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Results of the Acoustic-Trawl Survey of Walleye Pollock (*Gadus chalcogrammus*) in the Gulf of Alaska, May-August 2019 (DY2019-06)

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Results of the Acoustic-Trawl Survey of Walleye Pollock (*Gadus chalcogrammus*) in the Gulf of Alaska, May-August 2019 (DY2019-06)

by

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ABSTRACT

Scientists from the Midwater Assessment and Conservation Engineering (MACE) Program of the Alaska Fisheries Science Center's (AFSC) Resource Assessment and Conservation Engineering (RACE) Division conducted an acoustic-trawl (AT) survey of the Gulf of Alaska (GOA) shelf to estimate the distribution and abundance of walleye pollock (*Gadus chalcogrammus*) in summer 2019. Previous surveys of the GOA have also been conducted by the MACE program during the summers of 2003, 2005, 2011, 2013, 2015, and 2017. The 2019 survey covered the shelf from the Islands of Four Mountains to Yakutat Trough including many bays and troughs. Surface water temperatures across the GOA shelf from the ships flow-thru seawater system averaged 12.0°C, approximately 0.4°C warmer than in 2017 (mean 11.6°C), 0.2°C cooler than in 2015 (mean 12.2°C), and 1.4°C warmer than in 2013 (mean 10.6°C), which were the only other surveys with comparable coverage. Backscatter was attributed to species and size based on the selectivity-corrected catch of the nearest trawl haul. The estimated abundance of age-1+ pollock for the entire surveyed area was 4.64 billion fish weighing 593,572 metric tons (t), less than half of the 2017 estimated biomass. The majority of the pollock biomass was observed on the continental shelf (72%), Shelikof Strait (17%), the Shumagin Islands area (3%), and south of Kodiak Island in Barnabas Trough (6%). The observed pollock biomass consisted primarily of age-7 fish (34%) from the 2012 year class as well as age-1 (18%) and age-2 (31%) fish. Compared to previous summer surveys of the GOA, pollock weight at length was similar, but length and weight at age were slightly smaller than in 2013 and 2015. Abundance and biomass estimates were also calculated for Pacific ocean perch (*Sebastes alutus*; 218.0 million fish weighing 144,045 t), capelin (*Mallotus catervarius*; 5.29 billion fish weighing 16,525 t), and Pacific herring (*Clupea pallasii*; 1.77 billion fish weighing 135,504 t). The abundance of backscatter from euphausiids increased slightly relative that observed in 2017.

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INTRODUCTION

Scientists from the Midwater Assessment and Conservation Engineering (MACE) Program of the Alaska Fisheries Science Center's (AFSC) Resource Assessment and Conservation Engineering (RACE) Division conduct acoustic-trawl (AT) stock assessment surveys to estimate the abundance and distribution of walleye pollock (*Gadus chalcogrammus*) in Alaska waters. Annual surveys of pre-spawning aggregations in the Gulf of Alaska (GOA) are conducted during late winter and early spring. AT surveys were conducted in Chiniak and Barnabas troughs east of Kodiak Island during the summers of 2000-2006 to explore species spatial distribution relative to environmental conditions (Hollowed et al. 2007, Logerwell et al. 2007) and the effect of commercial fishing on walleye pollock abundance (Walline et al. 2012, Wilson et al. 2003). Expanded AT summer surveys to estimate walleye pollock distribution and abundance across the GOA were carried out in summers of 2003, 2005, and biennially since summer 2011. Surveys were abbreviated due to budget restrictions in 2003, and ship mechanical issues in 2005 and 2011. The 2013, 2015, 2017 (Jones et al. 2014, 2017 and 2019), and 2019 surveys covered the shelf and selected bays and troughs from the Islands of Four Mountains to Yakutat Trough. All summer surveys covered Shelikof Strait, Barnabas Trough, and Chiniak Trough. Estimates of the distribution and abundance of walleye pollock, Pacific ocean perch (POP; *Sebastes alutus*), and capelin (*Mallotus catervarius* (=*M. villosus*, see Mecklenburg et al. 2018)) have been made for the areas surveyed when they were sufficiently abundant to allow a reliable estimate. An estimate of the distribution and abundance of Pacific herring (*Clupea pallasii*) seen in the areas surveyed is included for 2019. Since 2011, an estimate of the distribution and abundance of backscatter attributed to euphausiids (or 'krill', primarily consisting of *Thysanoessa inermis, T. spinifera, and Euphausia pacifica*) has been provided.

This report presents the distribution and abundance estimates for walleye pollock, POP, capelin, Pacific herring, and euphausiids based on the summer AT survey conducted during June through August 2019. Acoustic system calibration results and observations of water temperature are also presented.

METHODS

The survey (cruise DY2019-06) was conducted between 30 May and 7 August on the Gulf of Alaska shelf extending from the Islands of Four Mountains in the west to Yakutat Trough in the east (Figs. 1-3). For this report, the area referred to as the "shelf" includes transects that are roughly perpendicular to the depth contours over the continental shelf. These transects extend in a generally north-south direction covering bottom depths of approximately 50 m to 1,000 m. Smaller-scale surveys were conducted in several bays and around islands including: Sanak Trough, Morzhovoi Bay, Pavlof Bay, the Shumagin Islands area (including Renshaw Point, Unga Strait, and West Nagai Strait), Mitrofania Island, Shelikof Strait, Alitak Bay, Barnabas Trough, Chiniak Trough, Marmot Bay, Resurrection Bay, and Prince William Sound. These areas were selected for inclusion in the survey due to the presence of pollock in prior surveys and catch records and recommendations from local fishermen. Survey itineraries and scientific personnel are listed in Appendices I and II. All activities were conducted aboard the NOAA ship *Oscar Dyson*, a 64-m stern trawler equipped for fisheries and oceanographic research. The survey followed established AT methods as specified in NOAA protocols for fisheries acoustics surveys and related sampling[1].

Acoustic Equipment, Calibration, and Data Collection

Acoustic measurements for abundance estimates were collected with a Simrad EK60 scientific echo sounding system (Simrad 2008, Bodholt and Solli 1992). The system electronics were housed in a permanent laboratory space dedicated to acoustics. Five split-beam transducers (18, 38, 70, 120, and 200 kHz) were mounted on the bottom of the vessel's retractable centerboard, which extended 9 m below the water surface. All frequencies were operated at pulse lengths of 0.5 ms at a ping interval of 1 second in water depths less than 500 m, or 2-3 seconds in waters deeper than 500 m. Acoustic backscatter data were collected to a maximum of 1,000 m.

[1] National Marine Fisheries Service (NMFS) 2014. NOAA protocols for fisheries acoustics surveys and related sampling (Alaska Fisheries Science Center), 26 p. Prepared by Midwater Assessment and Conservation Engineering Program, Alaska Fish. Sci. Center, Natl. Mar. Fish. Serv., NOAA.

Acoustic measurements were collected from 16 m below the sea surface to within 0.5 m of the sounder-detected bottom.

The EK60 echosounder was calibrated using the standard sphere method on 31 May and 5 August 2019. The vessel's dynamic positioning system was used to keep the vessel from drifting during calibrations. A tungsten carbide sphere (38.1 mm diameter) suspended below the centerboard-mounted transducers was used to calibrate the 38, 70, 120, and 200 kHz systems. A 64 mm diameter copper sphere was used to calibrate the 18 kHz system. A two-stage calibration approach was followed for each frequency. On-axis sensitivity (i.e., transducer gain and s_A correction) was estimated from split-beam target-strength and acoustic measurements when the sphere was placed in the center of the acoustic axis following the procedure described in Foote et al. (1987). Transducer beam characteristics (i.e., beam angles and angle offsets) were estimated by moving the sphere in a horizontal plane through the beam and then fitting these data to a second-order polynomial model of the beam pattern using the EK60's calibration utility (Simrad 2008, Jech et al. 2005). The equivalent beam angle (which is used to characterize the volume sampled by the beam) cannot be estimated from the calibration approach used because knowledge is required of the absolute position of the sphere (see Demer et al. 2015). Thus, the transducer-specific equivalent beam angle measured by the echosounder manufacturer, and corrected for the local sound speed (see Bodholt 2002), was used in data processing. Acoustic system gain and beam pattern parameters measured during the May and August calibrations were averaged in linear units to provide a final parameter set for data analysis (see results for details).

Raw acoustic data were recorded at five split-beam frequencies using Simrad EK60 software (v. 2.4.3). Acoustic telegram data were also logged with Echoview Echolog 500 (v. 8.0.1.0) software as a backup. Results presented in this report are based on post-processing the 38 kHz acoustic raw data using Echoview (v. 8.0.10432739).

Trawl Gear and Oceanographic Equipment

Midwater and near-bottom acoustic backscatter was sampled using an LFS1421 trawl and an Aleutian Wing 30/26 Trawl (AWT). This is the first survey in which the LFS1421 replaced the AWT as the primary sampling trawl. To determine if the species and size composition of catches varied between these two trawl types, which would affect survey results, back-to-back paired hauls were conducted throughout the survey area. The order in which the trawl types were fished at a given site was determined at random.

The headrope and footrope of the LFS1421 each measure 76.8 m, with meshes tapering from 650 cm in the forward sections to 8.9 cm in the codends. To increase retention of small organisms, the coded is fitted with a single 3.2 mm (1/8 in) codend liner. The AWT headrope and footrope each measure 81.7 m and mesh sizes taper from 325.1 cm in the forward section of the net to 8.9 cm in the codend, which is fitted with a 12.7 mm (0.5 in) codend liner. A poly Nor'eastern (PNE) bottom trawl, which is a 4-panel high-opening trawl equipped with roller gear and constructed with stretch mesh sizes that range from 13 cm in the forward portion of the net to 8.9 cm in the codend was available for sampling near-bottom organisms, but it was not utilized on this survey. The PNE codend was also fitted with a single 12.7 mm (0.5 in) codend liner. The AWT and PNE are described in detail by Guttormsen et al. (2010).

The LFS1421 and AWT were both fished with four 1.9 cm (0.75 in) diameter bridles (wire rope 82.3 m (270 ft) length for the AWT and synthetic rope 45.7 m (150 ft) length for the LFS1421) and 5 m^2 Fishbuster trawl doors [1,247 kg (2,750 lb) each]. The LFS1421 was fished either with no tom weights, 113 kg (250 lb), or 181 kg (400 lb) tom weights attached to each wingtip, while the AWT was solely fished with 113 kg (250 lb) tom weights. Average trawling speed was approximately 1.7 m/sec (3.3 knots) for both the LFS1421 and AWT. Vertical net openings and headrope depths were monitored with a Simrad FS70, third-wire netsonde attached to the headrope. The vertical net opening of the LFS1421 ranged from 11.5 to 21.3 m and averaged 16.7 m while fishing. The vertical mouth opening of the AWT ranged from 18 to 27 m and averaged 22.7 m while fishing.

