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REPORT ON THE COLLECTION OF DATA DURING THE SUMMER 2016 CALIFORNIA CURRENT ECOSYSTEM SURVEY (1606RL), 28 JUNE TO 22 SEPTEMBER 2016, CONDUCTED ABOARD FISHERIES SURVEY VESSEL *REUBEN LASKER*

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I. Introduction

The Summer 2016 California Current Ecosystem Survey (1606RL) was conducted aboard NOAA Fisheries Survey Vessel (FSV) *Reuben Lasker* (hereafter, *Lasker*), 28 June to 22 September 2016. The Acoustic-Trawl Method (ATM) was used to assess coastal pelagic fish species (CPS) and krill within the California Current Ecosystem (CCE). Data were collected using multi-frequency echosounders, surface trawls, vertically and obliquely integrating net tows, a continuous underway fish-egg sampler (CUFES), and conductivity-temperature-depth probes (CTDs).

The objectives of the survey were to: 1) acoustically map the distributions and estimate the abundances of CPS, including Pacific sardine (*Sardinops sagax*), Northern anchovy (*Engraulis mordax*), Pacific herring (*Clupea pallasii*), Pacific chub mackerel (*Scomber japonicus*), and jack mackerel (*Trachurus symmetricus*); and krill (euphausiid spp.); 2) characterize their biotic and abiotic environments, and investigate linkages; and 3) gather information regarding their life history parameters. The survey domain encompassed the anticipated distribution of the northern sub-population of sardine and the northern and central sub-populations of Northern anchovy off the west coasts of the U.S. and Canada, from approximately Cape Scott, British Columbia to San Diego, CA. The sampling domain was constrained by the modeled distribution of potential sardine habitat (Zwolinski *et al.*, 2011), information gathered from other concurrent research projects (e.g., CalCOFI samples) or the fishing industry (e.g., sardine bycatch or anchovy catch), and the number of days available to the survey.

This report provides an overview of the survey objectives and a summary of the survey equipment, acoustic-system calibration, sampling and analysis methods, and preliminary results. The distribution, biomass, and demography of the central stock of Northern anchovy is described in Zwolinski et al. (2017). This report does not include estimates or distributions of biomasses for other CPS.

I.1. Scientific Personnel

The collection and analysis of acoustic and trawl data was conducted by the SWFSC, as elaborated below.

Project Lead:

- D. Demer

Acoustic Calibration, Data Collection, and Processing:

- Pre-Leg 1 Calibration: D. Demer, J. Renfree, T. Sessions, K. Stierhoff, and J. Zwolinski
- Pre-Leg 1 Transit: K. Stierhoff and L. Demer
- Leg I: T. Sessions and K. Stierhoff
- Leg II: S. Mau
- Leg III: G. Cutter and D. Palance
- Leg IV: J. Zwolinski

Trawl Sampling:

- Leg I: S. Brett, A. Freire, K. Gilmore, D. Griffith, B. Macewicz, S. Manion, and N. Osborn
- Leg II: M. Craig, T. Fournier, K. Hinton, S. Manion, A. Thompson, W. Watson, and B. Wells
- Leg III: N. Bowlin, J. DiNardo, E. Gardner, A. Hays, M. Sedarat, and B. Winnacott
- Leg IV: N. Arthur-Mcghee, S. Charter, D. Griffith, B. Macewicz, B. Overcash, and D. Winter

II. Methods

II.1. Survey region and design

During spring, sardine typically aggregate offshore of central and southern California to spawn and during summer, if the stock is large enough, adults will migrate north, compress along the coast, and feed in the upwelled regions (Demer *et al.*, 2012, and reference therein, **Figure II.1**).

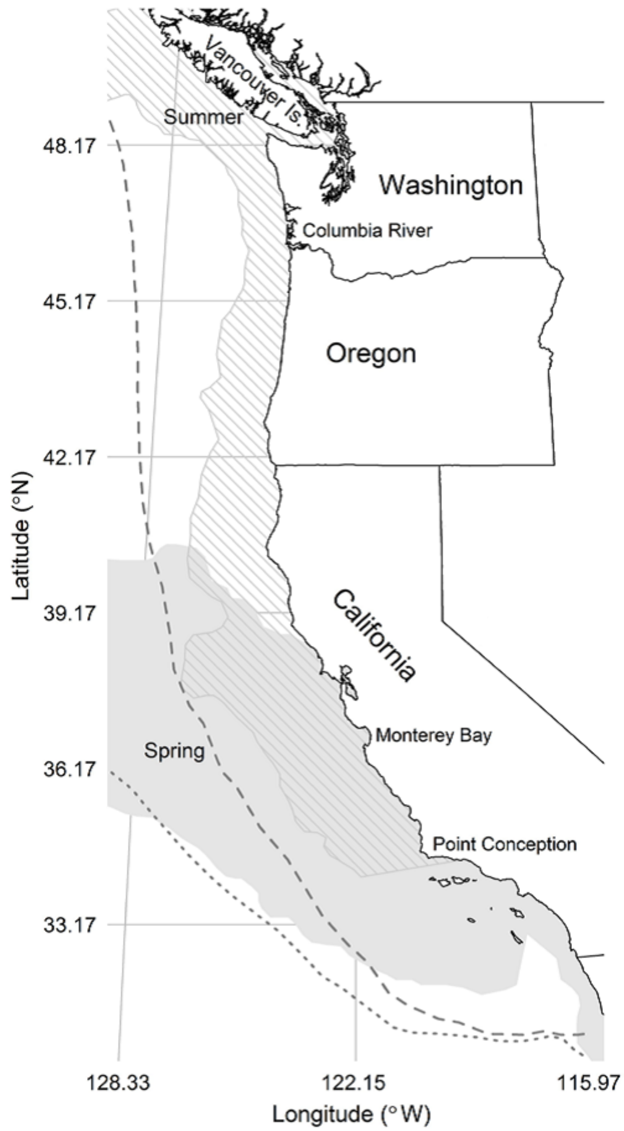


Figure II.1. Conceptual map showing the average spring and summer distributions of the northern sub-population of Pacific sardine potential habitat during spring and summer along the west coasts of Mexico, the United States, and Canada (Zwolinski *et al.*, 2014).

During summer 2016, the west coasts of the United States and Vancouver Island, Canada, were surveyed using *Lasker* during the feeding seasons of sardine and anchovy. The ship departed from San Diego, transited directly to the northern end of Vancouver Island, and sampled southward. Compulsory transects were nearly perpendicular to the coast with nominal separations of 20 nmi in most areas and with nominal separations of 10 nmi in areas where CPS were observed acoustically, in trawl catches, or both (**Figure II.2**).

The transect positions covered much of the potential habitat of sardine at the time of the survey (**Figure II.3**; http://swfscdata.nmfs.noaa.gov/AST/sardineHabitat/habitat.asp). Transect positions, lengths, and spaces were adjusted according to the expected or observed distributions of sardine and anchovy at the time of the survey.

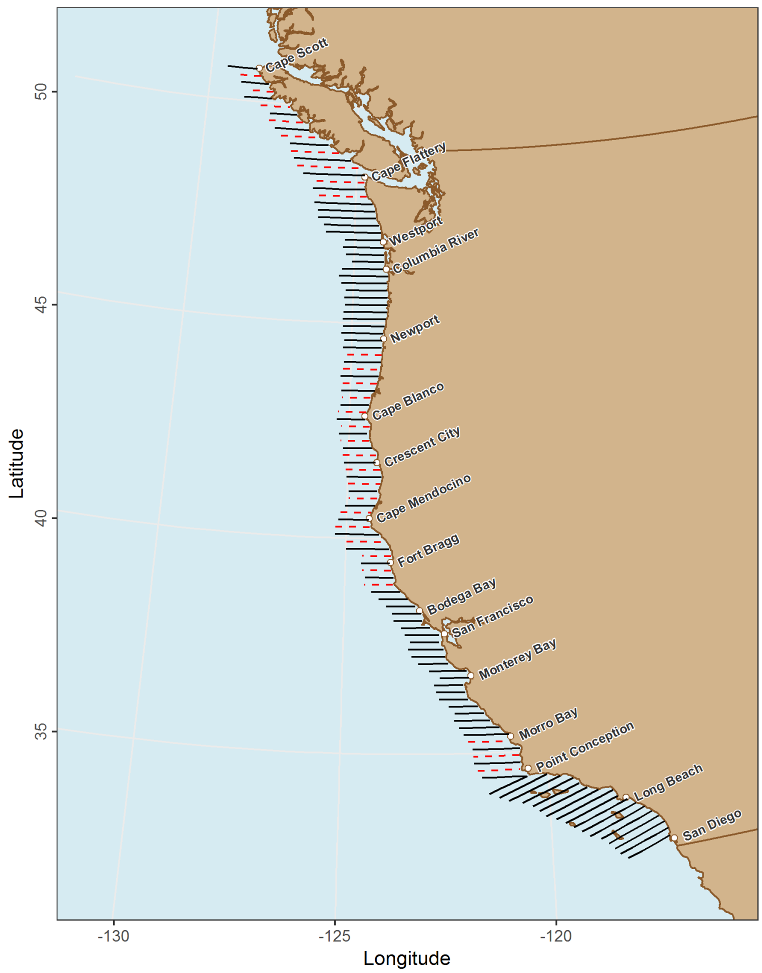


Figure II.2. Planned compulsory (solid black lines) and adaptive (dashed red lines) transect lines.

