI
LEG 2: 31 AUG - Depart Honolulu, HI	29 SEP - Arrive Manta, Ecuador
LEG 3: 05 OCT - Depart Manta, Ecuador	03 NOV - Arrive Manzanillo, Mexico
LEG 4: 09 NOV - Depart Manzanillo	07 DEC - Arrive San Diego, CA/EK 60 Calibration

CRUISE DESCRIPTION AND OBJECTIVES:
The STAR 2006 cruise surveyed marine mammals and their habitat in the eastern tropical Pacific Ocean (ETP). The primary objective was to assess the status of dolphin stocks which have been taken as incidental catch by the yellowfin tuna purse-seine fishery. An ecosystem approach was used. Research on physical and biological oceanography (dolphin habitat), mid trophic-level fishes and squids (dolphin prey), seabirds, marine turtles, and other cetaceans (dolphin commensals, competitors, and predators) was conducted. This cruise was a continuation of a multi-year study with previous cruises in 1986-1990, 1998-2000, and 2003 using a multidisciplinary approach.

Visual observations of cetaceans, seabirds, and sea turtles, their taxonomic composition, group size and geographic location were recorded. Photographs of cetaceans were taken for delineation of stocks and

identification of individuals, and projectile biopsies were collected to study geographic stock structure and phylogenetic relationships. Sonobuoys recorded vocalizations of cetaceans. Sea turtles were tagged, measured and had blood samples taken. Thermosalinograph, fluorometer, XBT, and CTD measurements logged the oceanographic properties of the survey area. Manta and bongo net tows and dipnet sampling collected surface and midwater invertebrates and ichthyoplankton.

The STAR 2006 cruise was a two-ship project. Activities of the other vessel, NOAA Ship *David Starr Jordan*, are covered in a separate report.

Study Area:
The eastern tropical Pacific Ocean (ETP). Tracklines covered are shown in **Figure 1.**

I. OPERATIONS

1. CETACEAN RESEARCH

Visual watches were conducted by observer teams on the flying bridge during all daylight hours (from sunrise to sunset), unless weather prohibited this activity.

1.1 Cetacean Survey - Line-transect survey methods were used to collect abundance data. At the beginning of each day search effort started on the trackline. The *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 one knot, the bridge personnel notified the mammal team on watch or the Cruise Leader. 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 three stations on the flying bridge for 40 minutes: a port side 25x150 binocular station, a center line data recorder position, and a starboard 25x150 binocular station. (SAME)

1.1.1 Logging of Data - A log of observation conditions, watch effort, sightings, and other required information were entered into a computer that was hooked up to the ship's Global Positioning System (GPS, for course, speed and position information) and SCS (for weather and heading information). An “independent observer” kept a separate watch of animals sighted during the cetacean survey operations to be compared later with the observer team’s data.

1.1.2 Breaking Trackline - Upon sighting a cetacean school or other feature of biological interest, the Cruise Leader or cetacean observer team on watch requested that the vessel be maneuvered to approach the school or feature for investigation. When the ship approached a school of dolphins, the observers made independent estimates of school size. Biopsy and photographic operations commenced from the box, 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 Dive-Interval Studies - Sightings of deep-diving whales prompted dive-interval studies at the discretion of the Cruise Leader. The collection of dive-interval data was necessary to produce sightability correction factors for those species that spend a considerable amount of time diving. The Cruise Leader or observer team on watch directed the vessel during these observations.

1.1.4 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 nm from the trackline, the observers were notified. The Cruise Leader or Senior Marine Mammal Observers often requested that, rather than proceeding directly toward the next waypoint, the ship take a heading back toward the trackline.

1.2 Biopsy Sampling - Biopsy samples for genetic analyses of cetaceans were collected on an opportunistic basis. Necessary permits were present on the vessel. The animals sampled were approached by the research vessel during normal survey operations, approached the vessel on their own, or approached by a small boat. Samples were collected from animals within 10 to 30m of the bow of the vessel using a dart fired from a crossbow or rifle. With the exception of the small boat and safety gear, all necessary equipment was furnished and deployed by the scientific party.

1.3 Photography - Photographs of cetaceans were taken on an opportunistic basis. These were 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 photographed were approached by the research vessel during normal survey operations, approached the vessel on their own, or approached by a small boat. With the exception of the small boat and safety gear, all necessary equipment was furnished by the scientific party.

1.4 Passive Acoustics

1.4.1 Towed Array - A small hydrophone array was towed during daylight hours to collect data on cetacean vocalizations. The array was deployed each morning prior to the start of visual observations; it was retrieved each evening after search effort ended or when required for increased maneuverability. The array was wound onto a hydraulic-powered winch supplied by the SWFSC and -powered by the ship's hydraulic system. A team of two acoustic technicians monitored the array; they recorded sounds made by cetaceans and localized their positions. Occasionally, the acoustic team requested the vessel to turn such that visual observers could search for acoustically detected cetaceans. During Leg 1, the Cruise Leader worked with the Commanding Officer and assessed the maneuvering limits of the ship for this array.

1.4.2 Sonobuoys - Sonobuoys were deployed periodically from NOAA Ship *McArthur II* or a small boat on an opportunistic basis at the discretion of the Cruise Leader. With the exception of the small boat and safety gear, all necessary equipment was supplied and operated by scientific personnel.