To gauge escapement of smaller organisms from the net, recapture (or pocket) nets were placed at several locations along both the LFS1421 and AWT nets (Williams et al. 2011). The LFS1421 trawl was fitted with a total of nine recapture nets placed on forward (813 mm stretch mesh), middle (102 mm stretch mesh), and aft (102 mm stretch mesh) sections of the trawl, one recapture net on the top, bottom, and port panel of each section. The recapture nets were constructed from 3.2 mm (1/8 inch) mesh. One recapture net was originally fitted on the forward portion of the LFS1421 trawl (3.25 m stretch mesh) but was removed after 30 LFS1421 hauls due to low catch and damage this net caused to the trawl. The AWT was fitted with eight recapture nets placed on the top, bottom, port, and starboard panels of the middle (406 mm stretch mesh) and aft (102 mm stretch mesh) sections of the net. These data are being used in ongoing work to estimate and correct for the trawl selectivity of the nets and to gauge and correct for escapement of juvenile pollock and other small organisms (see Appendix IV).

A stereo camera system (CamTrawl; Williams et al. 2010) was also attached to the starboard panel forward of the codend on both the LFS1421 and AWT nets. The CamTrawl was used to capture stereo images for species identification and length measurement of individual fish as they pass through the net toward the codend. The CamTrawl data are useful in determining size and species composition of fish when distinct and separate backscatter layers are sampled by a trawl haul but could not be differentiated in the trawl catch. Images are viewed and annotated using procedures described in Williams et al. (2010). CamTrawl images on hauls 89 (shelfbreak near Shelikof Strait), 136 (Barnabas Trough), and 149 (Chiniak Trough) indicated that smaller pollock (< 30 cm FL) were only encountered in the upper water column and were not in the deeper targeted layer. In these cases only pollock $\geq$ 30 cm FL from the catch of those hauls were used in determining biomass in the deeper targeted layer closest to those hauls.

A Methot trawl (Methot 1986) was used to target midwater acoustic layers containing macro-zooplankton such as euphausiids, age-0 walleye pollock, and other larval fishes. The Methot trawl had a rigid square frame measuring 2.3 m on each side, which formed the mouth of the net. Mesh sizes were 2 by 3 mm in the body of the net and 1 mm in the codend. A 1.8 m dihedral depressor was used to generate additional downward force. A calibrated General Oceanics flowmeter was attached to the mouth of the net; the number of flowmeter revolutions

and the total time the net was in the water was used to determine the volume of water filtered during the haul. The Methot trawl was attached to a single cable fed through a stern-mounted A-frame. Real-time haul depths were monitored using a Simrad ITI acoustic link temperature-depth sensor attached to the bottom of the Methot frame. The Methot net was towed at an average speed of ~1.2 m/sec (2.3 knots).

Physical oceanographic data collected during the cruise included temperature profiles obtained with a Sea-Bird Electronics temperature-depth probe (SBE 39) attached to the headrope of the LFS1421 and AWT trawls and the bottom of the Methot frame. Additional temperature-depth measurements were taken from conductivity-temperature-depth (CTD) observations collected with a Sea-Bird CTD (SBE 911plus) system at calibration sites, at several predetermined stations, and at nightly opportunistic sites. Sea surface temperature data were measured using the ship's flow-thru Sea-Bird Electronics sea surface temperature system (SBE 38, accuracy $\pm$ 0.002°C) located near the ship's bow, approximately 1.4 m below the surface. At times when the SBE 38 was not operating, sea surface temperatures were taken from the Furuno T-2000 temperature probe (accuracy $\pm$ 0.2°C) located amidships 1.4 m below the surface. During this survey, the SBE 38 was used 99% of the time and the Furuno was used 1% of the time. These and other environmental data were recorded using the ship's Scientific Computing Systems (SCS).

Survey Design

The survey design consisted primarily of a series of parallel line transects, except where necessary to reorient tracklines to maintain a perpendicular alignment to the isobaths and work around landmasses. Zig-zag transects were used in Alitak Bay/Deadman Bay and Resurrection Bay because of the narrow aspect ratio of the bays. Coverage and transect spacing were chosen to be consistent with previous surveys in each area. Acoustic and trawl data used in abundance estimation were collected during daylight hours (on average between 05:30 and 23:00 local time during the survey). Nighttime activities included collection of additional physical oceanographic data, and work with other specialized sampling devices (e.g., variance of rockfish abundance estimates in untrawlable habitat using repeat lowered camera deployments within a 1 km^2 area).

Trawl hauls were conducted to identify the species composition of acoustically observed fish aggregations and to determine biological characteristics of pollock and other specimens. Catches were sorted to species or group and weighed. When large numbers of juvenile pollock mixed with adult pollock were encountered in a haul, the predominant size groups were subsampled separately (e.g., age-1 vs. adults). Sex, length, body weight, maturity, ages (otoliths) and gonad measurements were taken from a random subset of pollock within each size group. Gonad maturity was determined by visual inspection and was categorized as immature, developing, mature (pre-spawning), spawning, or spent (post-spawning)[2]. Otoliths collected were stored in 50% glycerol/thymol/water solution and read by AFSC Age and Growth Program researchers to determine ages.

Pollock and other fishes were measured to the nearest 1 mm fork length (FL), or standard length (SL) for small specimens, with an electronic measuring board (Towler and Williams 2010). All fish lengths are reported as FLs in this report. Lengths were converted to FL using SL to FL regressions if necessary. Other invertebrate organisms (e.g., jellyfish, squid) were measured to the nearest 1 mm length using accepted measurements for their class (e.g. jellyfish bell diameter, squid mantle length). An electronic motion-compensating scale (Marel M60) was used to weigh individual organisms to the nearest 2 g. Trawl station information and biological measurements were electronically recorded in the Catch Logger for Acoustic Midwater Surveys (CLAMS) database. Each pocket net catch was logged separately in a manner similar to the codend catch.

The catch from Methot trawl hauls was transferred to a large tote. Large organisms (such as jellyfish) and small fishes were removed, identified, weighed, and measured. The remainder of the plankton catch was placed on a 1-mm mesh screen and weighed. A subsample of the zooplankton mixture was then weighed and sorted into broad taxonomic groups for which a count and weight were determined. A second subsample was weighed and preserved in a 5%

[2] Groundfish Survey and Species Codes. 2019. RACE Division, AFSC, NMFS, NOAA; 7600 Sand Point Way NE, Seattle, WA 98115. Available online: https://www.fisheries.noaa.gov/resource/document/groundfish-survey-species-code-manual-and-data-codes-manual.

buffered formalin solution for more detailed enumeration at the Polish Sorting Center in Szczecin, Poland.

Data Analysis

Processing of Acoustic Data

Although acoustic data were recorded at five frequencies, the results of this report and the survey time series are based on the 38 kHz data. The sounder-detected bottom was calculated by averaging the bottom detections for all five frequencies (Jones et al. 2011) and then carefully examined to remove bottom integrations. A minimum S_v threshold of –70 dB re 1 m^{-1} was applied to the 38 kHz acoustic data. Data were averaged at 0.5 nmi horizontal by 10 m vertical resolution intervals and exported to a database.

Associating Size and Species Composition with Acoustic Backscatter

Walleye pollock abundance was estimated by combining acoustic and trawl catch information. The analysis method employed here had three principal steps. First, backscatter was attributed to the trawl catch from nearest geographic haul locations within a stratum. Second, a correction estimate was made for species and size selectivity of the midwater net (based on relationships derived from the recapture nets, see Appendix IV; Williams et al. 2011). Third, backscatter was converted to estimates of abundance from the nearest-haul catch association (step 1) and sample corrections (step 2).

More specifically, acoustic backscatter was assigned to strata based on the appearance and vertical distribution of the aggregations in echograms. Strata containing backscatter not considered to be from pollock or other species to be scaled to biomass (e.g., the near-surface mixture of unidentifiable backscatter, backscatter with frequency response indicative of euphausiids or myctophiids (De Robertis et al. 2010), or near-bottom backscatter "haystack" morphology indicative of some rockfishes that could not be sampled) were excluded from further analyses. Each trawl haul was associated with a stratum, and the backscatter at a given location was associated with the species and size composition of the geographically nearest haul within that stratum (see De Robertis et al. 2017b for details). For example, juvenile pollock are often

found at shallow depths in dense schools in many areas and a diffuse layer of adult pollock are often found at deeper depths within a similar area. In this case, the backscatter dominated by aggregations of juveniles would be assigned to a shallow stratum (A) and the backscatter dominated by adult layers would be assigned to a deep stratum (B). Hauls that sampled the shallow layer would be assigned to stratum A, and hauls that sampled the deeper layer would be assigned to stratum B. Backscatter would be converted to abundance by species and size within a stratum using the selectivity-corrected catch composition from the geographically nearest trawl in that stratum as described below (see Appendix III for detailed description of this method).

Abundance Calculations

Fish abundance was calculated by combining species and size compositions from the hauls with acoustic backscatter data following the approach described in De Robertis et al. (2017b) and in Appendix III. A series of target strength (TS) to length relationships from the literature (Table 1) were used along with size and species distributions from trawl catches to estimate the proportion of the observed acoustic scattering attributable to each of the species captured in the hauls. For abundant species (e.g., contributing >5% of the numbers or weight of the total catch), the most appropriate TS to length relationship available in the literature was used for that species. Other, less abundant taxa, were assigned to one of five generic categories: fishes with swim bladders, fishes without swim bladders, jellyfish, squid, and pelagic crustaceans.

Pollock, capelin, POP, and herring contributed more than 5% of the catch in DY2019-06 by weight or numbers. Therefore, a more specific TS relationship was used for pollock, capelin, and herring in the analysis (Table 1). However, a more specific TS relationship is not available for Pacific ocean perch, so the relationship for generic fish with swim bladders, which has been used in other studies of rockfishes (e.g., Jones et al., 2012, Stanley et al., 2000) was used.

Selectivity Correction

Previous research has found that smaller fish are less likely to be retained in large midwater trawls than larger fish (Williams et al. 2011). To correct for this difference in retention, trawl selectivity was estimated using recapture nets mounted on the midwater nets (Appendix IV). The counts and weights of animals caught in the recapture nets were expanded to provide an

estimate of escapement from the entire trawl. The catch of all species was corrected for the estimated probability of escapement by dividing the abundance of a given species and size class by the estimated probability of retention of that species and size class. To generate trawl selectivity correction functions for all organisms in the catch, the species and size selectivity of the survey trawl was accounted for in the acoustic-trawl abundance estimate (e.g., De Robertis et al. 2017a). Species-specific selectivity functions were estimated for the most abundant species. More generic selectivity functions obtained by pooling species were applied to less abundant species (De Robertis et al. 2017b). Thus the 2019 estimates reflect adjustments to the trawl-derived estimates of species and size composition which reflect the estimated probability of retention of all organisms in the catch. This is the first year that explicit selectivity corrections have been applied to all species in the analysis (See Appendix IV).

