NOAA Technical Memorandum NMFS

OCTOBER 2010

OREGON, CALIFORNIA AND WASHINGTON LINE-TRANSECT AND ECOSYSTEM (ORCAWALE) 2008 CRUISE REPORT

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NOAA-TM-NMFS-SWFSC-465

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

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Oregon, California and Washington Line-transect and Ecosystem (ORCAWALE) 2008 Cruise Report

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Protected Resources Division
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National Marine Fisheries Service
National Oceanic and Atmospheric Administration
8604 La Jolla Shores Dr.
La Jolla, CA 92037, USA

Platform: NOAA Ship *McArthur II*

Cruise Number: M2-08-08, SWFSC Cruise Number 1635

Cruise Dates: 28 July - 30 November 2008

Study Area: The California Current Ecosystem from the coasts of California, Oregon and Washington seaward to approximately 300 nmi offshore.

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 objectives of the 2008 Oregon, California and Washington Line-transect and Ecosystem (ORCAWALE) cruise were to collect data for estimating the abundance of cetacean (dolphin, porpoise and whale) populations along the U.S. West Coast and for better understanding their habitat and distribution. This SWFSC project used a multidisciplinary approach. Visual and acoustic line-transect data were collected to determine cetacean density and abundance. Oceanographic data were collected to characterize cetacean habitats. Data were collected on the distribution and abundance of seabirds and squid to further characterize the ecosystem. Cetacean skin biopsies were collected to provide genetic samples for investigations of stock structure and phylogenetic relationships. Photographs were taken for individual identification of several whale species and to document geographic variation in dolphin color patterns. This survey is similar to West Coast cetacean surveys conducted by the SWFSC in 1996, 2001, and 2005. For additional information about ORCAWALE, please see: http://swfsc.noaa.gov/PRD-ORCAWALE/.

OPERATIONS

1.0 CETACEAN RESEARCH

1.1 Cetacean Visual Survey – Visual survey methods generally followed the line-transect survey protocols described by Kinzey et al. 2000. Weather permitting, a team of three marine mammal observers searched for cetaceans from the flying bridge during daylight hours (approximately 0600 to 1800, but varying with day of year). Six observers worked in 2-hour rotations and staffed three stations on the flying bridge for 40 minutes each: a port 25x150-binocular station, a center data-recorder position, and a starboard 25x150 binocular station. Line-transect methods were used to survey a systematic grid of transect lines. When extra personnel were available, an "independent observer" searched to detect groups that were missed by the usual team of observers. At the beginning of each day, search effort started on the trackline. The NOAA ship *McArthur II* traveled at approximately 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, which was connected 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 and networked to the timeserver. Additional data on each sighting were recorded on a paper sighting form. Behavioral data were recorded on the back of the sighting form for delphinid and porpoise sighting.

1.1.2 Departures from the Trackline - On sighting a cetacean group or other feature of interest, the Cruise Leader or marine mammal observer team on watch typically requested that the vessel be maneuvered to approach the group or feature for investigation. As the ship approached a group of marine mammals, observers made independent estimates of group size. On selected occasions, biopsy and photographic operations were conducted from the

ship 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 10 nmi 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 nmi 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 Cruise-Specific Instructions – The Chief Scientist gave the observers and Cruise Leaders several instructions that were specific to marine mammal survey protocols on this ORCAWALE survey. The ship was not diverted from the trackline for sightings of porpoises or pinnipeds unless species or group size could not be accurately determined. Whenever the observers saw a beaked whale group, they directed the ship to pass over the location where the beaked whales were last seen to obtain acoustic recordings and to determine acoustic detection probability. Ideally, the ship was directed to pass over the beaked whales at least 10 min after they dived to allow time for them to start vocalizing. On this survey, marine mammal observers only recorded sightings of two pinniped species: northern elephant seals (*Mirounga angustirostris*) and northern fur seals (*Callorhinus ursinus*), regardless of distance from shore (unlike some previous surveys). The seabird observers recorded sightings of all pinniped species if they were within their search strip, again without regard to distance from shore.

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 were 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 – Marine mammals were photographed for several purposes: (1) to aid species identification at sea; (2) to supplement identification information on the sighting form; (3) to identify individual whales for studies of movement and abundance; (4) to collect data on coloration and body proportions of dolphins to aid in stock identification; and (5) to document unusual events or sightings. Photographed animals were approached by the research vessel, approached the vessel on their own, or were approached by a small boat.

1.4 Passive Acoustics –

1.4.1 Towed Hydrophone Array - There were two main goals of the towed acoustics program during the ORCAWALE 2008 survey: (1) to field test automated acoustic detection methods; and (2) to test a new hydrophone design with an oil filled high frequency hydrophone array component for porpoise detection. In order to address these goals, a hydrophone array was deployed on-board NOAA Ship *McArthur II* for all legs within the study area. A full-time acoustician collected comprehensive data. A five-element hydrophone array

consisting of two mid-frequency hydrophones (EDO ceramic with a frequency response of 500 Hz to 55 kHz ±5 dB with a sensitivity of -155 dB re 1V/µPa after 40 dB pre-amplification) and three high-frequency hydrophones (Reson TC4013 hydrophones with a frequency response of 1.5 to 150 kHz ±3 dB with a sensitivity of -170 dB re 1V/µPa after 40 dB pre-amplification) was towed 300 m behind the NOAA ship MacArthur II at a depth of 4 – 8 m. Five computers ran the software needed for automated and manual acoustic detection. Software included Ishmael, WhalTrak, PAMGUARD 1.1.Core, Rainbow Click, Logger, ISHMAEL and WhalTrak2. PAMGUARD was used for automated click and whistle detection for a variety of species, Rainbow Click was used for automated porpoise detection, and Logger was used for 976 hours of high frequency recordings throughout the survey. A separate computer was used to record trackline positions and waypoints and to view spectrograms from opportunistic sonobuoy deployments using ISHMAEL.

The array was monitored for cetacean vocalizations aurally and visually for a total of 762 hours during 11,465 km of survey trackline. Data from two of the high frequency oil-filled array hydrophones were digitized at a sampling rate of 480 kHz using a National Instruments USB-6251 interface and were recorded continuously to hard drives (as 5-min files) using Logger software. Opportunistic recordings were made at various sampling rates using ISHMAEL. 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 recorded on data forms and input to a Microsoft Excel database. Recordings were obtained from at least 13 species.

A total of 838 cetacean groups was detected while both the acoustic and visual teams were on effort. Of these detections, 254 were made by both visual and acoustic teams and 584 detections were made only by the acoustic team.

1.4.2 Sonobuoys – Recordings were made from 47 sonobuoys deployed from NOAA Ship *McArthur II* on an opportunistic basis using ISHMAEL software. All of these deployments were for baleen whales, and at least 21 of these recordings included cetacean vocalizations.

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

2.0 ECOSYSTEM STUDIES

The goal of the Ecosystem Studies Program is to describe the physical and biological habitat, prey, predators, competitors, and commensals of marine mammal species. Sampling was conducted by an oceanographer, two seabird observers, the ship's Survey Technician, and visiting scientists. Chronological records of sampling in Coordinated Universal Time (UTC) were kept by the oceanographer and in the ship's Marine Operations Log. The ship provided an electronic copy of their operation logs, including the weather log and other meteorological data, to the Ecosystem Studies Program upon completion of the cruise.

2.1 Oceanography - All oceanographic data were processed by the Ecosystem Studies Program (ESP) of the Protected Resources Division (PRD) at the Southwest Fisheries Science

Center (SWFSC).

2.1.1 Thermosalinograph sampling - A Micro Thermosalinograph (TSG) SBE 45 was used to measure temperature and conductivity, and derive salinity, of surface seawater. These data were recorded at approximately 30-sec intervals by the ships' Scientific Computing System (SCS). The MicroTSG is located in the wet lab and measures water that has traveled through the ship's auxiliary seawater system. An SBE 38 temperature sensor was installed in the engine room to measure the temperature of the water closer to the intake, which is 3m below the surface.

Discrete surface salinity samples were collected weekly from the TSG outflow to verify the TSG readings. Salinity samples were analyzed on a Guildline Instruments Portasal salinometer (Model 8410A) calibrated during each run with IAPSO (The International Association for Physical Science of the Ocean) Standard Seawater, manufactured by Ocean Scientific International.

2.1.2 Discrete surface chlorophyll sampling - Discrete bucket surface temperatures and chlorophyll *a* and phaeophytin samples were collected four times per day, at the start-of-effort and approximately 0900, 1200, and 1500. An additional sample was collected at 1800, if mammal effort extended beyond 1830. Water samples of 265 ml were filtered through Whatman 25 mm GF/F (glass fiber) filters, which retain particles of 0.7 μm diameter or greater. Filters were then were immersed in 10 ml of 90% acetone for extraction and refrigerated for a minimum of 24 hours and a maximum of 36 hours.

Shipboard chlorophyll *a* and phaeophytin analysis (detailed in Holm-Hansen *et al*. 1965) was conducted using a Turner Designs Model 10-AU fluorometer. Results were recorded using FLog, version 0804 (author: Jim Wilkinson, Scripps Institution of Oceanography, 2008). The fluorometer was calibrated with chlorophyll *a* liquid standards prior to the research cruise. In total, 320 surface chlorophyll samples were collected.

2.1.3 Water column properties: CTD profiles - Conductivity, temperature, and depth (CTD) casts were made each evening an hour after sunset using a Sea-Bird Electronics 911*plus* CTD unit. The CTD was lowered to 1,000 m, and sensors connected to a shipboard computer measured conductivity, temperature, oxygen, and pressure (depth). Dual temperature and conductivity sensors were deployed to improve accuracy. CTD cast data were recorded using Sea-Bird Electronics Seasave software, version 7_14c (2007). Deck pressure tests with a zero pressure offset were conducted at the beginning of each leg. A deck pressure test was also conducted after the start of leg five, when a new CTD fish was used in an attempt to correct spiking in the dissolved oxygen data. Offsets from the deck tests were used to calculate depth during post-cruise data processing.

Micro7-washed General Oceanics Niskin bottles were retrofitted with silicone rubber o-rings in the valves and end-caps. Silicone rubber tubing was used as the closing mechanism. Before the first regular CTD cast of each leg, a bottle test cast was conducted to validate CTD sensor calibration and detect evidence of Niskin bottle leakage. During this cast, all 12 Niskin bottles were tripped at 500 meters and salinity samples were collected from each bottle.

On all regular CTD casts, Niskin bottles were tripped at standard depths (0, 20, 40, 60, 80, 100, 120, 140, 170, 200, 500 and 1000 m). Water samples were collected from Niskin bottles tripped

at ≤ 200m depth for chlorophyll *a* and phaeophytin analyses. Three replicate salinity samples were taken weekly from the 500m bottle to validate CTD sensor calibration. Protocols for analyzing CTD salinity samples were the same as those described for the TSG samples. In total, 86 normal and 5 bottle test CTD casts were completed.

2.1.4 Water column properties: XBT profiles - Expendable Bathythermograph (XBT) probes were dropped four times per day in conjunction with surface chlorophyll sampling, at the start-of-effort and approximately 0900, 1200, and 1500. An additional drop was conducted at 1800, if mammal effort extended beyond 1830. A drop was also conducted at the end-of-effort, if the evening CTD station was canceled. XBT probes measure the temperature of the water column to 760 m depth (Sippican MK21 USB Surface Ship Bathythermograph Data Acquisition System); data were recorded using the Sippican WinMK21 Data Acquisition and Post-processing Software, version 2.7.1 (2006). A total of 351 successful XBT drops were completed during the cruise.