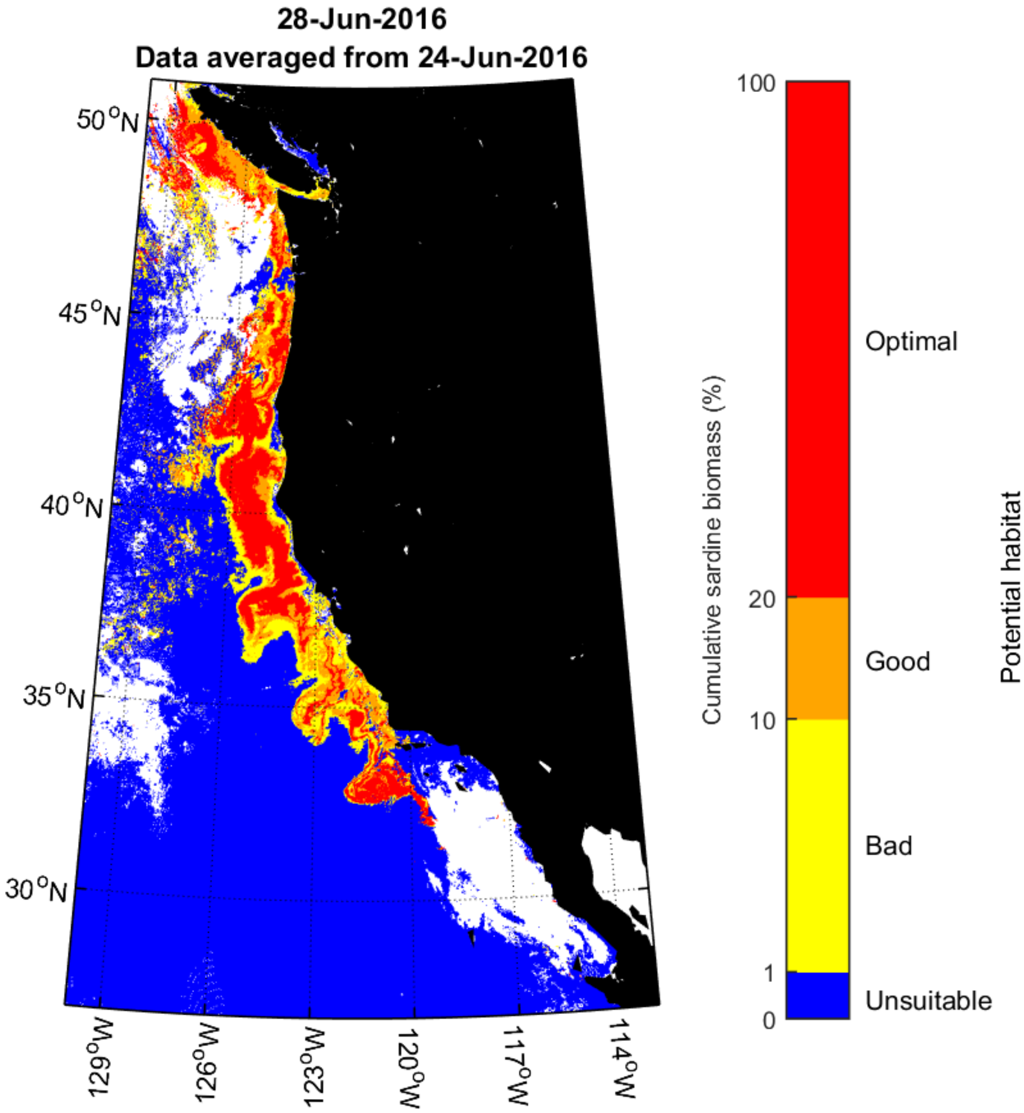


Figure II.3. Distribution of potential habitat for the northern stock of Pacific sardine on 28 June 2016 at the beginning of the survey.

II.2 Acoustic sampling

II.2.1. Echosounders

Multi-frequency (18, 38, 70, 120, 200, and 333 kHz) General Purpose Transceivers (Simrad EK60 GPTs) and Wideband Transceivers (Simrad EK80 WBTs) were configured with split-beam transducers (Simrad ES18-11, ES38B, ES70-7C, ES120-7C, ES200-7C, and ES333-7C, respectively) mounted on the bottom of a retractable keel or "centerboard" (**Figure II.4**). The keel was retracted (transducers ~5-m depth) during calibration, then extended to the intermediate position (transducers ~7-m depth) during the survey. Exceptions were made during shallow water operations, when the keel was retracted; or during times of heavy weather, when the keel was extended (transducers ~9-m depth) to provide extra stability and reduce the effect of weather-generated noise.

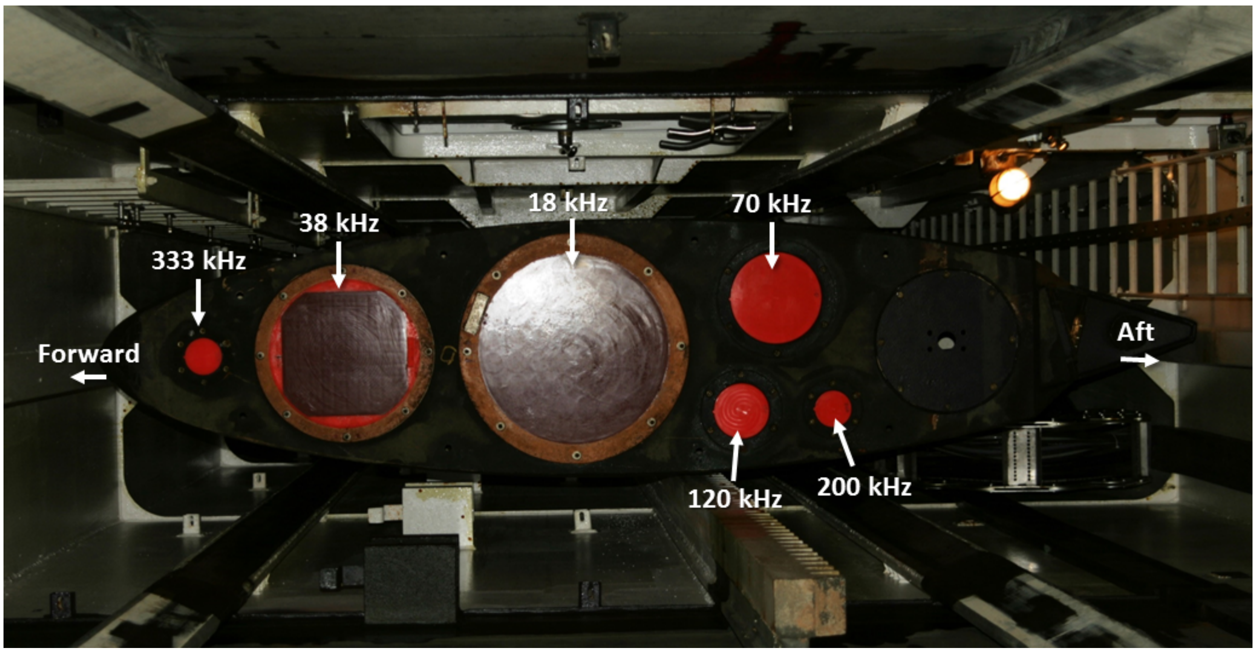


Figure II.4. Transducer locations on the bottom of the centerboard aboard *Lasker*.

II.2.2. Calibration

Prior to calibration, the integrity of each transducer was verified through impedance measurements of each transducer, with quadrants connected in parallel, using an LCR meter (Agilent Model E4980A) and custom Matlab software. For each transducer, the magnitude (Z,) and phase (θ, °) of the impedance, conductance (G, S), and admittance circles [G vs. susceptance (B, S)] were plotted (**Appendix A**).

The echosounders were then calibrated using the standard sphere technique (Demer *et al.*, 2015; Foote *et al.*, 1987). The reference target was a 38.1-mm diameter sphere made from tungsten carbide (WC) with 6% cobalt binder material (AST sphere #1). The EK80 WBTs were calibrated in both CW (narrowband) and FM (wideband) modes.

The GPTs were configured, via the ER60 software, using the parameters in **Table III.1** (below).

II.2.3. Data collection

The ER60-computer clock was set to GMT and synchronized with the GPS clock every six hours using open-source software (NetTime, http://www.timesynctool.com). Echosounder pulses were transmitted simultaneously at all frequencies, at variable intervals, as controlled by the ER60 Adaptive Logger (EAL, Renfree and Demer, 2016). The EAL optimizes the pulse interval and logging ranges, based on the seabed depth, while avoiding aliased seabed echoes. A custom multiplexer (AST EK-MUX) was used to alternate transmissions from the EK60 and EK80 echosounders. Acoustic sampling for CPS-density estimation along the pre-determined transects (see **Section II.1**) was limited to daylight hours (approximately between sunrise and sunset). The EK80 WBTs were set to collect narrowband CW pulses during daylight hours and wideband FM pulses at night.

Acoustic transmissions, used to calculate volume backscattering strength (S_{v}; dB re 1 m^2 m^{-3}) and target strength (TS; dB re 1 m^2) and indexed by time and geographic position, were logged to 350-m range, and stored in Simrad .raw format (50-MB maximum file size; each filename begins with "1606RL_" and ends with the logging commencement date and time) using the GPT-control software (Simrad ER60 V2.4.3).

To minimize acoustic interference, transmit pulses from EK60 GPTs, EK80 WBTs, two multibeam sonars (Simrad ME70 and MS70), an omni-directional sonar (Simrad SX90), and acoustic Doppler current profiler (Teledyne RD Instruments Ocean Surveyor Model OS75) were triggered using a synchronization system (Simrad K-Sync). To control timing of the transmit intervals, the K-Sync was set to use an external depth input, which was provided by the EAL based on the desired ping rate. All other instruments that produce sound within the echosounder bandwidths were secured during daytime survey operations. Exceptions were made during stations (e.g., plankton sampling and fish trawling) or in shallow water when the vessel's command occasionally operated the bridge's 50- and 200-kHz echosounders (Furuno), the Doppler velocity log (Sperry Marine Model SRD-500A), or both.

Throughout the survey, impedance measurements of each transducer were collected every 15 min using a custom multiplexer (SWFSC, Z-Mux). During each set of measurements, transmissions from the EK60 GPTs and EK80 WBTs were temporarily stopped while impedance was collected from each quadrant of each transducer at their respective CW frequencies (i.e., 18, 38, 70, 120, 200, and 333 kHz). Additionally, during the transit from San Diego, CA to Vancouver, WA, the Z-Mux collected broadband impedance measurements of each quadrant from each transducer.

II.2.4. Data processing

The calibrated echosounder data were processed on a dedicated computer, using commercial software (Echoview V7.1.12.29495, Echoview Software Pty Ltd.) and the following procedure:

1. For each transect, the associated data files (.raw format) were loaded into an Echoview (.ev) file. Data were referenced to the transducer faces by setting transducer depths to 0 m.
2. In each .ev file, values for the environment were set using Echoview calibration supplement (.ecs) files, including data from the closest CTD or UCTD cast. Since the CPS of interest reside in the upper mixed layer, environment data were averaged over 0- to 70-m depth.
3. For each frequency:
    - "Noise-reduced" echograms (**Figure II.5a**) were generated by setting samples with a signal-to-noise rati less than 10 to -999 dB (effectively zero).
    - The noise-reduced echograms were smoothed by computing the median value in non-overlapping 11-sample by 3-ping cells.
    - The smoothed, noise-reduced echograms were used to calculate S_{v}-differences using the 38-kHz S_{v} (S_{v38kHz}) as a reference (i.e., S_{v70kHz} - S_{v38kHz}; S_{v120kHz} - S_{v38kHz}; S_{v200kHz} - S_{v38kHz}).
    - A mask was created to ascribe regions as CPS where S_{v}-differences were within the expected ranges for CPS (**Table II.1.**).
    - The provisional CPS regions were ascribed to CPS schools if the standard deviation of each 11-sample by 3-ping cell was > -50 dB at 120 and 200 kHz.

- The 38-kHz CPS data with S_v < -60 dB (corresponding to a density of approximately three fish per 100 m^3 in the case of 20-cm-long sardine) were set to -999 dB (effectively zero; **Figure II.5b**).
- Data collected when the ship approached or departed a sampling station, typically associated with a ship-speed less than 4 kn, were automatically marked as "bad data."
- An integration-start line was created at a range of 5 m from the transducers. When necessary, this line was manually modified to exclude reverberation due to bubbles or include CPS above 5 m. – An integration-stop line was created at either 350 m or 3 m above the seabed, whichever was shallower.
- Between the integration lines, volume backscattering coefficients (s_v, m^2 m^{-3}) were integrated over 5-m depths and averaged over 100-m distances. The resulting integrated volume backscattering coefficients (s_A; m^2 nmi^{-2}), for each transect and frequency, were output to comma-delimited text (.csv) files.
- The s_A values were summed over ranges from the integration start line to the approximate depth of the bottom of the upper mixed layer, which was estimated using temperature profiles from CTD casts.
- Data collected during daytime (i.e., not earlier than 30 min before sunrise to not later than 30 min after sunset) were averaged over 2-km distances, and mapped. Nighttime data, assumed to be negatively biased due to diel-vertical migration and disaggregation of the target species' schools (Cutter and Demer, 2008; Demer and Hewitt, 1995) were omitted.