The primary analysis described above relies on the fewest assumptions to generate abundance estimates and is thus considered the most appropriate approach. Two alternative analyses were conducted to estimate the effect of adding the selectivity corrections and of accounting for the acoustic contributions of all species on the abundance estimates for walleye pollock and other target species. For example, in previous surveys, all species and size classes were assumed to have the same probability of capture in the net, and only the acoustic contributions of certain target species were considered. Thus, a secondary (no-selectivity) analysis was conducted, similar to the primary analysis except that it did not include a correction for escapement as computed from the recapture nets. That is, the selectivity (S_l) was set to 1 (see Eq. xi, Appendix IV) for all species and size classes. Finally, in most previous summer GOA analysis, only the acoustic contributions of dominant target species for which biomass estimates were being made were considered. Therefore, a third analysis was conducted in which only acoustic contributions from pollock, capelin, POP, and herring were included, and no selectivity corrections were applied.

Relative Estimation Error

In all areas where transects were parallel, relative estimation errors for the acoustic-based estimates were derived using a one-dimensional (1-D) geostatistical method (Petitgas 1993, Williamson and Traynor 1996, Walline 2007). “Relative estimation error” is defined as the ratio

of the square root of the 1-D estimation variance ($variance_{sum}$) to the biomass estimate (i.e., the sum of biomass over all transects, $biomass_{sum}$, kg):

$$Relative\ estimation\ error_{1\text{-}D} = \frac{\sqrt{variance_{sum}}}{biomass_{sum}} \quad . \qquad \text{(Eq. 1)}$$

Because sampling resolution affects the variance estimate, and the 1-D method assumes equal transect spacing, estimation variance is determined separately in each area with unique transect spacing. Relative estimation error for the entire survey (among n survey areas with different transect spacing) was computed by summing the estimation variance for each area j, taking the square root, and then dividing by the sum of the biomass over all areas, assuming independence among estimation errors for each survey area (Rivoirard et al. 2000):

$$Relative\ estimation\ error_{1\text{-}D\ survey} = \frac{\sqrt{\sum_{j=1}^{n} variance_{sum_j}}}{\sum_{j=1}^{n} biomass_{sum_j}} \quad . \qquad \text{(Eq. 2)}$$

A two-dimensional (2-D) geostatistical method (Petigas 1993, Rivoirard et al. 2000) was used to derive relative estimation errors in a few small survey areas where zig-zag transects were used (Deadman Bay, Resurrection Bay). The 2-D method differs from the 1-D method in that it computes a variance ($variance_{mean}$) for the mean biomass density ($biomass_{mean}$, kg nmi^{-2}) rather than the biomass sum (kg) in each area. Mean biomass density is multiplied by the surveyed area (nmi^2) to obtain the biomass estimate for that area (kg); likewise, 2-D relative estimation error is obtained as

$$Relative\ estimation\ error_{2\text{-}D} = \frac{variance_{mean_j} * area_j^2}{biomass_{mean_j} * area_j} \quad , \qquad \text{(Eq. 3)}$$

and over several zig-zag survey areas as

$$\textit{Relative estimation error}_{\textit{2-D survey}} = \frac{\sqrt{\sum_{j=1}^{n} variance_{mean_j} * area_j^2}}{\sum_{j=1}^{n} biomass_{mean_j} * area_j} \quad . \qquad \text{(Eq. 4)}$$

Equations 3 and 4 are analogous to Equations 1 and 2 after accounting for unit conversions.

The biomass estimate for the entire survey was obtained by summing biomass over all areas. However, the variance for that sum includes only the 1-D relative estimation errors, as it is not appropriate to combine 1-D and 2-D variance estimates since they involve different assumptions and may not be strictly comparable (Petitgas 1993). However, this is unlikely to bias the estimate in this case as 99% of the survey biomass total was observed in areas for which 1-D relative estimation errors were obtained.

Geostatistical methods were used to compute estimation error as a means to account for estimation uncertainty arising from the observed spatial structure in the fish distribution. These errors, however, quantify only transect sampling variability of the acoustic data (Rivoirard et al. 2000). Other sources of error (e.g., target strength, trawl sampling) were not evaluated.

Vertical Distribution and Height Above Bottom

To examine pollock vertical distribution two metrics were examined, 1) mean weighted depth (*MWD*) from the surface and 2) height above bottom (*HAB*) of pollock. *MWD* in each along-track interval *i* is computed as

$$MWD_i = \sum_j \left(\left(\frac{B_{i,j}}{\sum_j B_{i,j}} \right) d_{i,j} \right) \quad , \qquad \text{(Eq. 5)}$$

where $B_{i,j}$ is observed biomass in 0.5 nmi along-track interval *i* and 10 m depth bin *j*, and *d* is the depth in meters of bin *i* from the sea surface. The height above bottom (*HAB*) is computed in a similar fashion:

$$HAB_i = \sum_j \left(\left(\frac{B_{i,j}}{\sum_j B_{i,j}} \right) h_{i,j} \right) \quad , \qquad \text{(Eq. 6)}$$

where the terms are as described above and *h* is the height in meters of bin *i* above the sounder-detected seafloor echo. *MWD* and *HAB* were summarized for a given survey area by first summing biomass over all intervals *i* in the area and then computing the mean weighted depth or height above bottom using the equations above.

Euphausiid Abundance and Distribution

Euphausiid backscatter was isolated by comparing the relative frequency response at 18, 38, 120, and 200 kHz, following Simonsen et al. (2016) using custom-built programs in both Echoview and Matlab (Mathworks, Natick, Massachusetts, USA). Methot trawl catches were used to confirm the presence of euphausiids in the water column, determine euphausiid length and species composition, and help to ground-truth the multifrequency acoustic analyses.

RESULTS and DISCUSSION

Acoustic System Calibration

The acoustic system was calibrated at the beginning of the survey on 30 May and at the end of survey on 5 August (Table 2). The 38 kHz transducer showed no significant differences in gain parameters or beam pattern characteristics between calibrations, confirming that the acoustic system was stable throughout the cruise. The gain values from the two calibrations were averaged in the linear domain and used in post-processing.

AWT/LFS Net Comparison

A total of 52 hauls (26 hauls per net) were conducted to compare the catch of the LFS1421 and AWT trawls. The 1/8-inch codend liner in the LFS1421 retains smaller organisms than the 1/2-inch codend liner in the AWT, but the overall species compositions of the paired catches were similar (Fig. 4). Comparison of the length frequency of pollock between the LFS1421 and AWT trawl hauls suggested that catch of the two nets is very similar and the proportion of pollock captured at length does not differ appreciably between the LFS1421 and AWT nets (Fig. 5).

Net Selectivity and Accounting for Other Species

The results presented here account for escapement of organisms from the net based on the LFS1421 selectivity values obtained from catches in the codend and recapture nets. These results also reflect adjustments to the backscatter allotted to the target species by removing backscatter that would be attributable to other species based on the catch composition of the nearest haul and their estimated scattering properties. Analyses in previous years have not fully taken these factors into account, hauls were assigned to backscatter using a different method, and the contribution from other species was assumed negligible or adjusted for in a different manner. Thus alternate analyses were conducted that would more closely approximate analyses in prior years for comparison, and resulting numerical abundances and percent difference from the reported total are presented in Table 3. Column A in Table 3 represents the analysis with all species and selectivity accounted for and are the results presented throughout this report. Column B in Table 3 represents analysis of all species but does not include the effect of net selectivity and is similar to the analysis that was performed in 2017. Column C in Table 3 represents an analysis that only includes the four target species (pollock, capelin, POP, and herring; does not account for any other organisms in the water column), does not include the effect of net selectivity, and is most similar to analyses performed for surveys conducted in 2015 and earlier.

For walleye pollock these differences in methodology have little effect on abundance (Table 3; from a 2% decrease with no selectivity accounted for in analysis B, to a 1% increase if only target species are accounted for and no selectivity in analysis C), but for other species, there is a larger effect. Ignoring selectivity as in analysis B under-estimates capelin abundance by 58% and herring by 13%, which would be expected for smaller species. Ignoring selectivity plus the contribution of other organisms to the backscatter as in analysis C underestimates capelin abundance by 25%, but overestimates herring and POP by up to 13%. It is our goal to eventually re-compute prior years in the time series as these considerations impact abundance and biomass estimates of reported species.

Walleye Pollock Weight, Length, Maturity, and Age

In summer 2017, unusual and significant amounts of age-0 pollock were seen in CamTrawl images, but not retained in the AWT codend (with ½-inch liner) and were determined to account for a substantial proportion of the observed backscatter (>73% of all backscatter attributed to pollock). However, in 2019 age-0 pollock were comparatively scarce (4% of backscatter attributed to pollock) based on the LFS1421 trawl catches with a smaller (1/8-inch mesh) codend liner and CamTrawl observations. Age-0 pollock abundance in summer 2019 was largely accounted for with LFS1421 selectivity corrections. Therefore, adjustments to the observed backscatter based on proportion of age-0 pollock in CamTrawl images, as was done in 2017 when the age-0 pollock were poorly sampled by the AWT, were not necessary.

Both weight and length were measured on a total of 4,643 walleye pollock during the 2019 GOA survey (Table 4). Weight at length was observed to be similar throughout the surveyed areas, and pollock were grouped into a single weight at length key for the entire survey. Walleye pollock weight at length during the 2019 GOA survey was similar to that from previous surveys for fish less than or equal to 40 cm FL. Fish greater than 40 cm FL were similar to fish measured in 2015 but were slightly lighter at length compared to similar-sized fish in 2013 and 2017 (Fig. 6).

Almost all (~99%) male and female pollock examined throughout the survey were in the developing or spent stages of maturity (Fig. 7), with the remaining individuals primarily in the immature or mature stages. There is some ambiguity as to exactly when the stage of maturity reverts from spent back to developing prior to active spawning again. No actively spawning individuals were identified.

Otoliths were collected from a total of 1,939 walleye pollock (Table 4), of which 1,930 were aged. A single length at age key was used for the entire survey. Compared to most previous surveys, length at age was similar for pollock aged 1-3, but pollock aged 4 and older were shorter than in previous years except 2017 (Table 5; Fig. 8). Additionally, mean weight at age

was similar to previous surveys for pollock aged 1-3, but age-4 and older pollock in 2019 generally weighed less than in previous years (Table 6; Fig. 9).