1.4.3 Hull Mounted Hydrophone - A hydrophone mounted under the hull of *McArthur II* was activated by scientific personnel at the discretion of the Cruise Leader for listening and recording cetacean vocalizations at any time, day or night. All of the necessary equipment was supplied and operated by scientific personnel.

1.5 Aerial Photogrammetry - During Leg 5, the ship conducted coordinated operations with a NOAA Twin Otter aircraft operating out of airports along the west coast of Mexico (mainly Acapulco). The ship deployed and retrieved 50' sections of PVC pipe that were used to calibrate the radar altimeter on the aircraft. This operation required approximately one hour, and the pipes were attended by the ship's small boat at least 100 yards away from the ship. The small boat drifted alongside the pipes to ensure they were straight. Communications between the ship's scientific party and the aircraft was via Iridium phones at long range and VHF at short range. 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, school size calibration took precedence over line transect sampling. The ship/aircraft coordinated operations used 11 of the 12 days allocated. The Cruise Leader coordinated communications with the aircraft and kept the Command and Operations Officer informed of daily operations planning.

1.6 Salvage of Cetaceans - Cetacean body were salvaged on an opportunistic basis at the discretion of the Cruise Leader. This included whale and dolphin teeth, bones, and carcasses. When this occurred, scientific freezer space was used to store the cetacean body parts. Permits to salvage and import cetacean parts were present on the vessel. These permits were valid in US territorial waters and on the high seas only. All cetacean specimens obtained will be archived at the SWFSC but may be released on loan to recognized research institutions according to existing guidelines.

2.0 ECOSYSTEM STUDIES

2.1 Oceanography - Oceanographic sampling was conducted by the Oceanographer and ship's Survey Technician (excluding Leg 1), 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 a printed and electronic copy of the marine operations log (with the cruise Weather Log and SCS data) to the Chief Scientist at the completion of the cruise.

2.1.1 Thermosalinograph Sampling - Ship personnel provided and maintained a thermosalinograph (TSG), which was calibrated and in working order, for continuous measurement of surface water temperature and salinity. A backup unit (calibrated and in working order) was also provided by ship personnel and remained aboard during the cruise. The SCS served as the main data collection 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 Filtering Water Samples - Concurrent with squid sampling and dipnetting, small samples of particulate organic matter (POM) and zooplankton were collected by the visiting scientist in charge of squid sampling. One hour prior to the evening CTD, seawater was collected from the ship's uncontaminated seawater system, pre-filtered to remove large particles, and placed in a 10L carboy filtration system. The water was left for at least three hours to filter on to 25mm glass fiber filters. The glass fiber filters were stored frozen. For zooplankton collection, seawater collected from the sea surface was poured over a homemade nitex filter and stored frozen.

2.1.3 XBT Drops - Three XBT drops per day occurred at approximately 0900, 1200 and 1500 hours local ship time, or as requested by the Cruise Leader. The XBTs were provided by the Southwest Fisheries Science Center; the launcher and computer were provided by the ship. If the vessel was already stopped at the scheduled launch time, the drop was delayed until the ship was again underway. The scientist performing the drop would contact the bridge prior to deploying the XBT to ensure the vessel would move within half an hour. If the vessel would not move within half an hour, the drop was delayed or canceled at the discretion of the Cruise Leader.

2.1.4 Surface Water Samples - A surface water sample for chlorophyll *a* analysis and a bucket temperature were collected by the Cruise Leader at approximately 0900, 1200, 1500, and 1800 hours local ship time daily.

2.1.5 Argo Buoy Deployments – Fifteen Argo buoys were deployed by scientific personnel to improve coverage in the eastern tropical Pacific Ocean; eight on *McArthur II* and seven on *David Starr Jordan*. 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 times and locations of the deployments were determined by the Cruise Leader in consultation with the Command. Buoys were deployed off the stern by a member of the scientific party after notifying the Deck Officer. The buoys were loaded in San Diego and secured in a weather protected area and stored horizontally at all times.

2.1.6 CTD - The main SeaBird CTD system was provided, maintained, and operated by the scientific party. The collection of CTD data, samples, and their processing were conducted by the scientific party. The crew of the vessel operated all deck equipment and was responsible for the termination (and any necessary reterminations) of the CTD cable pigtail (provided by the scientific party) to the conducting cable of the winch. The ship provided a complete backup system, consisting of a frame with weights, a 12-place rosette with bottles, a deck unit, and a SeaBird 9/11+ CTD with conductivity and temperature sensors. All instruments, their spares, and spare parts provided by the ship were maintained in working order and, if applicable, had current calibrations (within the previous 12 months). We used both primary and backup conductivity and temperature sensors during our casts; conducting CTD casts with two temperature and salinity sensors provided immediate feedback about the performance of the sensors and the validity of the data. To ensure longevity of the CTD and Bottles, the CTD was rinsed completely with fresh water after every cast. Afterwards, the oceanographer covered and secured the CTD and rosette.

2.1.6.1 - Initial CTD Cast for Each Leg - We requested an additional CTD cast on the first evening 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 required extra time to take salinity samples from all bottles before the regular CTD cast was conducted: 30 minutes for the cast, 15 minutes for the sampling, and 15 minutes to prepare the CTD for the regular evening cast.