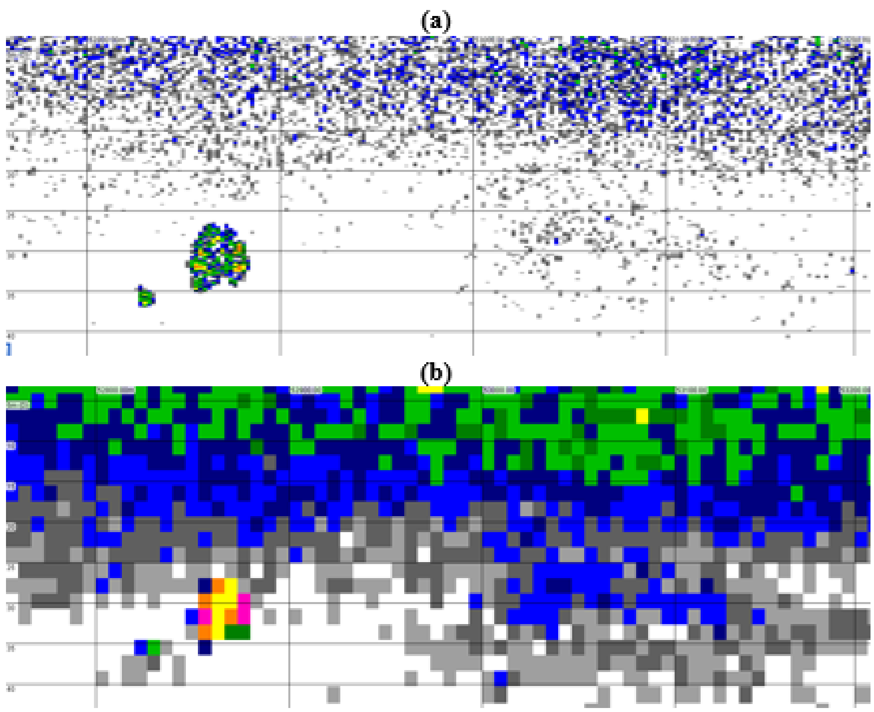


Figure II.5 Synchronized echograms of 38-kHz S_v after a) noise-subtraction and b) 38-kHz S_v thresholding at -60 dB (final, CPS-only).

Table II.1. S_v-differences (minimum, maximum; dB) for putative CPS.

$S_{v70kHz} - S_{v38kHz}$	$S_{v120kHz} - S_{v38kHz}$	$S_{v200kHz} - S_{v38kHz}$
-13.85, 9.89	-13.5, 9.37	-13.51, 12.53

II.3. Trawl sampling

During the day, CPS form schools in the upper mixed layer [to 70-m depth in the spring; (Kim *et al.*, 2005)], and much shallower in summer. After sunset, CPS schools tend to ascend and disperse. At that time, with reduced visibility and no schooling behavior, they are less able to avoid a net (Mais, 1974). Therefore, trawl sampling for identifying the species composition and length distributions of acoustic targets was performed at night.

The net, a Nordic 264 rope trawl (NET Systems; Bainbridge Island, WA), has a rectangular opening in the fishing portion of the net with an area of approximately 300 m^2 (~15-m tall x 20-m wide), variable-sized mesh in the throat, an 8-mm square-mesh cod end liner (to retain a large range of animal sizes), and a "marine mammal excluder device" to prevent the capture of large animals, such as dolphins, turtles, or sharks (Dotson *et al.*, 2010). The trawl doors are foam-filled and the trawl headrope is lined with floats so the trawl tows at the surface.

Whenever possible, nighttime trawl sampling was conducted where echoes from CPS schools were observed earlier that day. Trawls were towed at ~4 kn for 45 min. The total catch from each trawl was weighed and sorted by species or groups. From the catches with CPS, up to 75 fish were selected randomly for each of the target species. Those were weighed (g) and measured to either their standard length (L_s; mm) for sardine, anchovy, and herring, or fork length (L_f; mm) for jack mackerel and Pacific mackerel. In addition, otoliths were removed, sex and maturity recorded, and fin clips preserved in ethanol from up to 50 of the randomly selected individuals of each species. Regional species composition was estimated from the nearest trawl cluster, i.e., the combined catches of up to three trawls per night, separated by ~ 10 nmi.

II.4. Ichthyoplankton and oceanographic sampling

II.4.1. Egg and larva sampling

During the day, fish eggs were collected using CUFES (Checkley *et al.*, 1997), which collects water and plankton at a rate of ~640 l min^{-1} from an intake on the hull of the ship at ~ 3-m depth. The particles in the sampled water were sieved by a 505 μm mesh. All fish eggs were identified to lowest taxa, counted, and logged. Typically, the duration of each CUFES sample was 30 min, corresponding to a distance of 5 nmi at a speed of 10 kn. Because the duration of the initial stages of the egg phase is short for most fish species, the egg distributions inferred from CUFES indicate the nearby presence of actively spawning fish.

A CalCOFI bongo oblique (or bongo) net (a paired, bridleless, 71-cm diameter net with 505-μm mesh; Smith and Richardson, 1977) was used to sample ichthyoplankton and krill at one station each day soon after sunset. Where there was adequate depth, 300 m of wire was deployed at a rate of 50 m min^{-1} and then retrieved at 20 m min^{-1}, at a nominal wire angle of 45°. Bongo samples were stored in 5% formalin. Paired vertical egg tow (PairoVET; Smith *et al.*, 1985) nets (25-cm diameter; 150-μm mesh) were used to sample fish eggs and larvae from a depth of 70 m to the sea surface at a rate of 70 m min^{-1} at the same locations where bongo nets were deployed. These PairoVET samples were preserved in 95% ethanol for future genetic analysis.

II.4.2. Conductivity and temperature versus depth (CTD) sampling

Day and night, conductivity and temperature versus depth were measured to 350 m with calibrated sensors on a CTD rosette or underway probe (UCTD) cast from the vessel. These data were used to calculate the time-averaged sound speed (Demer, 2004), for deriving sample ranges, and frequency-specific sound absorption coefficients, for compensating signal attenuation of the sound wave (Simmonds and MacLennan, 2005). These data also provided indication of the depth of the upper-mixed layer, where most epipelagic CPS reside during the day.

III. Results

III.1. EK60 echosounder calibration

The EK60s were calibrated on 24 June 2016 (~2300 GMT) while the vessel was docked at 10th Avenue Marine Terminal, San Diego Bay (32.6956 °N, -117.15278 °W, **Figure III.1**). Thermosalinograph (Seabird Model SBE38) measurements of sea-surface temperature (t_{w} = 22.7 °C) and salinity (s_{w} = 34.1 psu) were input to the GPT-control software, which derived estimates of sound speed (c_{w} = 1527.8 m s^{-1}) and absorption coefficients (see **Table III.1**). Varying with tide, the seabed was 7 to 8 m beneath the transducers. The calibration sphere was positioned 5 to 7 m below the transducers.

GPT information, configuration settings, and beam model results following calibration are presented in **Table III.1**. Measurements of beam-uncompensated sphere target strength (TS_{u}, dB re 1 m^2) are plotted in **Figure III.2** and relative beam-compensated sphere target strength (TS_{rel}, dB re 1 m^2) are plotted in **Figure III.3**. A time-series of calibration results for *Lasker*, including on-axis gain (G_0), S_{a} Correction (S_{a}corr), beamwidths (α_{-3dB} and β_{-3dB}), offset angles (α_0 and β_0), and RMS, are plotted in **Figure III.4**.

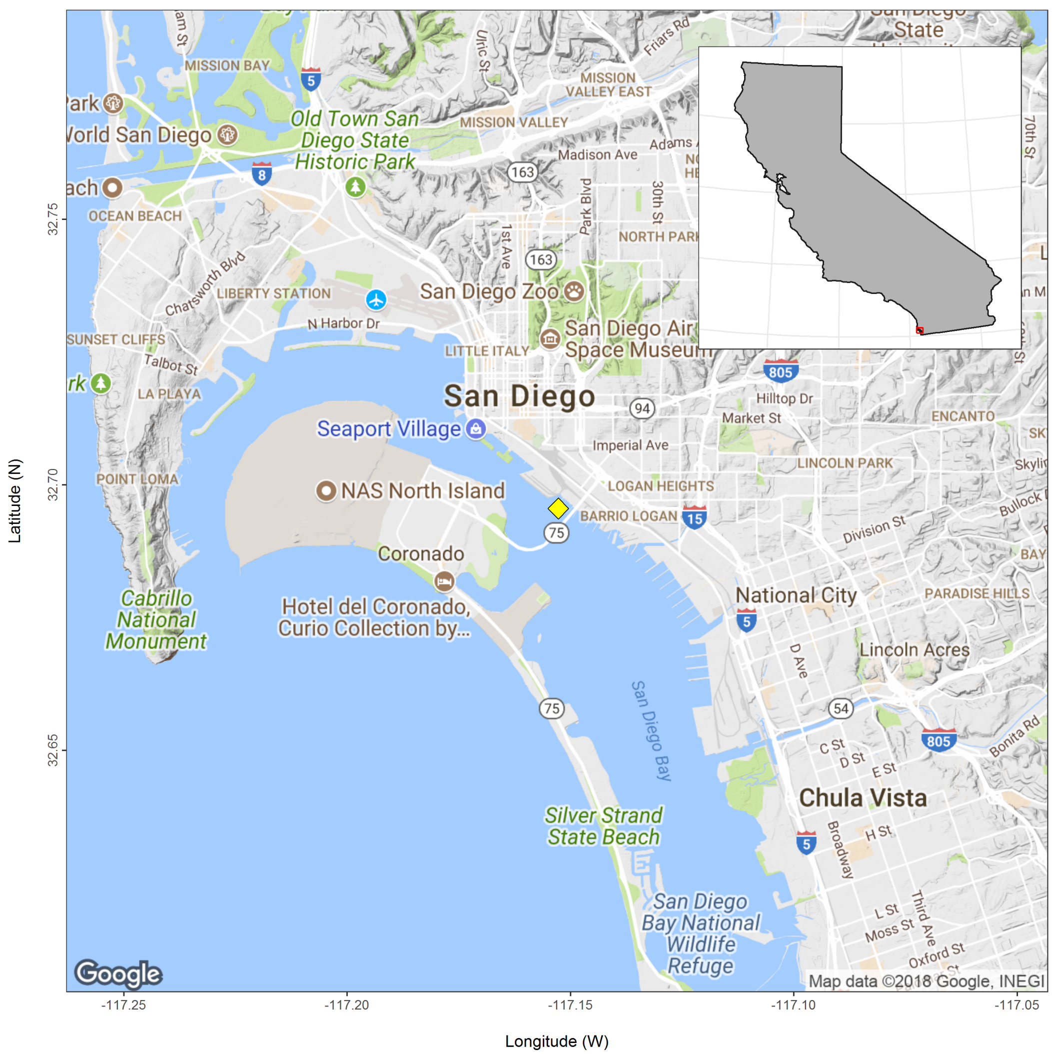


Figure III.1. Map of the calibration location (yellow diamond) near 10th Avenue Marine Terminal, San Diego Bay. The red box in the inset indicates the location and extent of the main map.