Pollock Biomass by Management Area

The individual survey areas outlined below do not necessarily follow the boundaries of the National Marine Fisheries Service (NMFS) reporting areas. Some areas, such as the expansive shelf survey, Mitrofania, and Shelikof Strait extend across multiple reporting areas. Because walleye pollock are managed by reporting area, survey results are summarized by reporting area in this section. Table 7 presents the biomass of pollock within each reporting area, along with the geographic survey area from which they were derived, for all pollock and for age-7 (2012 YC) pollock (between ~41 and 64 cm FL).

The total estimated amounts of age-1+ walleye pollock for the GOA summer acoustic-trawl survey were 4.64 billion fish weighing 593,572 t (Table 8). The relative estimation error of the overall biomass based on the 1-D geostatistical analysis was 5.5%. The survey spanned four different reporting areas. Pollock biomass was distributed predominately across areas 610, 620, and 630 with 20%, 36% and 35% in each area, respectively, and with 7% in 640. The majority of pollock on the shelf transects were detected in NMFS reporting area 630 (37%), similar the amount in that area in 2017. However, approximately 27% of shelf pollock were detected in reporting area 620 (slightly higher than the 23% in 2017), and roughly 24% of pollock on the shelf were detected in area 610 (down from 33% in 2017), and 10% were in area 640 (Table 7). The first transect extended to the west outside of area 610 where approximately 2% of the shelf pollock biomass was located. Approximately 34% of the total walleye pollock biomass in the entire GOA survey was attributed to age-7 fish from the 2012 year class (Table 7).

GOA Shelf and Slope from the Islands of Four Mountains to Yakutat Trough

The GOA shelf from the Islands of Four Mountains to the Yakutat Trough (Figs. 1-3) was surveyed between 4 June and 4 August. The survey area encompassed 153,476.2 km^2 (44,746.5 nmi^2) covering the shelf and shelf break between approximately the 50 and 1,000 m

depth contours. The mean depth across the shelf was 210.0 m. Acoustic backscatter was measured along 3,314.8 km (1,789.9 nmi) of trackline on 41 transects spaced 46.3 km (25 nmi) apart.

Surface water temperatures across the GOA shelf measured by the ship's flow-thru seawater system ranged from 5.7° to 16.8°C, increasing from west to east with an overall average of 12.0°C (Fig. 10a), approximately 0.4°C warmer than in 2017 (mean 11.6°C), 0.2°C cooler than in 2015 (mean 12.2°C), and 1.4°C warmer than in 2013 (mean 10.6°C). Inferences about spatial patterns in surface temperatures are confounded by the broad time span of the survey: the shelf was sampled over 2 months and generally progressed from west to east as water temperatures throughout the region were increasing to summer highs. Temperatures at 100 m depth from SBE 39 probes on the fishing gear ranged from 5.4° to 7.3°C and averaged 6.4°C (Fig. 11), approximately 0.5°C warmer than in 2017 (mean 5.9°C) but similar to temperatures at 100 m in 2015 (mean 6.6°C). Bottom temperatures from 26 CTD deployments on the shelf averaged 5.7°C with an average bottom depth of 300 m (Fig. 10b), 0.4°C warmer than bottom temperatures from CTD deployments across the shelf in 2017 (mean 5.3°C), and 0.1°C cooler than bottom temperatures from CTD deployments across the shelf in 2015 (mean 5.8°C).

Biological data and specimens were collected along the GOA shelf from 41 LFS1421 hauls (Tables 4, 9, and 10; Figs. 1-3). Walleye pollock was the most abundant species by weight (49.5%) caught on the shelf in the midwater hauls (Table 10) followed by *Chrysaora* sp. jellyfish (18.1%) and Pacific herring (15.2%). Euphausiids were the most abundant species captured by number (28.8%) in the midwater hauls on the shelf transects, followed by pollock (25.8%) and capelin (21.4%).

Age-1+ walleye pollock observed on the GOA shelf ranged in length from 13 to 66 cm FL with modes at 18, 29, and 47cm FL (Tables 11 and 12; Fig. 12). Pollock ranged in age from 1 to 14, with age-1 fish comprising the vast majority by number (59%) and age-7 fish comprising the majority of the biomass (39%; Tables 13 and 14). Walleye pollock were distributed across the shelf, with areas of greatest density between the Shumagin Islands and Shelikof Strait south of Mitrofania Island, and east of Kodiak Island on the western portion of Portlock Bank

(Figs. 13-15). The mean weighted depth of pollock on the shelf transects was approximately 127 m from the surface and 110 m above the bottom.

The estimated amounts of age-1+ pollock for the GOA shelf were 2.61 billion fish weighing 418,185 metric tons (t; Table 8), approximately 70% of the total pollock biomass observed in this survey and 37% of the estimate in 2017 for the same shelf area. The relative estimation error of the biomass resulting from the 1-D geostatistical analysis was 6.2%.

Sanak Trough

Sanak Trough (Fig. 1) was surveyed on 9-10 June along 83.5 km (45.1 nmi) of trackline on five transects spaced 7.4 km (4 nmi) apart encompassing a total area of 618.3 km^2 (180.3 nmi^2). Bottom depths in Sanak Trough ranged from 50 to 167 m and averaged 122.3 m. Surface temperatures in Sanak Trough averaged 8.3°C (Fig. 10), 0.1°C cooler than temperatures in 2017 (8.4°C), and 0.7°C cooler than temperatures in 2015 (9.0°C), and 1.4°C warmer than 2013 (6.9°C). The average temperature at 50 m depth from SBE 39 probes on the fishing gear was 6.7°C (Fig. 11), 1.2°C warmer than in 2017 (mean 5.5°C), and 0.5°C warmer than in 2015 (mean 6.2°C).

Two midwater hauls were conducted in Sanak Trough (Tables 4, 9, and 15; Fig. 1). Walleye pollock was the most abundant species in the catch by weight (86.2%) and euphausiids were the second most abundant species caught by weight (9.6%) in Sanak Trough (Table 15). Euphausiids (98.0%) and age-1+ pollock (1.9%) were the most abundant species by number caught in Sanak Trough, respectively. Walleye pollock captured in Sanak ranged in length from 12 to 51 cm FL with a major mode at 16 cm FL and smaller modes at 25 and 47 cm FL (Tables 11 and 12; Fig. 12). Pollock caught in Sanak Trough were aged 1-10, with age-1 fish most abundant by number (92%) and biomass (53%; Tables 13 and 14).

Walleye pollock biomass in Sanak Trough was low with the greatest abundance in the southern portion of the surveyed area (Fig. 13). The mean weighted depth of pollock in Sanak Trough was approximately 94 m from the surface and 44 m above the bottom. The estimated

amounts of age-1+ pollock for Sanak Trough were 27.17 million fish weighing 1,317 t (Table 8), approximately 36% of the 2017 estimate. The relative estimation error of the biomass based on the 1-D geostatistical analysis was 16.0%.

Morzhovoi Bay

Morzhovoi Bay (Fig. 1) was surveyed on 10 June. Acoustic backscatter in Morzhovoi Bay was measured along 38.7 km (20.9 nmi) of trackline encompassing an area of 286.9 km^2 (83.6 nmi^2). Transects were spaced 7.4 km (4 nmi) apart and bottom depths ranged from 50 to 130 m and averaged 83.9 m. Morzhovoi Bay had average surface temperatures of 8.5°C (Fig. 10), 0.1°C warmer than temperatures in 2017 (8.4°C), 0. 5°C cooler than temperatures in 2015 (9.0°C), and 1.8°C warmer than temperatures in 2013 (6.7°C). Trawl hauls did not extend to 100 m depth but temperatures in Morzhovoi Bay at 50 m were 6.6°C (Fig. 11), approximately 0.3°C warmer than in 2017 (6.3°C), and 0.4°C warmer than in 2015 (6.2°C).

Biological data and specimens were collected in Morzhovoi Bay from one midwater haul (Tables 4, 9, and 16; Fig. 1). Walleye pollock was the most abundant species caught by weight (99.6%) and number (98.8%; Table 16). Walleye pollock in Morzhovoi Bay ranged from 13 to 57 cm with modes at 15, 33, and 51 cm FL (Tables 11 and 12; Fig. 12). Pollock caught in Morzhovoi Bay were aged 1-11, with age-1 pollock accounting for 94% of the total number and 52% of the total biomass (Tables 13 and 14).

Walleye pollock abundance was low and evenly scattered throughout Morzhovoi Bay (Fig. 13). The mean weighted depth of pollock in Morzhovoi Bay was approximately 75 m from the surface and 17 m above the bottom. The estimated amount of age-1+ pollock in Morzhovoi Bay was 31.27 million fish weighing 1,592 t (Table 8), similar to the estimate for Morzhovoi Bay in 2017. The relative estimation error of the Morzhovoi biomass based on the 1-D geostatistical analysis was 14.7%.

Pavlof Bay

Pavlof Bay (Fig. 1) was surveyed on 13 June. Acoustic backscatter in Pavlof Bay was measured along 50.2 km (27.1 nmi) of trackline encompassing an area of 371.6 km^2 (108.3 nmi^2). Transects were spaced 7.4 km (4 nmi) apart and bottom depths ranged from 53 to 133 m and averaged 94.3 m. Pavlof Bay had average surface temperatures of 8.9°C (Fig. 10), similar to temperatures in 2017 but 1.3°C cooler than temperatures in 2015 (10.2°C), and 1.5°C warmer than temperatures in 2013 (7.4°C). No trawl hauls were conducted in Pavlof Bay because of mechanical issues with the trawl warp that occurred during that part of the survey so catch and composition information from the nearest haul conducted in the Shumagin Islands was applied to backscatter in Pavlof Bay.

Walleye pollock in Pavlof Bay were found at low abundance but fairly evenly scattered throughout the survey area with one area of greater abundance in the north near the mouth of the bay (Fig. 13). The mean weighted depth of pollock in Pavlof Bay was approximately 76 m from the surface and 33 m above the bottom. The estimated amount of age-1+ pollock in Pavlof Bay was 2.41 million fish weighing 1,666 t, slightly higher than the estimate for Pavlof Bay in 2017 (Table 8). The relative estimation error of the biomass based on the 1-D geostatistical analysis was 12.4%.