2.1.5 Underway pCO_2 System - The Pacific Marine Environmental Laboratory's (PMEL) underway pCO_2 system continuously measured the partial pressure of CO_2 in the air and surface water during the cruise. The pCO_2 values, along with wind, temperature, and salinity data were used to calculate the flux of CO_2 at the air-sea interface. The system uses 3 liters of seawater per minute and determines CO_2 content with a Licor infrared detector. For more information, contact the PMEL Carbon Group, http://www.pmel.noaa.gov/co2/uwpco2/.

2.1.6 Harmful Algal Bloom (HAB) Sampling - HAB samples were collected in collaboration with Dr. Raphael Kudela's laboratory at the University of California, Santa Cruz. Water samples were collected to analyze pigments, as a diagnostic measure of the general phytoplankton assemblage, and toxins. Toxins of particular interest are domoic acid (produced by species of the diatom *Pseudo-nitzschia*), which causes amnesic shellfish poisoning in humans, and saxitoxin (produced by the dinoflagellate *Alexandrium*), which causes paralytic shellfish poisoning in humans.

Replicate surface water samples of 250 ml or more were taken at the daily chlorophyll stations and the evening CTD station for analysis of phycotoxin, qPCR (molecular identification), and phytopigment samples. These samples were filtered onto 25mm GF/F filters. The filters were placed in 2mL cryovials and stored in the -80°C freezer. Water samples of 10 – 15ml were collected and stored in the -20°C freezer for post-cruise nutrient (i.e., N, P, and Si) analyses. Throughout ORCAWALE 2008, 2118 filtered HAB phycotoxin, qPCR, and phytopigment samples were collected from 353 HAB sampling locations.

2.1.7 Additional XBT sampling - XBT drops were typically conducted four times during daylight operations. However, five series of more frequent XBT drops were conducted to assess fine-scale variability in thermal profiles. The frequency of XBT drops in these series was usually hourly, but occasionally sampling was determined more by spatial location than time.

Eight comparative CTD casts and XBT drops were conducted by dropping an XBT while approaching a CTD station. These data were used to confirm the correction factor for the XBT drop rate equation. Operational protocols were the same as those detailed in the sections above.

2.1.8 Argo float deployment - Argo is a major contributor to the World Climate Research Program's 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.

In collaboration with PMEL, four Argo buoys were successfully deployed during ORCAWALE 2008. Approximate deployment locations are 36 º 10' N, 126 ºW; 34 º 30' N, 124 º 50' W; 32 º 30' N, 123 º 50' W; 33 º 30' N, 127 º W. For more information and data, please contact Greg Johnson or Elizabeth Steffen (pmel_floats@noaa.gov).

2.1.9 Phosphate limitation in phytoplankton - During Leg 1, phosphate limitation in phytoplankton along a gradient from coastal to offshore waters was examined by Misty Blakely, University of California, Santa Cruz. Water samples of 2-8L were collected 4-8 times per day, filtered, and refrigerated in cryovials containing ethanol. Incubation experiments were conducted using a cooler connected to a seawater intake. Photosynthetic activity of these samples was measured using a pulse amplitude modulated fluorometer. For more information please contact Misty Blakely (mistydblakely@gmail.com).

2.2 Mid-trophic Sampling

2.2.1 Oblique Bongo Tows – Eighty one Bongo tows were conducted following the CTD (i.e., approximately 2.5 hours after sunset) to sample subsurface ichthyoplankton and macrozooplankton. The Bongo net was towed obliquely from 200 m depth for 15 minutes. This paired zooplankton net frame had a 505 μm mesh cod end on the starboard side and a 333μm mesh cod end on the port side. A digital flowmeter (General Oceanics model 2030R) was placed in the mouth of both nets to measure the volume of water sampled during the tow. All samples are quantified using the number of revolutions measured by the flowmeter, the angle of the wire during the tow, the duration of the tow, and the length of wire out.

The sample from the 505 μm mesh cod end was preserved in 5% buffered formalin and sodium benzoate, labeled, and stored for post-cruise analysis. The sample from the 333 μm mesh cod end was collected at eight paired inshore and offshore stations to investigate the molecular genetics of zooplankton (Principal Investigator: Mark Ohman, University of California, San Diego, mohman@ucsd.edu); these samples were fixed in ethanol.

2.2.2 Issacs-Kidd Midwater Trawl – A total of 190 Issacs-Kidd Midwater Trawls (IKMT) were conducted in collaboration with Tony Koslow and Pete Davison at Scripps Institution of Oceanography. This net samples the larger macrozooplankton and micronekton; these samples will be used to determine the species composition of the acoustic backscatter data (see below). Following the evening bongo tow, the ship transited back along the trackline completed during the day while conducting the IKMT. The first IKMT was to a depth of 150 m; sampling time was approximately one hour. The second IKMT was to a depth of 500 m; sampling time was approximately two hours. Samples from both trawls were rough-sorted and preserved in 5% buffered formalin and sodium benzoate. Labeled samples were stored for post-cruise analysis.

When the acoustic backscatter data showed appropriate targets, opportunistic daytime trawls were conducted to the depth of the target. Daytime trawls were conducted primarily during

inclement weather when no mammal effort was possible.

2.2.3 Acoustic Backscatter - Acoustic backscatter data were collected on the *McArthur II* at 38, 120, and 200 kHz frequencies using a Simrad EK60 transceiver system and the ER60 software program. The echosounders were calibrated in Seattle on 28 July 2008; the post-cruise calibration was conducted on 1 December 2008 in San Diego Bay at 10th Avenue pier.

A transmitted pulse of 1.024 msec (i.e., the pulse duration of an individual ping transmitted by the transducer), a ping interval of four seconds, and a depth of 1000 m was used throughout the survey. The Ecosystem Studies Program typically records acoustic backscatter data to somewhere between 500 and 700 m. On this cruise, data were collected deeper to ensure that the deep scattering layer was completely sampled. The ping interval was modified from two seconds to four seconds to accommodate this deeper data collection. Data were recorded on a computer's internal hard drive and backed up on two external hard drives.

2.3 Apex predators

2.3.1 Squid Sampling - Squid sampling targeted Humboldt squid, *Dosidicus gigas*. One hour of squid jigging was conducted during the evening CTD station, one hour after sunset. Jigging effort began with 300 m of fishing line; attracting lights were used throughout jigging effort. A total of 56 squid stations were completed during ORCAWALE 2008, resulting in the collection of 135 squid (132 *Dosidicus gigas* and 3 unidentified squid).

Some whole specimens were frozen in plastic bags and labeled for further identification, morphometric analysis, and tissue collection. Data were collected at sea from other specimens, including weight, sex, maturity state, and mantle length. The gills and statoliths from these specimens were stored in 95% ethanol in 1.5 ml plastic vials. Muscle tissue, gladius and buccal mass samples were bagged and frozen at -20 ºC. Stomachs were collected for John Field (Fisheries Ecology Division, SWFSC) and frozen separately.

2.3.2 Seabirds - Weather permitting, visual surveys for seabirds were conducted from the flying bridge during all daylight hours (sunrise to sunset). One observer surveyed the quadrant ahead of the ship (bow to beam) on the side with best visibility and recorded in real time all birds within 300 m using strip transect methods. Data were entered directly into a computer that was also connected to the ship's GPS using the program "SEEBIRD". Cruise Number (a four-digit number unique to this cruise = 1635 for ORCAWALE 2008) and effort data (0 = position update, 1 = begin effort, 2 = on-effort sighting, 3 = end effort, 4 = cumulative counts of animals recorded during specific time blocks instead of in real time, 5 = off-effort sighting) were recorded, as well as the following variables for each seabird sighting:

- date (local and UTC: 2-digit year, 2-digit month, 2-digit day)
- position (automatically entered from the ship's GPS in decimal degrees)
- Beaufort sea state
- wind speed (knots) and direction
- ship's course (automatically entered from the ship's GPS)
- "observation condition" (see below)
- side of ship from which observations were made (1 = left; 2 = right)

- observer identification (17 = Lisa Ballance, 21 = Michael Force, 32 = Sophie Webb, 33 = Richard Rowlett, 99 = other)
- time (local and UTC: 2-digit hour in 24-hr time, 2-digit minute)
- species (Appendix 1)
- number of individuals ("9999" represents present but unknown number)
- distance from ship (1 = 0 – 100 m, 2 = 100 – 200 m, 3 = 200 – 300 m, 4 = outside of the quadrant surveyed)
- association with other animals or objects (1 = no association, 2 = associated, 3 = unknown)
- behavior (1 = sitting, 3 = following the ship, 4 = feeding, 5 = piracy, 6 = other, 7 = unknown, 8 = directional flight, 9 = non-directional flight)
- flight direction (for birds in directional flight, recorded relative to the ship's bow)
- age (1 = unknown, 2 = not full adult, 3 = adult)
- sex (1 = unknown, 2 = female, 3 = male)
- UTC offset
- comments

The variable "observation condition" combined all environmental and sighting conditions into a single value that was directly related to strip width as follows:

Observation Condition	Strip Width (m)	Taxa
5	300	All
4	300	All
3	200	Storm Petrels, Phalaropes, Small Auklets
	300	All others
2	100	Storm Petrels, Phalaropes, Small Auklets
	200	All others

Seabird observers also recorded the presence of crab pots, pinnipeds, and flyingfish (species codes in Appendix 1) within 300 m of the ship. The format for these data files is provided in Appendix 2.

A separate strip transect survey was conducted for seabird feeding flocks. Two marine mammal observers using 25x mounted binoculars and scanning ahead of the ship from beam to beam informed the seabird observer of any seabird feeding flocks detected within 4.8 km (1.0 binocular "reticle") of the ship. The seabird observer then identified all species in the flock, counted the number of individuals (for each species), and recorded behavior and association with any other animals or objects. The format for these data files is provided in Appendix 3.

3.0 SMALL BOAT WORK

A small boat was necessary for biopsy sampling, photography, and other ancillary work. The Cruise Leader requested deployment on an opportunistic basis; this request was granted if the Commanding Officer concurred that operating conditions were safe.

4.0 TRANSIT AT NIGHT

After the evening CTD, squid jigging and net tow operations, the ship usually moved a short distance (10-40 nmi) to the starting point for the next day's survey effort. The Cruise Leader determined the location of the starting point in consultation with the Operations Officer based on whether the overall progress for that leg was ahead of or behind schedule. If a longer night transit was needed to move between transect lines, net tows or other night operations were cancelled.

ACKNOWLEDGEMENTS

The authors thank the officers and crew of the NOAA Ship McArthur II for their time, dedication, and skill in making this cruise a success. Chief Electronics Technician Charlie Goertzen was especially important in keeping all our instruments and computers working. Special thanks go to the ecosystems study team (Misty Blakely, Lilian Carswell, Jared Cox, Pete Davison, Ryan Driscoll, Justin Garver, Shannon Lyday, Carl Mayhugh, Lacey O'Neal, Illiana Ruiz-Cooley, and Andrey Suntsov), the marine mammal observers (Jim Cotton, Chris Cutler, Mark Deakos, Allan Ligon, Jim Gilpatrick, Rich Pagen, Richard Rowlett, and Suzanne Yin), the seabird observers (Michael Force and Sofie Webb), the marine mammal acousticians (Shannon Rankin and Aly Fleming), the cruise leaders (Jim Carretta, Karin Forney, and Jeremy Rusin) and others who contributed during the survey (Nicky Beaulieu, Elizabeth Becker, Karla Garcia, Ioana Ionescu, and Heather Judkins). Additional shore-side support was provided by Anthony Cossio, Kerri Danil, Lynn Evans, Paul Fiedler, Siri Hakala, Robert Holland, Thomas J. Moore, Jeremy Rusin, Gabriela Serra-Valente, Barbara Taylor, and Elizabeth Zele. This manuscript was improved by helpful suggestions from Paul Fiedler, Aly Fleming, and William Perrin.