2.1.6.2 CTD Stations - Weather permitting, two CTD stations were occupied each night; an evening cast and a pre-dawn cast. 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 1000 m, with the descent rate at 30m/min for the first 100m of the cast, then 60m/min after that, including the up cast between bottles. Bottle samples were collected from 12 standard depths (0, 20, 40, 60, 80, 100, 120, 140, 170, 200, 500, and 1000 m). From each cast, chlorophyll samples were collected from all depths $\leq$ 250m, 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. Salinity samples (from all 12 Niskin bottles) were taken only from casts where bottle tripping errors were found. Analysis was done by the oceanographer. Cast times were subject to change since sunrise and sunset varied during the cruise. Additional CTD stations were requested by the Cruise Leader in areas of special interest.

2.1.6.3 Pre-dawn Cast - The morning cast began approximately 1-1/2 hours prior to sunrise. The exact starting time was determined the evening before by the Operations Officer or Deck Officer. The schedule was subject to modification by the Oceanographer. Samples for chlorophyll were collected as detailed above.

2.1.6.4 Evening Cast - An evening CTD cast was conducted no earlier sooner than one hour after sunset. The exact time was determined by the Deck Officer (by 1800 local ship time that day). Chlorophyll samples were collected as detailed above.

2.1.7 Buoys - The ship was not required to approach oceanographic buoys to repair or maintain scientific instruments for the Tropical Atmosphere Ocean (TAO) project during the cruise.

2.2 Prey Fishes and Squids

2.2.1 Acoustic Backscatter - The scientific EK-60 depth sounder was operated, at 38, 120, and 200 KHz and interfaced to a data acquisition system to estimate micronekton biomass between 0 and 500 m. The vessel's Abyss IES-10 Echo sounder was used at the discretion of the Commanding Officer, however, it normally remained off while underway in deep waters. Because the ship's navigational depth sounders (ES60 or ABYSS) may interfere with the EK-60 scientific sounder, the command informed the Cruise Leader when those navigational depth sounders were used. Use of the scientific EK-60 was continuous or at the discretion of the Cruise Leader.

2.2.2 Net Sampling - Net tows were conducted by the scientific party with the assistance of a winch operator from the vessel. The net tow schedule varied by leg.

2.2.3 Dipnetting - Concurrent with the evening CTD station, dipnetting for surface fauna was conducted by scientific personnel for one full hour from the starboard side of the ship. This station began no sooner than one full hour after sunset. 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 vessel's freezer. Surplus samples of any species of fishes, cephalopods, and crustaceans, were labeled and frozen for the Food-web Isotope Project. Scientists collected surface fauna for aquarium tanks on board. All live organisms were donated to the Scripps Aquarium upon return to San Diego.

2.2.4 Collection of Squid - Concurrent with the evening CTD station and dipnetting, cephalopods *Dosidicus gigas* and *Sthenoteuthis oualaniensis* were collected in the evening using attracting lights and handline jigs. They were collected along the Pacific coast of Mexico (off the Pacific Coast of the Baja Peninsula, Central Coast, and Gulf of Tehuantepec), Hawaii, Costa Rica Dome, and Ecuador. Jigging occurred nightly in these locations to locate areas where both species coexist. Squids were collected at three to five stations where both species coexisted; a maximum of 15 *D. gigas* and 15 *S. oualaniensis* will were collected at each station. Juvenile squid swimming at the surface were collected with dipnets. All specimens were frozen intact as soon as possible and labeled (ship, date, time and latitude and longitude position).

In areas not mentioned above, squids of all species with mantle sizes 35cm or less were collected opportunistically during dipnetting, labeled (ship, date, time, position), and frozen whole for the Food-web Isotope project. A maximum of two specimens per species per sampling location were collected as these numbers were sufficient for the project.

2.2.5 Manta Tow - A surface manta net tow was conducted for fifteen minutes immediately following the evening CTD station and dipnetting. The manta tow was conducted in the dark; hence, the deck lights were turned off for the duration of the tow. The net was deployed from the starboard hydro winch when working; otherwise, the port winch was utilized. While at-sea, samples were preserved in formalin, labeled, and stored in containers provided by the SWFSC. Average completion time for the entire procedure was 30 minutes.

2.2.6 Bongo Tow - An oblique bongo tow was conducted for 15 minutes (45 minute station time), to a depth of 200m (wire out 300m on starboard hydro winch) immediately following the manta tow. The Bongo net has 505µm mesh on the starboard side, and 333µm mesh on the port side. Two cod ends were used on the bongo tow. The samples were preserved in formalin or frozen (isotope analysis), labeled and stored in containers provided by the SWFSC while at-sea.

2.2.6.1 Samples for Leatherback Turtle Diet Isotope Project and the Inter-American Tropical Tuna Commission Food-web Isotope Project - The contents of the second cod end (333 µm mesh) bongo tow were collected, placed in whirl-packs, labeled, and stored frozen for later

stable isotope analysis. Samples were separated twice a week with gelatinous samples specifically stored for the Turtle Diet Isotope Project. J. Seminoff (SWFSC) and R. Olson (IATTC) provided supplies to label and store these samples.