Table III.1 Simrad EK60 general purpose transceiver (GPT) information, pre-calibration settings, and beam model results following calibration (below horizontal line). Prior to the survey, on-axis gain (G_0), beam angles and angle offsets, and S_a Correction ($S_\mathrm{a}$corr) values from calibration results were entered into the GPT-control software (Simrad ER60).

Frequency (f, kHz)	Units	18	38	70	120	200	333
Model		ES18-11	ES38B	ES70-7C	ES120-7C	ES200-7C	ES333-7C
Serial Number		2116	31296	233	783	513	124
Transmit Power (p_et)	W	2000	2000	750	250	105	50
Pulse Duration (τ)	ms	1.024	1.024	1.024	1.024	1.024	1.024
On-axis Gain (G_0)	dB re 1	22.52	24.74	27.14	26.71	27.24	25.59
S_a Correction ($S_\mathrm{a}$corr)	dB re 1	-0.65	-0.66	-0.32	-0.36	-0.26	-0.41
Bandwidth (W_f)	Hz	1570	2430	2860	3030	3090	3110
Sample Interval	m	0.196	0.196	0.196	0.196	0.196	0.196
Eq. Two-way Beam Angle ( )	dB re 1 sr	-17.3	-20.6	-20.4	-20.3	-20.3	-19.8
Absorption Coefficient (α_f)	dB km^{-1}	1.8	6.9	20.4	45.3	77.9	113.4
Angle Sensitivity Along. (Λ_α)	Elec.°/Geom.°	13.9	21.9	23	23	23	23
Angle Sensitivity Athw. (Λ_β)	Elec.°/Geom.°	13.9	21.9	23	23	23	23
3-dB Beamwidth Along. ($\alpha_{-3\mathrm{dB}}$)	deg	11.2	7.12	6.46	6.43	6.29	6.17
3-dB Beamwidth Athw. ($\beta_{-3\mathrm{dB}}$)	deg	10.94	7.09	6.48	6.46	6.53	6.84
Angle Offset Along. (α_0)	deg	-0.09	-0.02	0.03	-0.03	0	-0.08
Angle Offset Athw. (β_0)	deg	-0.11	-0.05	-0.01	0.01	0.07	-0.11
Theoretical TS (TS_theory)	dB re 1 m^2	-42.4	-42.36	-41.65	-39.84	-38.84	-37.43
Ambient Noise	dB re 1 W	-128	-145	-154	-160	-161	-137
On-axis Gain (G_0)	dB re 1	22.61	24.9	27.07	26.64	26.95	25.33
S_a Correction ($S_\mathrm{a}$corr)	dB re 1	-0.76	-0.74	-0.43	-0.36	-0.32	-0.4
RMS	dB	0.37	0.21	0.19	0.25	0.66	0.91
3-dB Beamwidth Along. ($\alpha_{-3\mathrm{dB}}$)	deg	10.87	6.88	6.49	6.49	6.08	5.97
3-dB Beamwidth Athw. ($\beta_{-3\mathrm{dB}}$)	deg	11.07	6.95	6.5	6.51	6.22	6.55
Angle Offset Along. (α_0)	deg	-0.15	0.06	0.06	-0.02	-0.02	-0.06
Angle Offset Athw. (β_0)	deg	-0.14	0.02	-0.05	0.05	0.1	-0.04

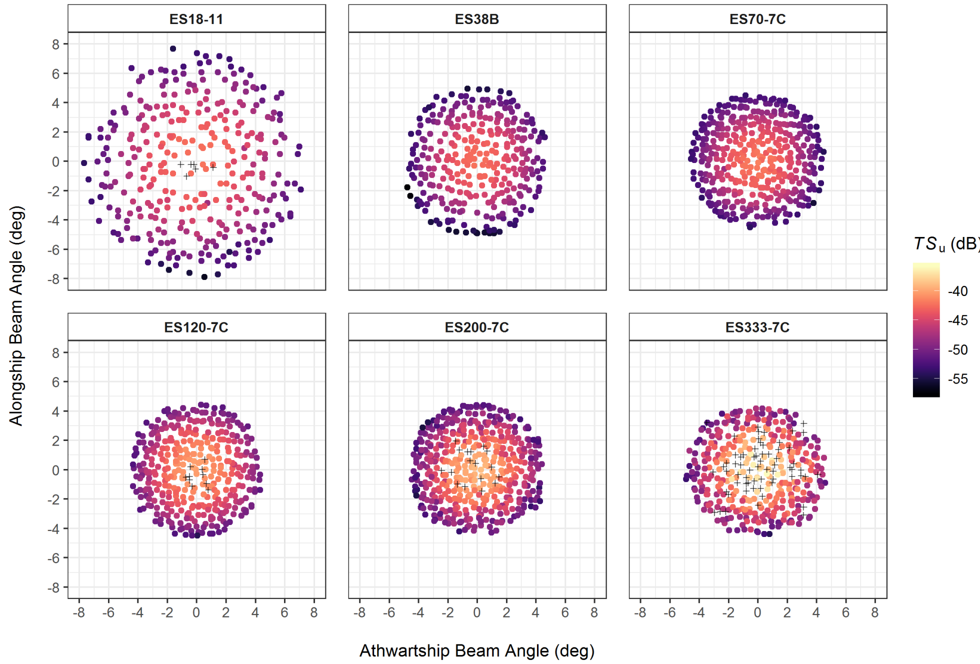


Figure III.2. Beam-uncompensated sphere target strength (TS_{u}, dB re 1 m^2) measurements of a 38.1-mm diameter sphere made from tungsten carbide (WC) with 6% cobalt binder material, at multiple EK60 frequencies (18, 38, 70, 120, 200, and 333 kHz). Crosses indicate measurements marked as outliers after viewing the beam model results.

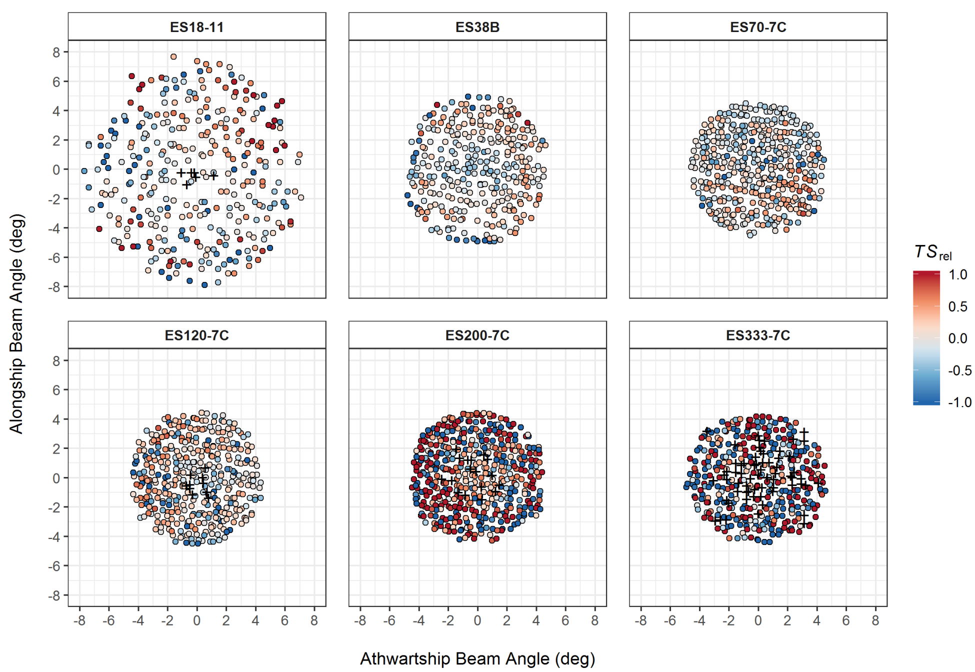


Figure III.3. Relative beam-compensated sphere target strength (TS_{rel}, dB re 1 m^2) measurements of a 38.1-mm diameter sphere made from tungsten carbide (WC) with 6% cobalt binder material, at multiple EK60 frequencies (18, 38, 70, 120, 200, and 333 kHz). TS_{rel} is calculated as the difference between the beam-compensated target strength (TS_{c}) and the theoretical target strength (TS_{theory}, see **Table III.1**). Crosses indicate measurements marked as outliers after viewing the beam model results.

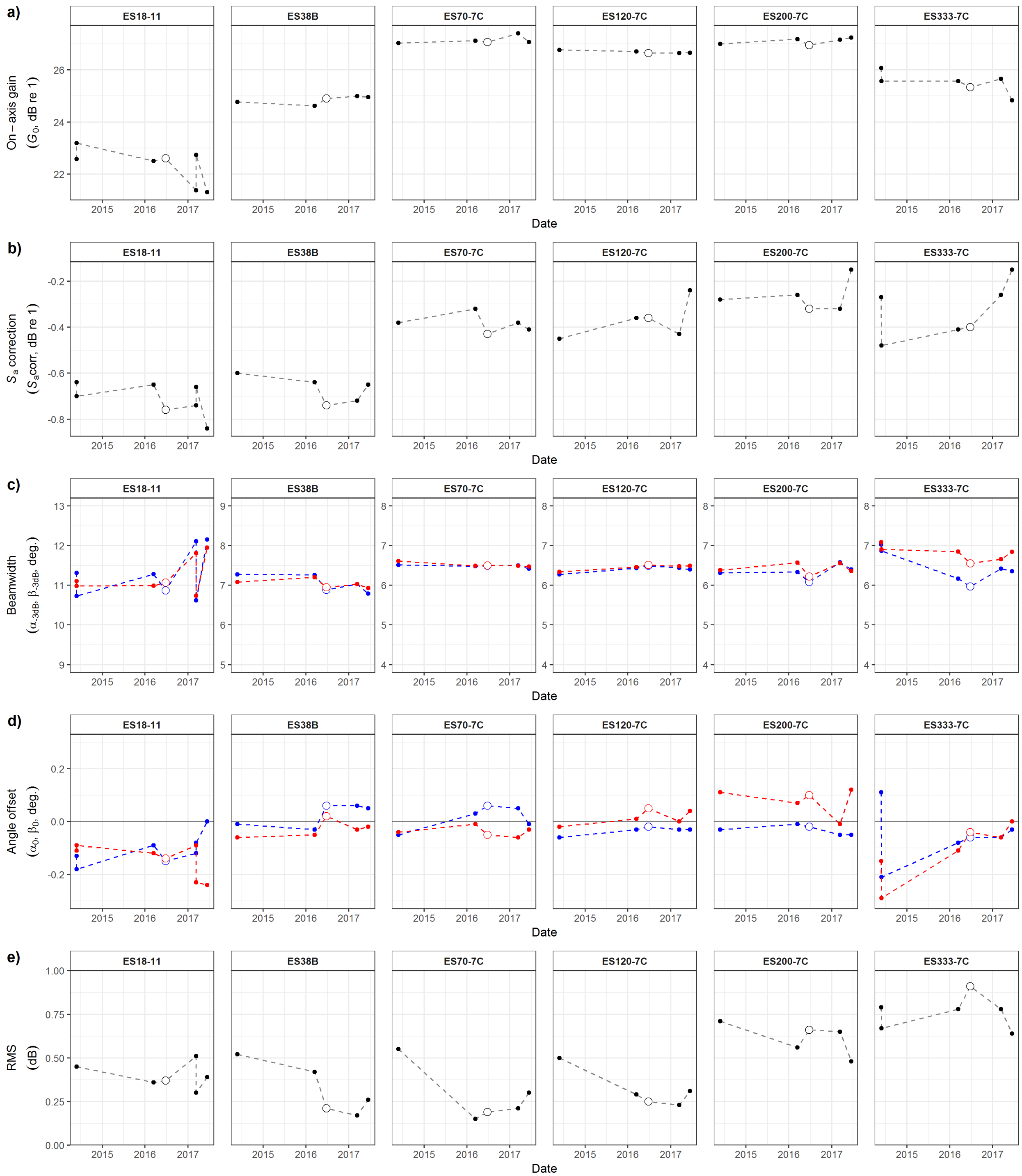


Figure III.4. Time series of beam model results of a) on-axis gain (G_0, dB); b) S_{a} correction (S_{a}corr, dB re 1); c) alongship ($\alpha_{-3\mathrm{dB}}$, blue) and athwartship ($\beta_{-3\mathrm{dB}}$, red) beamwidths (deg); d) alongship (α_0, blue) and athwartship (β_0, red) offset angles (deg.); and e) RMS (dB) for each EK60 transducer frequency aboard *Lasker*. Unfilled circles indicate results from the current survey.