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Table 1. Cruise itinerary for NOAA Ship *McArthur II* during ORCAWALE 2008.

Date	Event
7/24-25	Ship loading and gear preparation in Seattle WA
7/28	Leg 1: Depart Seattle WA
8/19	Arrive Newport OR
8/24	Leg 2: Depart Newport OR
9/13	Arrive San Francisco CA
9/17	Leg 3: Depart San Francisco CA
10/08	Arrive San Diego CA
10/15	Leg 4: Depart San Diego CA
11/01	Arrive San Francisco CA
11/06	Leg 5: Depart San Francisco CA
11/30	Arrive San Diego, CA

Table 2. Participating scientists aboard NOAA Ship *McArthur II* during ORCAWALE 2008. Observer codes are given for marine mammal observers and independent observers.

Name	Obs. Code	Affiliation	Nationality	Position	Legs
Jay Barlow	015	SWFSC-PRD	USA	Cruise Leader	1
Jeremy Rusin	202	SWFSC-PRD	USA	Cruise Leader	2
Jim Carretta	071	SWFSC-PRD	USA	Cruise Leader	3
Karin Forney	086	SWFSC-PRD	USA	Cruise Leader	4
Lisa Balance	120	SWFSC-PRD	USA	Cruise Leader	5
Jim Cotton	007	SWFSC-PRD	USA	Mar. Mamm. Observer	1,2,3,4,5
Chris Cutler	228	SWFSC-PRD	USA	Mar. Mamm. Observer	1,2,3,4,5
Mark Deakos	235	SWFSC-PRD	Canada	Mar. Mamm. Observer	2
Allan Ligon	238	SWFSC-PRD	USA	Mar. Mamm. Observer	1,2,3,4,5
Jim Gilpatrick	080	SWFSC-PRD	USA	Mar. Mamm. Observer	1
Rich Pagen	232	SWFSC-PRD	USA	Mar. Mamm. Observer	3,4,5
Richard Rowlett	073	SWFSC-PRD	USA	Mar. Mamm. Observer	1,2,3,4,5
Suzanne Yin	197	SWFSC-PRD	USA	Mar. Mamm. Observer	1,2,3,4,5
Michael Force	098	SWFSC-PRD	Canada	Seabird Observer	1,2,3,4,5
Sofie Webb	229	SWFSC-PRD	USA	Seabird Observer	1,2,3,4,5
Tina Yack		SWFSC-PRD	USA	Mar. Mamm. Acoustician	1,2,3,4
Shannon Rankin	184	SWFSC-PRD	USA	Mar. Mamm. Acoustician	5
Aly Fleming	296	UCSD-SIO	USA	Mar. Mamm. Acoustician	3
Ryan Driscoll	289	SWFSC-PRD	USA	Oceanographer	1,2,3,4,5
Misty Blakely		U. Calif., Santa Cruz	USA	Oceanographic Assistant	2
Shannon Lyday	274	Farallones Mar. Sanctuary	USA	Oceanographic Assistant	3
Justin Garver		SWFSC-PRD (intern)	USA	Oceanographic Assistant	4,5
Pete Davison		UCSD-SIO	USA	Pelagic Net Sampling	1,2,5
Andrey Suntsov		UCSD-SIO	Russia	Pelagic Net Sampling	3,4
Jared Cox		University of Redlands	USA	Pelagic Sampling Assistant	1
Illiana Ruiz-Cooley		New Mexico State U.	Mexico	Pelagic Sampling Assistant	2
Carl Mayhugh		Prescott College	USA	Pelagic Sampling Assistant	3
Jason Blackburn		NOAA MPA Center	USA	Pelagic Sampling Assistant	4
Lilian Carswell	234	US Fish & Wildlife Serv.	USA	Pelagic Sampling Assistant	5
Karla Garcia		New Mexico State U.	USA	Visiting Scientist	2
Ioana Ionescu	298	University of San Diego	USA	Visiting Scientist	2
Elizabeth Becker	297	SWFSC-PRD	USA	Visiting Scientist	3
Nicky Beaulieu		SWFSC-PRD	USA	Visiting Scientist	5
Heather Judkins	294	University of S. Florida	USA	Teacher-at-Sea	1

Table 3. Summary of marine mammal sightings during ORCAWALE 2008 aboard NOAA Ship *McArthur II.* Mixed species groups are counted within the tallies for each species, and, therefore, the total number of sightings will be less than the sum of the column.

Species or Taxon	Species Code	Total Sightings
Balaenoptera acutorostrata	071	4
Balaenoptera borealis	073	3
Balaenoptera musculus	075	24
Balaenoptera physalus	074	93
Balaenoptera sp.	070	47
Berardius bairdii	063	7
Delphinus capensis	016	10
Delphinus delphis	017	147
Delphinus sp.	005	11
Globicephala macrorhynchus	036	1
Grampus griseus	021	10
Kogia sp.	080	1
Lagenorhynchus obliquidens	022	32
Lissodelphis borealis	027	17
Megaptera novaeangliae	076	67
Mesoplodon sp.	051	1
Orcinus orca	037	7
Physeter macrocephalus	046	13
Phocoena phocoena	040	7
Phocoenoides dalli	044	85
Stenella coeruleoalba	013	20
Tursiops truncatus	018	4
Ziphius cavirostris	061	11
Unid. cetacean	096	4
Unid. dolphin	077	3
Unid. porpoise	477	3
Unid. small delphinid	177	27
Unid. small whale	078	3
Unid. whale	098	2
Unid. large whale	079	12
Ziphiid whale	049	4
Callorhinus ursinus	CU	116
Mirounga angustirostris	MA	101
Zalophus californianus	ZC	1
Unid. fur seal	UA	5
Total		782

Table 4. Summary of acoustic monitoring effort per leg.

	Leg 1	Leg 2	Leg 3	Leg 4	Leg 5	Total
Effort (km)	2,710	1,621	3,033	1,959	2,142	11,465

Table 5. Summary of sonobuoys deployed from NOAA Ship *McArthur II* during ORCAWALE 2008.

Species ID	Sonobuoy Recordings	Sonobuoy Recordings With Acoustic Encounters
Balaenoptera borealis & Balaenoptera physalus	2	2
Balaenoptera musculus	17	5
Balaenoptera physalus	22	9
Balaenoptera physalus & Balaenoptera musculus	1	0
Balaenoptera phsalus & Balaenoptera Sp.	2	2
Balaenoptera physalus & Delphinus delphis	3	3
Total	47	21

Table 6. 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 ORCAWALE 2008. All non-sighted acoustic detections during which whistles were detected were considered "unidentified delphinids." Detections during which only echolocation and/or burst pulses were detected were considered "unidentified cetaceans." Sperm whales, *Physeter macrocephalus*, were identified to species by their characteristic vocalizations. Beaked whales and porpoise were identified to family by their vocalizations using a combination of automated and manual methods.

Species	Leg 1	Leg 2	Leg 3	Leg 4	Leg 5	Total
Unid. cetacean	18	18	54	142	20	252
Unid. porpoise	1	25	74	31	-	131
Unid. beaked whale	22	11	21	11	-	65
Unid. delphinid	-	14	13	16	56	99
Physeter macrocephalus	4	5	6	7	2	24
Possible *Berardius*	-	1	10	2	-	13
Total	45	74	178	209	78	584

Table 7. Number of cetacean groups (sighted and unsighted) per leg for which acoustic recordings were obtained using a towed hydrophone array on NOAA Ship *R/V McArthur II* during ORCAWALE 2008.

Species	**Leg 1**	**Leg 2**	**Leg 3**	**Leg 4**	**Leg 5**	**Total**
Unid. cetacean	18	18	54	142	20	252
Unid. porpoise	1	25	74	31	-	131
Unid. delphinid	1	15	14	17	58	105
Delphinus delphis	-	10	13	24	34	81
Unid. beaked whale	22	11	21	11	-	65
Physeter macrocephalus	6	5	12	10	4	37
Phocoenoides dalli	4	5	19	3	-	31
Mixed Delphinid	1	6	10	8	4	29
Balaenoptera physalus	4	1	6	8	-	19
Unid. small delphinid	-	-	5	8	-	13
Possible *Berardius*	-	1	10	2	-	13
Lagenorhynchus obliquidens	3	5	-	1	-	9
Balaenoptera musculus	4	1	1	2	-	8
Berardius bairdii	2	2	3	-	-	7
Ziphius cavirostris	4	-	1	2	-	7
Megaptera novaeangliae	2	1	-	3	-	6
Mixed *Balaenoptera*	3	-	-	1	-	4
Mixed species	-	2	1		-	3
Beaked whale sp.	-	-	2	-	-	2
Grampus griseus	-	-	-	1	1	2
Lissodelphis borealis	1	-	-	1	-	2
Offshore *Orcinus orca*	-	1	-	-	*1*	2
Transient *Orcinus orca*	-	2	-	-	-	2
Delphinus capensis	-	-	-	1	-	1
Delphinus sp.	-	-	1	-	-	1
Mesoplodon sp.	1	-	-	-	-	1
Ziphiid sp.	1	-	-	-	-	1
Mixed Delphinid & Porpoise	-	1	-	-	-	1
Unid. large whale	-	-	-	1	-	1
Unid. whale	-	1	-	-	-	1
Total	78	113	247	277	122	837

Table 8. Number of sighted cetacean groups per leg for which acoustic recordings were obtained using a towed hydrophone array on NOAA Ship *McArthur II* during ORCAWALE 2008, listed in order of the total number of recordings obtained.

Species	**Leg 1**	**Leg 2**	**Leg 3**	**Leg 4**	**Leg 5**	**Total**
Delphinus delphis	-	10	13	24	34	81
Phocoenoides dalli	4	5	19	3	-	31
Mixed delphinid	1	6	10	8	4	29
Balaenoptera physalus	4	1	6	8	-	19
Unidentified small delphinid	-	-	5	8	2	15
Physeter macrocephalus	2	-	6	3	2	13
Lagenorhynchus obliquidens	3	5	-	1	-	9
Balaenoptera musculus	4	1	1	2	-	8
Berardius bairdii	2	2	3	-	-	7
Ziphius cavirostris	4	-	1	2	-	7
Megaptera novaeangliae	2	1	-	3	-	6
Mixed *Balaenoptera*	3	-	-	1	-	4
Unidentified delphinid	1	1	1	1	-	4
Mixed species	-	2	1	-	-	3
Beaked whale sp.	-	-	2	-	-	2
Lissodelphis borealis	1	-	-	1	-	2
Transient *Orcinus orca*	-	2	-	-	-	2
Offshore *Orcinus orca*	-	1	-	-	1	2
Grampus griseus	-	-	-	1	1	2
Delphinus sp.	-	-	1	-	-	1
Delphinus capensis	-	-	-	1	-	1
Mesoplodon sp.	1	-	-	-	-	1
Mixed delphinid & porpoise	-	1	-	-	-	1
Unidentified large whale	-	-	-	1	-	1
Unidentified whale	-	1	-	-	-	1
Ziphiid sp.	1	-	-	-	-	1
Total	33	39	69	68	44	253

Table 9. Cetacean biopsy samples collected during ORCAWALE 2008 aboard NOAA Ship *McArthur II*.