2.2.7 Collection of Fish - Fish were collected on an opportunistic basis at the discretion of the Cruise Leader. While underway, trolling gear was used when conditions permitted. While stationary, hook-and-line gear was used. Fish were measured, sexed, and stomach contents were examined and recorded by scientific personnel. The stomach with contents intact, a piece of liver, and a core of white muscle were removed from each scientifically caught fish and stored frozen for the Food-web Isotope Project (R. Olson, IATTC, will provide supplies and instructions). The Cruise Leader was responsible for the disposition of the catch, in accordance with NOAA Administrative Order 202-735B, dated January 9, 1989. All flyingfish specimens that landed on the decks were collected by the scientific party and frozen. Individuals who found flyingfish on deck notified Robert Pitman or the flyingfish team leader.

2.2.8 Collection of Jellyfish Samples - Jellyfish and other gelatinous plankton were collected opportunistically for leatherback turtle dietary studies. Jellyfish were collected using dip nets, during scheduled bongo and manta tows, opportunistically from the surface, or from the small boat. Jellyfish and gelatinous plankton on the CTD were collected upon its retrieval. Samples were frozen for future stable isotope analysis.

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).

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 were 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 7x50 handheld and 25x150 binoculars.

2.3.2 Seabird Colony Censuses - No nesting site surveys were conducted by the scientists aboard NOAA Ship *McArthur II*.

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. Marine turtles were captured from a small boat on an opportunistic basis at the discretion of the Cruise Leader. Turtles were measured, weighed, flipper tagged, and a small amount of blood or skin might have been collected for genetic and stable isotope analyses, or hormonal studies. All turtles were released unharmed. With the exception of the small boat and safety gear, all necessary equipment was supplied and operated by the scientific party. All necessary permits were aboard the vessel.

3. Small Boat Work

A small boat was necessary for biopsy sampling, photography, seabird collection, island surveys, and marine turtle work. Deployment was requested by the Cruise Leader on an opportunistic basis, including multiple times in a single day, provided the Commanding Officer concurred that operating conditions were safe. Unless the Commanding Officer allowed otherwise, the small boat remained within sight and radio contact at all times while deployed. The small boat returned to the ship immediately when recalled by the CO, OOD, or Cruise Leader. With the exception of the small boat and required safety gear, all

necessary equipment was furnished by the scientific party.

4. Transit at Night

When scientific operations were completed for the night, the ship resumed course along the trackline, at a speed determined by the Cruise Leader, until it was necessary to stop for the morning (pre-dawn) CTD station. Generally, the ship transited between 50 and 100 nm per night. The Cruise Leader determined the nightly transit length on a daily basis.

II. SCIENTIFIC PERSONNEL

1. Chief Scientist - The Chief Scientist for STAR 2006 was Dr. Lisa T. Ballance. In addition to her Chief Scientist duties, she was Cruise Leader for three legs: Leg 2 aboard NOAA Ship *McArthur II* and Legs 4 and 5 aboard NOAA Ship *David Starr Jordan*.

1.1 Participating Scientists - Participating scientists are listed in the tables below by leg.

Leg 1: San Diego, California to Honolulu, Hawaii

Name	Position	Affiliation
Jessica Redfern	Cruise Leader	NOAA Fisheries / SWFSC
James Cotton	Senior Mammal Observer	NOAA Fisheries / SWFSC
Richard Rowlett	Senior Mammal Observer	NOAA Fisheries / SWFSC
Suzanne Yin	Marine Observer	NOAA Fisheries / SWFSC
Isabel Beasley	Mammal Observer	AFL
Erin LaBrecque	Mammal Observer	NOAA Fisheries / SWFSC
Howard Goldstein	Mammal Observer	NOAA Fisheries / SWFSC
Michael Force	Senior Bird Observer	AFL
Sophie Webb	Bird Observer	NOAA Fisheries / SWFSC
Melinda Kelley	Oceanographer	NOAA Fisheries / SWFSC
Shannon Rankin	Acoustician	NOAA Fisheries / SWFSC
Elizabeth Zele	Acoustic Technician	AFL
Cyndy Martin	Teacher-at-sea	ARMADA

Leg 2: Honolulu, Hawaii to Manta, Ecuador

Name	Position	Affiliation
Lisa Ballance	Cruise Leader	NOAA Fisheries / SWFSC
James Cotton	Senior Mammal Observer	NOAA Fisheries / SWFSC
Richard Rowlett	Senior Mammal Observer	NOAA Fisheries / SWFSC
Suzanne Yin	Marine Observer	NOAA Fisheries / SWFSC
Isabel Beasley	Mammal Observer	AFL
Erin LaBrecque	Mammal Observer	NOAA Fisheries / SWFSC
Howard Goldstein	Mammal Observer	NOAA Fisheries / SWFSC
Michael Force	Senior Bird Observer	AFL
Sophie Webb	Bird Observer	NOAA Fisheries / SWFSC
Melinda Kelley	Oceanographer	NOAA Fisheries / SWFSC
Shannon Rankin	Acoustician	NOAA Fisheries / SWFSC
Elizabeth Zele	Acoustic Technician	AFL
Maria Elena Tapia	Official Foreign Observer	Country of Ecuador
Ignacio García-Godos Naveda	Official Foreign Observer	Country of Perú