Shumagin Islands

The West Nagai Strait, Unga Strait, Renshaw Point, and Shumagin Trough areas in the Shumagin Islands (Fig. 1) were surveyed from 13 to 18 June. Acoustic backscatter was measured along 346.0 km (186.8 nmi) of trackline from 25 transects encompassing an area of 2,726.7 km^2 (795.0 nmi^2). Transects were spaced 5.6 km (3.0 nmi) apart in West Nagai Strait, Unga Strait, Renshaw Point, and inner Shumagin Trough, and 11.1 km (6.0 nmi) apart in the outer Shumagin Trough area. Bottom depths in the Shumagin Islands area ranged from 54 to 225 m and averaged 137.8 m. Surface water temperatures in the Shumagin Islands area averaged 8.9°C (Fig. 10), 0.9°C cooler than temperatures in 2017 (9.8°C), 1.6°C cooler than temperatures in 2015 (10.5°C), and 0.4°C warmer than temperatures in 2013 (8.4°C). Temperatures at 100 m depth

from SBE 39 probes on the fishing gear in this area averaged 6.1°C (Fig. 11), approximately 1.7°C warmer than 2017 (4.4°C), and 0.4°C warmer than 2015 (5.7°C).

Biological data and specimens were collected in the Shumagin Islands in nine midwater hauls (Tables 4, 9, and 17; Fig. 1). Walleye pollock was the most abundant species caught in midwater hauls by weight (95.2%), and capelin (1.6%) was the second most abundant species caught by weight in the Shumagin Islands (Table 17). Euphausiids (25.7%) were the most abundant species caught by number in the Shumagin Islands followed by capelin (25.5%). Walleye pollock lengths in the Shumagin Islands ranged from 14 to 55 cm FL with a dominant mode at 47 cm FL (Tables 11 and 12; Fig. 12). Pollock caught in the Shumagin Islands were aged 1 - 10, with age-7 fish accounting for 53% by number and 65% of the biomass (Tables 13 and 14).

Walleye pollock in the Shumagin Islands area were most abundant in the Unga Strait area and in Shumagin Trough near the mouth of Stepovak Bay (Fig. 13). The mean weighted depth of pollock in the Shumagin Islands was approximately 77 m from the surface and 60 m above the bottom. The estimated amounts of age-1+ pollock for the Shumagins Islands area were 29.04 million fish weighing 17,256 t (Table 8), a slight increase (1%) from the 2017 estimate. The pollock abundance in the Shumagin Islands accounted for approximately 3% of the entire GOA summer survey pollock biomass. The relative estimation error of the biomass based on the 1-D geostatistical analysis was 14.0%.

Mitrofania Island

The AT survey near Mitrofania Island (Fig. 1) was conducted on 5 July along 57.8 km (31.2 nmi) of trackline from three transects spaced 14.8 km (8.0 nmi) apart encompassing an area of 855.8 km^2 (249.5 nmi^2). Bottom depths near Mitrofania Island ranged from 60 to 173 m and averaged 134.2 m. Surface water temperatures near Mitrofania Island averaged 10.8°C (Fig. 10), 1.1°C warmer than temperatures in 2017 (9.7°C), 0.1°C warmer than temperatures in 2015 (10.7°C), 3.3°C warmer than temperatures in 2013 (7.5°C). Temperatures at 100 m depth from SBE 39 probes on the fishing gear in Mitrofania averaged 6.7°C (Fig. 11), approximately 0.6°C

warmer than 2015 (6.1°C). No temperature data were recorded from trawl hauls in this area in 2017.

Biological data and specimens were collected from one midwater haul in the Mitrofania area (Tables 4, 9, and 18; Fig. 1). Walleye pollock was the most abundant species caught (84.3%; Table 18) by weight, followed by Chinook salmon (8.9%). Walleye pollock (age-0) was the most abundant species by number (63.9%) followed by age-1+ pollock (29.4%) and capelin (1.7%). Pollock lengths (age 1+) in Mitrofania ranged from 33 to 56 cm FL with a major mode at 47 cm FL (Tables 11 and 12; Fig. 12). Pollock caught near Mitrofania Island were aged 2-10, with age-7 fish accounted for 69% of the number and 71% of the biomass (Tables 13 and 14).

Walleye pollock near Mitrofania Island were patchy with the greatest abundance on the northern transects and decreasing as the survey progressed to the south (Fig. 14). The mean weighted depth of pollock near Mitrofania Island was approximately 121 m from the surface and 19 m above the bottom. The estimated amounts of age-1+ pollock for the Mitrofania Island area were 2.21 million fish weighing 1,604 t (Table 8), less than 4% of the amount that was seen in 2017. The relative estimation error of the biomass based on the 1-D geostatistical analysis was 16.1%.

Shelikof Strait

The Shelikof Strait sea valley (Fig. 2) was surveyed between 26 June and 7 July. Acoustic backscatter was measured along 16 transects spaced 27.8 km (15 nmi) apart along 975.3 km (526.6 nmi) of trackline encompassing an area of 27,094.6 km^2 (7,899.5 nmi^2). Bottom depths in Shelikof Strait ranged from 47 to 331 m and averaged 206.6 m. Surface water temperatures in Shelikof Strait averaged 11.4°C (Fig. 10), 0.4°C warmer than in 2017 (11.0°C), 0.5°C cooler than surface temperatures in 2015 (11.9°C), and 1.9°C warmer than in 2013 (9.5°C). Water temperatures at 100 m depth from SBE 39 probes on the fishing gear averaged 6.4°C (Fig. 11), 0.3°C warmer than in 2017 (6.1°C), and 0.2°C warmer than in 2015 (6.2°C).

Biological data and specimens were collected in Shelikof Strait from 12 midwater hauls (Tables 4, 9, and 19; Fig. 2). Walleye pollock was the most abundant species captured in the midwater trawls contributing 76.9% by weight and 69.0% by number (Table 19). Pacific herring was the second most abundant species caught by weight (11.4%) while eulachon (*Thaleichthys pacificus*) were the second most abundant species caught by number (16.8%) in the midwater trawls in Shelikof Strait. Two size classes of walleye pollock were abundant in Shelikof Strait: one ranging from 13 to 19 cm FL and the other from 20 to 39 cm FL with respective modes at 15 and 24 cm FL (Tables 11 and 12; Fig. 12). Walleye pollock from Shelikof Strait ranged from 1 to 14 years old, with age-1 fish comprising 69% of the numbers and 32% of the biomass, age-2 fish comprising 29% of the numbers and 48% of the biomass, and age-7 fish only comprising 1% of the numbers and 11% of the biomass (Tables 13 and 14).

Walleye pollock were predominantly distributed in the central portion of Shelikof Strait off the northwest corner of Kodiak Island and in the southern portion of the Strait between the Semidi Islands and Chirikof Island (Fig. 14). The mean weighted depth of pollock in Shelikof Strait was approximately 111 m from the surface and 107 m above the bottom. The estimated amounts of age-1+ pollock for Shelikof Strait were 1.64 billion fish weighing 106,327 t (Table 8), a 38% increase over the 2017 estimate. The pollock abundance in Shelikof Strait accounted for approximately 17% of the entire GOA summer survey pollock biomass, and increase from 5% in 2017. The relative estimation error of the biomass based on the 1-D geostatistical analysis was 14.4%.

Alitak and Deadman Bay

Alitak and Deadman bays (Fig. 2) were surveyed on 30 June with a zig-zag pattern into the narrow inner bay area. Acoustic backscatter was measured along 72.7 km (39.3 nmi) of trackline encompassing an area of 202.0 km^2 (58.9 nmi^2). Bottom depths ranged from 50 to 171 m and averaged 113.9 m. Surface water temperatures averaged 12.5°C (Fig. 10), 1.3°C warmer than temperatures in 2017 (11.2°C), 0.3°C warmer than temperatures in 2015 (12.2°C), and 2.1°C warmer than temperatures in 2013 (10.4°C). Water temperatures at 100 m depth from

SBE 39 probes on the fishing gear averaged 4.8°C (Fig. 11), 0.1°C warmer than in 2015 (4.7°C); hauls in 2017 did not go to 100 m depth and therefore can't be compared with those in 2019.

Biological data and specimens were collected from one AWT haul in Deadman Bay (Tables 4, 9, and 20; Fig. 2). Walleye pollock made up 97.0% by weight and 96.5% by number of the catch from the midwater trawl (Table 20). Pacific herring was the second most abundant species captured by weight (2.7%) and number (2.5%) in the area. The walleye pollock ranged in length from 17 to 63 cm FL with a mode at 28 cm FL (Tables 11 and 12; Fig. 12). Walleye pollock were found primarily in the inner Deadman Bay area of Alitak and were on average 105 m from the surface and 19 m above the bottom. Ages of walleye pollock from Alitak Bay ranged from 1 to 11 years old, with age-2 fish most abundant by number (80%) and biomass (71%; Tables 13 and 14).

The estimated amounts of age-1+ pollock for the Alitak/Deadman Bay area were 10.24 million fish weighing 1,893 t (Table 8), nearly three times greater than the Alitak/Deadman Bay estimate for 2017. The relative estimation error of the biomass based on the 2-D geostatistical analysis was 42.6%.

Barnabas Trough

Barnabas Trough (Fig. 2) was surveyed from 10 to 13 July along 12 transects spaced 11.1 km (6 nmi) apart encompassing 274.4 km (148.3 nmi; 3,052.9 km^2; 890.1 nmi^2). Depths in Barnabas Trough ranged from 41 to over 1,000 m and averaged 174.1 m. Surface water temperatures in Barnabas Trough averaged 12.2°C (Fig. 10), 0.9°C cooler than in 2017 (13.1°C), 0.4°C cooler than in 2015 (12.6°C), and 1.5°C warmer than in 2013 (10.7°C). Water temperatures at 100 m depth from SBE 39 probes on the fishing gear averaged 6.6°C (Fig. 11), approximately 0.4°C warmer than in 2017 (6.2°C), 0.1°C cooler than in 2015 (6.7°C).

Biological data and specimens were collected in Barnabas Trough from eight midwater trawls (Tables 4, 9, and 21; Fig. 2). Walleye pollock was the dominant species caught in the midwater hauls, contributing 74.2% by weight and 83.2% of the catch by number (Table 21).

Pacific herring was the second most abundant species caught by weight (12.9%, 99% of which was caught in haul 144 near the mouth of Ugak Bay), and number (10.4%) in Barnabas Trough. Pollock caught in Barnabas Trough ranged in length from 15 to 62 cm FL and had modes at 19, 30, and 48 cm FL (Tables 11 and 12; Fig. 12). Pollock caught in Barnabas Trough were aged 1-14, with age-1 fish most abundant and comprising 51% of the numbers but only 15% of the biomass, age-2 fish comprising 35% of the numbers and 36% of the biomass, and age-7 fish only comprising 6% of the numbers and 27% of the biomass (Tables 13 and 14).