III.2. Data collection

III.2.1. Acoustic and trawl sampling

The survey spanned an area from approximately Cape Scott, British Columbia to San Diego, CA (**Figure III.5**), with 103 east-west transects totaling 4627 nmi, and 118 Nordic trawls.

Leg I

On 28 June 2016, *Lasker* departed San Diego, CA and transited to Neah Bay, WA. On 4 July, *Lasker* arrived in Neah Bay; personnel were exchanged via small boat and *Lasker* resumed the transit toward Cape Scott (off Vancouver Island). *Lasker* arrived at the first transect (transect 001) at ~0100 (all times GMT) on 6 July to begin survey operations. On 16 July, acoustician Steve Sessions was replaced by acoustician Kevin Stierhoff via small boat in Westport, WA. Transect 035 was completed at ~1400 on 22 July, and *Lasker* arrived at NOAA Marine Operations Center-Pacific (MOC-P) in Newport, OR at ~2300 on 22 July to complete Leg I.

Leg II

On 27 July, *Lasker* departed from MOC-P in Newport, OR at ~1430 and arrived at the start of transect 035 at ~1900 near Cascade Head to resume survey operations. On 31 July at ~2245, the EK-MUX froze; the survey resumed using only the EK60 until ~0600 on 1 August when it was repaired by replacing the IC chip. On 8 August, acoustic sampling ceased when a seawater cooling pipe broke, which required all echosounders to be secured to avoid hardware damage. On 8 August, *Lasker* arrived at Pier 32 in San Francisco, CA at ~0530 to complete Leg II. Repairs to the damaged pipe was scheduled to occur prior to Leg III.

Leg III

On 20 August, *Lasker* departed from Pier 32 in San Francisco at ~0130, and arrived at transect 071 near Point Cabrillo at ~1700 on 20 August to resume survey operations. The MS70 was still not functional from the end of the previous leg and remained offline for the remainder of the survey. The SX90 periodically froze and was rebooted throughout Leg III. Rough seas and high winds were encountered on 29 August; consequently, the ship slowed to 7 kn and began tacking on 30 August to minimize roll and preserve data quality. Only one trawl was successfully conducted on 29 August due to weather. UCTD operations were suspended for the remainder of Leg III. *Lasker* arrived at 10th Ave Marine Terminal in San Diego, CA on 2 September at ~1600 to complete Leg III.

Leg IV

On 6 September, *Lasker* departed from 10th Ave Marine Terminal in San Diego, CA at ~2000, and arrived at transect 102 at ~1330 on 7 September to resume survey operations. On 16 September, *Lasker* arrived at 10th Ave Marine Terminal in San Diego at ~1800 to complete the survey.

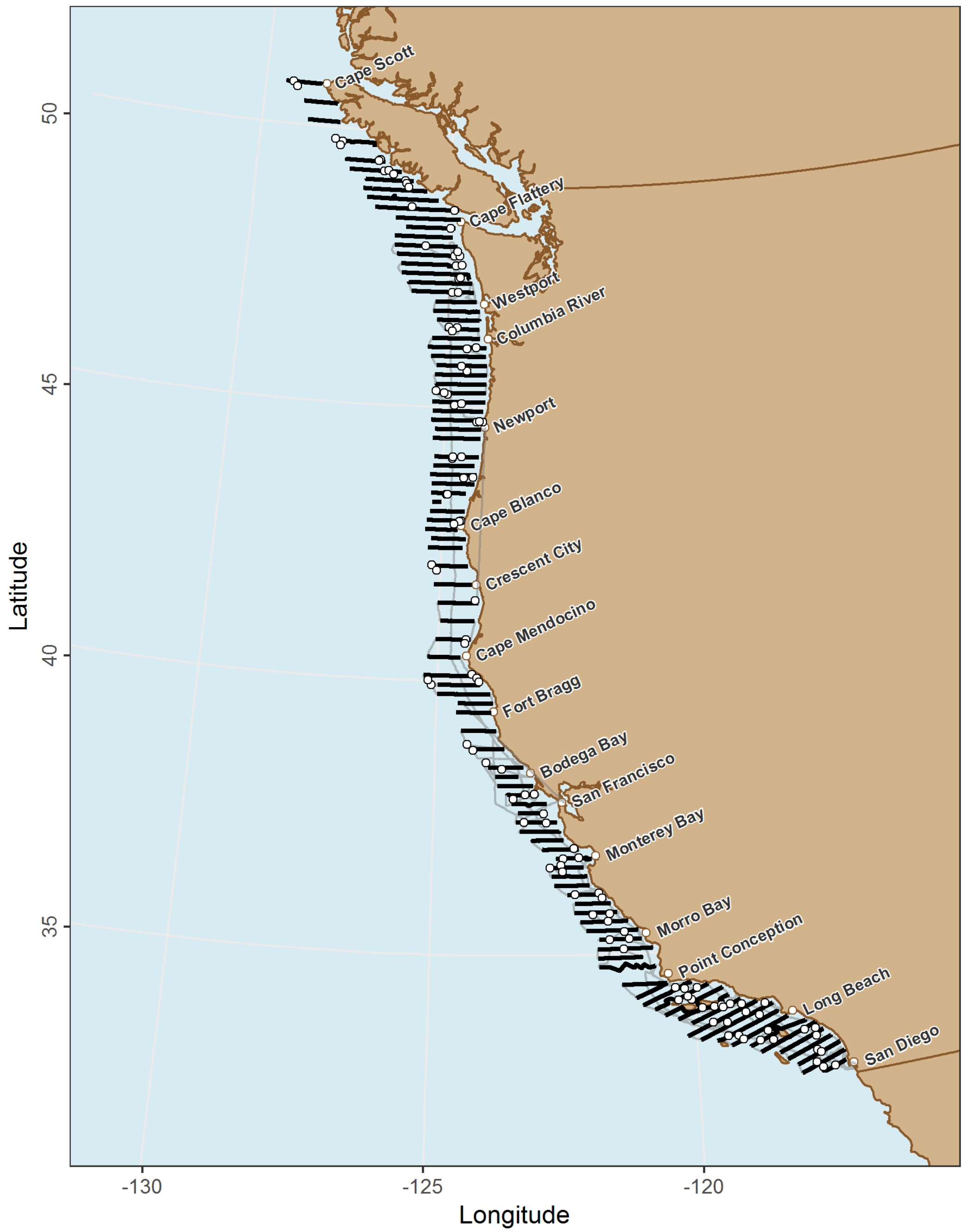


Figure III.5. Cruise track of *Lasker* (gray line), east-west acoustic transects (black lines), and locations of surface trawls (white points).

III.2.2. Ichthyoplankton and oceanographic sampling

A total of 55 CTD casts, 60 bongo tows, and 54 PairoVET tows were conducted at fixed stations throughout the survey. In addition, 109 UCTD casts were conducted and 1206 CUFES samples were collected while underway. The locations of CTD and UCTD stations are shown in **Figure III.6** and **Appendix B**.

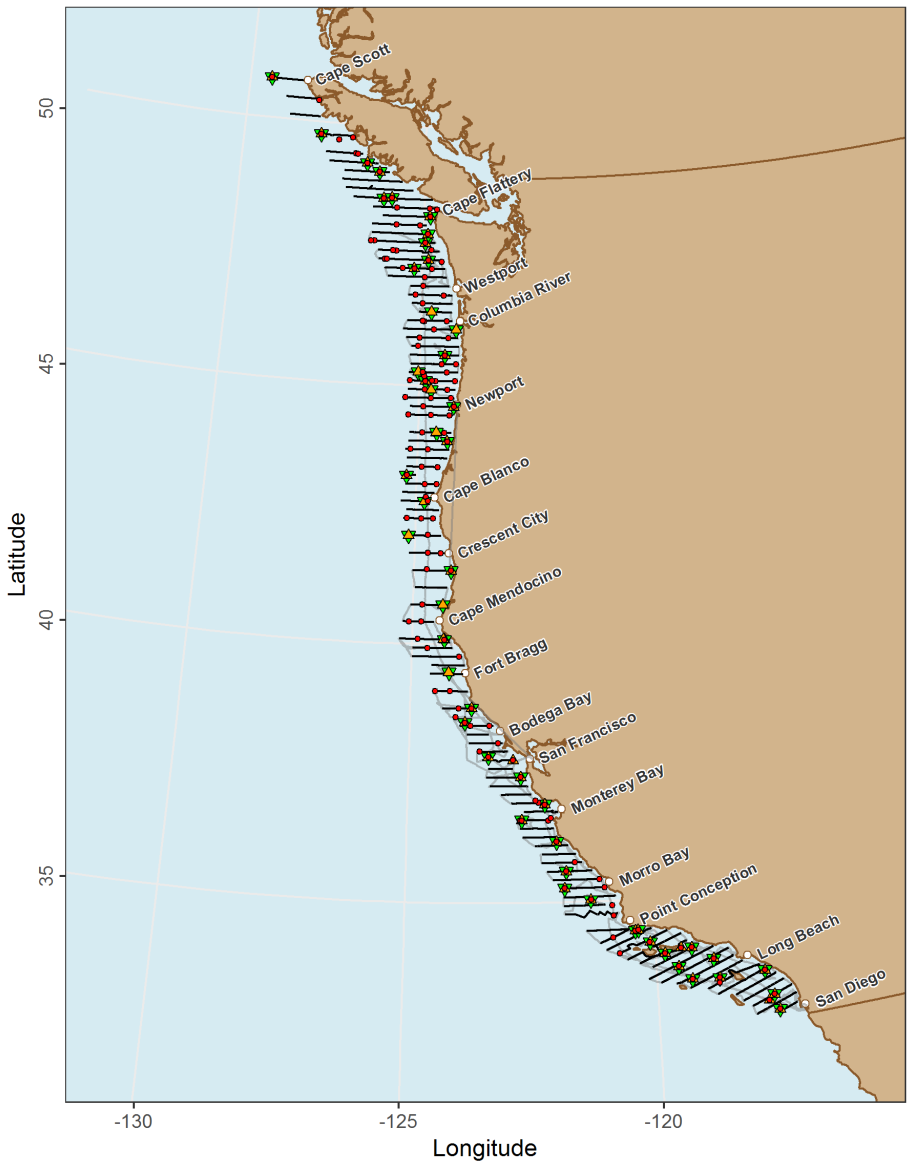


Figure III.6. CTD and UCTD locations (red circles) and plankton net samples (bongo net in orange triangles; PairoVET net in green triangles) relative to the vessel track (bold gray line), acoustic transects (black lines).