Species or Taxon	Leg 1	Leg 2	Leg 3	Leg 4	Leg 5	Total
Delphinus sp.			3			3
Delphinus capensis			7	12	1	20
Delphinus delphis		23	57	32	44	156
Tursiops truncatus					2	2
Grampus griseus					1	1
Lagenorhynchus obliquidens	10	17				27
Lissodelphis borealis	4	6		2	1	13
Globicephala macrorhynchus		4				4
Orcinus orca		4			2	6
Physeter macrocephalus					1	1
Berardius bairdii	1					1
Balaenoptera physalus	14	2	6	6	4	32
Balaenoptera musculus					2	2
Total	30	58	76	56	63	268

Table 10. Number of photographs taken (# Photos) and number of distinctly marked individuals photographed (Ind. IDs) during ORCAWALE 2008 aboard NOAA Ship *McArthur II*.

Species or Taxon	# Photos	Ind. IDs
Balaenoptera borealis	78	
Balaenoptera physalus	811	10
Balaenoptera musculus	332	95
Megaptera novaeangliae	214	25
Phocoenoides dalli	4	
Stenella coeruleoalba	30	1
Delphinus delphis	1177	24
Delphinus capensis	155	
Tursiops truncatus	2	1
Lagenorhynchus obliquidens	238	
Lissodelphis borealis	9	
Globicephala macrorhynchus	58	8
Orcinus orca	275	36
Physeter macrocephalus	16	2
Berardius bairdii	198	5
Ziphius cavirostris	29	
Callorhinus ursinus	1	
Total	3627	230

Table 11. Summary of seabird sightings recorded using 300-m strip transect methods during ORCAWALE 2008 aboard NOAA Ship McArthur II.

Common Name	Taxon	Leg 1	Leg 2	Leg 3	Leg 4	Leg 5	Total
Albatrosses	Diomedeidae	95	33	64	34	71	297
Fulmars	*Fulmarus*	99	92	8	18	12	229
Shearwaters	*Puffinus*	1315	695	292	155	106	2563
Petrels	*Pterodroma*	6	0	43	32	23	104
Storm Petrels	Hydrobatidae	438	249	270	544	296	1797
Tropicbirds	Phaethontidae	0	0	17	4	7	28
Pelicans	Pelecanidae	0	12	50	9	16	87
Boobies	Sulidae	0	0	1	0	0	1
Cormorants	Phalacrocoracidae	1	13	18	8	7	47
Frigatebirds	Fregatidae	0	0	0	0	0	0
Phalaropes	Phalaropodidae	792	271	138	485	156	1842
Skuas and	Catharactidae,	70	272	151	40	19	552
Gulls	*Larus*	173	389	286	1438	148	2434
Terns	*Sterna*	125	559	37	208	2	931
Auks	Alcidae	448	453	198	97	203	1399
Total		3562	3038	1573	3072	1066	12,311

Table 12. Disposition of data collected aboard NOAA Ship *McArthur II* during ORCAWALE 2008 for analysis and further distribution.

Data	PI	Affiliation	Contact
Marine mammal sightings	Dr. Jay Barlow	NOAA - NMFS - SWFSC	jay.barlow@noaa.gov 858-546-7131
Passive acoustics	Dr. Jay Barlow	NOAA - NMFS - SWFSC	jay.barlow@noaa.gov 858-546-7178
Marine mammal photographs and database	Dr. Jay Barlow	NOAA - NMFS - SWFSC	jay.barlow@noaa.gov 858-546-7178
Biopsies	Dr. Barbara Taylor	NOAA - NMFS - SWFSC	barbara.taylor@noaa.gov 858-546-5620
Seabird sightings	Dr. Lisa Ballance	NOAA - NMFS - SWFSC	lisa.ballance@noaa.gov 858-546-7173
Acoustic backscatter	Dr. Jessica Redfern	NOAA - NMFS - SWFSC	jessica.redfern@noaa.gov 858-546-7117
Oceanographic	Dr. Jessica Redfern	NOAA - NMFS - SWFSC	jessica.redfern@noaa.gov 858-546-7117
Net samples	Dr. Jessica Redfern	NOAA - NMFS - SWFSC	jessica.redfern@noaa.gov 858-546-7117

Table 13. Summary of ecosystem data collected during the 2008 ORCAWALE survey aboard the NOAA Ship *McArthur II*.

Leg	CTD stations	XBT stations	Chlorophyll surface samples	Bongo Tows	IKMT	Squid stations	HAB sampling
1	22	93	95	20	49	1	95
2	14	53	49	10	31	8	47
3	21	76	69	20	47	17	89
4	16	62	53	15	28	12	55
5	18	67	54	16	35	18	67
Total	91	351	320	81	190	56	353

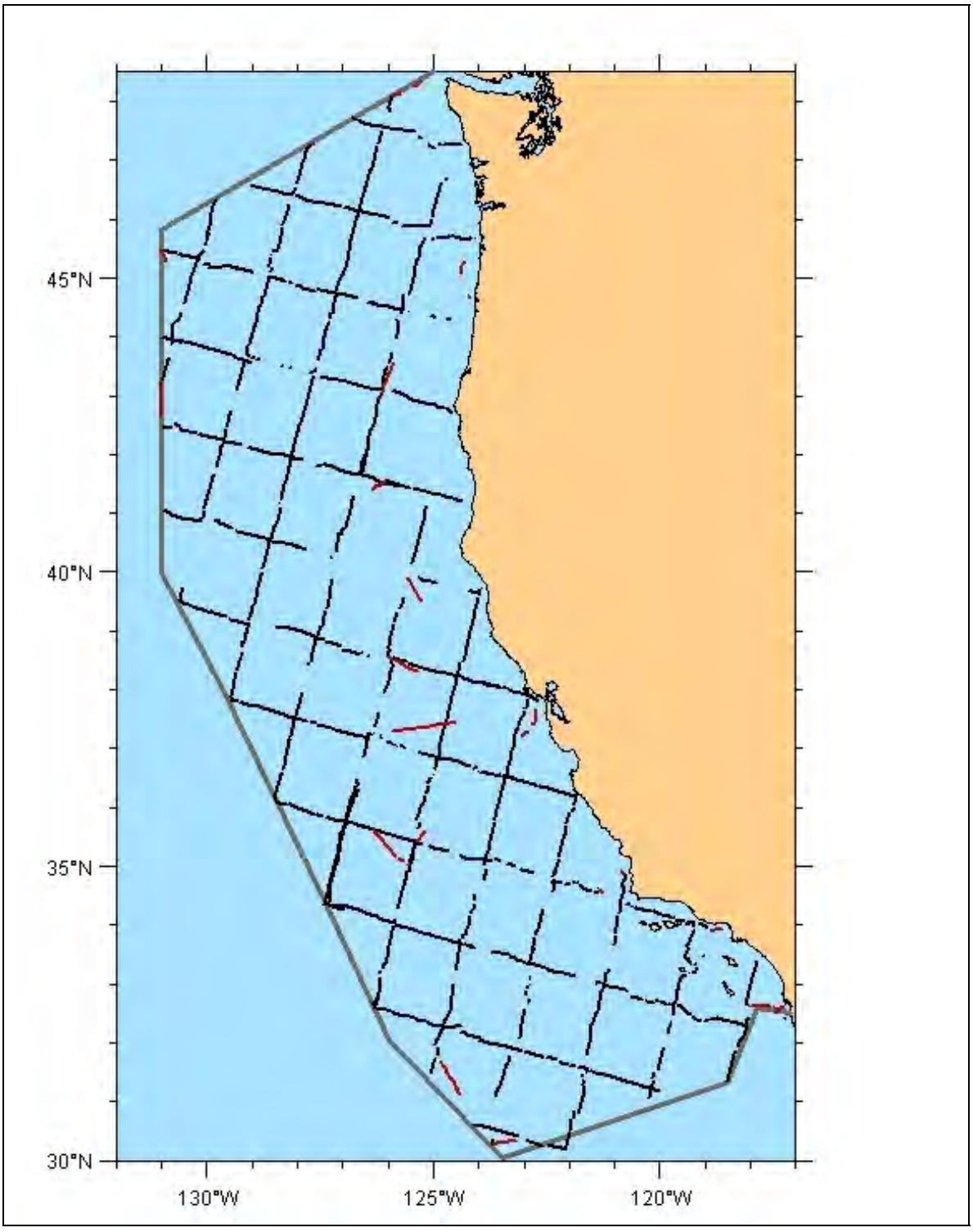

Figure 1. Coverage of tracklines during the 2008 ORCAWALE survey. Survey effort on planned transect lines is shown in black, and unplanned transits are shown in red.

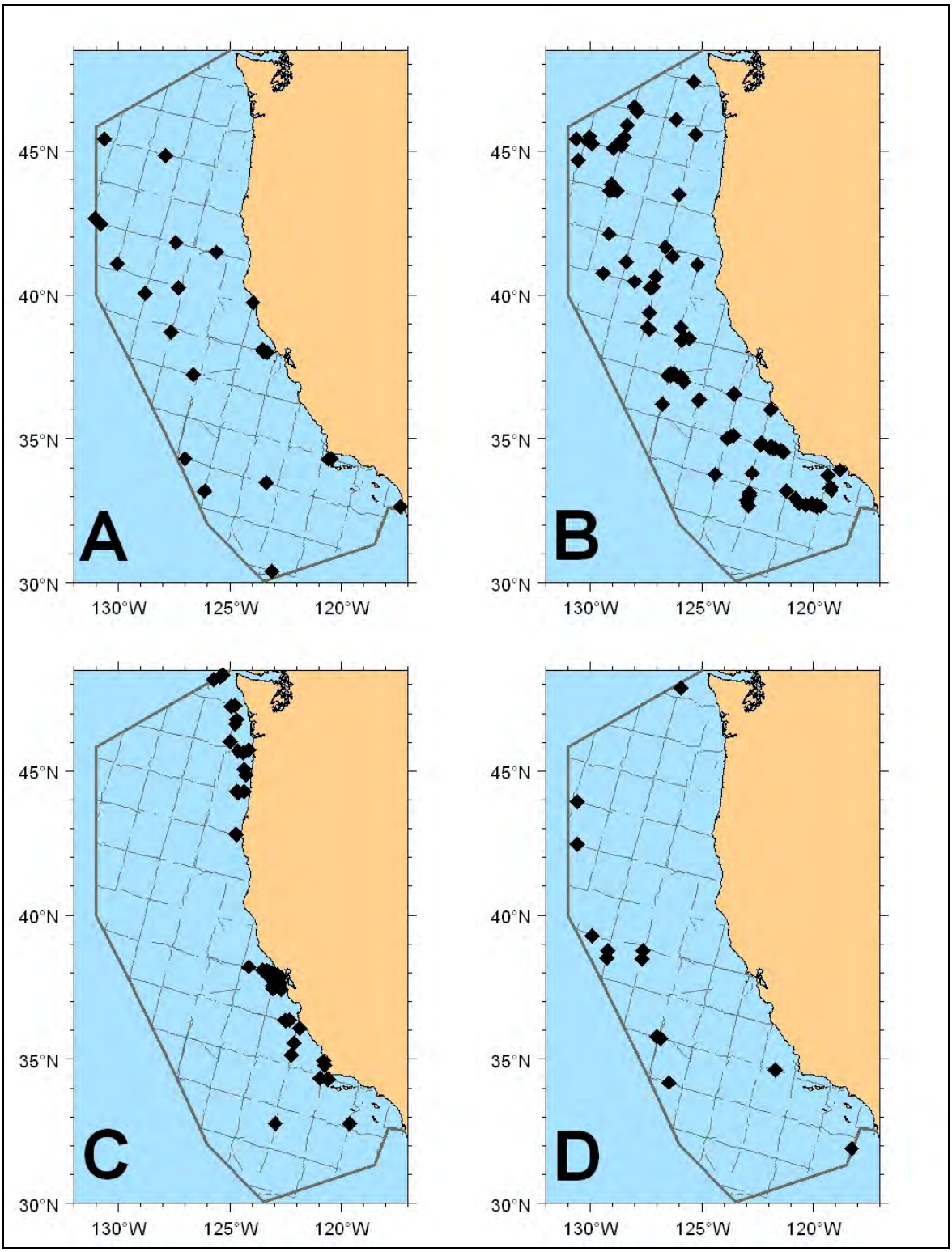

Figure 2. On- and off-effort sightings of (**A**) blue (*Balaenoptera musculus*), (**B**) fin (*B. physalus*), (**C**) humpback (*Megaptera novaeangliae*) and (**D**) sperm (*Physeter macrocephalus*) whales recorded during the 2008 ORCAWALE survey.