Leg 3: Manta, Ecuador to Manzanillo, México

Name	Position	Affiliation
Jay Barlow	Cruise Leader	NOAA Fisheries / SWFSC
James Cotton	Senior Mammal Observer	NOAA Fisheries / SWFSC
Richard Rowlett	Senior Mammal Observer	NOAA Fisheries / SWFSC
Suzanne Yin	Marine Observer	NOAA Fisheries / SWFSC
Isabel Beasley	Mammal Observer	AFL
Erin LaBrecque	Mammal Observer	NOAA Fisheries / SWFSC
Howard Goldstein	Mammal Observer	NOAA Fisheries / SWFSC
Michael Force	Senior Bird Observer	AFL
Sophie Webb	Bird Observer	NOAA Fisheries / SWFSC
Melinda Kelley	Oceanographer	NOAA Fisheries / SWFSC
Shannon Rankin	Acoustician	NOAA Fisheries / SWFSC
Elizabeth Zele	Acoustic Technician	AFL
Kruger Loor	Official Foreign Observer	IATTC / Ecuador
Danna Schulman	Visiting Scientist	Hopkins Marine Station

Leg 4: Manzanillo, México to San Diego, California

Name	Position	Affiliation
Lisa Ballance	Cruise Leader	NOAA Fisheries / SWFSC
James Cotton	Senior Mammal Observer	NOAA Fisheries / SWFSC
Richard Rowlett	Senior Mammal Observer	NOAA Fisheries / SWFSC
Suzanne Yin	Marine Observer	NOAA Fisheries / SWFSC
Isabel Beasley	Mammal Observer	AFL
Erin LaBrecque	Mammal Observer	NOAA Fisheries / SWFSC
Howard Goldstein	Mammal Observer	NOAA Fisheries / SWFSC
Michael Force	Senior Bird Observer	AFL
Sophie Webb	Bird Observer	NOAA Fisheries / SWFSC
Melinda Kelley	Oceanographer	NOAA Fisheries / SWFSC
Shannon Rankin	Acoustician	NOAA Fisheries / SWFSC
Elizabeth Zele	Acoustic Technician	AFL
Dave Bratten	Official Observer	IATTC / United States
Sophie Van Parijs	Visiting Scientist	NOAA Fisheries / NEFSC

III. RESULTS

The area surveyed is shown in Figure 1; the data collected are summarized in the following tables:

Table 1. Cetacean sightings and behavioural data

Table 2. Cetacean biopsy samples

Table 3. Number of cetacean schools or individuals photographed

Table 4. Acoustic recordings

Table 5. Photogrammetry photographs and effort

Table 6. Environmental data

Table 7. Cephalopod samples

Table 8. Seabird sightings

Table 9. Marine turtle sightings

IV. DISPOSITION OF DATA

All data are currently being analyzed. The final data reports will be completed by February 2008. Marine mammal data were delivered to Dr. Tim Gerrodette, NOAA Fisheries / SWFSC, for analysis and distribution. Passive acoustic data were delivered to Dr. Jay Barlow, NOAA Fisheries / SWFSC, for analysis and distribution. Acoustic backscatter data were delivered to Dr. David Demer, NOAA Fisheries / SWFSC, for analysis and distribution. Oceanographic data were delivered to DR. Paul Fiedler, NOAA Fisheries / SWFSC, for analysis and distribution. Biopsy samples were delivered to Dr. Barbara Taylor, NOAA Fisheries / SWFSC, for analysis and distribution. Aerial photogrammetry data were delivered to Wayne Perryman, NOAA Fisheries / SWFSC, for analysis and distribution. Ecosystem data (seabirds, turtles, net samples) were delivered to the Chief Scientist, Dr. Lisa Ballance, NOAA Fisheries / SWFSC, for analysis and distribution.

Prepared by: _____ Date: 30 Mar 07
Annette E. Henry
Survey Coordinator

_____ Date: 30 Mar 2007
Dr. Lisa T. Ballance, Chief
Chief Scientist, STAR 2003

Approved by: _____ Date: 3/30/07
Dr. Stephen B. Reilly
Director, Protected Resources Division