III.3. Distribution of CPS

The majority of acoustic backscatter ascribed to CPS was observed along the coast of Vancouver Island; between the Strait of Juan de Fuca and Tillamook, OR; around Cape Blanco, and between Monterey and Morro Bay, CA (**Figure III.7a**). To a lesser extent, CPS backscatter was observed around the northern Channel Islands in the SCB (**Figure III.7a**). CPS backscatter was coincident with concentrations of anchovy eggs off the coast of WA and sardine eggs in the SCB sampled by the CUFES.

Anchovy eggs were most abundant in the CUFES samples inshore between Cape Flattery and Tillamook, OR, and between Bodega Bay and Half Moon Bay (**Figure III.7b**). Lower densities of jack mackerel eggs were observed offshore of central Vancouver Island, offshore between Westport, WA and Newport, OR, and to a lesser extent inshore between Bodega Bay and Monterey and around Point Conception (**Figure III.7b**). Sardine eggs observed in the CUFES were most abundant offshore of central Vancouver Island and around the northern Channel Islands in the SCB (**Figure III.7b**). There was little overlap in the distribution of anchovy and sardine eggs in CUFES.

Jack mackerel comprised the greatest proportion of catch in trawl samples between Westport, WA and Monterey, CA (**Figure III.7c**). Pacific herring comprised the greatest proportion of catch in trawl samples inshore along the coast of Vancouver Island, between Cape Flattery and Westport, and around Newport (**Figure III.7c**). Anchovy were predominantly found in trawls conducted inshore between Bodega Bay and Morro Bay and throughout the SCB, with some present inshore between Cape Flattery and Westport, WA (**Figure III.7c**). The few trawl samples that contained sardine were collected offshore near the Columbia River, between Cape Mendocino and Bodega Bay, off Big Sur, and near San Nicolas Island in the SCB.

Overall, the 118 trawls captured a combined 9273 kg of CPS (1533 kg sardine, 519 kg anchovy, 4360 kg jack mackerel, 2711 kg Pacific mackerel, and 150 kg Pacific herring; **Appendix C**).

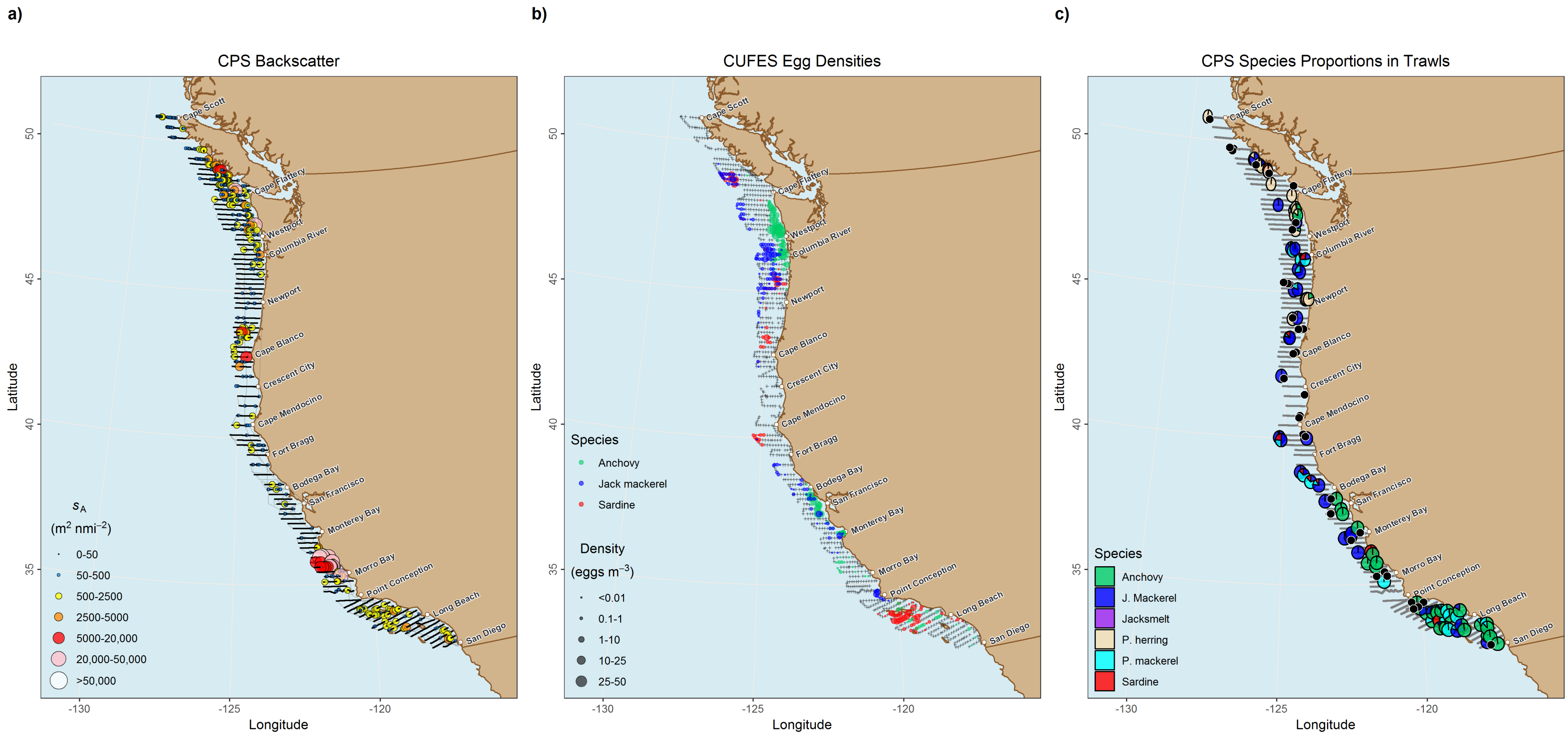


Figure III.7. Survey transects performed aboard *Lasker* overlaid with (a) the distribution of 38-kHz integrated backscattering coefficients (s_A, m^2 nmi^{-2}; averaged over 2000-m distance intervals and from 5- to 70-m deep) ascribed to CPS; (b) anchovy-, jack mackerel-, and sardine-egg densities (eggs m^{-3}) from the CUFES; and (c) proportions of CPS species in trawl clusters (black points indicate trawls with no CPS).

IV. Disposition of Data

Archived on the SWFSC data server are approximately 212 GB of raw EK60 data, 16.4 TB of raw EK80 data, 1 TB of raw ME70 data, 411 GB of raw MS70 data, and 1.29 TB of raw SX90 data. For more information, contact: David Demer (Southwest Fisheries Science Center, 8901 La Jolla Shores Drive, La Jolla, California, 92037, U.S.A.; phone: 858-546-5603; email: david.demer@noaa.gov).

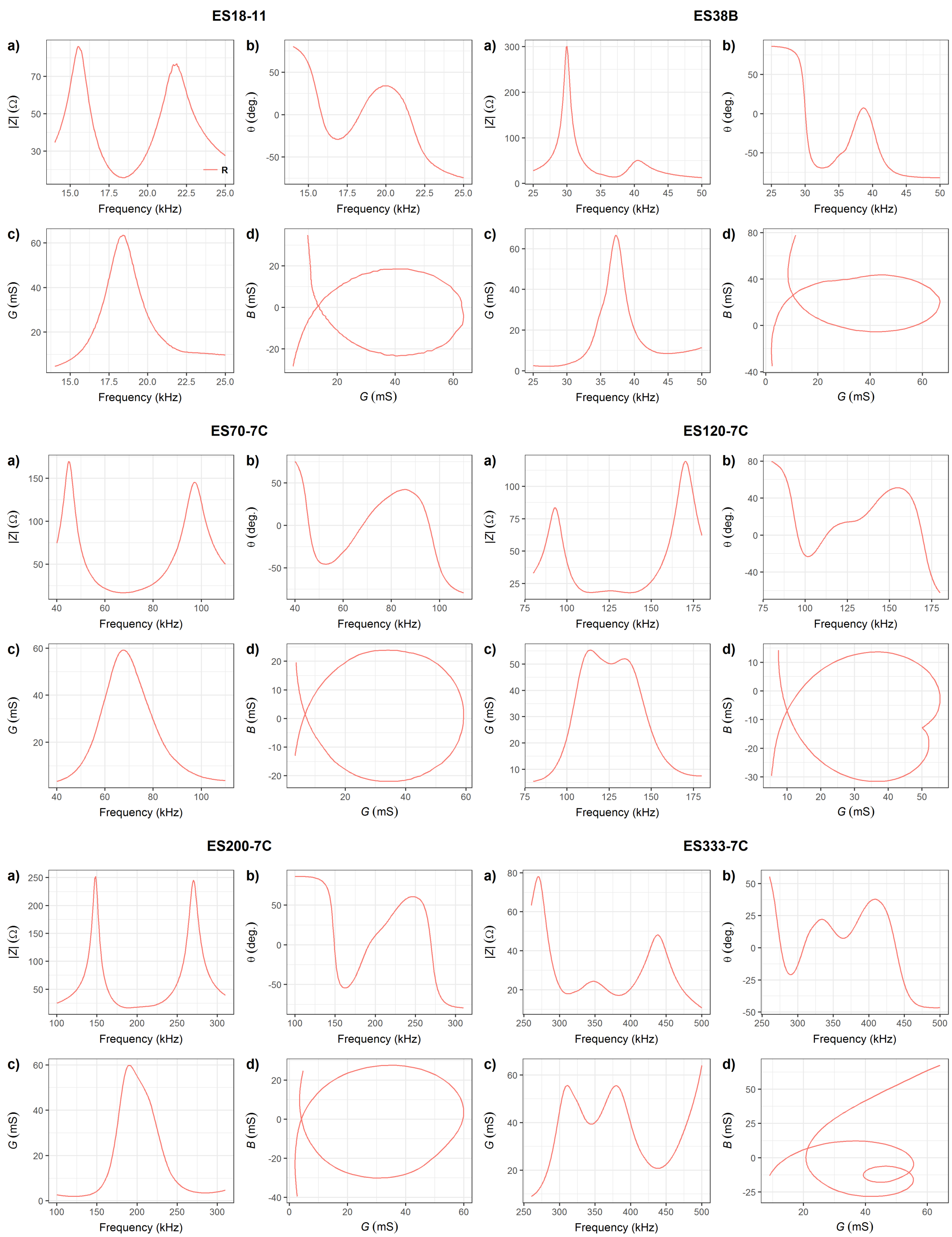
V. Acknowledgements

We thank the crew members of FSV *Lasker*, as well as the scientists and technicians that participated in the sampling operations at sea. CPS-catch data were compiled by Bev Macewicz and CPS-egg data were compiled by Ed Weber. Critical reviews by David Griffith and Gerard Dinardo improved this report.

