REPORT OF THE CALIFORNIA CURRENT ECOSYSTEM SURVEY (CCES): Cetacean and Seabird Data Collection Efforts June 26 – December 4, 2018

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PROJECT OVERVIEW AND OBJECTIVES

The 2018 California Current Ecosystem Survey (CCES) was a joint project of the Marine Mammal and Turtle Division (MMTD) and the Fisheries Resources Division (FRD) of National Oceanographic and Atmospheric Administration's (NOAA) Southwest Fisheries Science Center (SWFSC). The survey was conducted over the course of 7 legs aboard the NOAA ship *Reuben Lasker* between 26 June and 4 December 2018 (Table 1). CCES was an assessment survey for coastal pelagic fish stocks, marine mammals, seabirds, and oceanography along the west coasts of southern Canada (Vancouver Island), US, and northern Mexico (Baja California), out to a distance of approximately 200 nautical miles offshore (Fig. 1). MMTD and FRD worked jointly aboard the vessel during Legs 1 through 4 (OMAO Project No. RL-18-03) (Tables 1, 2a, and 2b), during which the vessel surveyed off the coasts of Vancouver Island and the US West Coast. Only MMTD operations were conducted during Legs 5 through 7 (OMAO Project No. RL-19-01), during which the vessel surveyed off the US West Coast and Mexico. This document covers the work conducted by MMTD (MMTD Survey No. 1651). Work conducted by FRD is presented separately (Stierhoff et al. 2019).

CCES 2018 was the second survey conducted under PacMAPPS, the Pacific Marine Assessment Program for Protected Species[1], an initiative by NOAA, the US Navy, and Bureau of Ocean Energy Management (BOEM), to conduct annual cetacean and ecosystem surveys throughout the North Pacific and generate data products used by all three agencies to meet regulatory requirements pertaining to protected species. The first PacMAPPS survey was the Hawaiian Islands Cetacean and Ecosystem Assessment Survey (HICEAS) 2017 (Yano et al. 2018; Bradford et al. *In press*).

The primary MMTD objectives of CCES 2018 were to collect visual sightings data for marine mammals and seabirds, passive acoustic detection data for cetaceans, photo identification, and biopsy tissue samples for cetaceans, and additional ecosystem data (e.g., oceanographic and prey distribution data). These datasets will be used in a suite of analyses that support MMTD's fulfillment of regulatory requirements and scientific initiatives (e.g., marine mammal stock assessments, integrated ecosystem assessments, mapping cetacean distributions for stakeholders such as the US Navy and BOEM).

CCES 2018 differed markedly – by virtue of its inclusion of a coastal pelagic fish stock survey – from MMTD's marine mammal and ecosystem assessment surveys conducted between 1991 and 2014 (VonSaunder and Barlow 1999, Philbrick et al. 2003, Appler et al. 2004, Forney 2007, Barlow 2010, Barlow et al. 2010, Becker et al. 2012, Moore and Barlow 2017). Whereas the typical MMTD survey design consists of a regular intersecting grid of transect lines (spaced at 60 nmi) throughout the entire US West Coast EEZ (and out to 300 nmi from shore), the first four legs of the CCES 2018 survey design, driven primarily by needs for the fish stock survey, consisted of closely spaced (10 nmi) parallel transects, running perpendicular from shore, concentrated predominantly over the continental shelf (Fig. 1). This resulted in a relative wealth of data over the continental shelf and slope, but a relative paucity of data from distant offshore

[1] https://www.fisheries.noaa.gov/west-coast/science-data/pacmapps-pacific-marine-assessment-program-protected-species

regions, compared to data collected during previous California Current cetacean assessment cruises. In the second part of the study (Legs 5 – 7), transect distribution was dictated in large part by routes taken to retrieve drifting passive acoustic devices (called DASBRs) that had been deployed during the first four legs and to deploy (then eventually retrieve) additional DASBRs. These DASBR-tied routes were modified to some extent to obtain as much far-offshore effort as possible, given the lack of data collected from such areas during Legs 1 – 4. The 2018 survey also differed from past marine mammal stock assessment surveys of the area by its inclusion of northern Baja California as part of the study area. Given the uneven sampling throughout the study area, the 2018 study design will require model-based (rather than design-based) analytical approaches for updating population size estimates for US West Coast marine mammal stocks (Becker et al. 2019, Forney et al. 2010)).

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SURVEY OPERATIONS

1.0 CETACEAN RESEARCH

Weather permitting, visual watches were conducted by the marine mammal observer team on the flying bridge during daylight hours (from sunrise to sunset) along predetermined tracklines (Fig. 1); actual effort completed is shown in Figure 2.

1.1 Cetacean Survey – Standard line-transect survey methods, as implemented on past California Current cetacean surveys (Barlow and Forney 2007), were used to collect information for CCES 2018 . A watch for cetaceans was maintained on the flying bridge during daylight hours by six (6) mammal observers aboard the ship (three were on watch at a time). Each mammal observer worked in 2-hour rotations, manning each of the following three stations on the flying bridge for 40 minutes: a portside 25 x 150 binocular station, a center-line data recorder position, and a starboard 25 x 150 binocular station. During Legs 1 through 4, the visual team was in communication (via satellite phone, cell phone, and VHF radio) with a shore-based small-boat research team from Cascadia Research Collective (Cascadia), which coordinated with personnel on the NOAA Ship *Lasker* to locate groups of marine mammals (especially large whales) to conduct photo identification and biopsy sampling.

At the beginning of each day, search effort started on a trackline determined in advance in consultation between the Cruise Leader and the Command. The ship traveled at ~10 knots (speed over ground) along the designated trackline.

1.1.1 Logging of Data – A log of observation conditions and sightings (e.g., effort status, environmental variables, sighting details) was entered using WinCruz software into a computer connected to the ship's Global Position System (GPS) and Scientific Computer System (SCS, for weather and heading information).

1.1.2 Breaking Trackline and Recording Sighting Details – Surveys were conducted in "closing mode." This means that, upon sighting a marine mammal school or other feature of biological interest, and after recording initial location information for the sighting, the Cruise Leader or marine mammal observer team on watch might take the team 'off effort' and request that the vessel be maneuvered to approach the school or feature for investigation (to determine size and species composition of the school, attempt biopsy and photo identification collection, etc.). When the ship approached the cetaceans (or from the trackline if no approach was needed), the observers made independent estimates of the number of animals (school size). If biopsy and photography operations were to be conducted, these would commence from the bow, based on directions from the Cruise Leader or Senior Marine Mammal Observers. In some instances, during Legs 5 through 7 (MMTD only), the Cruise Leader requested the deployment of a small boat for biopsy, photography, or other operations. During Legs 1 through 4, when sharing the vessel with FRD, the sum duration of the excursions from the trackline was not to exceed an average of 2 h per day; this precluded small-boat operations being conducted from the *Lasker* during these legs (instead, a shore-based small-boat team was used, as described below).

It was occasionally desirable to divert the ship's course from the established trackline during regular effort due to glare or adverse sea conditions. Under these circumstances, during Legs 5 through 7 (when not working with FRD), the ship could divert up to 30 degrees from the established course. This deviation would continue until the ship was 5nm from the trackline, at which point the ship turned back toward the trackline.

1.1.3 Resuming Effort – When the observers completed scientific operations for the sighting, the ship resumed the same course and speed as prior to the sighting and returned to an 'on-effort' state. During legs 1 through 4, this followed the ship's return to the point where the ship had departed from the trackline. During Legs 5 through 7, if the pursuit of the sighting took the ship more than 5nmi from the trackline, the observers were notified and the Cruise Leader or Senior Marine Mammal Observers may request, rather than proceed directly toward the next waypoint, that the ship take a heading of 20 degrees back toward the trackline or return to the position at which the ship diverted before resuming effort.

1.2 Biopsy Sampling – Samples for genetic and hormone analyses of cetaceans were collected on an opportunistic basis. The animals biopsied were approached by the research vessel during normal survey operations, approached the vessel on their own, or were approached by a small boat. Cetacean biopsy samples collected using a dart fired from a crossbow. During Legs 1 – 4, small boat work was conducted by a shore-based team led by Cascadia (see "4.0 Small Boat Work"). During Legs 5 – 7, small boat deployment from the *Lasker* was requested by the Cruise Leader on an opportunistic basis during all daylight hours, occasionally multiple times in a single day. Unless the Captain allowed otherwise, the *Lasker's* small boat always remained within sight and radio contact while deployed.

1.3 eDNA Samples – Via small boats, seawater samples were collected for environmental DNA (eDNA) by Cascadia and NOAA Ship *Lasker* in areas where large whales and large dolphin groups were present. The whale's fluke print, as well as areas of the greatest density of the dolphins' schools, were the target areas. Seawater samples were collected in sterilized Nalgene bottles and stored in a cool, dark place until the water could be filtered. Aboard *Lasker*, samples were vacuum filtered within 24 hrs of collection and then stored in 5 ml of Longmire's lysis buffer at ambient temperature for storage and transport to SWFSC laboratory for DNA extraction.

1.4 Photography –Photographs of marine mammals were taken on an opportunistic basis from aboard the *Lasker* and its small boat. Photographs collected over the course of many years have been and continue to be used to study social behavior, geographic variation in morphology, stock structure, and movement patterns of identified individuals. The animals photographed were approached by the research vessel during normal survey operations, approached the vessel on their own, or were approached by a small boat. Small boat deployment requested by the Cruise Leader on an opportunistic basis during all daylight hours, occasionally multiple times in a single day, providing the Captain concurs that operating conditions are safe. Unless the Captain allowed otherwise, the *Lasker's* small boat always remained within sight and radio contact while deployed. More dedicated

photographic data were collected during Legs 1 - 4 by the Cascadia's small-boat team (see "4.0 Small Boat Work"), for the purposes of informing a long-term photo identification study for large whales.

1.5 Passive Acoustics –

1.5.1 Drifting Autonomous Spar Buoy Recorders (DASBRs) – DASBRs are used to collect passive acoustic data for cetaceans, in particular for deep-diving species such as beaked whales (Griffiths and Barlow 2016, Keating et al. 2018, Griffiths et al. 2020). DASBRs consisted of a black ABS spar buoy, bungee and nylon line, a submerged recorder, and hydrophone system at ~100 depth, an 11" sub-surface buoy, and a 30-lb weight at 100-150 m depth (see Simonis et al. 2020 for details). The spar buoys were attached to a secondary round buoy using a 10 m floating line to aid in detection and retrieval. Buoys included two SPOT geo-locators (inside the spar buoy) and were marked with reflective tape. Deployment and retrieval were in accordance with *Lasker's* Ship Specific Instructions (SSI 1102-16.1RL) for DASBR deployment. Deployments and retrievals occurred during day and night. DASBRs were retrieved after a period of weeks to months by a member of the scientific team and a member of the ship's crew. A 12-volt line-puller was used to aid retrieval.

Buoys were tracked with a satellite geolocator. During daylight, they were relocated visually with the assistance of observers on big-eye binoculars (typically at 5 nmi range). At night, they were relocated visually using the ship's spotlight and reflective tape on the buoys (typically at 0.5 nmi range). Usually, deployment or retrieval (once buoys were located) required approximately 30 minutes. Extreme care was taken to ensure that the vessel did not drift over the top of the line. The Officer of the Day (OOD) or Survey Technician (ST) recorded the time of DASBR deployment or retrieval in the SCS event logger.

1.5.2 Sonobuoys – Sonobuoys were deployed opportunistically in the presence of large whales at the request of the Cruise Leader or Sr. Marine Mammal Observer and the OOD or ST recorded the time of sonobuoy deployment in the SCS event logger.