_____ Date: 4/2/07
Dr. William W. Fox, Jr.
Director, NOAA Fisheries - SWFSC

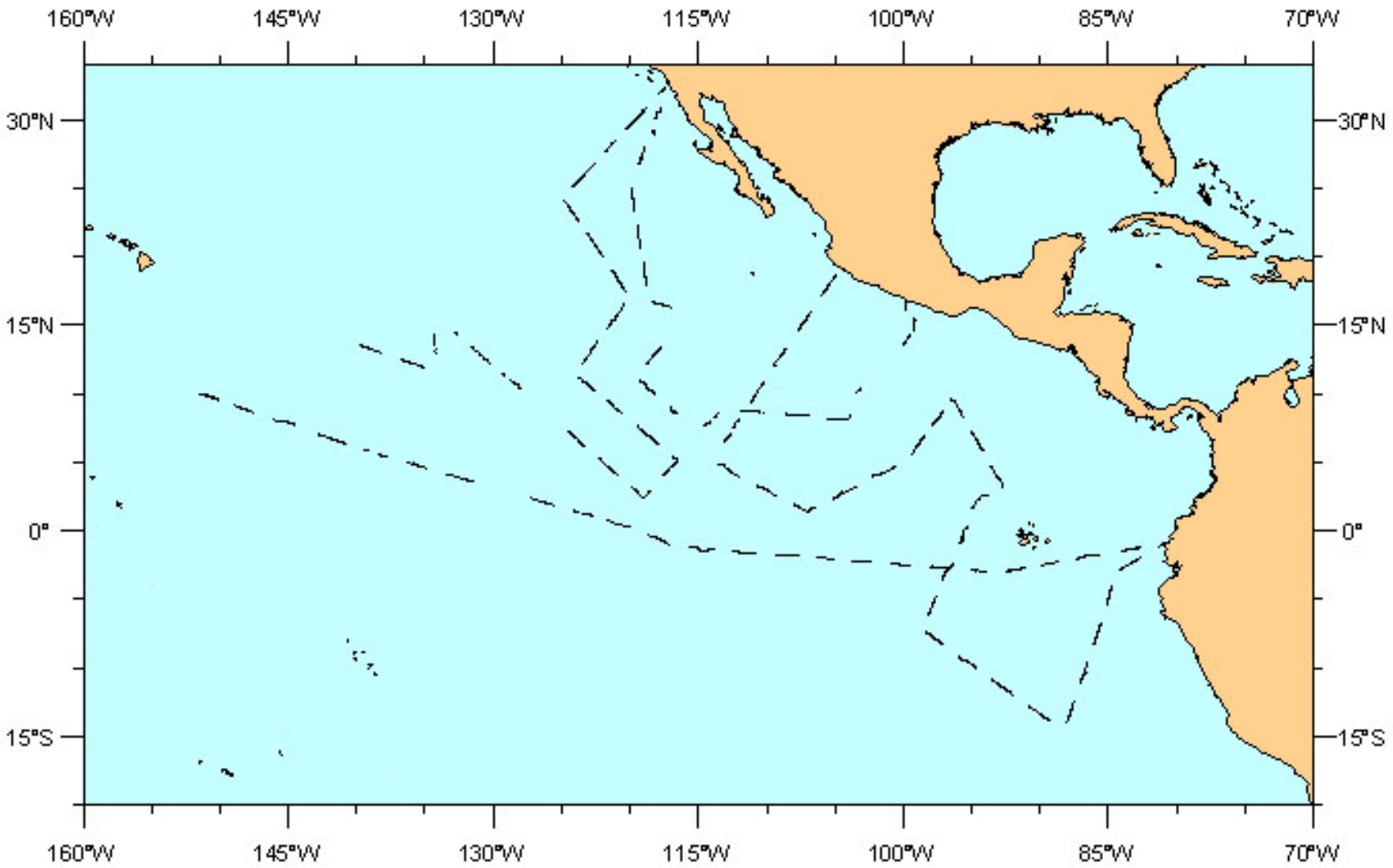

Figure 1. Trackline surveyed while on effort aboard NOAA Ship *McArthur II* during STAR 2006.

Table 1. Summary of cetacean sightings during STAR 2006 aboard NOAA Ship *McArthur II*. Behavioural data were collected on each sighting.

Species or taxon	Leg 1	Leg 2	Leg 3	Leg 4	Total
Mesoplodon peruvianus	0	0	0	1	1
Stenella longirostris orientalis	1	0	3	3	7
Stenella longirostris (southwestern)	0	1	3	1	5
Stenella longirostris (whitebelly)	0	1	1	2	4
Stenella coeruleoalba	11	14	11	6	42
Steno bredanensis	0	1	1	9	11
Delphinus delphis	12	3	11	13	39
Unid. small delphinid	7	9	17	32	65
Tursiops truncatus	5	3	1	7	16
Stenella attenuata (offshore)	6	1	6	22	35
Grampus griseus	0	1	4	1	6
Lagenodelphis hosei	0	1	0	0	1
Unid. medium delphinid	1	1	1	3	6
Stenella longirostris (unid. subsp.)	0	0	0	3	3
Feresa attenuata	0	1	1	3	5
Pseudorca crassidens	2	2	1	0	5
Globicephala sp.	0	0	1	0	1
Globicephala macrorhynchus	1	17	11	3	32
Orcinus orca	1	1	3	1	6
Unid. large delphinid	1	1	2	0	4
Physeter macrocephalus	5	0	6	3	14
Kogia breviceps	3	0	0	0	3
Kogia sima	0	0	0	6	6
Ziphiid whale	1	2	6	6	15
Mesoplodon sp.	1	4	2	9	16
Stenella attenuata graffmani	0	0	0	1	1
Ziphius cavirostris	0	3	1	1	5
Balaenoptera sp.	3	15	5	3	26
Balaenoptera edeni	1	7	4	1	13
Balaenoptera musculus	4	10	10	0	24
Megaptera novaeangliae	0	0	3	1	4
Unid. dolphin	4	3	2	4	13
Unid. small whale	1	2	1	1	5
Unid. large whale	4	6	11	1	22
Kogia sp.	0	0	0	1	1
Stenella longirostris centroamericana	0	0	0	3	3
Stenella attenuata (unid. subsp.)	0	0	0	9	9
Unid. whale	0	1	0	1	2

Species or taxon	Leg 1	Leg 2	Leg 3	Leg 4	Total
Balaenoptera borealis/edeni	2	4	5	3	14
Arctocephalus townsendi	8	0	0	0	8
Mirounga angustirostris	1	0	0	0	1
Total	**86**	**115**	**134**	**164**	**499**

Table 2. Cetacean biopsy samples collected during STAR 2006 aboard NOAA Ship *McArthur II*.