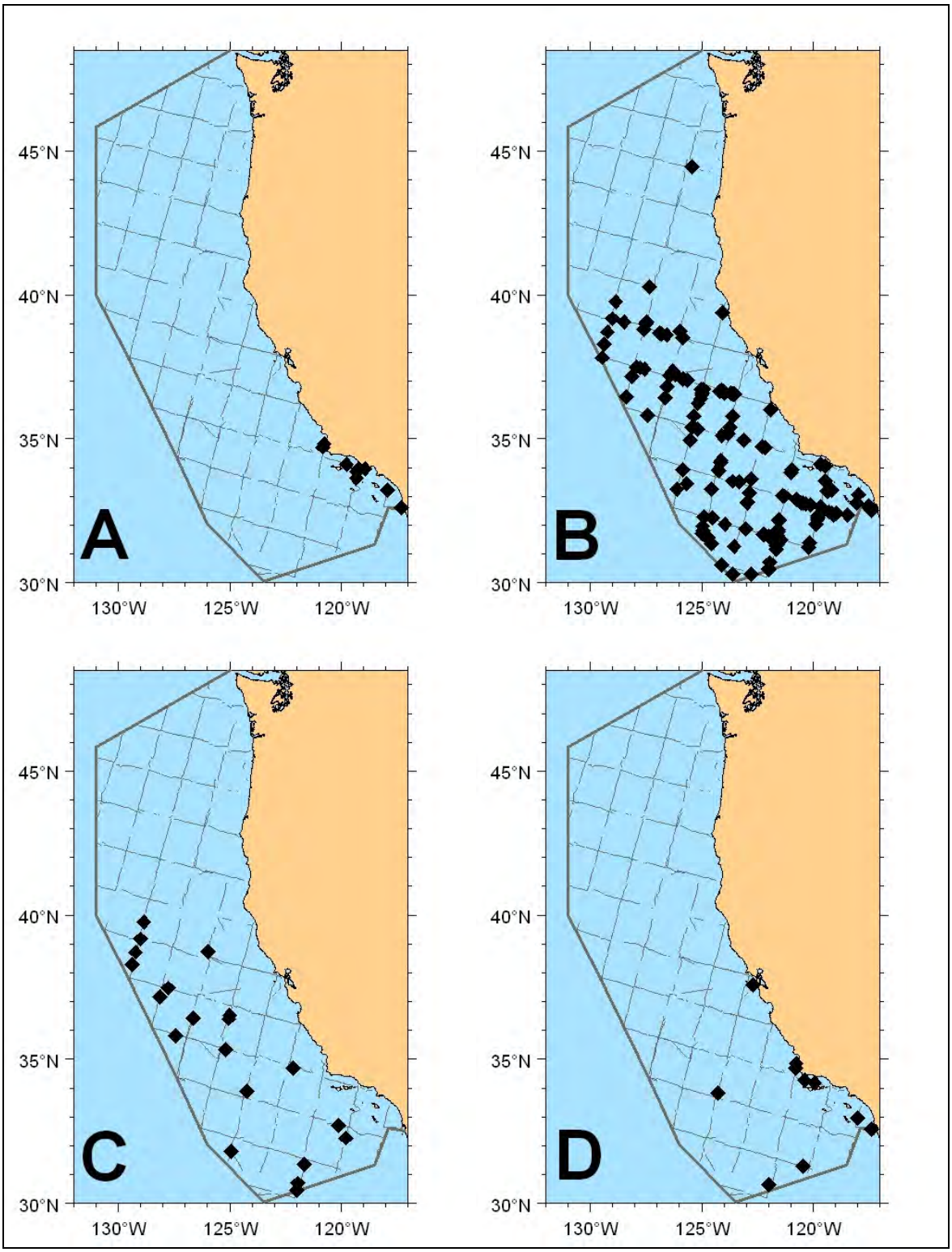

Figure 3. On- and off-effort sightings of (**A**) long-beaked common (*Delphinus capensis*), (**B**) short-beaked common (*D. delphis*), (**C**) striped (*Stenella coeruleoalba*) and (**D**) Risso's (*Grampus griseus*) dolphins recorded during the 2008 ORCAWALE survey.

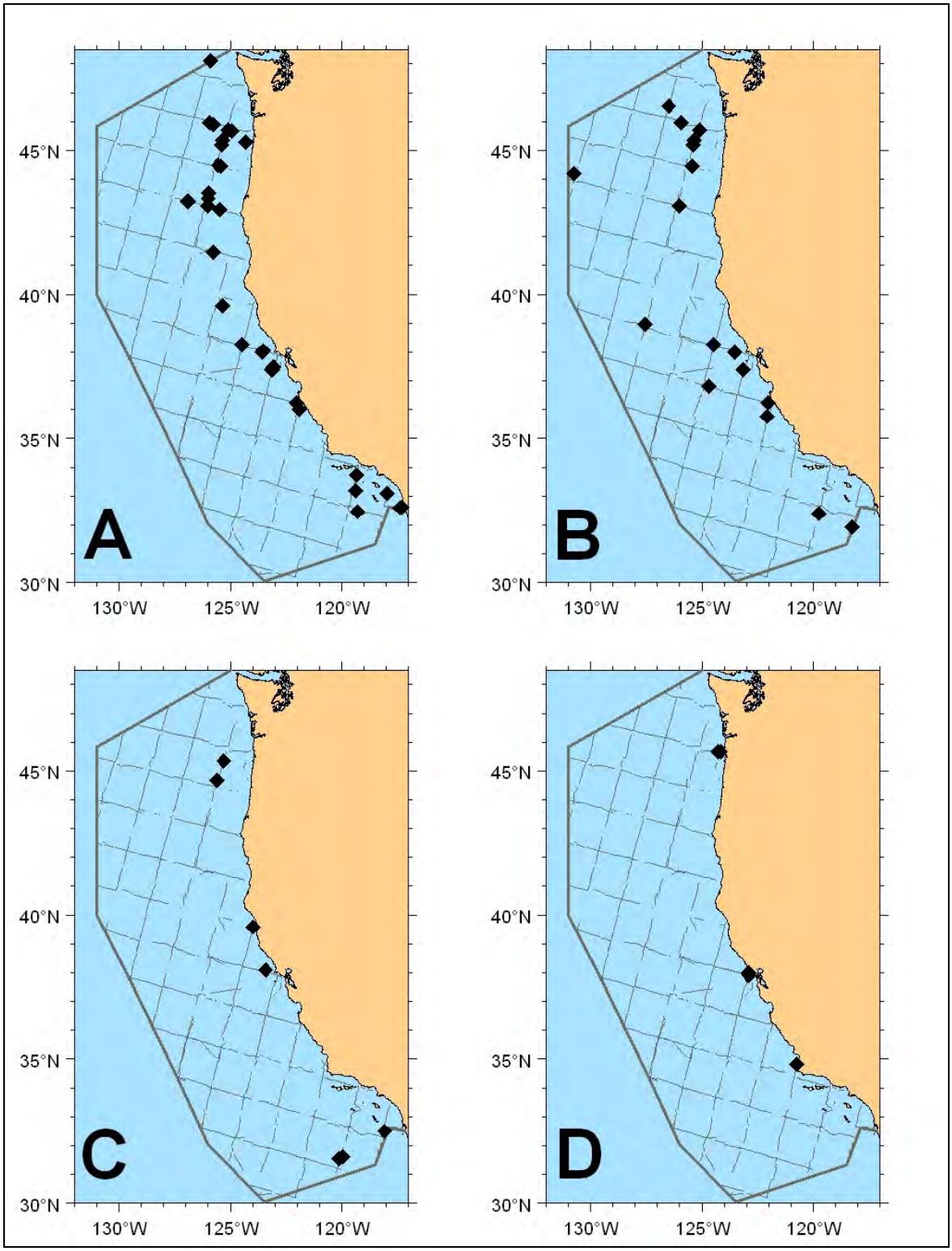

Figure 4. On- and off-effort sightings of (**A**) Pacific white-sided (*Lagenorhynchus obliquidens*) and (**B**) northern right whale (*Lissodelphis borealis*) dolphins, (**C**) killer whales (*Orcinus orca*) and (**D**) harbor porpoise (*Phocoena phocoena*) recorded during the 2008 ORCAWALE survey.

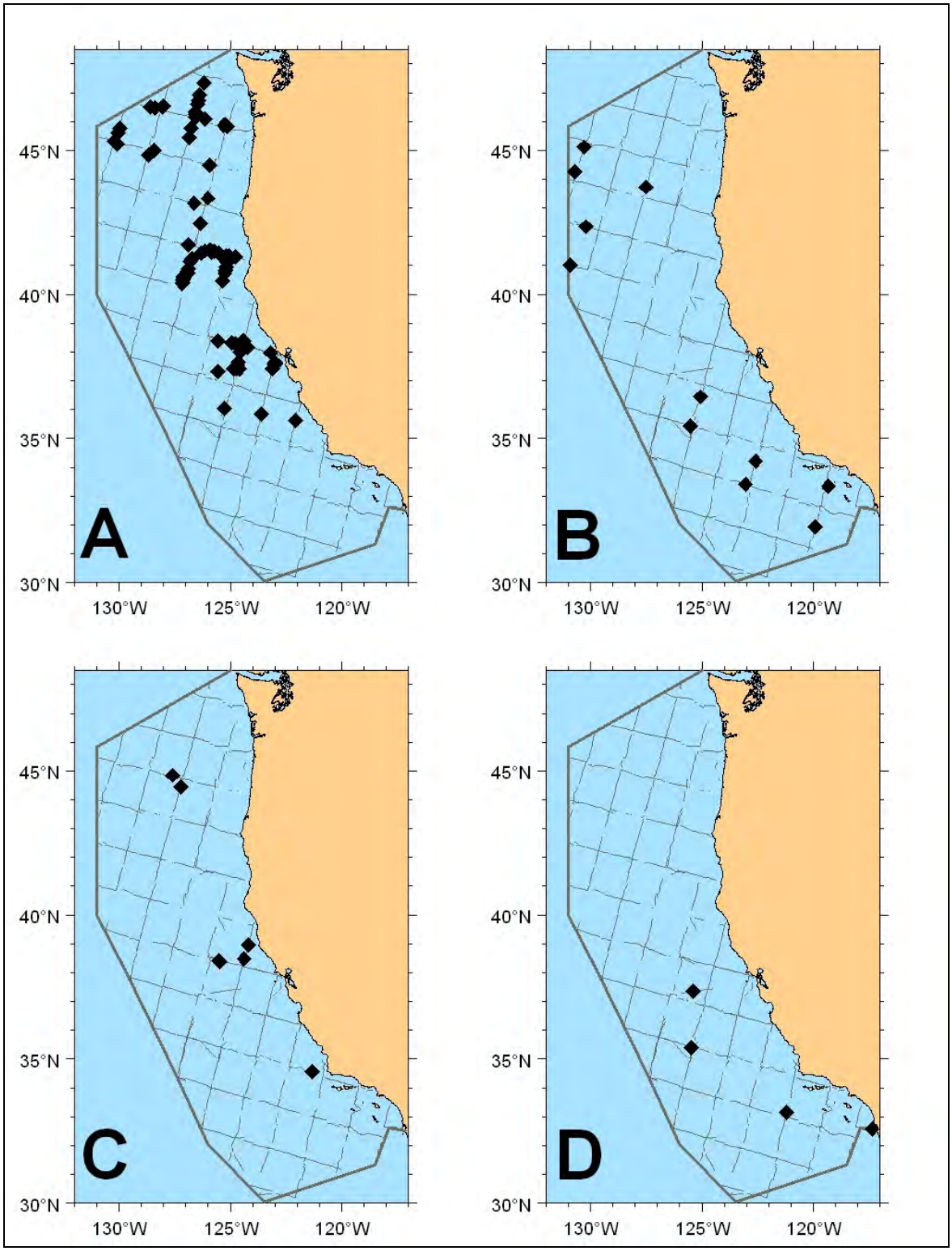

Figure 5. On- and off-effort sightings of (**A**) Dall's porpoise (*Phocoenoides dalli*) and (**B**) Cuvier's beaked (*Ziphius cavirostris*), (**C**) Baird's beaked (*Berardius bairdii*) and (**D**) common minke (*Balaenoptera acutorostrata*) whales recorded during the 2008 ORCAWALE survey.