1.5.3 Towed Acoustic Recorder – During daylight hours, an experimental autonomous acoustic recorder was towed approximately 150-180 m behind the ship. The instrument package included a single-channel SoundTrap ST300HF recorder or a SoundTrap ST4300 recorder with two HTI-96-min hydrophones inside a streamlined tow body (10 cm diameter x 1.2 m length). The instrument was deployed from the stern on the starboard side each day before marine mammal operations began and retrieved each night after marine mammal observations ended. The line was deployed and retrieved by hand or with a 12-v battery-powered winch at steerage speed. Data were downloaded weekly by the cruise leader or marine mammal personnel. The OOD or ST recorded the time of towed array deployment or retrieval in the SCS event logger.

After loss of the prototype on Leg 5, the system was re-designed and tested again on Leg 7. The 1/8" stranded stainless cable leading into the tow body was replaced with a

stronger and more flexible 1/2" Dyneema cable or with a 1/2" stainless steel rod. A longer 30-m 1/2" tail rope was added to reduce side-to-side motion. The 150-m 1/8" Kevlar tow cable was replaced by a 180-m, 3/16" Dyneema tow cable to provide a greater margin of safety. This new system was successfully deployed and retrieved seven times on Leg 7.

1.6 Salvage of Marine Mammals, Birds, and Turtles – During CCES 2018, six (6) bird carcasses were salvaged and stored in the ship's scientific freezer. Permits to salvage and import birds were on the vessel and all bird specimens were turned over to the San Diego Natural History Museum.

2.0 SEABIRD RESEARCH

2.1 Seabird Surveys – Visual surveys of seabirds were conducted using strip-transect methodology from the flying bridge during daylight hours. On Legs 1 through 4, one seabird observer was on duty; two hours on watch was followed by two hours rest. There were two seabird observers on Legs 5 through 7 which provided continual coverage. A log of visibility conditions, effort, sightings, and other required information was entered into a computer interfaced with the ship's GPS (for course, speed, and position information) and SCS (for weather and heading information). Science computers were connected to the same ship's GPS when possible. Seabird observers primarily used handheld binoculars; 25 x 150 binoculars were available when needed.

3.0 OCEANOGRAPHIC AND OTHER DATA

3.1 Oceanography –The ship's SCS maintained a chronological record of oceanographic stations including locations, dates, and times.

3.1.1 Thermosalinograph (TSG) Sampling – The ship provided and maintained a thermosalinograph (TSG) for continuous measurement of surface water temperature and salinity. The TSG continuously collected surface water temperature and salinity from the ship's clean seawater system.

3.1.2 UCTD Stations (Legs 1 through 4) – Underway Conductivity-Temperature-Depth (UCTD) stations were fixed for Legs 1 through 4. The UCTD (Teledyne Oceanscience Underway CTD) was deployed one to five times along each acoustic transect, during the daytime, at preassigned locations which were spaced approximately 15-nmi apart and staggered on adjacent transect lines to improve sampling coverage. If the waypoint provided did not occur precisely on the acoustic transect, the OOD chose the point on the transect closest to the UCTD waypoint. The vessel speed during UCTD casts was nominally 10 knots but was reduced further at the request of the UCTD operator to achieve the desired cast depth. The OOD recorded the time that the UCTD is deployed and recovered in the SCS event logger. If the Underway CTD could not be used, weather permitting, two CTD stations were occupied each day. A morning CTD was completed 15 minutes before sunrise. A second CTD station was occupied each night no earlier than one hour after sunset. No bottle samples were collected. Additional information on the

CTD casts during Legs 1 through 4 in the FRD Technical Memorandum (Stierhoff et al. 2019).

3.1.3 CTD Stations (Legs 5 through 7) – An evening CTD station was occupied at the end of each day no earlier than one hour after sunset and after sonobuoy deployments. No bottle samples were collected. The CTD was equipped with both a WetLab profiling sensor and redundant dissolved oxygen sensors.

All casts were engaged to a depth range of 500 m, where bottom depths permitted. When bottom depths were too shallow for the 500 m cast, the Cruise Leader and ship's Survey Technician determined a safe depth and notified the bridge prior to operations. Cast descent rates were 30 m/min for the first 100 m of the cast, then 60 m/min after that, including the upcast. Cast times were subject to change given daily operations schedules. Additional CTD stations may have been requested by the Cruise Leader in areas of special interest while other CTD stations might have been omitted due to time constraints or proximity to the last station.

The ship provided the Sea-Bird CTD system, which they maintained and was operated by the ship's Survey Technician. The crew of the vessel operated the winch and other deck equipment and was responsible for the termination (and any necessary reterminations) of the CTD cable pigtail to the conducting cable of the winch. All instruments, their spares, and spare parts provided by the ship were maintained in working order and, if applicable, had current (within the previous 12 months) calibrations. The ship provided two sets of sensors for all casts; conducting CTD casts with dual sensors provided immediate feedback about the performance of the sensors and the validity of the data.

3.2 Active Acoustics – An acoustic calibration of Simrad EK60 and EK80 echosounders was conducted while the ship was dockside in San Diego prior to the start of the Juvenile Rockfish survey (RL-18-02). Prior to the calibration, the transducer faces were cleaned of all barnacles or any other bio-fouling that might have hindered the calibration operations and degraded echosounder data. Additional details can be found in Technical Memorandum 609 (Stierhoff et al. 2019).

The EK60 and EK80 echosounders were operated at 18, 38, 70, 120, 200, and 333 kHz (note: the 18 kHz frequency was secured during Legs 5 through 7 because of possible interference with cetacean detections). Extensive information about echosounder use during Legs 1 through 4 was provided by Stierhoff et al. (2019).

3.3 Loggerhead Turtle Tagging – Loggerhead turtle tagging was scheduled for Legs 6 and 7 when the ship was in the Southern California Bight region; however, no loggerhead turtles were observed in US waters during these legs and so no tagging occurred.

4.0 SMALL BOAT WORK

A small boat was necessary for biopsy sampling, photography, and collecting eDNA. During Legs 1 through 4, this work was conducted by Cascadia, who would launch their rigid-hull inflatable boats (RHIBs) from shore in the morning (when conditions allowed) and return to the

launch site by end of day. The Cascadia team (typically two persons) transported their RHIBs down the coast by ground to different launch sites as the *Lasker* progressed south through the survey area. Daily communication between Cascadia and the marine mammal cruise leader on the *Lasker* (from ship to shore, and from ship to RHIBs working on the water) facilitated coordination (e.g., the *Lasker* team would inform Cascadia of the area they anticipated working for the day or where they had recently spotted concentrations of whales). The Cascadia team would find whales and collect skin and blubber biopsy samples and photo identification data. The emphasis was on collecting data for large whales and, in particular, humpback whales.

During Legs 5 through 7, all data were collected from the *Lasker* or from a NOAA small boat launched from the *Lasker*. Deployment of the small boat was requested by the Cruise Leader on an opportunistic basis, provided that the Commanding Officer concurred that operating conditions were safe.

RESULTS

SURVEY EFFORT

A total of 12,857 km of transect line was surveyed by the *Lasker* for marine mammals and seabirds (Table 3, Fig. 2). Most of these data will be used for the model-based analysis to construct density surfaces and estimate population size for as many marine mammal stocks as possible (depending on sample size). Some spatial gaps in survey coverage (Fig. 2) occurred in areas of extended periods of poor weather (wind, fog). The *Lasker* generally continued its progress along FRD study lines during these conditions, in which it was not possible to collect marine mammal visual-survey data.

Cascadia conducted 65 vessel-days of effort dedicated to collecting large whale photo identification and biopsy samples as part of this study (Fig. 3).

MARINE MAMMAL SIGHTINGS

In total, 2,122 marine mammal groups were sighted by *Lasker* observers (Table 4). This is a record for a California Current cetacean stock assessment survey. Of these, 2,004 were recorded while 'on-effort' and 118 were 'off-effort'. Sightings of all positively identified species are displayed in Figures 4 through 15. Additional sightings not identified to at least the family level or sub-family level in the case of delphinids have not been mapped but are noted in Table 4.

BIOPSY DATA

Off the US West coast, 328 biopsy samples were collected via projectile sampling (Table 5). Cascadia collected the vast majority of these samples (323) and the remainder (5) were collected by scientists aboard *Lasker*, including a single biopsy collected from an encountered dead humpback whale. An additional 20 samples were collected in Mexican waters, all from the *Lasker*.

eDNA

Fourteen seawater samples were collected for eDNA analysis by the Cascadia (six samples) and *Lasker* (eight samples).

PHOTOGRAPHY DATA COLLECTED *from Lasker and Cascadia Research Collective*

Photographs were obtained by *Lasker* observers for 231 of the marine mammal sightings (Table 6). Cascadia obtained good quality photographic IDs for > 1000 unique individuals, mostly for humpbacks (895) but also blue whales (100), fin whales (22), and gray whales (11) (Table 7). Additional photo identifications and biopsies were obtained opportunistically during the course of other Cascadia projects (e.g., dedicated to tagging, entanglement response) conducted within the same study area and date frame as the CCES survey.

PASSIVE ACOUSTICS

Seven DASBRs were successfully deployed and retrieved in US West Coast waters and another 8 were successfully deployed and retrieved in Mexican waters (Fig. 16). Eight additional

DASBRs were deployed in US West Coast waters but not successfully retrieved (Fig. 16). The total recording time of the recovered DASBRs was 1,888 hours (Table 8). Most of the lost DASBRs were deployed early in the survey in the northernmost section of the study area, which resulted in a paucity of coverage in those areas (Fig. 16). For the current DASBR design, the number of days at sea was determined to have increased the risk of losing a DASBR before retrieving it. Shorter deployment times or a more robust DASBR design is recommended for future surveys. Acoustic data from the DASBRs has been analyzed to identify detections of beaked whales, sperm whales, and dwarf and pygmy sperm whales (Simonis et al. 2020).

Due to competing priorities, sonobuoy deployment was rare during CCES 2018; the total number of deployments with data is 10.

The prototype autonomous towed array was tested on Leg 5 and performed well during two 1-day test deployments. However, the tow body and recorder (a single-channel ST300HF) were lost during a third trial when the stainless steel cable parted at the point where it entered the nose section of the tow body. The loss was attributed to metal fatigue, likely caused by side-to-side movement of the tow-body.

The redesigned autonomous towed hydrophone array was successfully deployed 7 times. Very clear dolphin whistles and clicks were recorded in calm sea conditions with little noise; however, high noise levels were recorded in high swell conditions. Greater depth is needed in such conditions, which likely could be achieved with a combination of greater weight and a longer tow cable.

OCEANOGRAPHY

During Legs 1 through 4, the FRD from SWFSC conducted CTD measurements using an Underway CTD (n = 239) or CTD rosette (n = 59). On Legs 5 through 7, 98 CTDs were conducted by the Marine Mammal and Turtle Division.

SEABIRDS

During the 609.4 hours seabird observers spent on effort, 133 species of birds were sighted. *Ardenna* shearwaters were the most common genus counted (54.1%), followed by *Puffinus* shearwaters (16.4%) and *Uria* murres (8.6%) (Table 9).

DISPOSITION OF DATA

Table 10 specifies points of contact for the various datasets collected during CCES 2018.

ANALYSES

The scope of this report is limited to a description of the survey methods and work completed, and basic data summaries. Most analyses of these data will be conducted using separate sources of funding support, on varying timetables. Some data, for lack of such support, may not be analyzed for some time. Here is a brief overview of some analyses that are planned or underway.

- Support from BOEM or the Navy (for the CCES 2018 survey) did include funds to process the DASBR data, i.e., to extract detections of different deep-diving cetacean

species (such a beaked whales) from the passive acoustic data files, so that these can be summarized and mapped. This work is summarized in a separate Technical Memorandum (Simonis et al. 2020).