Species or taxon	**Leg 1**	**Leg 2**	**Leg 3**	**Leg 4**	**Total**
Balaenoptera edeni	0	1	0	0	1
Balaenoptera musculus	0	4	5	0	9
Delphinus delphis	2	0	0	0	2
Globicephala macrorhynchus	0	14	4	0	18
Megaptera novaeangliae	0	0	0	1	1
Physeter macrocephalus	0	0	0	1	1
Pseudorca crassidens	0	0	3	0	3
Stenella attenuata	1	0	0	7	8
Stenella attenuata graffmani	0	0	0	1	1
Stenella attenuata subsp.	0	0	0	8	8
Stenella longirostris orientalis	0	0	0	3	3
Tursiops truncatus	6	8	9	1	24
Total	**9**	**27**	**21**	**22**	**79**

Table 3. Number of cetacean schools or individuals photographed during STAR 2006 aboard NOAA Ship *McArthur II*.

Species or taxon	**Leg 1**	**Leg 2**	**Leg 3**	**Leg 4**	**Total**
Stenella attenuata (offshore)	1		3	13	17
Stenella longirostris (unid.)			1	2	3
Stenella attenuata graffmani				1	1
Stenella longirostris orientalis			1	8	9
Stenella longirostris (whitebelly)	2	4	0	0	6
Stenella longirostris centroamericana				3	3
S. longirostris centroamericana/orientalis				1	1
Stenella attenuata (unid. subsp.)				2	2
Stenella attenuata (southwestern)		1	3	1	5
Stenella coeruleoalba	2	2	9	3	16
Steno bredanensis		1	1	0	2
Delphinus delphis	4	2	6	5	17
Tursiops truncatus	3	6	4	3	16

Grampus griseus			1	0	1
Lagenodelphis hosei		2			2
Peponocephala electra		1			1
Feresa attenuata				2	2
Pseudorca crassidens		4	2		6
Globicephala macrorhynchus	2	14	13	2	31
Orcinus orca	1		3		4
Physeter macrocephalus	1		3	1	5
Balaenoptera edeni		6	3	1	10
Balaenoptera musculus	1	8	8		17
Megaptera novaeangliae			1	1	2
Total	**17**	**51**	**62**	**49**	**179**

Table 4a. Number of non-sighted cetacean groups per leg for which acoustic recordings were obtained using a towed hydrophone array on NOAA Ship *McArthur II* during STAR 2006, listed in order of the number of recordings obtained. All non-sighted acoustic detections in which whistles were detected were considered "unidentified dolphins." Detections in which only echolocation and/or burst pulses were detected were considered "unidentified cetaceans." Sperm whales, *Physeter macrocephalus*, and minke whales, *Balaenoptera acutorostrata*, were identified to species by their vocalizations. There were a total of 538 non-sighted acoustic detections, of which nine were minke whales, and 23 were sperm whales.

Species or taxon	**Leg 1**	**Leg 2**	**Leg 3**	**Leg 4**	**Total**
Unidentified delphinids	58	128	155	124	465
Unidentified cetaceans	1	2	14	24	41
Physeter macrocephalus	7	5	11	0	23
Balaenoptera acutorostrata	0	0	0	9	9
Total	**66**	**135**	**180**	**157**	**538**

Table 4b. Number of sighted cetacean groups per leg for which acoustic recordings were obtained using a towed hydrophone array on NOAA Ship *McArthur II* during STAR 2006, listed in order of the number of recordings obtained. A total of 248 sighted cetacean schools were detected and recorded with the acoustic array.

Species or taxon	**Leg 1**	**Leg 2**	**Leg 3**	**Leg 4**	**Total**
Unidentified delphinid	6	8	11	13	38
Stenella coeruleoalba	7	13	11	5	36
Stenella longirostris, Stenella attenuata (mixed)	10	8	8	9	35
Globicephala macrorhynchus	1	12	8	2	23
Stenella attenuata	5	0	4	13	22
Delphinus delphis	1	2	8	8	19
Physeter macrocephalus	4	1	6	3	14
Stenella longirostris	1	1	7	5	14
G. macrorhynchus, Tursiops truncatus (mixed)	0	8	4	0	12
Tursiops truncatus	5	1	0	2	8

Species or taxon	Leg 1	Leg 2	Leg 3	Leg 4	Total
Steno bredanensis	0	2	1	4	7
Pseudorca crassidens	2	2	1	0	5
T. truncatus, P. crassidens (mixed)	0	1	1	0	2
Orcinus orca	0	0	2	0	2
G. macrorhynchus, P. crassidens (mixed)	0	0	2	0	2
T. truncatus, G. macrocephalus, Indopacetus pacificus (mixed)	1	0	0	0	1
Lagenodelphis hosei	0	1	0	0	1
Peponocephala electra, S. bredanensis, G. macrorhynchus (mixed)	0	1	0	0	1
P. electra, L. hosei (mixed)	0	1	0	0	1
Feresa attenuata	0	0	0	1	1
O. orca, G. macrorhynchus, T. truncatus (mixed)	0	0	1	0	1
D. delphis, S. longirostris (mixed)	0	0	1	0	1
G. macrorhynchus, T .truncatus, S. bredanensis (mixed)	0	0	1	0	1
Grampus griseus	0	0	1	0	1
Total	**43**	**62**	**78**	**65**	**248**

Table 4c. Number of sonobuoys deployed per leg for which acoustic recordings were obtained on NOAA Ship *McArthur II* during STAR 2006, listed in order of the number of recordings obtained. There were a total of 44 recordings from sonobuoys during this survey. Not all recordings contain vocalizations.