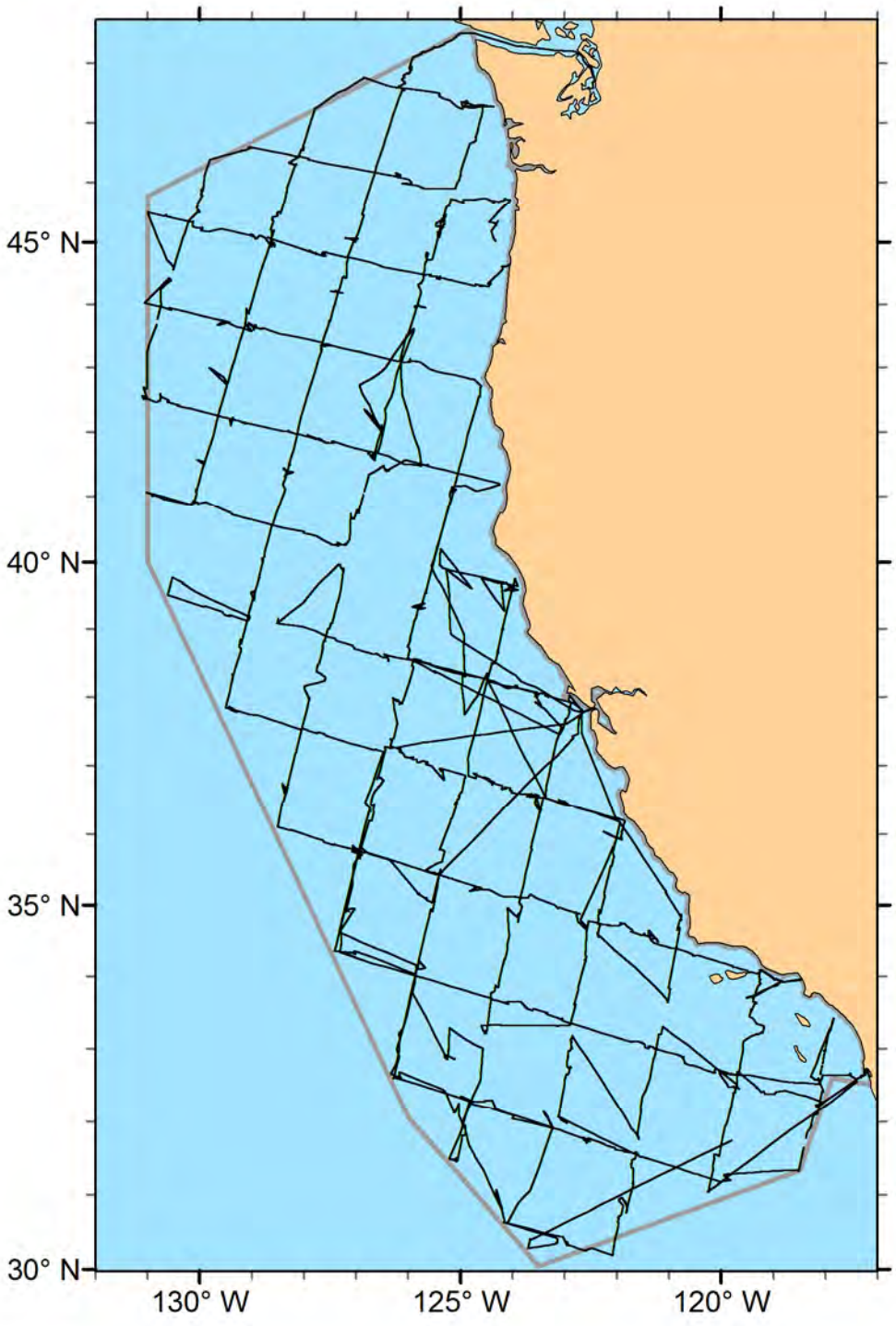

Figure 6. Thermosalinograph sampling conducted on the McArthur II during the 2008 ORCAWALE survey.

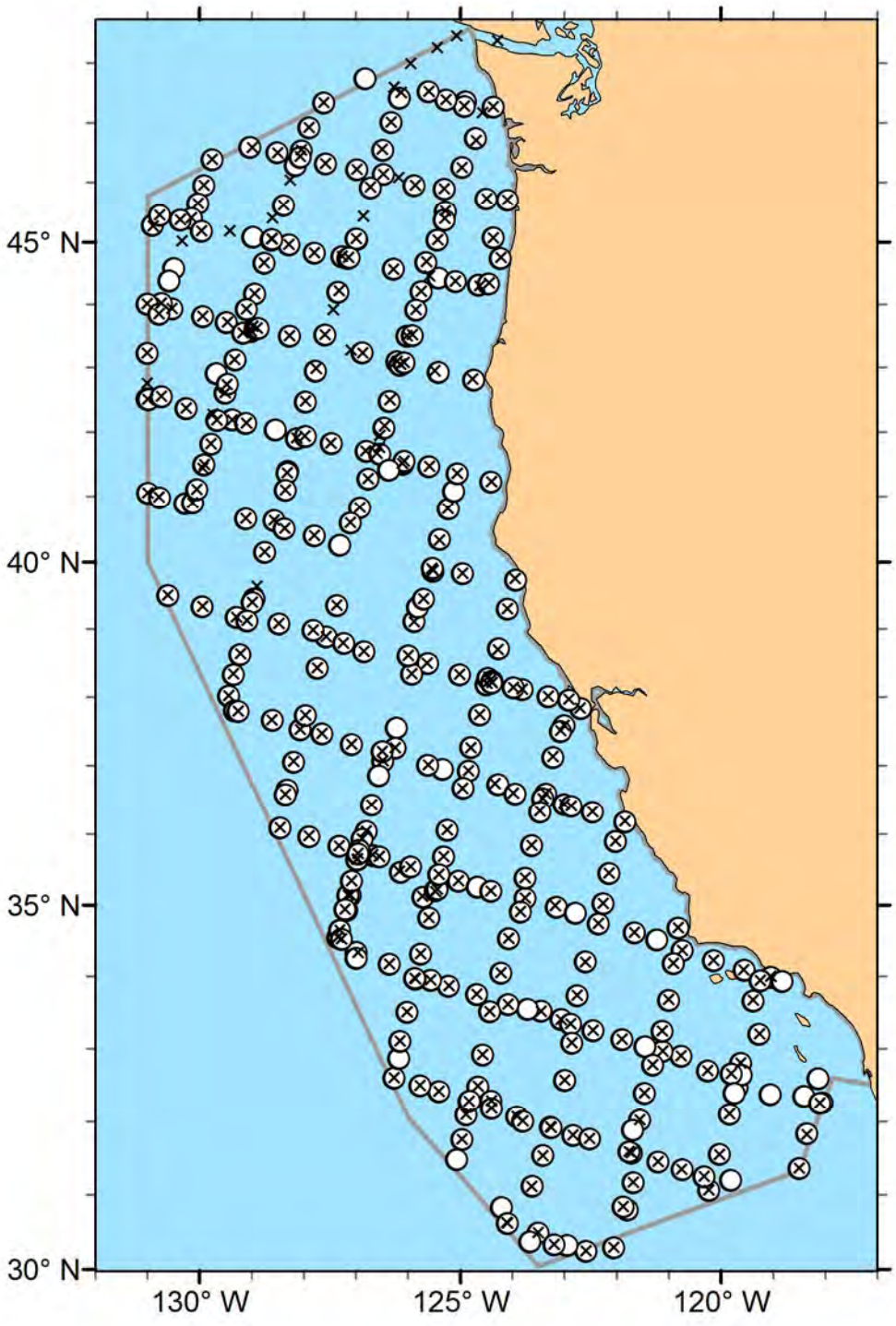

Figure 7. Surface chlorophyll (crosses) and HAB (circles) sampling conducted on the McArthur II during the 2008 ORCAWALE survey.

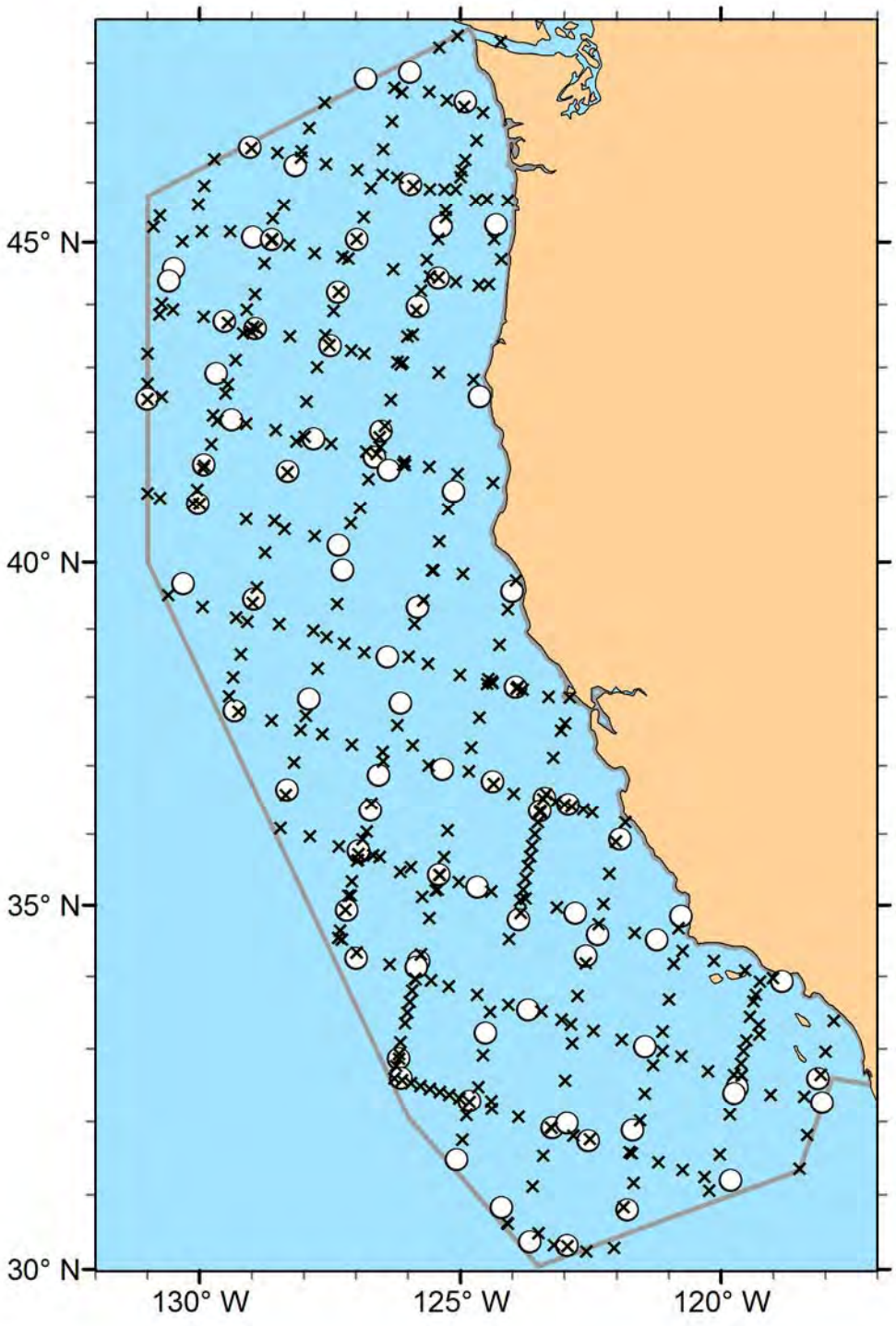

Figure 8. CTD (circles) and XBT (crosses) sampling conducted on the McArthur II during the 2008 ORCAWALE survey.