- The DASBR data summaries will subsequently be used to estimate population density and abundance for Cuvier's beaked whales. Progress toward doing this for *Mesoplodon* species will also be attempted.
- Support from BOEM or the Navy (for the CCES 2018 survey) also included funds to construct spatial density models (SDMs) for as many cetacean species as possible (depending on the amount of data available). This work will be communicated in a separate report.
- The SDMs will be subsequently used to estimate population size and trends for many cetacean species in the California Current.
- The photo identification data collected for humpback whales is currently being analyzed to inform several population assessment analyses for this species in the region
- Humpback whale biopsy samples have already been assayed for hormonal and genetic information

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PERMITS

NMFS Permit No. 19091, issued to Southwest Fisheries Science Center by the National Marine Fisheries Service, Office of Protected Resources – this permit covers marine mammal and turtle research.

FWS Permit No. MB033305-0, issued to Southwest Fisheries Science Center by the U.S. Fish and Wildlife Service Migratory Bird Permit Office, Region 8.

NMS Permit No. MULTI-2013-009, issued to Southwest Fisheries Science Center to collect biopsies in National Marine Sanctuary waters

NMS Permit No. MULTI-2017-001, issued to Southwest Fisheries Science Center to deploy DASBRs in National Marine Sanctuary waters

Washington State Scientific Collection Permit No. MOORE 18-179 issued by Washington Department of Fish and Wildlife to biopsy whales in Washington State waters

Canadian Marine Mammal Licence No. XMMS 5 2018 issued by Fisheries and Oceans, Canada (DFO) for collection of cetacean biopsies in Canadian waters

Canadian Permit No. IGR-708 issued by Canadian Global Affairs; Authorization for NOAA Ship *Reuben Lasker* to collect DASBRs in Canadian waters (note: not used)

Mexican Permit No. Oficio Nº SGPA/DGVS/ 009395 /18 issued by SEMARNAT for cetacean and ecosystem assessment research in Mexican waters

Mexican Permit No. CTC/06770/18v issued by Secretaría de Relaciones Exteriores for cetacean and ecosystem assessment research in Mexican waters

Mexican Permit No. Oficio núm. 400./331/2018 INEGI.GMA 1.03 issued by Instituto Nacional Estadística y Geografía for cetacean and ecosystem assessment research in Mexican waters

Mexican Permit No. PPFE/DGOPA-198/18 issued by Conapesca for cetacean and ecosystem assessment research in Mexican waters

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Table 1. Survey itinerary for NOAA Ship *Lasker* during CCES 2018.

NOAA Ship *Lasker*	Ports	Dates	Days at Sea	In Port Days
RL-18-03 Leg 1	San Francisco	26-Jun-18	21	
	Newport	16-Jul-18		3
RL-18-03 Leg 2	Newport	20-Jul-18	21	
	San Francisco	09-Aug-18		3
RL-18-03 Leg 3	San Francisco	13-Aug-18	19	
	San Diego	31-Aug-18		4
RL-18-03 Leg 4	San Diego	05-Sep-18	19	
	San Diego	23-Sep-18		10
RL-19-01 Leg 5	San Diego	04-Oct-18	21	
	San Diego	24-Oct-18		4
RL-19-01 Leg 6	San Diego	29-Oct-18	17	
	San Diego	14-Nov-18		5
RL-19-01 Leg 7	San Diego	20-Nov-18*	15	
	San Diego	04-Dec-18		–

* Sailing day lost because foreign national clearances were not issued in a timely manner for Mexican observers.

Table 2a. Cetacean and Ecosystem Assessment participating scientists aboard NOAA Ship *Lasker* during CCES 2018.

Position	Name	Leg 1	Leg 2	Leg 3	Leg 4	Leg 5	Leg 6	Leg 7
CCES Chief Scientist and Chief Scientist Leg 1	Jeff Moore	X						
MMTD Cruise Leader	Jim Carretta		X					
Chief Scientist for Leg 3	Lisa Ballance			X				
MMTD Cruise Leader	Eric Archer				X			
Cruise Leader	Jay Barlow					X		
Cruise Leader	Barb Taylor						X	
Cruise Leader	Karin Forney							X
Assistant Cruise Leader	Brittany Hancock-Hanser							X
Sr. Marine Mammal Observer	Juan Carlos Salinas	X	X	X	X	X	X	X
Sr. Marine Mammal Observer	Paula Olson	X	X					
Sr. Marine Mammal Observer	Suzanne Yin			X	X	X	X	X
Marine Mammal Observer	Dawn Breese	X	X	X	X			
Marine Mammal Observer	Chris Hoefer	X	X	X	X	X	X	X
Marine Mammal Observer	Felipe Triana	X	X	X	X	X	X	X
Marine Mammal Observer	Jim Gilpatrick	X	X	X				
Marine Mammal Observer	Joel Schumacher				X	X	X	X
Marine Mammal Observer	Adam Ü					X	X	
Marine Mammal Observer	Carrie Sinclair							X
Seabird Observer	Michael Force	X	X	X	X	X	X	X
Seabird Observer	Dawn Breese					X	X	X
Visiting Scientist	Lindsey Peavey					X		
Visiting Scientist	Mridula Srinivasan						X	
Mexican Observer	LT Paola Moreno Quintana						X	X
Mexican Collaborator	Sergio Martinez Aguilar						X	X

Table 2b. Fisheries Resources Division participating scientists aboard NOAA Ship *Lasker* during CCES 2018.

Position	Name	Leg 1	Leg 2	Leg 3	Leg 4	Leg 5	Leg 6	Leg 7
Chief Scientist/FRD Lead	David Demer	X						
Chief Scientist Leg 2/Acoustician	Juan Zwolinski		X					
FRD Lead/ Acoustician	Josiah Renfree			X				
Chief Scientist Leg 4/Biologist	David Griffith				X			
Fishery Acoustician	Daniel Palance	X	X					
Fishery Biologist	Dave Griffith	X						
Fishery Biologist	Lanora V. del Mercado	X						
Fishery Biologist	Anne Freire	X						
Fishery Biologist	Megan Human	X						
Fishery Biologist	Kevin Runge	X						
Fishery Biologist	Amy Hays		X					
Fishery Biologist	Lanora V. del Mercado		X					
Fishery Biologist	Emily Gardner		X					
Fishery Biologist	Bill Watson		X					
Fishery Acoustician	Thomas Sessions			X				
Fishery Biologist	Rachel Pound		X					
Fishery Biologist	Bryan Overcash			X				
Fishery Biologist	Debra Winter			X				
Fishery Biologist	Emily Gardner			X				
Fishery Biologist	Sherri Charter			X				
Fishery Acoustician	David Murfin				X			
Fishery Biologist	Tor Mowatt-Larssen			X				
Fishery Biologist	Bryan Overcash				X			
Fishery Biologist	Scott Mau				X			
Fishery Biologist	Alyssa Mische				X			
Fishery Biologist	Melissa Mayaraga				X			
Fishery Biologist	Sue Manion/Lanora V. del Mercado*				X			

Table 3. Transect effort accomplished during CCES 2018 by Beaufort state.

Beaufort	Effort (km)
0	147
1	816
2	1,972
3	3,188
4	3,775
5	2,959
Total	12,857

Table 4. Cetacean sightings during CCES 2018 from NOAA Ship *Lasker*.

Common name	Scientific name	On effort	Off effort	Total
Grey whale	*Eschrichtius robustus*	15	3	18
Common minke whale	*Balaenoptera acutorostrata*	16	4	20
Sei whale	*Balaenoptera borealis*	4	0	4
Bryde's whale	*Balaenoptera edeni*	8	0	8
Sei or Bryde's whale	*Balaenoptera borealis/edeni*	10	2	12
Blue whale	*Balaenoptera musculus*	31	10	41
Fin whale	*Balaenoptera physalus*	139	13	152
Fin or sei or Bryde's whale	*Balaenoptera physalus/borealis/edeni*	73	2	75
Humpback whale	*Megaptera novaeangliae*	644	36	680
Unidentified rorqual (*Balaenoptera* or *Megaptera*)		132	8	140
Sperm whale	*Physeter macrocephalus*	13	3	16
Dwarf or pygmy sperm whale	*Kogia* sp.	2	0	2
Baird's beaked whale	*Berardius bairdii*	10	0	10
Mesoplodon beaked whale	*Mesoplodon* sp.	4	0	4
Cuvier's beaked whale	*Ziphius cavirostris*	11	2	13
Unidentified Beaked whale	*Ziphiid* sp.	6	0	6
Eastern north Pacific long-beaked common dolphin	*Delphinus delphis bairdii*	35	0	35
Common dolphin	*Delphinus delphis delphis*	161	5	166
Unidentified *D. delphis* subspecies	*Delphinus* sp.	128	5	133
Short-finned pilot whale	*Globicephala macrorhynchus*	1	0	1
Risso's dolphin	*Grampus griseus*	46	1	47
Pacific white-sided dolphin	*Lagenorhynchus obliquidens*	98	10	108
Northern right whale dolphin	*Lissodelphis borealis*	27	2	29
Killer whale	*Orcinus orca*	9	1	10
Offshore spotted dolphin	*Stenella attenuata*	1	0	1
Striped dolphin	*Stenella coeruleoalba*	15	0	15
Bottlenose dolphin	*Tursiops truncatus*	13	1	14
Harbor porpoise	*Phocoena phocoena*	108	6	114
Dall's porpoise	*Phocoenoides dalli*	95	1	96
Unidentified dolphin or porpoise		17	0	17
Unidentified small whale		3	0	3
Unidentified large whale		38	0	38
Unidentified cetacean		2	0	2
Unidentified whale		12	0	12
Unidentified small delphinid		71	3	74
Unidentified medium delphinid		1	0	1
Unidentified large delphinid		1	0	1
Unidentified porpoise		4	0	4
Total		2004	118	2122

Table 5. Cetacean biopsy samples collected during CCES 2018 by SWFSC and Cascadia Research Collective, by country of collection.

Common Name	Species	United States	Mexico
Gray whale	*Eschrichtius robustus*	1	0
Blue whale	*Balaenoptera musculus*	33	1
Fin whale	*Balaenoptera physalus*	6	1
Unidentified rorqual	*Balaenoptera* sp.	0	1
Humpback whale	*Megaptera novaeangliae*	286	1
Pacific white-sided dolphin	*Lagenorhynchus obliquidens*	2	10
Unidentified dolphin	---	0	6
Total		328	20

Table 6. Number of sightings photographed from aboard the *Lasker* during CCES 2018.

Common name	Scientific name	Total
Gray whale	*Eschrichtius robustus*	*1*
Common minke whale	*Balaenoptera acutorostrata*	6
Sei whale	*Balaenoptera borealis*	4
Bryde's whale	*Balaenoptera edeni*	7
Rorqual identified as a sei or Bryde's whale	*Balaenoptera borealis/edeni*	5
Blue whale	*Balaenoptera musculus*	20
Fin whale	*Balaenoptera physalus*	38
Unidentified rorqual	*Balaenoptera* sp.	2
Humpback whale	*Megaptera novaeangliae*	18
Sperm whale	*Physeter macrocephalus*	3
Mesoplodon beaked whale	*Mesoplodon* sp.	1
Cuvier's beaked whale	*Ziphius cavirostris*	5
Eastern north Pacific long-beaked common dolphin	*Delphinus delphis bairdii*	8
Common dolphin	*Delphinus delphis delphis*	61
Unidentified *D. delphis* subspecies	*Delphinus* sp.	1
Short-finned pilot whale	*Globicephala macrorhynchus*	1
Risso's dolphin	*Grampus griseus*	6
Pacific white-sided dolphin	*Lagenorhynchus obliquidens*	13
Northern right whale dolphin	*Lissodelphis borealis*	6
Killer whale	*Orcinus orca*	6
Offshore pantropical spotted dolphin	*Stenella attenuata* (offshore)	1
Striped dolphin	*Stenella coeruleoalba*	8
Bottlenose dolphin	*Tursiops truncatus*	3
Harbor porpoise	*Phocoena phocoena*	1
Dall's porpoise	*Phocoenoides dalli*	1
Northern fur seal	*Callorhinus ursinus*	4
Steller sea lion	*Eumetopias jubatus*	1
Total sightings photographed		231

Table 7. Sightings (animal groups observed), number of animals comprising these groups, and number of unique individuals identified (or estimated IDs for species not yet processed) from good quality photos collected during small boat effort by Cascadia and their collaborators from June to November 2018 on the US West Coast. WA = Washington, OR = Oregon, NCA = Northern California, GF = Gulf of Farallones region, MB = Monterey Bay region, SC = Southern California.