Walleye pollock were evenly distributed throughout Barnabas Trough (Fig. 14) with a mean weighted depth of approximately 114 m from the surface and 67 m above the bottom. The estimated amounts of age-1+ pollock for Barnabas Trough were 215.27 million fish weighing 35,686 t (Table 8), a 29% decrease from the 2017 estimate but still approximately 6% of the entire GOA summer survey biomass estimate. The relative estimation error of the biomass based on the 1-D geostatistical analysis was 9.6%.

Chiniak Trough

Chiniak Trough (Fig. 2) was surveyed from 14 to 16 July. Acoustic backscatter was measured along seven transects spaced 11.1 km (6 nmi) apart covering 99.4 km (53.7 nmi; 1,104.3 km^2; 322.0 nmi^2) of trackline. Bottom depths ranged from 73 to 184 m and averaged 132.4 in Chiniak Trough. Surface water temperatures in Chiniak Trough averaged 11.5°C (Fig. 10), 0.4 °C warmer than in 2017 (11.1°C), 0.2°C warmer than in 2015 (11.3°C), 0.9°C warmer than in 2013 (10.8°C). Water temperatures at 100 m depth from SBE 39 probes on the fishing gear averaged 7.6°C (Fig. 11), approximately 0.9°C cooler than in 2017 (6.7°C), and 0.1°C warmer than in 2015 (7.6°C).

Biological data and specimens were collected from four midwater hauls in Chiniak Trough (Tables 4, 9, and 22; Fig. 2). Walleye pollock was the dominant species caught, contributing 58.2% by weight and 57.3% by number to the catch (Table 22). *Chrysaora* jellyfish were the second most abundant species by weight (26.3%) and age-0 walleye pollock were the second most abundant species by number (21.0%) caught in Chiniak Trough. Pollock caught in

Chiniak Trough ranged in length from 16 to 54 cm FL, with a dominant mode at 29 cm FL and smaller modes at 19 cm and 49 cm FL (Tables 11 and 12; Fig. 12). Pollock in Chiniak Trough ranged in age from 1 to 10 years old with age-2 fish most abundant by number (58%) and biomass (54%; Tables 13 and 14).

Walleye pollock were sparsely distributed throughout Chiniak Trough (Fig. 14) with a mean weighted depth of approximately 93 m from the surface and 51 m above the bottom. The estimated amounts of age-1+ pollock for Chiniak Trough were 25.91 million fish weighing 4,922 t (Table 8), a decrease of approximately 84% from the 2017 estimate. The relative estimation error of the biomass based on the 1-D geostatistical analysis was 7.7%.

Marmot Bay

Marmot Bay (Fig. 2) was surveyed 20-22 July. Acoustic backscatter in Marmot Bay was measured along 203.5 km (109.9 nmi) of trackline along 11 transects spaced 3.7 km (2.0 nmi) apart in the inner bay and Spruce Gully, 5 transects spaced 7.4 km (4.0 nmi) apart in the outer bay, and 2 transects spaced 2.78 km (1.5 nmi) apart in Izhut Bay encompassing a total area of 1,193.0 km^2 (347.8 nmi^2). Bottom depths ranged from about 43 to 256 m and averaged 138.3 m in Marmot Bay. Average surface water temperature in Marmot Bay was 11.3°C (Fig. 10), 0.6°C warmer than in 2017 (10.7°C), 0.7°C warmer than in 2015 (10.6°C), and 0.2°C warmer than in 2013 (11.1°C). Water temperatures at 100 m depth from SBE 39 probes on the fishing gear in Marmot Bay averaged 7.6°C (Fig. 11), 0.6°C warmer than in 2017 (7.0°C), and 0.4°C cooler than in 2015 (8.0°C).

Biological data and specimens were collected from five midwater hauls in Marmot Bay (Tables 4, 9, and 23; Fig. 2). Walleye pollock was the most abundant species caught by weight (40.6%), and Pacific herring was the second most abundant species (21.5%) caught in midwater hauls in Marmot Bay (Table 23). Unidentified juvenile smelt were the most abundant species captured by number (41.0%) and age-1+ pollock was the second most abundant species captured by number (25.4%) in the midwater hauls in Marmot Bay. Walleye pollock ranged in length from 12 to 51 cm FL with a primary mode at 19 cm FL and a secondary mode at 28 cm FL

(Tables 11 and 12; Fig. 12). Walleye pollock from Marmot Bay ranged in age from 1 to 10 years old with age-1 fish most abundant by number (84%) and biomass (57%; Tables 13 and 14).

Walleye pollock abundance was low but evenly distributed in Marmot Bay with the greatest amounts found in the outer bay (Fig. 14). The mean weighted depth of pollock in Marmot Bay was approximately 126 m from the surface and 34 m above the bottom. The estimated amounts of age-1+ pollock for Marmot Bay were 40.93 million fish weighing 2,792 t (Table 8), only slightly higher than the 2017 estimate. The relative estimation error of the Marmot biomass based on the 1-D geostatistical analysis was 13.4%.

Resurrection Bay

Resurrection Bay on the Kenai Peninsula (Fig. 3) was surveyed on 28-29 July along 79.1 km (42.7 nmi) of trackline using a zig-zag pattern and encompassed a total area of 219.7 km^2 (64.1 nmi^2). Bottom depths in Resurrection Bay ranged from 123 m to 293 m and averaged 232.0 m. Surface water temperatures averaged 14.6°C (Fig. 10), 2.2°C cooler than in 2015 (16.8°C). The temperature at 100 depth from SBE 39 probes on the fishing gear in the Resurrection Bay averaged 6.6°C (Fig. 11). No trawl hauls were conducted in Resurrection Bay in 2015 but hauls in two adjacent bays averaged 7.1°C at 100 m depth that year. Kenai Peninsula Bays were not surveyed in 2013 or 2017.

Biological collections were made with 1 midwater haul in Resurrection Bay (Tables 4, 9, and 24; Fig. 3). *Chrysaora* jellyfish was the most abundant species caught by weight (77.2%) and pollock age-1+ was the most abundant species (21.8%; Table 24). Pollock age-1+ was the dominant species caught by number (82.8%) and *Chrysaora* jellyfish were the second most abundant (10.2%) species caught in Resurrection Bay. Pollock caught in Resurrection Bay ranged in length from 14 to 54 cm FL with a major mode at 17 cm and a smaller mode at 27 cm FL (Tables 11 and 12; Fig. 12). Pollock in the Resurrection Bay ranged in age from 1 to 8 years old with age-1 fish most abundant by number (95%) and biomass (82%; Tables 13 and 14).

Walleye pollock abundance was relatively low in Resurrection Bay and was greatest in the outer area near the mouth of the bay (Fig. 15). The mean weighted depth of pollock in Resurrection Bay was approximately 126 m from the surface and 71 m above the bottom. The estimated amounts of age-1+ pollock for Resurrection Bay were 7.77 million fish weighing 316 t (Table 8), only 16% of what was detected in Resurrection Bay in 2015, the only other survey that has been conducted in the Bay during the summer. The relative estimation error based on the 2-D geostatistical analysis of the acoustic backscattering was 45.7%.

Prince William Sound

Prince William Sound (PWS; Fig. 3) was surveyed from 31 July to 1 August along 130.7 km (70.6 nmi) of trackline from 5 transects spaced at 14.8 km (8 nmi) encompassing an area of 1,936.3 km^2 (564.5 nmi^2). Bottom depths in PWS ranged from 53 to 451 m and averaged 318.0 m. Surface water temperatures in PWS averaged 15.5°C (Fig. 10), 1.3°C cooler than in 2015 (16.8°C), and 1.6°C cooler than in 2013 (17.1°C). The temperature at 100 m depth from SBE-39 probes on the fishing gear in PWS averaged 6.5°C (Fig. 11), similar to hauls conducted in the same area in 2015 (6.5°C), PWS was not surveyed in 2017.

Biological collections were made within PWS from one midwater haul (Tables 4, 9, and 25; Fig. 3). Northern smoothtongue was the most abundant species caught by weight (52.0%) and number (76.2%) in the midwater haul in PWS (Table 25). *Chrysaora* jellyfish was the second most abundant species caught by weight (17.7%) and Pacific glass shrimp was the second most abundant species by number (15.7%) caught in the midwater trawl in PWS. Only two walleye pollock were caught in PWS and were 46 and 51 cm FL (Tables 11 and 12; Fig. 12). One pollock caught in Prince William Sound was aged at 6 years old and the other was aged at 7 years old (Tables 13 and 14).

Walleye pollock biomass in PWS was even lower than in past years (Fig. 15). The biomass estimate for PWS was 16 t (Table 8). The relative estimation error based on the 1-D geostatistical analysis of the acoustic backscattering was 21.5%.

Inter-annual Changes in Vertical Distribution

Pollock depth from the surface and height above the bottom were compared for the GOA surveys conducted in 2013, 2015, 2017, and 2019. In 2013 pollock appear to be slightly deeper in the water column compared to other years, with less than 40% found within 100 m from the surface, whereas in 2015, 2017, and 2019 more than 50% were found within 100 m from the surface (Figs. 16a and b). However, in 2019 pollock appear to be farther above the seafloor with approximately 70% within 100 m of the seafloor compared to approximately 90% in the previous years (Figs. 16c and d).

This trend is also seen in pollock height above the bottom from the last four surveys when looked at by age class. At ages 1 and 3, 50% of the 2012 year class were located within 50 m of the seafloor, and at age 5 they were within 25 m of the seafloor, not unlike similar aged pollock from previous years (Fig. 17a-c). However, at age 7 approximately 55% of the 2012 year class was found within 50 m of the seafloor, whereas approximately 75% of 7-year-old pollock from other surveys were found within that same distance (Fig. 17d). Given that the 2012 year class comprises approximately 34% of the pollock biomass in 2019 and 81% of pollock biomass was found on the shelf transects, it is possible that these larger pollock are moving farther out towards the shelf break and over deeper water. Thus, they may be farther above the bottom, even if they are not actually farther from the surface.

Inter-annual Changes in Water Temperature

The only areas that have been surveyed in all seven summer GOA AT surveys since 2003 are Shelikof Strait, Barnabas Trough, and Chiniak Trough. Given differences in equipment and haul locations among those surveys, the temperatures from SBE 39 probes attached to the net during fishing and other deployment operations provide the only consistent means of comparing temperature among years in these places. Overall mean surface temperatures in 2019 (11.4°C) was similar to 2017 (11.4°C), and both were slightly lower than 2015 (11.9°C; Fig. 18a). Summer 2003 exhibited the coolest average surface temperatures (9.4°C) and 2005 the warmest (12.5°C) for all of these consistently sampled areas.