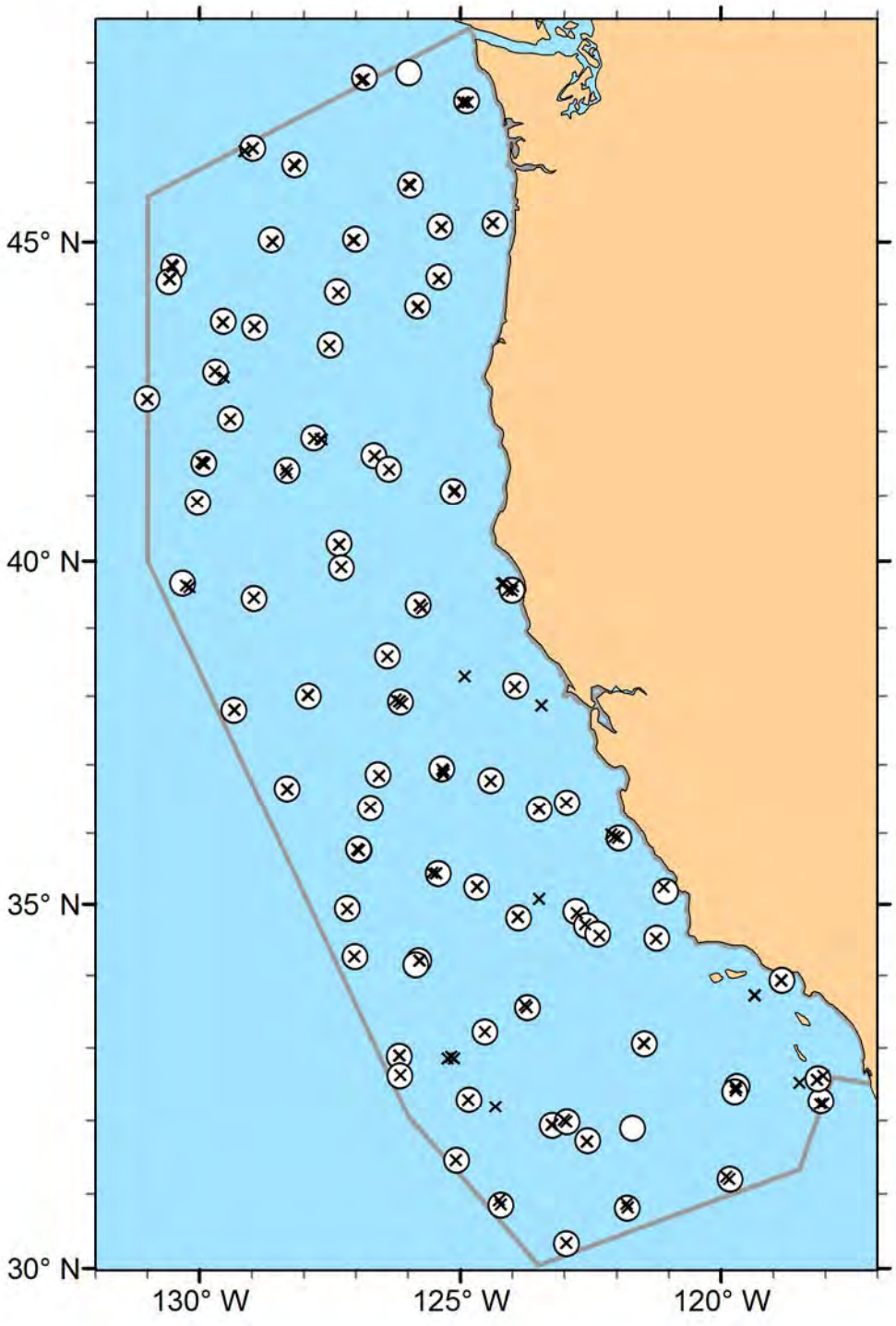

Figure 9. Bongo (circles) and IKMT (crosses) sampling conducted on the McArthur II during the 2008 ORCAWALE survey.

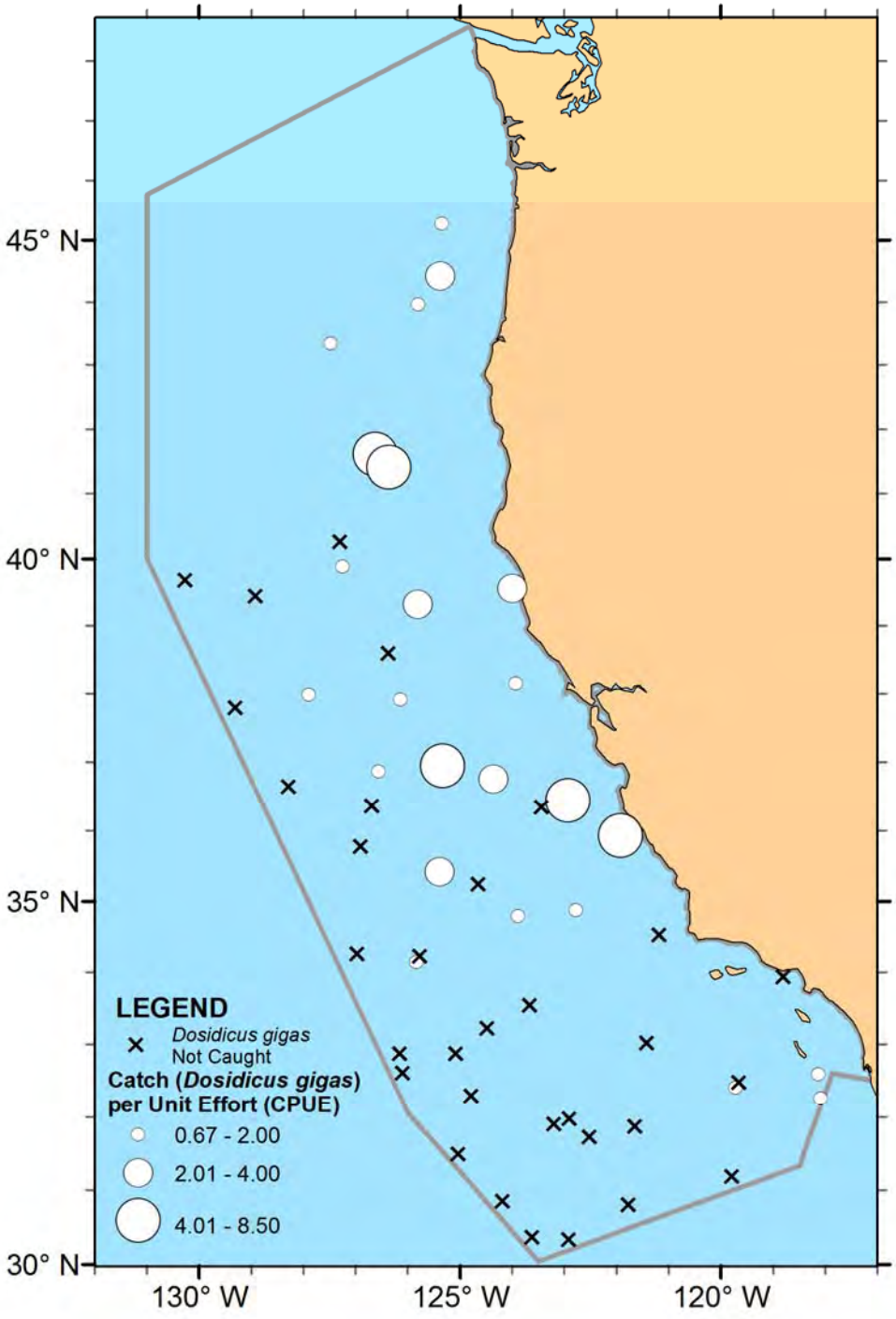

Figure 10. Humboldt squid, *Dosidicus gigas*, catch-per-unit-effort (CPUE) on the *McArthur II* during the 2008 ORCAWALE survey. CPUE is determined as the quantity of the target species caught by an amount of effort at each station, where effort is a combination of gear type, number of jiggers and length of fishing time.

Appendix 1. Four-letter species codes used in the seabird surveys for ORCAWALE 2008, conducted by the Protected Resources Division of Southwest Fisheries Science Center, National Marine Fisheries Service, NOAA. Only those codes for species recorded in the 2008 data are included below.

Seabirds (listed in Phylogenetic order)