Species/Region	1-WA	2-OR	3-NCA	4-GF	5-MB	6-SC	Total
Gray whales							
Sightings	9	1					10
Animals	12	1					13
Estimated IDs	10	1					11
Blue whales							
Sightings		25	2	25	111	8	171
Animals		42	4	42	219	16	323
Unique IDs		26	4	23	42	12	100
Fin whales							
Sightings	1	5			16	2	24
Animals	1	7			17	2	27
Estimated IDs	1	7			12	2	22
Humpback whales							
Sightings	179	109	97	207	214	15	821
Animals	578	614	263	438	682	28	2,603
Estimated IDs	174	242	177	186	134	0	895

Table 8. Deployment and retrieval times and locations for Drifting Acoustic Spar Buoy Recorder (DASBR) deployments. The number of 2-minute files recorded during each deployment is also given. Deployment and retrieval times & locations are taken from electronic bridge logs and may include small errors due to delays in communicating this information from the deck to the bridge. The count of files includes a small number recorded before and after the deployment. A more accurate file count will be available after the acoustic data are analyzed. Seven DASBRs could not be found (NA). Drift 3 was retrieved twice and re-deployed; the first time it was retrieved (3A), equipment was accidentally lost. It was re-deployed with a different recorder (3B), but its satellite locator was not transmitting regularly. Additional floatation was added a few days later and it was re-deployed again (3C).

	Deployment				Retrieval				
DASBR Drift	Date GMT	Time GMT	North latitude	West longitude	Date GMT	Time GMT	North latitude	West longitude	#2-min files recovered
1	7/4/18	19:33	48.3440	126.7029	NA	NA	NA	NA	NA
2	7/10/18	3:04	47.5919	128.5120	NA	NA	NA	NA	NA
3A	7/14/18	0:52	46.2560	125.3746	NA	NA	NA	NA	NA
3B	7/15/18	21:50	46.0893	125.3746	7/21/18	21:56	45.6098	125.2710	NA
3C	7/21/18	21:56	45.6098	125.2710	NA	NA	NA	NA	NA
4	7/25/18	3:30	45.0834	128.2082	10/13/18	0:36	41.7569	127.1545	11,167
5	7/27/18	2:37	44.0938	125.0046	NA	NA	NA	NA	NA
6	7/31/18	2:37	43.0957	127.9195	NA	NA	NA	NA	NA
7	8/5/18	14:48	41.2604	125.0157	10/22/18	9:00	42.0400	124.4850	4,246
8	8/16/18	2:34	38.9485	126.6449	10/10/18	16:53	34.3774	128.3174	3,323
9	8/17/18	18:40	38.7919	124.3891	NA	NA	NA	NA	NA
10	8/22/18	2:11	36.7607	125.0584	10/22/18	0:21	35.9671	122.9397	4,400
11	8/27/18	2:43	36.1534	122.6094	NA	NA	NA	NA	NA
12	8/30/18	2:34	34.8303	123.8146	10/6/18	17:08	34.0316	124.3911	2,716
13	9/11/18	20:35	33.8980	120.9078	10/23/18	14:34	31.4444	119.7754	3,025
14	10/5/18	5:46	32.2688	118.2563	11/1/18	16:55	31.9507	119.2481	1,981
16	10/30/18	14:33	31.3534	117.4199	11/21/18	4:18	32.1253	118.0337	2,428
17	10/31/18	0:02	30.7250	118.6933	11/24/18	4:31	28.2857	118.4385	9,077
18	10/31/18	9:58	30.0108	120.1815	11/23/18	18:41	29.5059	118.8216	2,519
19	11/1/18	2:11	30.0477	117.4605	11/27/18	14:20	28.4041	115.5497	2,519
20	11/5/18	14:04	29.4590	118.3930	11/22/18	19:21	29.3920	116.3355	2,530
21	11/6/18	3:43	29.4677	116.0120	11/11/18	9:29	29.8233	116.0796	1,279
22	11/7/18	14:04	28.7247	116.4778	11/27/18	4:55	28.2846	116.6829	2,337
23	11/22/18	8:10	30.9285	117.3812	12/3/18	0:25	31.0542	119.0123	3,098
								Total files	56,645
								Total minutes	113,290
								Total hours	1,888

Table 9. Summary of seabird sightings during CCES 2018.

Common Name	Scientific Name	No. Individuals	Comments
Greater White-fronted Goose	*Anser albifrons*	1	
Brant	*Branta bernicla*	116	
Cackling Goose	*Branta hutchinsii*	22	
Northern Pintail	*Anas acuta*	85	
Unidentified duck	*Anatinae sp.*	10	Scaup sp. (9)
Greater Scaup	*Aythya marila*	3	
Surf Scoter	*Melanitta perspicillata*	42	
Eared Grebe	*Podiceps nigricollis*	1	108 nmi SW of Cape Flattery; unusual this far offshore
Western Grebe	*Aechmophorus occidentalis*	4	
Eurasian Collared-Dove	*Streptopelia decaocto*	1	
White-winged Dove	*Zenaida asiatica*	1	
Mourning Dove	*Zenaida macroura*	19	
Unidentified hummingbird	*Trochilidae sp.*	2	
Black-bellied Plover	*Pluvialis squatarola*	11	
Semipalmated Plover	*Charadrius semipalmatus*	1	
Whimbrel	*Numenius phaeopus*	72	
Marbled Godwit	*Limosa fedoa*	2	
Black Turnstone	*Arenaria melanocephala*	2	
Least Sandpiper	*Calidris minutilla*	8	
Sanderling	*Calidris alba*	2	
Baird's Sandpiper	*Calidris bairdii*	1	
Western Sandpiper	*Calidris mauri*	2	
Short-billed Dowitcher	*Limnodromus griseus*	1	ship-strike fatality
Spotted Sandpiper	*Actitis macularius*	1	
Wandering Tattler	*Tringa incana*	4	
Lesser Yellowlegs	*Tringa flavipes*	1	
Greater Yellowlegs	*Tringa melanoleuca*	1	
Red Phalarope	*Phalaropus fulicarius*	1,330	
Red-necked Phalarope	*Phalaropus lobatus*	519	
Unidentified phalarope	*Phalaropus sp.*	76	
Unidentified shorebird	*Scolopacidae sp.*	43	
South Polar Skua	*Stercorarius maccormicki*	42	
Pomarine Jaeger	*Stercorarius pomarinus*	84	
Parasitic Jaeger	*Stercorarius parasiticus*	65	
Long-tailed Jaeger	*Stercorarius longicaudus*	77	
Parasitic/Long-tailed Jaeger	*Stercorarius parasiticus/longicaudus*	1	

Common Name	Scientific Name	No. Individuals	Comments
Unidentified jaeger	*Stercorarius sp.*	4	
Common Murre	*Uria aalge*	4,666	
Pigeon Guillemot	*Cepphus columba*	11	
Marbled Murrelet	*Brachyramphus marmoratus*	1	
Scripps's Murrelet	*Synthliboramphus scrippsi*	12	
Guadalupe Murrelet	*Synthliboramphus hypoleucus*	16	Includes first photographically confirmed sighting for Canada
Scripps's/Guadalupe Murrelet	*Synthliboramphus scrippsi/hypoleucus*	5	
Craveri's Murrelet	*Synthliboramphus craveri*	3	
"Xantus's"/Craveri's Murrelet	*Synthliboramphus scrippsi/hypoleucus/craveri*	23	
Ancient Murrelet	*Synthliboramphus antiquus*	4	
Cassin's Auklet	*Ptychoramphus aleuticus*	1,337	
Parakeet Auklet	*Aethia psittacula*	1	
Rhinoceros Auklet	*Cerorhinca monocerata*	353	
Horned Puffin	*Fratercula corniculata*	1	Off Estevan Point, Vancouver Island
Tufted Puffin	*Fratercula cirrhata*	25	
Unidentified small alcid	*Ptychoramphus/Aethia/Synthliboramphus sp.*	6	
Sabine's Gull	*Xema sabini*	148	
Bonaparte's Gull	*Chroicocephalus philadelphia*	183	
Laughing Gull	*Leucophaeus atricilla*	1	first cycle
Heermann's Gull	*Larus heermanni*	46	
Mew Gull	*Larus canus*	4	
Western Gull	*Larus occidentalis*	1,626	
Herring Gull	*Larus argentatus*	54	
California Gull	*Larus californicus*	269	
Iceland Gull	*Larus glaucoides*	7	"Thayer's" Gull
Glaucous-winged Gull	*Larus glaucescens*	178	
Western x Glaucous-winged Gull	*Larus occidentalis x L. glaucescens*	42	
Unidentified *Larus*	*Larus sp.*	237	
Caspian Tern	*Hydroprogne caspia*	5	
Common Tern	*Sterna hirundo*	12	
Arctic Tern	*Sterna paradisaea*	181	
Forster's Tern	*Sterna forsteri*	5	
Arctic/Common Tern	*Sterna paradisaea/hirundo*	15	
Unidentified *Sterna* tern	*Sterna sp.*	42	
Royal Tern	*Thalasseus maximus*	14	
Elegant Tern	*Thalasseus elegans*	57	
Red-billed Tropicbird	*Phaethon aethereus*	15	

Common Name	Scientific Name	No. Individuals	Comments
Red-tailed Tropicbird	*Phaethon rubricauda*	1	~40 nmi SW of Point Sur
Pacific Loon	*Gavia pacifica*	7	
Common Loon	*Gavia immer*	5	
Laysan Albatross	*Phoebastria immutabilis*	69	
Black-footed Albatross	*Phoebastria nigripes*	367	
Wilson's Storm-Petrel	*Oceanites oceanicus*	1	Over Vizcaino Canyon
Fork-tailed Storm-Petrel	*Oceanodroma furcata*	682	
Leach's Storm-Petrel	*Oceanodroma leucorhoa*	704	Includes 12 "Chapman's" Storm-Petrels
Townsend's Storm-Petrel	*Oceanodroma socorroensis*	21	
Ashy Storm-Petrel	*Oceanodroma homochroa*	166	
"Leach's" Storm-Petrel	*Oceanodroma sp.*	32	Leach's complex
Black Storm-Petrel	*Oceanodroma melania*	76	
Least Storm-Petrel	*Oceanodroma microsoma*	28	Unseasonally far N (off Pigeon Point)
“White-rumped” storm-petrel	*Hydrobatidae sp.*	2	
“Dark-rumped” storm-petrel	*Hydrobatidae sp.*	3	
Unidentified storm-petrel	*Hydrobatidae/Oceanitidae sp.*	2	
Northern Fulmar	*Fulmarus glacialis*	842	
Murphy's Petrel	*Pterodroma ultima*	3	
Mottled Petrel	*Pterodroma inexpectata*	1	
Hawaiian Petrel	*Pterodroma sandwichensis*	17	
Cook's Petrel	*Pterodroma cookii*	47	
Unidentified Cookilaria	*Pterodroma sp.*	6	
Unidentified *Pterodroma*	*Pterodroma sp.*	1	
Buller's Shearwater	*Ardenna bulleri*	1,706	One bird off Estevan Point, Vancouver Island; early date for this location
Short-tailed Shearwater	*Ardenna tenuirostris*	27	
Sooty Shearwater	*Ardenna grisea*	4,284	
Sooty/Short-tailed Shearwater	*Ardenna grisea/tenuirostris*	20,231	
Pink-footed Shearwater	*Ardenna creatopus*	1971	
Flesh-footed Shearwater	*Ardenna carneipes*	4	