VI. Appendices

Appendix A. Echosounder transducer impedance measurements

The magnitude of impedance ($|Z|$, ; panel a), phase (θ, °; panel b), and conductance (G, S; panel c) versus frequency, and susceptance (B, S) versus G (admittance circle; panel d), for all quadrants in parallel.



Appendix B. CTD and UCTD sample summary

Times and locations of conductivity and temperature versus depth measurements while on station (CTD) and underway (UCTD).

Date	Event	Latitude	Longitude
06/28/2016 23:49	CTD Cast	32.86583	-117.8443
06/29/2016 18:20	UCTD Cast	34.27800	-120.8218
06/29/2016 22:03	UCTD Cast	34.70200	-120.7945
06/29/2016 23:43	CTD Cast	34.90700	-120.8133
06/30/2016 02:40	UCTD Cast	35.26200	-120.9578
06/30/2016 14:16	UCTD Cast	36.58150	-122.0645
06/30/2016 15:12	CTD Cast	36.63233	-122.0058
06/30/2016 17:45	CTD Cast	36.92933	-122.2623
06/30/2016 18:16	UCTD Cast	36.97417	-122.3213
07/02/2016 14:34	UCTD Cast	41.44583	-124.7045
07/02/2016 18:56	UCTD Cast	42.11033	-124.6967
07/03/2016 00:09	UCTD Cast	42.83967	-124.7658
07/03/2016 14:31	UCTD Cast	45.18133	-124.8740
07/03/2016 21:20	CTD Cast	46.23683	-124.9187
07/04/2016 02:11	CTD Cast	46.92467	-124.9652
07/04/2016 15:06	UCTD Cast	48.40767	-124.6563
07/05/2016 14:58	UCTD Cast	49.67217	-127.3842
07/06/2016 05:23	CTD Cast	50.76267	-129.4077
07/06/2016 19:41	UCTD Cast	50.40717	-128.0305
07/07/2016 05:41	CTD Cast	49.75950	-127.8940
07/07/2016 17:49	UCTD Cast	49.73000	-127.0170
07/07/2016 20:56	UCTD Cast	49.42633	-126.9057
07/08/2016 09:36	CTD Cast	49.42600	-126.8410
07/09/2016 05:09	CTD Cast	49.09483	-126.2285
07/10/2016 04:15	CTD Cast	49.25733	-126.5830
07/11/2016 04:39	CTD Cast	48.59267	-126.0838
07/11/2016 07:26	CTD Cast	48.60733	-125.8670
07/11/2016 21:02	UCTD Cast	48.42233	-124.8472
07/12/2016 00:34	UCTD Cast	48.42167	-125.7222
07/13/2016 11:23	CTD Cast	48.26233	-124.8332
07/13/2016 22:05	UCTD Cast	48.09383	-125.7098
07/14/2016 00:21	UCTD Cast	48.09317	-125.0883
07/14/2016 04:34	CTD Cast	47.75583	-124.9455
07/14/2016 18:55	UCTD Cast	47.76450	-126.2787
07/14/2016 19:18	UCTD Cast	47.76533	-126.3690
07/15/2016 03:37	CTD Cast	47.92250	-124.8800
07/15/2016 19:20	UCTD Cast	47.59183	-125.6858
07/15/2016 19:45	UCTD Cast	47.59150	-125.7858
07/15/2016 23:36	UCTD Cast	47.42467	-125.9800
07/15/2016 23:48	UCTD Cast	47.42450	-125.9272
07/16/2016 04:16	CTD Cast	47.42350	-124.8465
07/16/2016 11:12	CTD Cast	47.61767	-124.7797
07/16/2016 14:07	UCTD Cast	47.39417	-124.5108
07/17/2016 02:13	UCTD Cast	47.25733	-124.7573

(continued)

Date	Event	Latitude	Longitude
07/17/2016 04:17	CTD Cast	47.25833	-125.2105
07/17/2016 14:45	UCTD Cast	47.25750	-125.5142
07/17/2016 21:22	UCTD Cast	47.09533	-124.9378
07/18/2016 15:52	UCTD Cast	46.75067	-125.1572
07/18/2016 18:40	UCTD Cast	46.74583	-124.4325
07/19/2016 00:17	UCTD Cast	46.58833	-124.9677
07/19/2016 16:51	UCTD Cast	46.25417	-124.3460
07/19/2016 19:22	UCTD Cast	46.25417	-124.9528
07/20/2016 01:30	UCTD Cast	46.08750	-124.6660
07/20/2016 14:35	UCTD Cast	45.92533	-124.2972
07/20/2016 17:35	UCTD Cast	45.92550	-125.0265
07/20/2016 20:49	UCTD Cast	45.75783	-125.0555
07/21/2016 03:59	CTD Cast	45.58783	-124.3798
07/21/2016 21:00	UCTD Cast	45.41833	-124.4557
07/21/2016 22:26	UCTD Cast	45.42000	-124.1003
07/22/2016 00:55	UCTD Cast	45.25617	-124.3247
07/22/2016 03:31	UCTD Cast	45.25433	-124.9230
07/27/2016 19:11	UCTD Cast	45.08933	-124.1183
07/27/2016 21:13	UCTD Cast	45.09017	-124.6017
07/27/2016 21:34	UCTD Cast	45.09067	-124.6860
07/27/2016 23:54	UCTD Cast	45.09000	-125.2365
07/28/2016 02:58	UCTD Cast	44.92400	-124.8630
07/28/2016 07:27	CTD Cast	45.08350	-124.8492
07/28/2016 07:31	CTD Cast	45.08617	-124.8482
07/28/2016 07:31	UCTD Cast	45.08667	-124.8480
07/28/2016 14:46	UCTD Cast	44.92683	-124.3035
07/28/2016 17:01	UCTD Cast	44.76050	-124.2187
07/28/2016 19:05	UCTD Cast	44.76200	-124.7080
07/28/2016 21:41	UCTD Cast	44.75983	-125.3258
07/29/2016 00:21	UCTD Cast	44.59433	-124.8857
07/29/2016 03:59	CTD Cast	44.59517	-124.1403
07/29/2016 16:39	UCTD Cast	44.42800	-124.2397
07/29/2016 18:32	UCTD Cast	44.42867	-124.6950
07/29/2016 22:53	UCTD Cast	44.42717	-125.2443
07/30/2016 02:18	UCTD Cast	44.09083	-124.8905
07/30/2016 14:06	UCTD Cast	44.09050	-124.3613
07/30/2016 19:01	UCTD Cast	43.76283	-124.7432
07/30/2016 20:53	UCTD Cast	43.76200	-125.1612
07/31/2016 03:59	CTD Cast	43.92400	-124.2867
07/31/2016 19:56	UCTD Cast	43.42667	-124.8858
07/31/2016 21:37	UCTD Cast	43.42567	-124.5072
08/01/2016 03:04	CTD Cast	43.25417	-125.2347
08/01/2016 18:00	UCTD Cast	43.09483	-124.8030
08/01/2016 19:24	UCTD Cast	43.09417	-124.5157
08/02/2016 14:35	UCTD Cast	42.76117	-124.7147
08/02/2016 20:55	UCTD Cast	42.42733	-125.1938

(continued)

Date	Event	Latitude	Longitude
08/02/2016 22:38	UCTD Cast	42.42833	-124.8632
08/02/2016 23:50	UCTD Cast	42.42750	-124.5927
08/03/2016 20:56	UCTD Cast	41.75867	-124.3993
08/03/2016 22:35	UCTD Cast	41.76000	-124.6928
08/04/2016 12:07	CTD Cast	41.42233	-124.1588
08/05/2016 16:58	UCTD Cast	40.75900	-124.7860
08/05/2016 21:08	UCTD Cast	40.43033	-125.0812
08/05/2016 22:30	UCTD Cast	40.43100	-124.7993
08/06/2016 04:33	CTD Cast	40.09150	-124.2792
08/06/2016 18:42	UCTD Cast	40.09400	-124.8715
08/07/2016 05:46	CTD Cast	39.92533	-124.6510
08/07/2016 19:17	UCTD Cast	39.75900	-123.9430
08/20/2016 19:05	UCTD Cast	39.09450	-124.1362
08/20/2016 20:40	UCTD Cast	39.09433	-124.4597
08/21/2016 00:34	UCTD Cast	38.76250	-123.9485
08/21/2016 01:53	UCTD Cast	38.76083	-123.6668
08/21/2016 03:08	CTD Cast	38.76217	-123.6705
08/21/2016 14:02	UCTD Cast	38.59400	-124.0077
08/21/2016 18:49	UCTD Cast	38.42800	-123.2850
08/21/2016 20:49	UCTD Cast	38.42783	-123.6873
08/21/2016 20:49	UCTD Cast	38.42783	-123.6880
08/21/2016 20:49	UCTD Cast	38.42783	-123.6880
08/21/2016 20:49	UCTD Cast	38.42783	-123.6882
08/21/2016 20:49	UCTD Cast	38.42783	-123.6882
08/21/2016 20:49	UCTD Cast	38.42783	-123.6887
08/22/2016 08:37	CTD Cast	38.48717	-123.8110
08/22/2016 18:31	UCTD Cast	38.09483	-123.1025
08/22/2016 18:32	UCTD Cast	38.09483	-123.1025
08/22/2016 18:32	UCTD Cast	38.09483	-123.1025
08/22/2016 18:32	UCTD Cast	38.09483	-123.1023
08/22/2016 18:32	UCTD Cast	38.09483	-123.1023
08/22/2016 18:32	UCTD Cast	38.09483	-123.1022
08/22/2016 18:32	UCTD Cast	38.09483	-123.1022
08/22/2016 18:32	UCTD Cast	38.09483	-123.1020
08/23/2016 00:15	UCTD Cast	37.92817	-123.4928
08/23/2016 03:47	CTD Cast	37.82050	-123.3032
08/23/2016 16:58	CTD Cast	37.76000	-122.7880
08/23/2016 16:58	UCTD Cast	37.76000	-122.7880
08/23/2016 16:58	UCTD Cast	37.76000	-122.7878
08/23/2016 16:58	UCTD Cast	37.76000	-122.7878
08/23/2016 16:58	UCTD Cast	37.76000	-122.7878
08/24/2016 02:54	CTD Cast	37.42900	-122.6268
08/25/2016 03:58	CTD Cast	36.89450	-122.1295
08/26/2016 00:17	UCTD Cast	36.59250	-122.6460
08/26/2016 04:39	CTD Cast	36.59217	-122.6112
08/27/2016 02:50	CTD Cast	36.16850	-121.9095

(continued)