ALSP	UNID. ALBATROSS, DIOMEDEA SP.
ALWN	WANDERING ALBATROSS, DIOMEDEA EXULANS
ALLA	LAYSAN ALBATROSS, DIOMEDEA IMMUTABILIS
ALBF	BLACK-FOOTED ALBATROSS, DIOMEDEA NIGRIPES
FUNO	NORTHERN FULMAR, FULMARUS GLACIALIS
FUND	NORTHERN FULMAR DARK MORPH,
FUNI	NORTHERN FULMAR INTERMEDIATE MORPH
FUNL	NORTHERN FULMAR LIGHT MORPH
SHSP	UNID. SHEARWATER, PUFFINUS SP.
SHNZ	BULLER'S (NEW ZEALAND) SHEARWATER, PUFFINUS BULLERI
SHFF	FLESH-FOOTED SHEARWATER, PUFFINUS CARNEIPES
SHPF	PINK-FOOTED SHEARWATER, PUFFINUS CREATOPUS
SHSO	SOOTY SHEARWATER, PUFFINUS GRISEUS
SHBV	BLACK-VENTED SHWTR., PUFFINUS OPISTHOMELAS
SHSB	SLENDER-BILLED SHWTR., PUFFINUS TENUIROSTRIS
SHSS	SOOTY/SLENDER-BILLED SHEARWATER
PTSP	UNID. PTERODROMA, PTERODROMA SP.
PECO	COOK'S PETREL, PTERODROMA COOKII
PEMO	MOTTLED PETREL, PTERODROMA INEXPECTATA
PEST	STEJNEGER'S PETREL, PTERODROMA LONGIROSTRIS
PEHA	HAWAIIAN PETREL, P. SANDWICHENSIS
PEMU	MURPHY'S PETREL, PTERODROMA ULTIMA
COOK	UNID. COOKILARIA, PTERODROMA SP.
SPSP	UNID. STORM PETREL, OCEANODROMA SP.
SPWI	WILSON'S STORM PETREL, OCEANITES OCEANICUS
SPLE	LEACH'S STORM PETREL, OCEANODROMA LEUCORHOA
SPAS	ASHY STORM PETREL, OCEANODROMA HOMOCHROA
SPFT	FORK-TAILED STORM PETREL, OCEANODROMA FURCATA
SPBL	BLACK STORM PETREL, OCEANODROMA MELANIA
SPLS	LEAST STORM PETREL, OCEANODROMA MICROSOMA
SPLW	WHITE-RUMPED LEACH'S S P, OCEANODROMA LEUCORHOA
SPLD	DARK-RUMPED LEACH'S S P, OCEANODROMA LEUCORHOA
SPLI	INTERMEDIATE-RUMPED LEACH'S S P, OCEANODROMA LEUCORHOA
TROP	UNID. TROPIC BIRD, PHAETHON SP.
TBRB	RED-BILLED TROPICBIRD, PHAETHON AETHEREUS
TBRT	RED-TAILED TROPICBIRD, PHAETHON RUBRICAUDA
PEBR	BROWN PELICAN, PELECANUS OCCIDENTALIS
BOBR	BROWN BOOBY, SULA LEUCOGASTER
CORM	UNID. CORMORANT, PHALACROCORAX SP.
CODC	DOUBLE-CRESTED CORM., PHALACROCORAX AURITUS
COBR	BRANDT'S CORMORANT, PHALACROCORAX PENICILLATUS
COPE	PELAGIC CORMORANT, PHALACROCORAX PELAGICUS
PHAL	UNID. PHALAROPE, PHALAROPUS FULICARIUS/LOBATUS
PHRE	RED PHALAROPE, PHALAROPUS FULICARIUS
PHNO	RED-NECKED (NORTHERN) PHALAROPE, PHALAROPUS LOBATUS
SKUA	UNID. SKUA, CATHARACTA SP.
SKSP	SOUTH POLAR SKUA, CATHARACTA MACCORMICKI
JAEG	UNID. JAEGER, STERCORARIUS SP.
JAPO	POMARINE JAEGER, STERCORARIUS POMARINUS
JAPA	PARASITIC JAEGER, STERCORARIUS PARASITICUS

JALT	LONG-TAILED JAEGER, STERCORARIUS LONGICAUDUS
GULL	UNID. GULL, LARUS SP.
GUHE	HEERMANN'S GULL, LARUS HEERMANNI
GUME	MEW GULL, LARUS CANUS
GUHR	HERRING GULL, LARUS ARGENTATUS
GUTH	THAYER'S GULL, LARUS THAYERI
GUCA	CALIFORNIA GULL, LARUS CALIFORNICUS
GUWE	WESTERN GULL, LARUS OCCIDENTALIS
GUGW	GLAUCOUS-WINGED GULL, LARUS GLAUCESCENS
GUWG	WESTERN/GLAUCOUS-WINGED GULL HYBRID
GUBO	BONAPARTE'S GULL, LARUS PHILADELPHIA
KIBL	BLACK-LEGGED KITTIWAKE, RISSA TRIDACTYLA
GUSA	SABINE'S GULL, LARUS SABINI
TERN	UNID. TERN
TECA	CASPIAN TERN, STERNA CASPIA
TECO	COMMON TERN, STERNA HIRUNDO
TEAR	ARCTIC TERN, STERNA PARADISAEA
TEFO	FORSTER'S TERN, STERNA FORSTERI
TERO	ROYAL TERN, STERNA MAXIMA
TEEL	ELEGANT TERN, STERNA ELEGANS
MUCO	COMMON MURRE, URIA AALGE
MUXA	XANTUS'S MURRELET, SYNTHLIBORAMPHUS HYPOLEUCA
MUXC	XANTUS'/CRAVERI'S MURRELET
AUCA	CASSIN'S AUKLET, PTYCHORAMPHUS ALEUTICUS
AURH	RHINOCEROS AUKLET, CERORHINCA MONOCERATA
PUHO	HORNED PUFFIN, FRATERCULA CORNICULATA
PUTU	TUFTED PUFFIN, FRATERCULA CIRRHATA

Land Birds

LOON	UNID. LOON, GAVIA SP.
LOPA	PACIFIC LOON, GAVIA PACIFICA
GREB	UNID. GREBE, PODICIPEDIDAE
DUCK	UNIDENTIFIED DUCK
SHOR	UNIDENTIFIED SHOREBIRD
RAPT	UNIDENTIFIED RAPTOR
NPSS	UNIDENTIFIED NON-PASSERINE
PASS	UNIDENTIFIED PASSERINE

Cetaceans

BAAC	MINKE WHALE, BALAEONOPTERA ACUTOROSTRATA

Pinnipeds

CAUR	NORTHERN FUR SEAL, CALLORHINUS URSINUS
EUJU	STELLER SEA LION, EUMETOPIAS JUBATUS
ZACA	CALIFORNIA SEA LION, ZALOPHUS CALIFORNICUS
MIAN	NORTHERN ELEPHANT SEAL, MIROUNGA ANGUSTIROSTRIS
PHVI	HARBOR SEAL, PHOCA VITULINA
PINN	UNIDENTIFIED PINNIPED

Fish/Squid

FFFW	UNIDENTIFIED FOUR-WING FLYINGFISH
FISH	UNID. FISH
TUSM	SMALL TUNA
SRSP	UNID. SHARK
MOLA	OCEAN SUNFISH, MOLA MOLA

Other

CRPO	CRAB POT
FLOT	UNIDENTIFIED FLOTSAM

Appendix 2. Format for seabird survey data using 300 m strip transect methods.

ABBREVIATION	VARIABLE NAME	COLUMNS RECORDED IN DATA SET	ALPHA/ NUMERIC	RANGE OF VALUES
CRUISE #	Cruise Number	1 - 4	Numeric	0000 - 9999
GM DATE	Greenwich Mean Date (YYMMDD)	6 - 11	Numeric	All accepted
LM DATE	Local Mean Date (YYMMDD)	13 - 18	Numeric	All accepted
LATITUDE	Latitude (+/- DD.DDD)	20 - 26	Numeric	All accepted
LONGITUDE	Longitude (+/- DDD.DDD)	28 - 35	Numeric	All accepted
BEAUFORT	Sea State	37	Numeric	0 – 7
WIND SPEED	Wind Speed	39 - 40	Numeric	
WIND DIRECTION	Wind Direction	42 – 44	Numeric	000 - 359
SHIP COURSE	Ship's Course	46 - 48	Numeric	000 – 359
OBSERVER CONDITION	Observation Conditions	50	Numeric	1 - 5
OBSERVATION SIDE	Observation Side	52	Numeric	1 - 2
OBSERVER CODE	Observer Code	54 - 55	Numeric	1 - 99
EVENT	Event Code	57	Numeric	1 – 5
GM TIME	Greenwich Mean Time (HHMMSS)	59 - 64	Numeric	000000 -235959
LM TIME	Local Mean Time (HHMMSS)	66 - 71	Numeric	000000 -235959
SPECIES CODE	Species Code	73 - 76	Alpha	AAAA – ZZZZ
SPECIES NUMBER	Species Number	78 - 81	Numeric	0001 – 9999
DISTANCE	Distance	83	Numeric	1 – 4
ASSOCIATION	Association	85	Numeric	1 – 3
BEHAVIOR	Behavior	87	Numeric/ Alpha	1 - 9 A - E
FLIGHT DIRECTION	Flight Direction	89 - 91	Numeric	000 - 359, 999
AGE	Age	93	Numeric	1 – 3
SEX	Sex	95	Numeric	1 - 3
COMMENTS	Comments	97	Numeric	1 - 2
GMT OFFSET	GMT offset (+ hours)	99 - 100	Numeric	1 - 11
TEXT	Text of comments	102 - ___	Alpha	AAAA – ZZZZ

Appendix 3. Format for seabird feeding flock data using strip transect methods.

ABBREVIATION	VARIABLE NAME	COLUMNS RECORDED IN DATA SET	ALPHA/ NUMERIC	RANGE OF VALUES
CRUISE #	Cruise Number	1 - 4	Numeric	0000 - 9999
GM DATE	Greenwich Mean Date (YYMMDD)	6 - 11	Numeric	All accepted
LM DATE	Local Mean Date (YYMMDD)	13 - 18	Numeric	All accepted
LATITUDE	Latitude (+/- DD.DDD)	20 - 26	Numeric	All accepted
LONGITUDE	Longitude (+/- DDD.DDD)	28 - 35	Numeric	All accepted
ANGLE	Angle to Flock	37 - 39	Numeric	000 - 359
RETICLE	Reticles to Flock	41 - 44	Numeric	0.0 - 15.0
OBSERVER CODE #1	Observer Code #1	47 - 48	Numeric	1 – 99
EVENT	Event Code	50	Numeric	1 - 6
GM TIME	Greenwich Mean Time (HHMMSS)	52 - 57	Numeric	000000 -235959
LM TIME	Local Mean Time (HHMMSS)	59 - 64	Numeric	000000 -235959
SPECIES CODE	Species Code	66 - 69	Alpha	AAAA - ZZZZ
SPECIES NUMBER	Species Number	71 - 74	Numeric	0001 - 9999
DISTANCE	Distance	76	Numeric	1 - 4
ASSOCIATION	Association	78	Numeric	1 - 3
BEHAVIOR	Behavior	80	Numeric/ Alpha	1 - 9 A - E
FLIGHT DIRECTION	Flight Direction	82 - 84	Numeric	000 - 359, 999
AGE	Age	86	Numeric	1 - 3
SEX	Sex	88	Numeric	1 - 3
COMMENTS	Comments	90	Numeric	1 - 2
FLOCK ID	Flock Identification No.	92 - 95	Numeric	0001 - 9999
NAUTICAL MILES	Nautical Miles to Flock	97 - 99	Numeric	0.0 - 7.0
GMT OFFSET	GMT Offset (+ hours)	101 - 102	Numeric	1 - 11
TEXT	Text of Comments	104 - ___	Alpha	AAAA - ZZZZ

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(February 2010)

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J. BARLOW
(February 2010)

457 Variation and Predictors of Vessel-Response Behavior in a Tropical Dolphin Community.
F.I. ARCHER, S.L. MESNICK, and A.C. ALLEN
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458 Evidence of genetic differentiation for Hawai'i insular false killer whales *(Pseudorca crassidens)*.
S.J. CHIVERS, R.W. BAIRD, K.M. MARTIEN, B.L. TAYLOR, E. ARCHER, A.M. GORGONE, B.L HANCOCK, N.M. HEDRICK, D. MATILLA, D.J. McSWEENEY, E.M. OLESON, C.L. PALMER, V. PEASE, K.M. ROBERTSON, J. ROBBINS, J.C. SALINAS, G.S. SCHORR, M. SCHULTZ, J.L. THEILEKING, and D.L. WEBSTER
(June 2010)

459 Assessing trends in abundance for vaquita using acoustic monitoring: within refuge plan and outside refuge research needs.
L. ROJAS-BRANCHO, A. JARAMILLO-LEGORETTA, G. CARDENAS, E. NIETO, P. LADRON DE GUEVARA, B.L. TAYLOR, J. BARLOW, T. GERRODETTE, A. HENRY, N. TREGENZA, R. SWIFT, and T. AKAMATSU
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E.J. DICK, and A.D. MacCALL
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462 Serious injury determinations for cetaceans caught in Hawaii longline fisheries during 1994-2008.
K.A. FORNEY
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N.C.H. LO, B.J. MACEWICZ, and D.A. GRIFFITH
(November 2010)

464 Ecosystem survey of *Delphinus* species cruise report.
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