Common Name	Scientific Name	No. Individuals	Comments
Unidentified shearwater	*Ardenna sp.*	1,069	
Manx Shearwater	*Puffinus puffinus*	1	7 nmi W of Point of Arches, WA
Black-vented Shearwater	*Puffinus opisthomelas*	8,853	
Masked Booby	*Sula dactylatra*	11	Adult and subadult seen of San Nicolas Island
Nazca Booby	*Sula granti*	9	Sub-adult seen in Oregon (rare)
Nazca/Masked Booby	*Sula granti/dactylatra*	4	
Brown Booby	*Sula leucogaster*	52	
Red-footed Booby	*Sula sula*	3	
Unidentified booby	*Sula sp.*	1	
Brandt's Cormorant	*Phalacrocorax penicillatus*	248	
Double-crested Cormorant	*Phalacrocorax auritus*	12	
Pelagic Cormorant	*Phalacrocorax pelagicus*	2	
Brown Pelican	*Pelecanus occidentalis*	110	
Snowy Egret	*Egretta thula*	1	
Black-crowned Night-Heron	*Nycticorax nycticorax*	2	
Barn Owl	*Tyto alba*	1	
Merlin	*Falco columbarius*	1	
Peregrine Falcon	*Falco peregrinus*	1	
Yellow-bellied Flycatcher	*Empidonax flaviventris*	1	
Western Wood-Pewee	*Contopus sordidulus*	1	
Unidentified wood-pewee	*Contopus sp.*	1	
Say's Phoebe	*Sayornis saya*	1	
Purple Martin	*Progne subis*	1	
Barn Swallow	*Hirundo rustica*	3	
Unidentified swallow	*Hirundinidae sp.*	1	
House Wren	*Troglodytes aedon*	1	
Ruby-crowned Kinglet	*Regulus calendula*	2	
European Starling	*Sturnus vulgaris*	3	
Cedar Waxwing	*Bombycilla cedrorum*	1	
Red-throated Pipit	*Anthus cervinus*	1	
Lesser Goldfinch	*Spinus psaltria*	3	
House Finch	*Haemorhous mexicanus*	1	
Lapland Longspur	*Calcarius lapponicus*	2	
Cassin's Sparrow	*Peucaea cassinii*	1	

Common Name	Scientific Name	No. Individuals	Comments
Lark Sparrow	*Chondestes grammacus*	1	
Savannah Sparrow	*Passerculus sandwichensis*	1	
Dark-eyed Junco	*Junco hyemalis*	2	
Bobolink	*Dolichonyx oryzivorus*	1	
Western Meadowlark	*Sturnella neglecta*	2	
Bullock's Oriole	*Icterus bullockii*	2	
Brown-headed Cowbird	*Molothrus ater*	94	
Common Yellowthroat	*Geothlypis trichas*	3	
American Redstart	*Setophaga ruticilla*	1	
Northern Parula	*Setophaga americana*	2	
Blackburnian Warbler	*Setophaga fusca*	1	
Yellow Warbler	*Setophaga petechia*	1	
Palm Warbler	*Setophaga palmarum*	5	
Yellow-rumped Warbler	*Setophaga coronata*	2	
Townsend's Warbler	*Setophaga townsendi*	12	
Hermit Warbler	*Setophaga occidentalis*	13	
Warbler sp. (*Parulidae* sp.)	*Parulidae* sp.	2	Unidentified *Setophaga*
Canada Warbler	*Cardellina canadensis*	1	
Wilson's Warbler	*Cardellina pusilla*	10	
Western Tanager	*Piranga ludoviciana*	3	
Lazuli Bunting	*Passerina amoena*	1	
Unidentified Passerine		3	
Total Individual Birds		54,136	

Table 10. Disposition of data collected aboard NOAA Ship *Lasker* during CCES 2018 for analysis and further distribution.

Data	Primary Investigator	Affiliation	Contact
Marine mammal sightings	Dr. Jeff Moore	NOAA Fisheries – SWFSC	Jeff.E.Moore@noaa.gov
Biopsy and eDNA samples	Dr. Barbara Taylor	NOAA Fisheries – SWFSC	Barbara.Taylor@noaa.gov
Passive acoustics (DASBRs)	Shannon Rankin	NOAA Fisheries – SWFSC	Shannon.Rankin@noaa.gov
Seabird sightings	Dr. Trevor Joyce	NOAA Fisheries – SWFSC	Trevor.Joyce@noaa.gov
Oceanographic data	Dr. Paul Fiedler and Dr. David Demer	NOAA Fisheries – SWFSC	Paul.Fiedler@noaa.gov David.Demer@noaa.gov
Active acoustic data	Dr. David Demer	NOAA Fisheries – SWFSC	David.Demer@noaa.gov
Photographic ID data collected from small-boat operations during Legs 1-4	Dr. John Calambokidis	Cascadia Research Collective	Calambokidis@CascadiaResearch.org

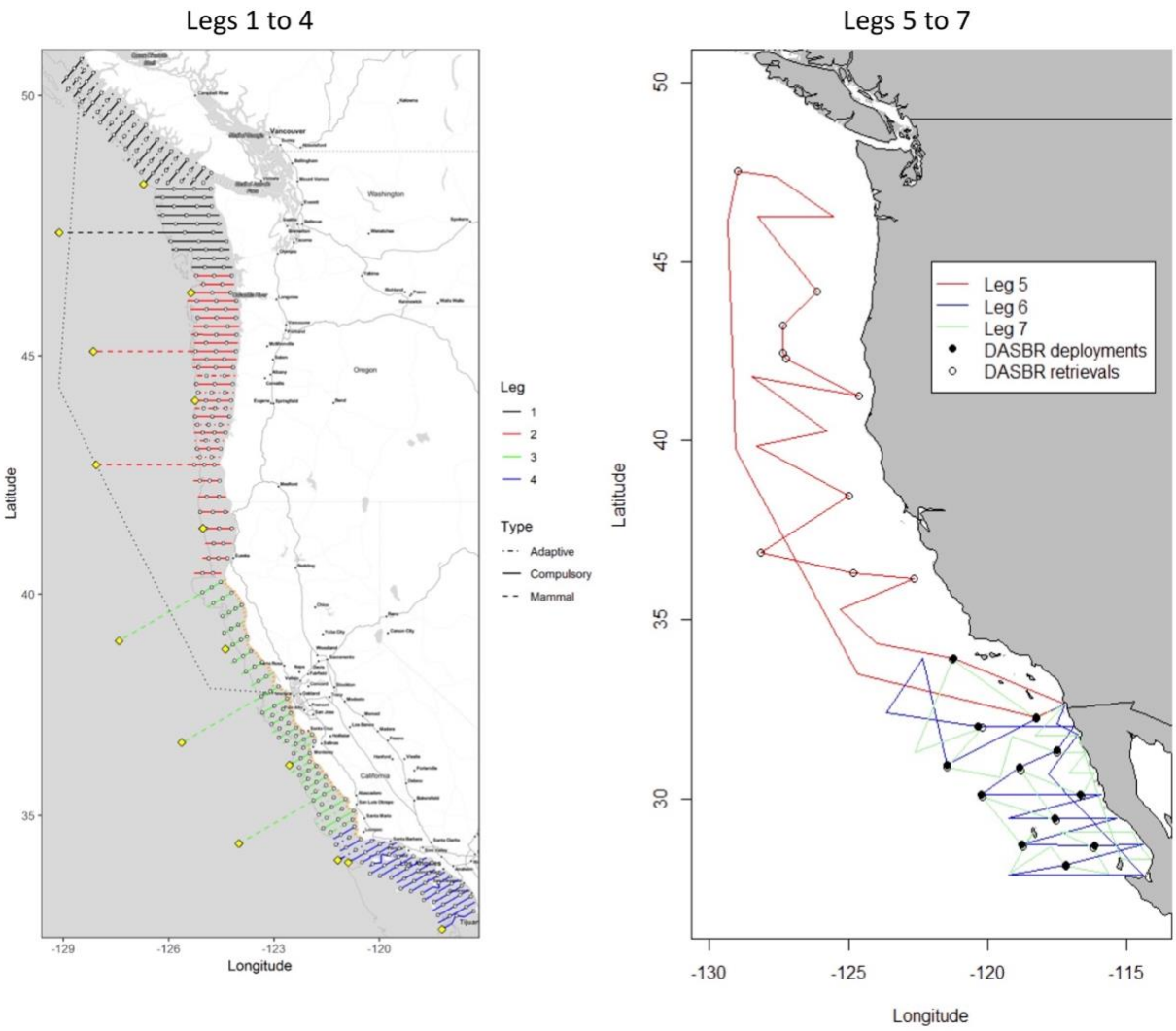

Figure 1. Planned tracklines for Legs 1-4 (left) and Legs 5-7 (right). Map for Legs 1-4 includes planned compulsory (solid lines) and adaptive (dashed lines) active-acoustic transects. Some of these were extended far offshore for marine mammal survey. The long dotted line segments connecting San Francisco to the north end of Vancouver Island represents the initial transit route of the ship. Also shown are UCTD stations (small points), planned DASBR deployment stations (yellow diamonds), and Saildrone transects (orange lines right along the Central California coast), which were part of the FRD study and are not discussed in this report. For Legs 5-7, planned transects were tied to DASBR deployment and anticipated retrieval locations. Actual tracklines for Legs 5-7 varied from the planned lines, as dictated by routes taken to retrieve DASBRs in real time.