Date	Event	Latitude	Longitude
08/27/2016 21:39	UCTD Cast	35.76050	-121.5333
08/28/2016 03:02	CTD Cast	35.59033	-121.7180
08/28/2016 21:17	UCTD Cast	35.42567	-121.0533
08/29/2016 02:57	CTD Cast	35.26233	-121.7610
08/30/2016 04:42	CTD Cast	35.02633	-121.2347
08/31/2016 04:36	CTD Cast	34.39200	-120.3735
09/01/2016 05:06	CTD Cast	34.40350	-120.3160
09/07/2016 19:43	UCTD Cast	33.97133	-120.7087
09/08/2016 05:29	CTD Cast	34.15567	-120.1020
09/08/2016 05:29	CTD Cast	34.15567	-120.1020
09/08/2016 20:00	CTD Cast	34.01433	-119.4895
09/09/2016 02:06	CTD Cast	33.92467	-119.8133
09/10/2016 02:16	CTD Cast	34.00183	-119.2812
09/11/2016 05:31	CTD Cast	33.65250	-119.5555
09/12/2016 06:23	CTD Cast	33.75650	-118.8673
09/13/2016 05:10	CTD Cast	33.39350	-119.3060
09/14/2016 04:43	CTD Cast	33.37633	-118.7690
09/14/2016 04:43	CTD Cast	33.37633	-118.7690
09/14/2016 15:12	UCTD Cast	33.28350	-118.7822
09/15/2016 05:17	CTD Cast	33.45167	-117.8820
09/16/2016 02:19	CTD Cast	32.97017	-117.7363
09/17/2016 04:47	CTD Cast	32.67167	-117.6543
09/17/2016 04:48	CTD Cast	32.67167	-117.6545

Appendix C. Trawl sample summary

Date, time, and location at the start of trawling (i.e., at net equilibrium), and biomasses (kg) of CPS species collected in each trawl. The duration of each trawl set was nominally 45 min.

Trawl	Date	Latitude	Longitude	Anchovy	Sardine	P. mackerel	J. mackerel	P. herring	All CPS
1	07/05/2016 23:10	50.767	-129.270					16.970	16.970
2	07/06/2016 03:11	50.682	-129.157						
3	07/06/2016 23:25	49.751	-127.852						
4	07/07/2016 01:56	49.680	-127.899						
5	07/07/2016 04:11	49.788	-128.038						
6	07/07/2016 20:59	49.462	-126.827				0.731	0.173	0.904
7	07/07/2016 23:46	49.441	-126.874					0.303	0.303
8	07/08/2016 22:36	49.106	-126.164	0.046	342.319	0.944		11.278	354.587
9	07/09/2016 01:36	49.048	-126.130	0.031				5.610	5.641
10	07/09/2016 04:28	48.983	-126.078						
11	07/09/2016 21:45	49.256	-126.721						
12	07/10/2016 00:09	49.268	-126.601	0.030				4.045	4.075
13	07/10/2016 02:26	49.211	-126.471	0.021			0.199	1.285	1.505
14	07/10/2016 22:14	48.631	-125.963					0.300	0.300
16	07/12/2016 01:44	48.594	-124.895						
17	07/13/2016 01:32	48.265	-124.972					35.440	35.440
18	07/13/2016 22:26	47.761	-124.862	0.066		2.300	0.403	8.945	11.714
19	07/14/2016 00:47	47.759	-124.732	3.135		0.325		7.890	11.350
20	07/14/2016 03:02	47.841	-124.782	29.195				14.310	43.505
21	07/15/2016 00:30	47.925	-125.588				1.539		1.539
22	07/15/2016 22:49	47.584	-124.818	0.210				0.160	0.370
23	07/16/2016 01:34	47.588	-124.670	0.238				0.047	0.285
24	07/16/2016 23:30	47.340	-124.745						
25	07/17/2016 01:34	47.363	-124.706	0.036			0.599	0.195	0.830
26	07/17/2016 21:12	47.091	-124.894						
27	07/17/2016 23:48	47.094	-124.754	15.747	0.472			38.990	55.209
28	07/18/2016 21:15	46.447	-124.757				21.977		21.977
29	07/18/2016 23:35	46.460	-124.947		0.418	1.012	13.884		15.314
30	07/19/2016 02:30	46.386	-124.864			10.914	4.169		15.083
31	07/19/2016 22:10	46.093	-124.288	7.250	124.958	271.979	107.850	0.210	512.247

(continued)

Trawl	Date	Latitude	Longitude	Anchovy	Sardine	P. mackerel	J. mackerel	P. herring	All CPS
32	07/20/2016 01:53	46.074	-124.508		19.796	111.462	192.954		324.212
33	07/20/2016 21:33	45.661	-124.499		2.450	40.203	118.038		160.690
34	07/21/2016 00:55	45.752	-124.624			3.582	117.123		120.706
35	07/21/2016 21:35	45.233	-124.947						
36	07/22/2016 00:12	45.256	-125.026						
37	07/22/2016 02:24	45.288	-125.215						
38	07/27/2016 22:04	45.029	-124.771				2.889		2.889
39	07/28/2016 01:16	45.067	-124.608			7.153	30.765		37.918
40	07/28/2016 22:00	44.733	-124.250	0.024				0.372	0.396
41	07/29/2016 00:55	44.739	-124.113	0.013				0.057	0.070
42	07/29/2016 03:05	44.747	-124.192					2.765	2.765
43	07/29/2016 20:49	44.094	-124.588				1.685	0.130	1.815
44	07/29/2016 23:23	44.062	-124.791					0.405	0.405
45	07/30/2016 02:01	44.093	-124.777						
46	07/30/2016 22:05	43.724	-124.312						
47	07/31/2016 00:40	43.707	-124.529						
48	07/31/2016 22:57	43.408	-124.911		372.786	67.588	1578.910		2019.284
49	08/01/2016 02:46	43.410	-124.881		200.014	113.982	1256.196		1570.192
50	08/01/2016 22:16	42.925	-124.568						
51	08/02/2016 00:47	42.919	-124.606						
52	08/02/2016 03:12	42.865	-124.721						
53	08/02/2016 21:10	42.107	-125.189				4.735		4.735
54	08/02/2016 23:44	42.013	-125.080						
55	08/04/2016 06:09	41.476	-124.225						
56	08/04/2016 21:18	40.762	-124.403						
57	08/05/2016 00:02	40.687	-124.432						
58	08/05/2016 22:17	40.127	-124.265						
59	08/06/2016 01:10	40.055	-124.167						
60	08/06/2016 05:44	39.992	-124.119				0.012		0.012
61	08/07/2016 00:33	39.916	-125.117		84.806	88.700	173.467		346.973
62	08/07/2016 02:50	40.010	-125.193		5.191	2.039	136.159		143.389
63	08/20/2016 22:59	38.845	-124.346				0.046		0.046
64	08/21/2016 01:53	38.740	-124.227		35.347	185.459	51.237		272.043

(continued)

Trawl	Date	Latitude	Longitude	Anchovy	Sardine	P. mackerel	J. mackerel	P. herring	All CPS
65	08/21/2016 22:06	38.395	-123.638		3.037	4.673	27.190		34.900
66	08/22/2016 02:22	38.515	-123.951		338.270	1785.712	512.157		2636.139
67	08/22/2016 22:11	37.939	-122.974	68.425	0.118	0.138	0.178		68.859
68	08/23/2016 01:09	37.935	-123.169						
69	08/23/2016 03:41	37.854	-123.401				0.034		0.034
70	08/23/2016 20:40	37.419	-122.749	0.543					0.543
71	08/23/2016 22:58	37.581	-122.801	232.462	1.308	0.354			234.124
72	08/24/2016 02:42	37.431	-123.189						
73	08/24/2016 21:13	36.940	-122.204	6.688			0.009		6.697
74	08/25/2016 00:27	36.767	-122.109						
75	08/25/2016 03:13	36.760	-122.420				0.229		0.229
76	08/25/2016 22:20	36.589	-122.684				0.040		0.040
77	08/26/2016 01:19	36.639	-122.463				1.509		1.509
78	08/26/2016 04:07	36.518	-122.441						
79	08/26/2016 21:44	36.101	-122.204				0.046		0.046
80	08/27/2016 01:38	36.119	-121.733		0.092				0.092
81	08/27/2016 03:21	36.026	-121.679	0.015					0.015
82	08/27/2016 20:48	35.597	-121.573	10.288	0.006				10.295
83	08/27/2016 23:13	35.732	-121.538	25.507	0.046	0.025			25.578
84	08/28/2016 02:21	35.723	-121.867	36.422					36.422
85	08/28/2016 21:17	35.262	-121.552						
86	08/29/2016 00:51	35.401	-121.267						
87	08/29/2016 02:55	35.267	-121.179						
88	08/29/2016 22:25	35.080	-121.297			0.178			0.178
90	08/31/2016 00:55	34.311	-119.941						
91	08/31/2016 23:40	34.312	-120.175	0.313					0.313
92	09/01/2016 02:05	34.334	-120.355						
93	09/07/2016 19:24	34.108	-120.057	25.863		0.171			26.034
94	09/07/2016 23:12	34.163	-120.127						
95	09/08/2016 01:46	34.107	-120.302						
96	09/08/2016 19:49	33.949	-119.867	4.660		0.058	2.045		6.763
97	09/08/2016 22:49	33.950	-119.641	0.398			0.161		0.559
98	09/09/2016 02:05	33.974	-119.502	0.164					0.164

(continued)

Trawl	Date	Latitude	Longitude	Anchovy	Sardine	P. mackerel	J. mackerel	P. herring	All CPS
99	09/09/2016 20:01	33.983	-119.341	0.788		0.062	0.043		0.892
100	09/09/2016 23:14	33.927	-119.482	6.790		0.076	0.007		6.874
101	09/10/2016 02:44	33.965	-119.136	0.044		0.072			0.116
102	09/10/2016 19:16	33.649	-119.421	0.141	1.556	1.802			3.499
103	09/10/2016 23:49	33.661	-119.675	8.035	0.314	3.158	0.008		11.515
105	09/11/2016 19:12	33.807	-119.064	10.561	0.072	5.529			16.162
106	09/12/2016 00:21	33.742	-118.810	0.029		0.799			0.828
107	09/12/2016 03:40	33.952	-118.695	0.259			0.048		0.308
108	09/12/2016 19:22	33.394	-119.221	12.005			0.372		12.377
109	09/12/2016 23:18	33.395	-119.414	1.863			0.134		1.997
110	09/13/2016 02:03	33.323	-119.137			0.004			0.004
111	09/13/2016 19:05	33.438	-118.674	0.008			0.014		0.022
112	09/13/2016 22:30	33.273	-118.830	0.032		0.014	0.032		0.079
113	09/14/2016 01:58	33.269	-118.594	0.145			0.002		0.146
114	09/14/2016 19:22	33.414	-117.806	0.298		0.131			0.430
115	09/14/2016 23:19	33.400	-118.005	1.159		0.124			1.282
116	09/15/2016 02:03	33.274	-117.801	0.310		0.035			0.346
117	09/15/2016 20:02	33.016	-117.806	0.100					0.100
118	09/15/2016 23:33	32.791	-117.832				0.018		0.018
119	09/16/2016 02:32	32.968	-117.734	0.148					0.148
120	09/16/2016 19:08	32.687	-117.725						
121	09/16/2016 22:56	32.699	-117.501	8.284	0.032				8.316

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