Species or taxon	Leg 1	Leg 2	Leg 3	Leg 4	Total
Balaenoptera musculus	0	10	10	0	20
Balaenoptera edeni	1	11	4	1	17
Balaenoptera edeni/borealis (unidentified)	0	0	2	0	2
Opportunistic Sonobuoy Station	0	0	1	1	2
Unidentified Balaenopteridae	0	0	1	1	2
Megaptera novaeangliae	0	0	0	1	1
Total	**1**	**21**	**18**	**4**	**44**

Table 5a. Photogrammetry effort for STAR 2006; data collected from deHavilland Twin Otter fixed-wing aircraft. DSJ: *David Starr Jordan*; MAC: *McArthur II*. Each ship was allocated 12 flight days to complete calibration; calibrations recorded include schools photographed, not necessarily final number used, and include partial calibrations (observations with < 6 observers).

Ship	Days			Flight		No. schools photographed	No. calibration schools photographed
	flown	lost	% flown	hours	hours/day		
DSJ Leg	11	1	92	56.3	5.1	40	28
MAC Leg	8	4	67	44.0	5.5	35	15
Total	**19**	**5**	**79**	**100.3**	**5.3**	**75**	**43**

Table 5b. Schools photographed by the aerial photogrammetry team during STAR 2006.

Species or taxon	DSJ Leg	MAC Leg	Total
Stenella attenuata	0	4	4
Stenella longirostris	3	4	7
Mixed schools: *S. attenuata* and *S. longirostris*	25	9	34
Stenella coeruleoalba	0	0	0
Delphinus. sp	4	10	14
Other small cetaceans	3	4	7
Unid. small cetaceans	0	1	1
Total small cetaceans	**35**	**32**	**67**
Large whales (*B. edeni*)	1	0	1
Beaked whales	4	3	7
Total sightings photographed	**40**	**35**	**75**

Table 6a. Dipnet samples collected during STAR 2006 aboard NOAA Ship *McArthur II.*

Description	Leg 1	Leg 2	Leg 3	Leg 4	Total
No. of stations occupied	27	24	29	22	102
No. of fish collected	119	377	548	93	1,137

Table 6b. Summary of environmental data collected during STAR 2006 aboard NOAA Ship *McArthur II.*

Operation	Leg 1	Leg 2	Leg 3	Leg 4	Total
CTD Casts	49	43	47	31	170
Salinity	25	12	12	12	61
CHL - Surface	99	103	110	82	394
CHL - CTD	485	410	449	287	1,631
XBT	76	80	97	85	338

Table 7. Cephalopods collected during STAR 2006 aboard NOAA Ship *McArthur II*. Note: squid species labeled as "unidentified" will be identified at a later date.

Species or taxon	Leg 1	Leg 2	Leg 3	Leg 4	Total
D. gigas	0	23	6	0	29
Unidentified	0	5	0	0	5
Mixed D. gigas/S. oualaniensis	0	20	0	0	20
Total	**0**	**48**	**6**	**0**	**54**

Table 8. Seabirds sighted during STAR 2006 aboard NOAA Ship *McArthur II*.

Common Name	Scientific Name	Leg 1	Leg 2	Leg 3	Leg 4	Total
Albatrosses	Diomedeidae	3	5	3	0	11
Shearwaters	Puffinus spp.	796	687	204	2,693	4,380
Petrels	Pterodroma spp., Fulmarus spp.	1,713	1,079	603	129	3,524
Skuas	Catharactidae	5	0	5	2	12
Cormorants	Phalacrocoracidae	0	0	0	0	0
Storm-Petrels	Oceanitidae	385	390	576	382	1,733
Tropicbirds	Phaethontidae	23	24	32	19	98
Boobies	Sulidae	134	33	325	504	996
Frigatebirds	Fregatidae	11	17	58	4	90
Phalaropes	Phalaropodidae	5	23	92	1,165	1,285
Jaegers	Stercorariidae	32	15	45	73	165
Gulls	Larus spp.	5	21	15	52	93
Terns	Sterna spp., Gygis spp., Chlidonias spp., Anous spp.	239	752	522	2,790	4,303
Auks	Alcidae	3	0	0	0	3
Total		**3,354**	**3,046**	**2,480**	**7,813**	**16,693**

Table 9. Summary of marine turtle sightings during STAR 2006 aboard NOAA Ship *McArthur II*.

Species or taxon	Leg 1	Leg 2	Leg 3	Leg 4	Total
Lepidochelys olivacea	0	0	1	0	1
Caretta caretta	0	0	0	0	0
Eretmochelys imbricata	0	0	0	0	0
Total	**0**	**0**	**1**		**1**