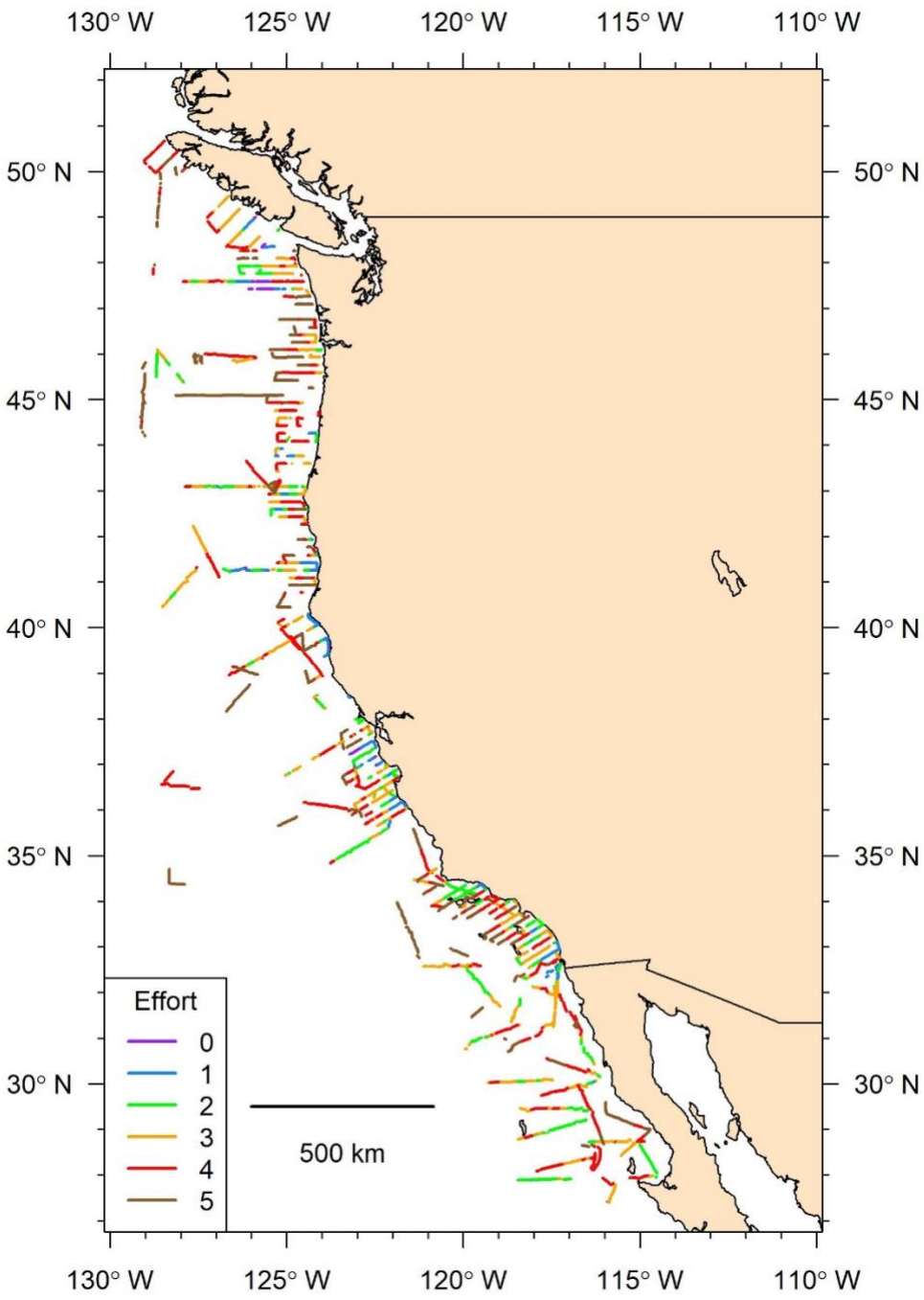

Figure 2. Transect lines completed during CCES 2018 by NOAA Ship *Lasker* that included marine mammal and seabird effort. Colors indicate Beaufort state.

Figure 3. Tracks of small-boat survey effort conducted by Cascadia Research Collective (left), and humpback whale tissue samples collected (right).

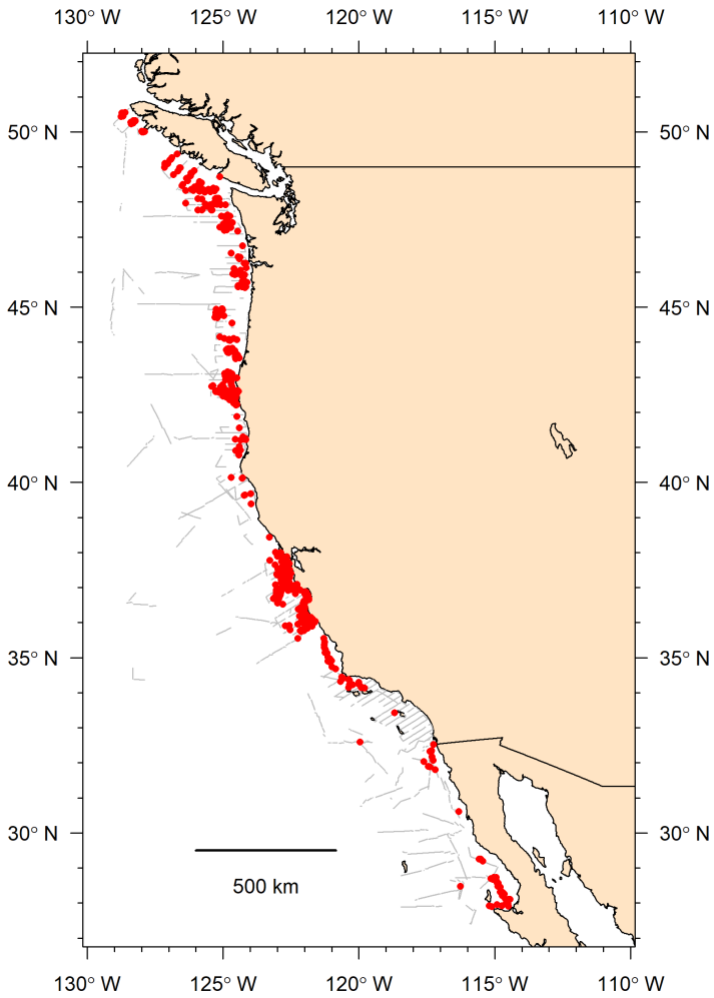

Figure 4. Sightings of humpback whales (red).

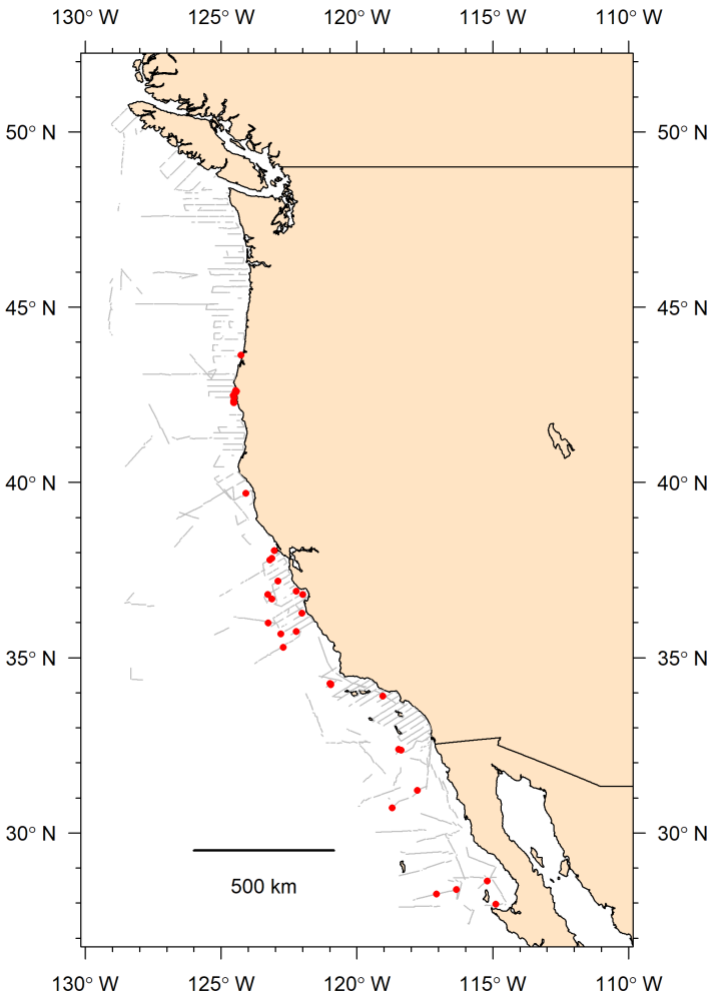

Figure 5. Sightings of blue whales (red).

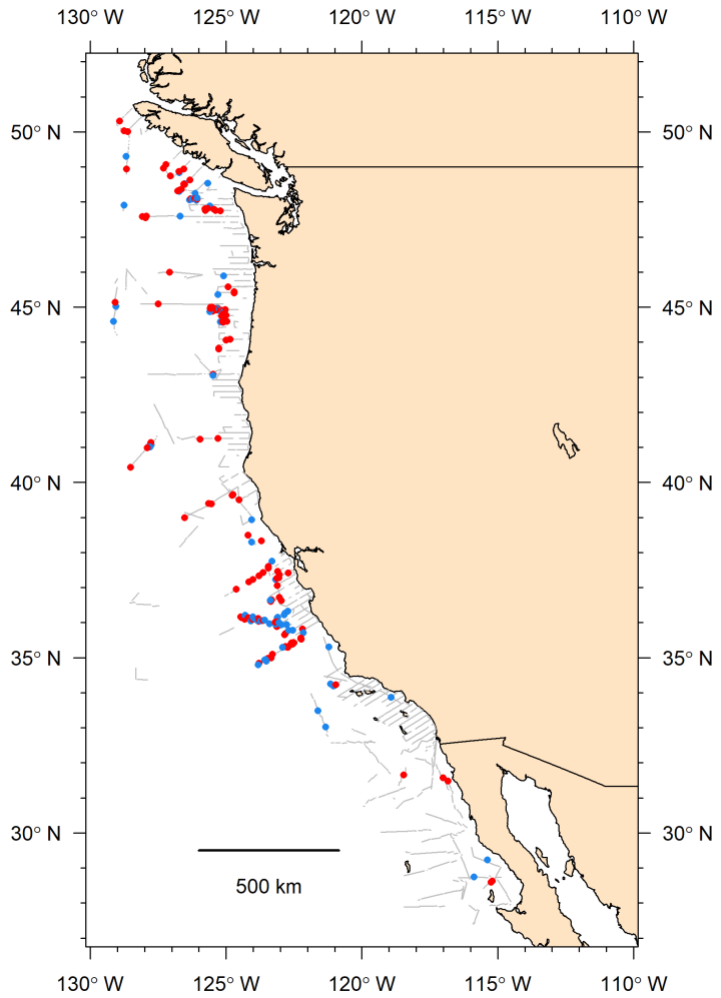

Figure 6. Sightings of fin whales (red) and unidentified *Balaenoptera* species (blue), most of which are likely fin whales.

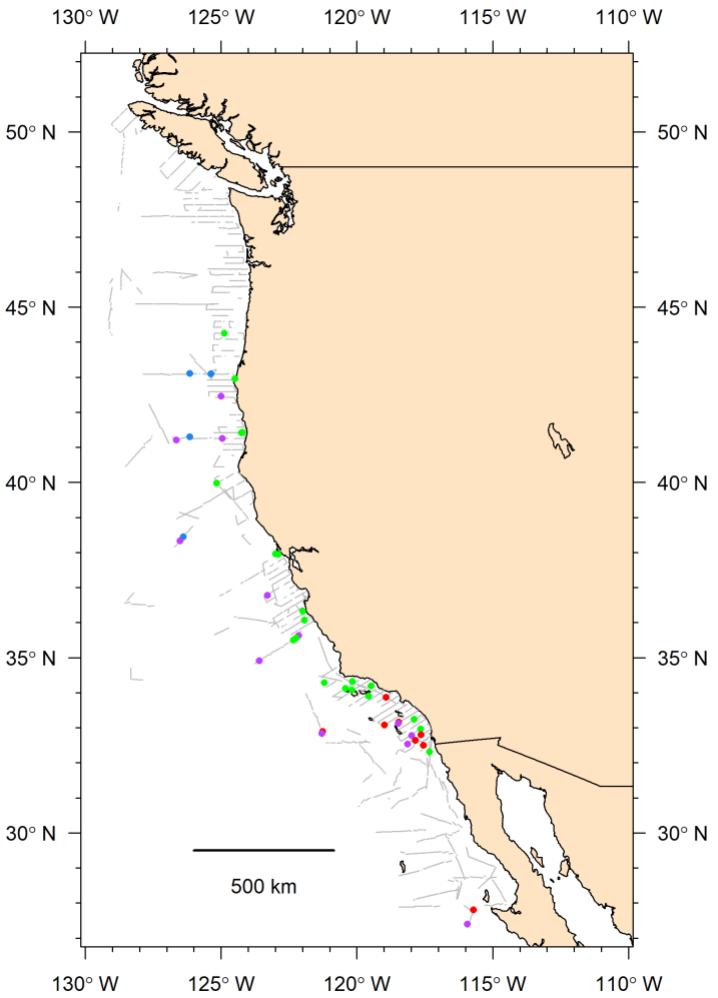

Figure 7. Sightings of Bryde's (red), sei (blue), and minke whale (green). Purple = Bryde's or sei whale.