Mean temperature in 2019 at 100 m depth (6.5°C) in the consistently sampled areas was slightly warmer than in 2017 (6.1°C) and cooler than in 2015 (6.8°C). Temperatures at 100 m depth in 2019 were similar to those in 2003 (6.3°C) and 2005 (6.4°C; Fig. 18b). Summer 2013 had the coolest mean temperatures (5.2°C) at 100 m depth, while summer 2015 had the warmest (6.8°C).

Other Species

The GOA AT survey design is designed to encompass the geographic distribution of the highest densities of midwater age-1+ walleye pollock during summer. Other species are encountered, but the survey design may not provide adequate coverage for complete population assessment. Thus, the following distribution and abundance estimates for species other than walleye pollock are not comprehensive, and are likely underestimates due to incomplete coverage of the population's geographic extent. Abundances of these species are reported to establish a time series of relative abundances and distributions within the surveyed area.

POP

Pacific ocean perch (POP) were captured in 22 hauls across the GOA survey in 2019 (Fig. 19). The distribution and abundance of POP was determined by apportioning backscatter with the nearest trawl catch composition and length frequencies of hauls in which they were captured. POP were most often found intermixed with pollock in midwater and were located predominately across the Portlock Bank area east of Kodiak Island (hauls 193 and 202 and 193; 51% and 74% POP by number, respectively), and on the outer shelf transects near the shelf break from Kodiak Island to Yakutat Bay (hauls 203, 204, 231, and 255; 28%, 74%, 33%, and 36% POP by number, respectively; Figs. 19 and 20). POP comprised less than 10% of the catch by number in all other hauls. POP captured in trawl hauls ranged from 27 cm to 45 cm FL with a mode at 36 cm (Fig. 19). POP abundance estimates were calculated using similar methods described above in the Data Analysis section. For a net selectivity correction the Generic Fish group was used (see Appendix IV) due to the sparse recapture data available for POP. The estimated amounts of POP for the 2019 GOA survey area were 218.0 million fish weighing 144,045 t, approximately a third lower than the 2017 estimate. The relative estimation error of the POP biomass based on the 1-D geostatistical analysis was 15.0%.

Capelin

Capelin were captured in 39 hauls across the GOA survey in 2019 (Fig. 21) with the largest catches near the Shumagin Islands area (hauls 21, 38, 44, and 47; 94%, 75%, 18%, and 11% capelin by number, respectively), in Marmot Bay, (haul 163; 89% capelin by number) and on the Portlock Bank area of the shelf east of Kodiak Island (hauls 174 and 184; 94% and 90% capelin by number, respectively). Capelin comprised less than 10% of the catch by number in all other hauls. Capelin sizes ranged in length from 4 cm to 14 cm SL with a mode of 8 cm SL (Fig. 21). Capelin abundance estimates were calculated using similar methods described above in the Data Analysis section. For a net selectivity correction the Capelin group was used (see Appendix IV). The estimated amounts of capelin for the 2019 GOA survey area were 5.3 billion fish weighing 16,525 t (Fig. 22). The relative estimation error of the capelin biomass based on the 1-D geostatistical analysis was 24.48%.

Pacific Herring

Pacific herring were captured in 42 hauls across the GOA survey in 2019 (Fig. 23) with the largest catches on the shelf transects near Prince William Sound and Yakutat Bay (hauls 297, 247, 223, 246, and 178; all caught at least 60% herring by number), in the inshore area of Barnabas trough (haul 144; 83% herring by number), and in the north-eastern area of Shelikof Strait (hauls 60, 64, and 62; 55%, 25% and 20% herring by number) (Fig. 24). Herring sizes ranged in length from 12 cm to 30 cm FL with a small mode at 15 and a larger mode at 21 cm FL (Fig. 23). Almost all (97%) of the herring < 18 cm FL were captured in a single haul near the mouth of Prince William Sound at the north end of transect 35. Herring abundance estimates were calculated using similar methods described above in the Data Analysis section. For a net selectivity correction the Herring group was used (see Appendix IV). The estimated amounts of herring for the 2019 GOA survey area were 1.8 billion fish weighing 135,504 t. The relative estimation error of the herring biomass based on the 1-D geostatistical analysis was 12.8%.

Eulachon

Because eulachon lack swimbladders, they do not produce a strong acoustic return (Gauthier and Horne 2004); therefore, they are generally only detected in our surveys when they are caught in trawl hauls. Unlike previous years eulachon were not a large component of the

catch in the 2019 summer GOA survey. Eulachon were only caught in 18 hauls (Fig. 25) with the largest catches (> 61% by weight and number) occurring in Shelikof Strait (primarily hauls 61 and 79 in the central and southern portions of the Strait respectively). The second largest catches of eulachon (37% of all eulachon captured by number) were on the shelf transects, primarily haul 177 on the northern section of transect 28 between Kodiak Island and the Kenai Peninsula, where 31% of all eulachon from the survey were caught. Lengths of eulachon in catches ranged from 7.7 cm to 22.2 cm FL and averaged 16.6 cm FL. No biomass estimate was calculated for eulachon as small errors in attributing backscatter from fish with swimbladders will translate into large errors in eulachon abundance.

Methot Hauls and Euphausiid Abundance

A total of nine Methot hauls were conducted over the course of the survey. Of those, eight were on the shelf and one was in Shelikof Strait. Methot hauls were targeted on high-density suspected euphausiid backscatter layers. The average depth fished was 133 m below the surface and 44 m above the bottom. Catch composition (Table 26) was numerically dominated by euphausiids (97%). Catch by weight consisted predominately of various jellyfish (69.6% total) and euphausiids (29.3%). Species and length composition from summer 2019 Methot trawls are not yet available but previous results have shown species composition primarily consisting of *Thysanoessa inermis*, *T. spinifera*, and *Euphausia pacifica*.

Backscatter attributed to euphausiids was found throughout the survey area, but it was patchy in distribution (Fig. 26; Ressler 2019). Areas of relatively high abundance included the shelf transects (63% of backscatter, 33% of which was in area 640 between Prince William Sound and Yakutat Bay), Sanak (6%), the Shumagin Islands (11%), Shelikof Strait (9%; primarily in the southwestern half), and Barnabas Trough (7%). Although surveys since 2013 have covered the shelf from the Islands of Four Mountains to Yakutat Bay, the index reported here is limited to areas that were consistently sampled (Shelikof Strait, Barnabas Trough, and Chiniak Trough) in all years (Simonsen et al. 2016). In those years since 2013 with consistent survey coverage, interannual changes in mean krill s_A in the consistently sampled area were positively correlated with those in the whole surveyed area ($r^2 = 0.37$, n = 4 surveys). Results indicate that highest abundance of euphausiids in the time series was observed in 2011 and the

lowest in 2003 (Fig. 26). There was a modest increase in 2019 from the previous update in 2017, but the 2019 value is the third lowest in the time series. Barnabas Trough appears to be a local hotspot, as observed in previous surveys (Simonsen et al. 2016).

Additional Projects

Data collections in support of ongoing work that addresses rockfish assessment in untrawlable habitat on the GOA shelf were conducted (contact: darin.jones@noaa.gov, 206-526-4166). Activities included surveying untrawlable areas with lowered stereo video camera deployments (n = 77) to record bottom type and assess abundance of rockfishes. Operations were conducted during nighttime hours.

Ovaries from walleye pollock at various maturity stages were collected throughout the survey and preserved in formalin for maturity development analysis (contact: Sandi.Neidetcher@noaa.gov, 206-526-4521).

Pollock gill filament tissue were collected for DNA analysis to study the genomic variability and natural selection within highly fecund species (contact: Einar Arnason, einararn@hi.is, 354-525-4613, Iceland).

Results for these special projects are to be reported elsewhere.

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Table 1. -- Target strength (TS) to size relationships from the literature used to allocate 38 kHz acoustic backscatter to most species in this report. The symbols in the equations are as follows: r is the bell radius in cm and L is length in cm for all groups except pelagic crustaceans, in which case L is in mm. The species for which the TS was derived is given.

Group	**TS** (dB re a m^2)	**Length type**	**TS derived for which species**	**Reference**
Walleye pollock	$TS = 20 \log_{10} L - 66$	L = fork length	*Gadus chalcogrammus*	Foote & Traynor 1988, Traynor 1996
Capelin	$TS = 20 \log_{10} L - 66$	L = total length	*Mallotus villosus*	Guttormsen and Wilson, 2009
Pacific herring	$TS = 20 \log_{10} L - 2.3 \log(1 + depth/10) - 65.4$	L = fork length	*Clupea harengus*	Ona 2003
Fish with swim bladders	$TS = 20 \log_{10} L - 67.5$	L = total length	Physoclist fishes	Foote 1987
Fish without swim bladders	$TS = 20\log_{10} L - 83.2$	L = total length	*Pleurogrammus monopterygius*	Gauthier & Horne 2004
Jellyfish	$TS = 10\log_{10}(\pi r^2) - 86.8$	r = bell radius	*Chrysaora melanaster*	De Robertis & Taylor 2014
Squid	$TS = 20\log_{10} L - 75.4$	L = mantle length	*Todarodes pacificus*	Kang et al. 2005
Pelagic crustaceans*,+,#	$TS = A*(\log10(BkL)/(BkL))^C + D((kL)^6) + E((kL)^5) + F((kL)^4) + G((kL)^3) + H((kL)^2) + I(kL) + J + 20\log_{10}(L/Lo)$	L = total length	*Euphausia superba*	Demer & Conti 2005

*A = -930.429983; B = 3.21027896; C = 1.74003785; D = 1.36133896 x 10^{-8};
E = -2.26958555 x 10^{-6}; F=1.50291244 x 10^{-4}; G = -4.86306872 x 10^{-3}; H = 0.0738748423;
I = -0.408004891; J=-73.9078690; and Lo=0.03835.
+If L < 15 mm, TS = -105 dB; and if L > 65 mm, TS = -73 dB.
#k = 2πfc, where f = 38,000 (frequency in Hz) and c = 1470 (sound speed in m/s).

Table 2. -- Simrad EK60 38 kHz acoustic system description and settings used during the summer 2019 acoustic-trawl surveys of walleye pollock in the Gulf of Alaska, results from standard sphere acoustic system calibrations conducted in association with the surveys and final analysis parameters.