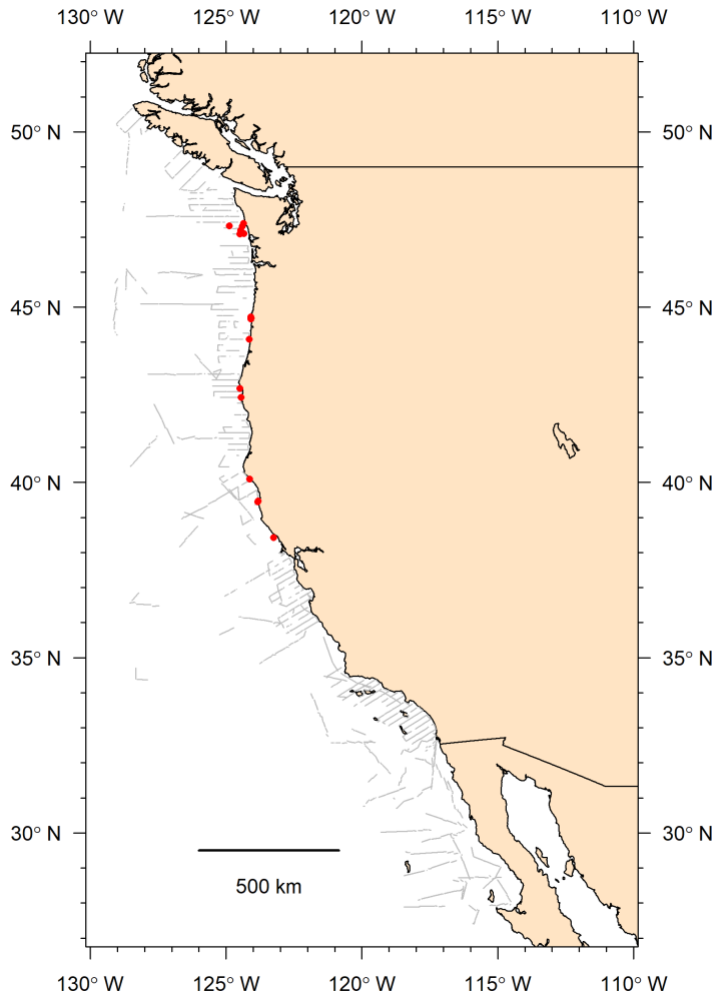

Figure 8. Sightings of gray whales (red).

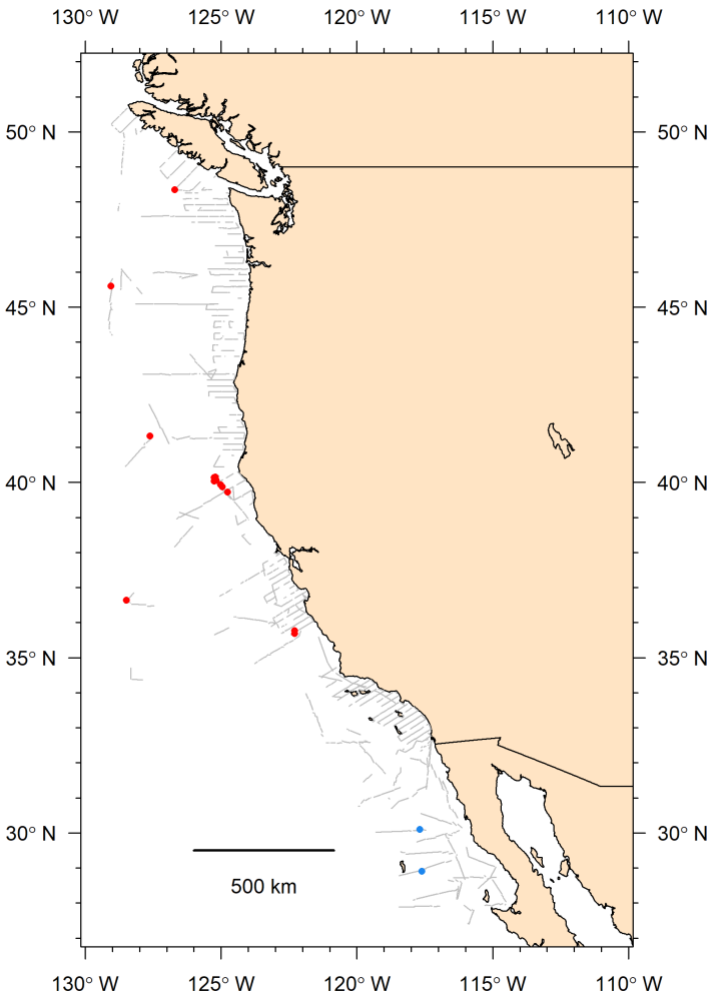

Figure 9. Sightings of sperm whale (red) and *Kogia* species (blue).

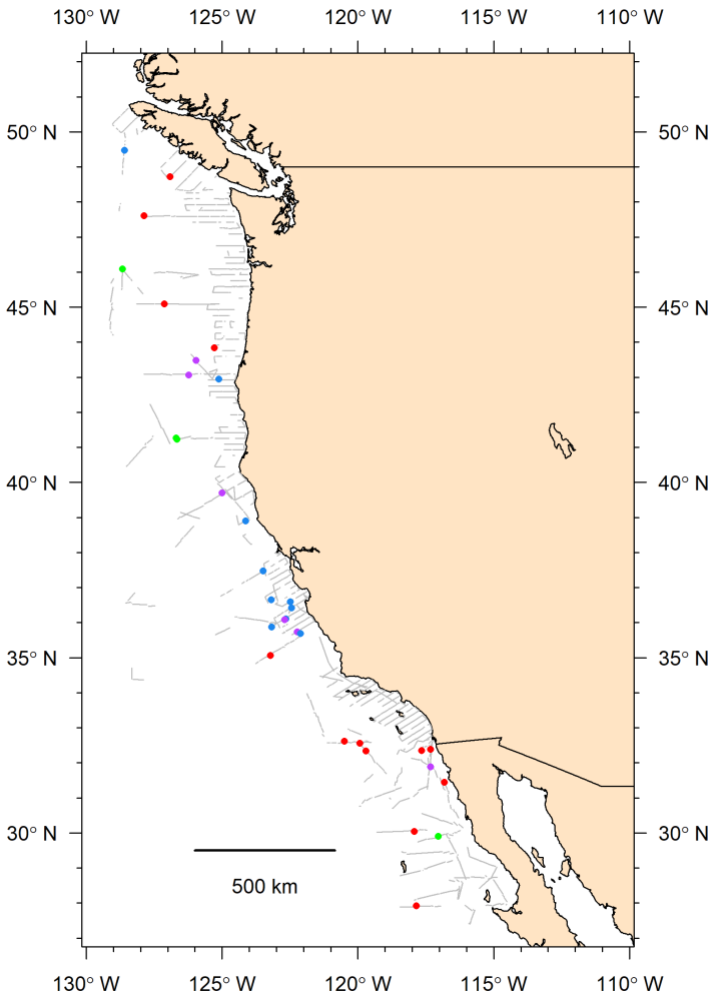

Figure 10. Sightings of beaked whales, including Cuvier's beaked whale (red), Baird's beaked whale (blue), *Mesoplodon* species (green), and unidentified Ziphiids (purple).

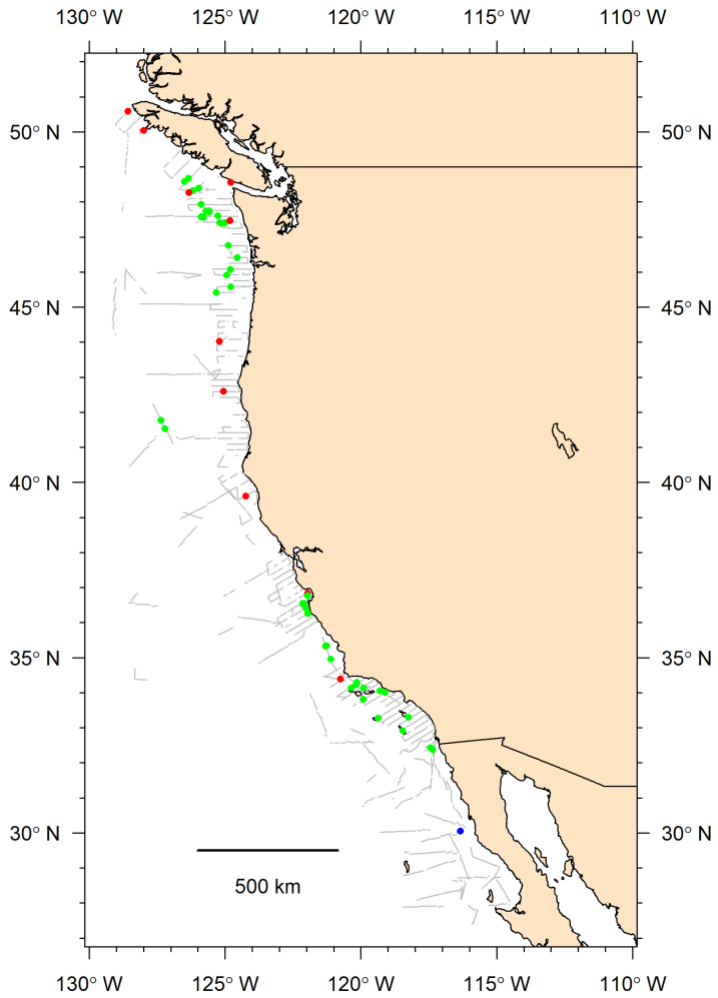

Figure 11. Sightings of "blackfish": killer whales (red), Risso's dolphins (green), and short-finned pilot whales (blue).

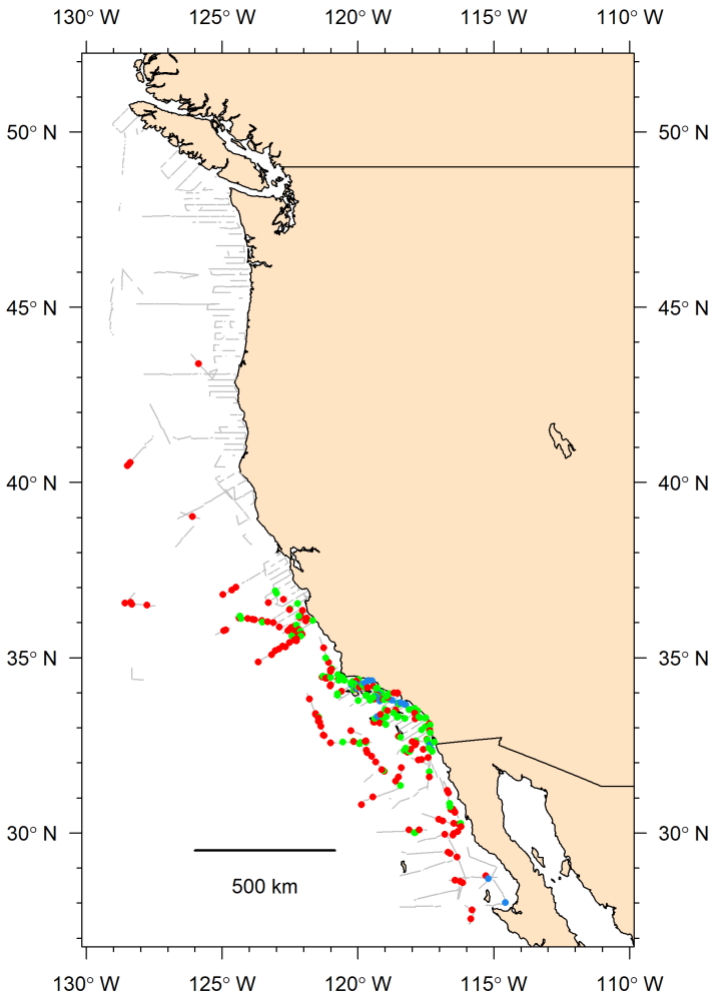

Figure 12. Sightings of common dolphin: *D. delphis*, common dolphins (red), *D. delphis bairdii*, eastern Pacific long-beaked common dolphins (blue), and *D. delphis* not identified to subspecies (green).

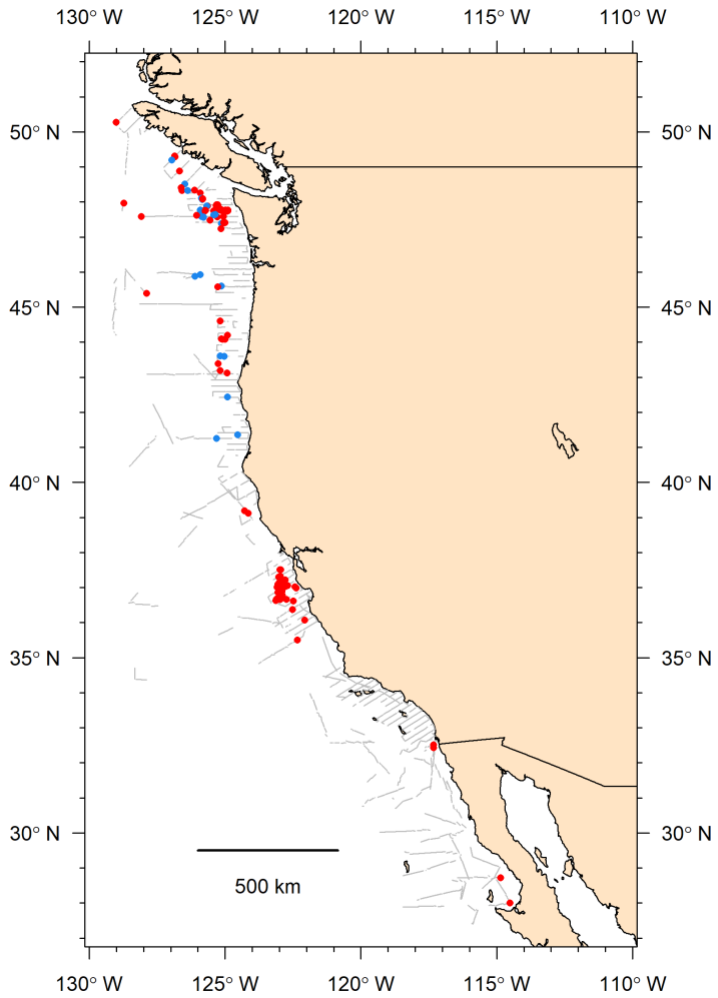

Figure 13. Sightings of Pacific white-sided dolphins (red) and northern right whale dolphins (blue).

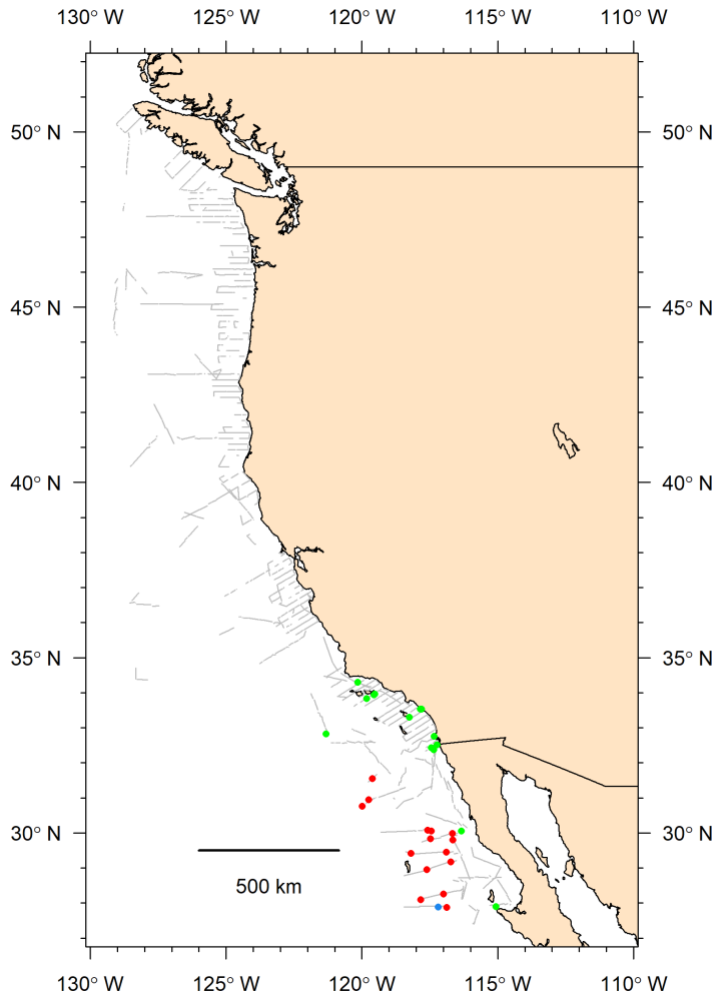

Figure 14. Sightings of other delphinids: striped dolphin (red), offshore spotted dolphin (blue), and bottlenose dolphin (green).

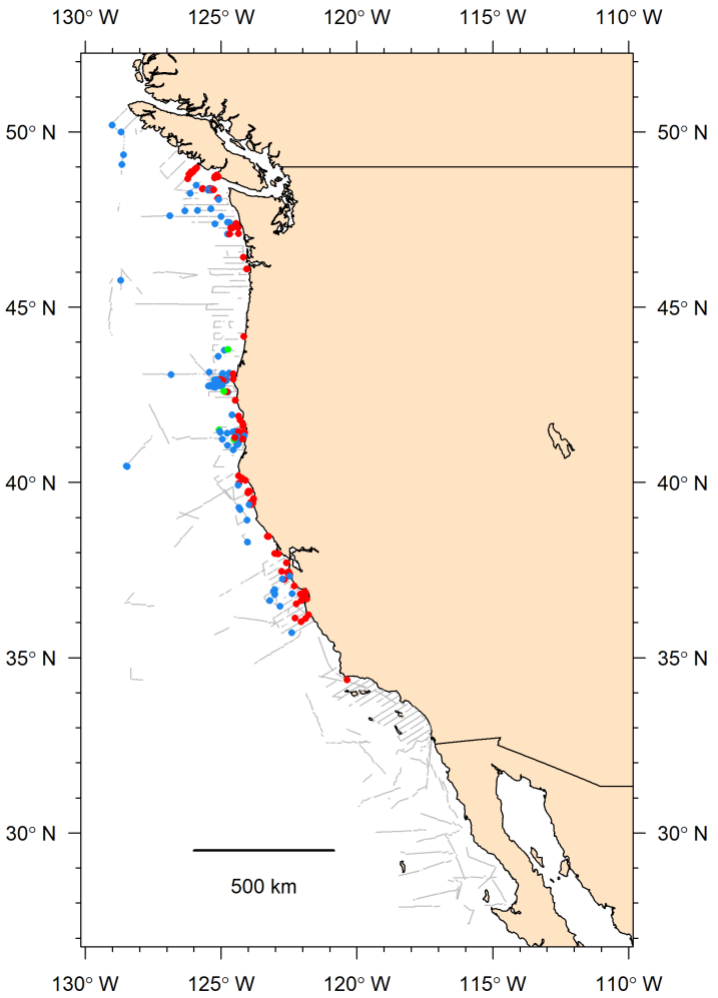

Figure 15. Sightings of porpoise: Harbor porpoise (red), Dall's porpoise (blue), and unidentified porpoises (green).

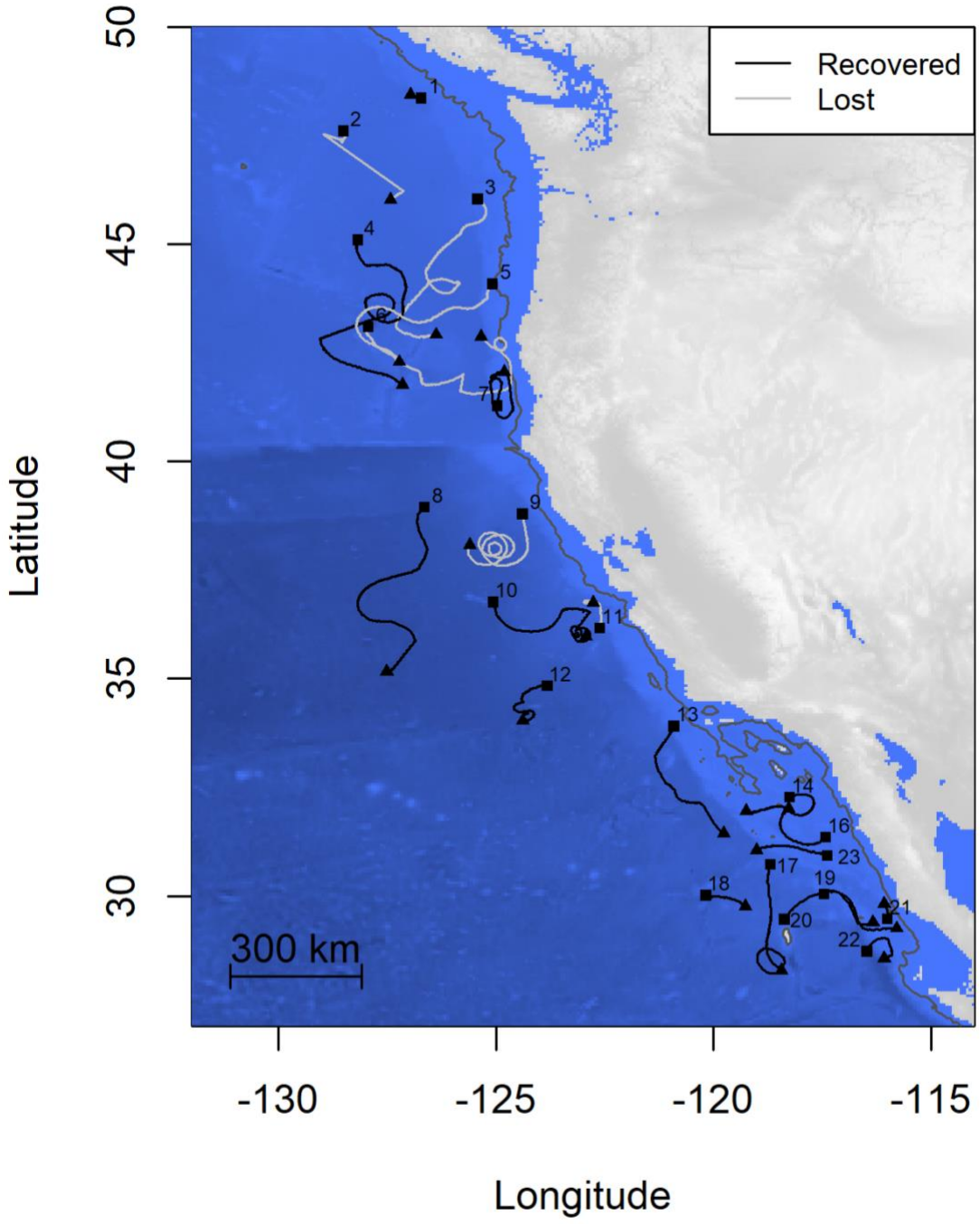

Figure 16. Locations of DASBR deployments (black squares), retrievals or last known location (black triangles), and buoy drifts (recovered = black lines, lost = light gray lines). Medium gray line is the 500-m isobath.