		Collection Settings	31 May Kalsin Bay Kodiak	5 Aug. Redfield Cove Yakutat Bay	Final Analysis Parameters
Echosounder		Simrad EK60	--	--	Simrad EK60
Transducer		ES38B	--	--	ES38B
Frequency (kHz)		38	--	--	38
Transducer depth (m)		9.15	--	--	9.15
Pulse length (ms)		0.512	--	--	0.512
Transmitted power (W)		2000	--	--	2000
Angle sensitivity	Along	22.67	--	--	22.67
	Athwart	21.29	--	--	21.29
2-way beam angle (dB re 1 steradian)		-20.71	--	--	-20.71
Gain (dB)		21.89	21.90	22.07	21.98
s_A correction (dB)		-0.62	-0.62	-0.61	-0.62
Integration gain (dB)		21.27	21.27	21.46	21.37
3 dB beamwidth	Along	6.77	6.77	6.80	6.79
	Athwart	7.22	7.22	7.24	7.23
Angle offset	Along	-0.05	-0.05	-0.05	-0.05
	Athwart	-0.05	-0.05	-0.06	-0.06
Post-processing S_v threshold (dB re 1 m^-1)		-70	--	--	-70
Measured standard sphere TS (dB re 1 m^2)		--	-42.50	-41.83	--
Sphere range from transducer (m)		--	20.28	31.88	--
Absorption coefficient (dB/m)		0.0096	0.0096	0.0094	0.0096
Sound velocity (m/s)		1476.0	1477.2	1475.7	1476.0
Water temp at transducer (ºC)		--	8.0	7.9	--

Note: Gain and beam pattern terms are defined in the Operator Manual for Simrad EK60 Scientific echosounder application, which is available from Simrad Strandpromenaden 50, Box 111, N-3191 Horten, Norway.

Table 3. -- Numerical abundance (million) and percent change compared to the final analysis of walleye pollock, capelin, Pacific herring, and Pacific ocean perch using different analysis scinarios during the 2019 summer Gulf of Alaska acoustic-trawl survey. Analysis senarios include; A) reported amounts with all species in catch accounted for along with selectivity values, B) all species in catch accounted for with no selectivity values, and C) only target species accounted for from the catch with no selectivity.

Target species	A all species w/selectivity	B all species no selectivity	% change	C target species only no selectivity	% change
walleye pollock	4,643.10	4,565.72	-2%	4,686.40	1%
capelin	5,291.81	2,212.35	-58%	3,991.97	-25%
Pacific herring	1,771.37	1,535.57	-13%	1,985.11	12%
Pacific ocean perch	218.04	223.94	3%	246.27	13%

Table 4. -- Number of biological samples and measurements collected during the summer 2019 walleye pollock acoustic-trawl survey of the Gulf of Alaska shelf and associated areas.

Haul	Walleye pollock					Capelin	Eulachon	Pacific herring	POP	Dusky rockfish	Other*
no.	Lengths	Weights	Maturity	Otoliths	Ovaries	length/weight	length/weight	length/weight	length/weight	length/weight	length/weight
2	261	50	50	45	2						43/25
3	82	50	50	45	5				1/1		78/29
5	407	50	50	45	8						55/14
8	331	45	45	45	3						52/19
9	142	49	49	46	4						103/19
10	43	43	43	43	2						48/12
11	137	50	50	45	5				44/20		104/12
12	171	73	53	36	5	4/4					6/5
16	134	62	43	27	2						4/2
17	247	97	73	35	9			1/1			5/3
18	51	51	51	21	3						46/13
20	62	50	50	10	2						34/14
21	110	50	50	10		37/10					39/12
28	368	54	54	15	5						46/13
37	35	35	35	12	3	19/10					24/4
38	47	47	47	10	3	62/17					49/12
44	371	50	50	10		35/10					18/8
45	545	95	76	20			36/10				6/6
46	626	85	84	26	5	1/1					2/2
47	57	57	57	11	3	32/10					34/26
48	282	48	48	12	4	3/0		2/0			4/4
52	382	50	50	13	4	37/10					16/7
53	333	50	50	10							30/16
54	174	75	20	16		33/9		36/10			41/17
60	155	100	40	25		5/5		39/10			13/12
61	186	88	69	30	7		37/10	19/10			25/20
62	112	64	49	34	8	3/3	34/10	40/10			41/15
64	203	64	49	27	5			35/10			17/10
69	186	66	46	31				38/10			79/23
72	642	106	88	39	7		13/13	35/10			23/23
73	175	78	58	42				36/10			26/11
77	210	105	75	35		35/10		39/10			80/13
79	221	109	98	34	5	3/3	36/10				95/37
80	156	78	48	33			1/1	2/2			36/25
84	358	99	80	30	8			2/2			31/11

Table 4. -- Cont.

Haul	Walleye pollock					Capelin	Eulachon	Pacific herring	POP	Dusky rockfish	Other*
no.	Lengths	Weights	Maturity	Otoliths	Ovaries	length/weight	length/weight	length/weight	length/weight	length/weight	length/weight
85	517	116	105	43							18/9
86	328	50	50	20	1	40/11					100/60
88	190	54	34	25				1/1			52/13
89	712	124	108	27					75/25		33/13
95	219	68	48	33	1						41/16
104	431	50	50	20					4/4		8/8
110	346	40	40	20	2						59/21
114	69	41	41	20					5/0	4/0	204/33
115	412	43	37	20				2/2			101/25
118	201										62/0
126	203	88	74	25		1/0					91/10
128	273	90	24	22				2/2			49/20
136	388	98	83	35		1/0		10/10	5/5		90/7
137	186	43	24	15				14/14			59/20
144	222	51	44	20	5	35/10		57/11			72/32
149	485	40	40	15		7/7	34/26		76/25		102/22
150	323							3/0			79/0
157	44	44	44	19		39/10		43/43			86/29
158	427	65	36	18		2/2	14/14	50/0			104/23
163						60/10					85/0
164	479	75	21	17		35/10		35/10			54/38
165	2	2	2	2		35/10					130/41
171	298	50	29	19				93/10	35/10		174/28
172	547	113	26	28	2	13/13		35/10	85/25		47/18
173	483	79	76	27						1/1	22/18
174						29/0					75/1
175	277	71	32	34	9	1/1		36/10	81/25		35/25
177	404	82	29	27		3/0	100/25	100/25	25/25		68/5
178	2	2	2	2				36/10			42/19
184						43/0		2/2			99/28
193	1	1	1				23/11	1/1	88/25	42/25	57/5
200	462	63	34	31		40/10	30/10	1/0	13/10	2/2	49/10
202	4	4	4	4	2	1/1	35/10		131/25	15/10	129/42
203	294	69	69	25	9				76/27		64/18
204	36	36	36	30	4				96/25		41/7

Table 4. -- Cont.

Haul	Walleye pollock					Capelin	Eulachon	Pacific herring	POP	Dusky rockfish	Other*
no.	Lengths	Weights	Maturity	Otoliths	Ovaries	length/weight	length/weight	length/weight	length/weight	length/weight	length/weight
205	305	45	45	23			18/18		20/10		20/2
207	251	67	20	21	6	17/10	20/10	25/10			56/13
215	451	76	23	24	11			2/2		1/1	90/23
223								102/25			82/26
224	592	51	11	21		13/10	16/10	35/20			75/17
231	195	50	50	18		1/0			52/15		88/26
233	385	59	51	25		1/0		1/0	4/4	2/2	18/13
235	220	50	30	18		3/3		25/10	2/2	1/1	35/20
245	2	2	2	2							164/60
246								74/10			82/8
247						13/0		137/20			64/22
248	137	31	11	6	1	3/0	1/0	56/10			101/22
254	5	5	5	5		8/0		1/1			91/10
255	156	50	50	20	1				87/25		132/53
261	79	50	50	20					81/23		54/35
267	32	32	18	22				147/25		3/3	143/19
	20,077	4,643	3,537	1,836	171	753/220	448/188	1,450/389	1,086/356	71/45	5,229/1,527

*Lengths and weights were collected from a sample of all species caught in each haul. See species composition by area tables for details.

Table 5. -- Average walleye pollock length (cm) at age (and sample size) for each area of the Gulf of Alaska shelf for all summer acoustic-trawl surveys. Ages were not determined from the 2005 summer GOA survey.

		Age															
Survey	**n**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**18**
2019																	
Alitak	39	19.4	28.0	37.1	43.0	41.0	48.7	56.7	68.0								
Barnabas	157	18.8	29.7	39.6			49.8	49.3	61.0								
Chiniak	52	19.0	28.6				47.1	48.8									
Marmot	66	18.8	29.1				46.8	49.0	49.0								
Mitrofania	20			43.0		44.0	47.8	46.2									
Morzhovoi	35	14.4	31.6			46.0	49.5	50.1	53.7								
PWS	2						46.0	51.0									
Resurrection Bay	24	17.4	36.0	40.0	41.2	41.0		49.7									
Sanak	63	15.4	26.2	33.8		46.0	45.3	46.4									
GOA Shelf	929	18.7	28.3	37.5	41.6	44.9	46.8	47.4	48.1	52.0	52.7			62.0			
Shelikof	410	16.0	24.8	34.7	41.0	44.0	47.3	48.7	49.0			57.0					
Shumagins	140	17.5	27.3	34.3			44.9	46.7	46.6								
average		**17.9**	**27.5**	**36.5**	**41.5**	**44.4**	**47.0**	**47.7**	**49.2**	**52.0**	**52.7**	**57.0**		**62.0**			
2017																	
Alitak	50	19.0			39.0	45.2	49.3	51.3	51.0		62.0						
Barnabas	162	20.5			40.7	44.3	48.6	57.5									
Chiniak	58	21.4			43.5	44.9		51.0									
Marmot	30	20.2				45.1	48.0	51.5	55.3								
Mitrofania	21				47.0	41.9		55.0					60.0				
Morzhovoi	25				43.0	47.4	52.3	50.8									
Nakchamik	42	17.5			43.6	44.2	46.0										
Pavlof	23			37.0		45.0	48.0										
Sanak	52				40.6	42.5				60.0							
Shelikof	223	16.9		37.0	42.1	43.8	48.3	56.5									
Shumagins	82	16.0			42.3	42.9	44.4										
GOA Shelf	#####	19.7	33.7		42.3	44.0	46.8	52.7	58.0		53.5	52.0					
average		**19.1**	**33.7**	**37.0**	**42.3**	**44.0**	**47.4**	**52.7**	**55.0**	**60.0**	**56.3**	**52.0**	**60.0**				
2015																	
Alitak	77	18.9	28.0	33.5	47.8	49.7	53.1	56.4	55.9	62.0	71.5	67.2					
Barnabas	102		35.6	38.7	51.0	51.8	56.5	54.9	60.3	62.1	65.1						
Chiniak	10			33.7		50.3		54.5		59.6							
GOA shelf	573	17.7	27.6	38.0	45.8	49.5	52.1	55.8	57.5	57.3	59.9	56.3	56.8				
Marmot	104	18.7	31.9	39.4	48.9	49.9	58.5	53.8			61.8						
Morzhovoi	70	17.8	31.9	38.5	43.2	45.6	49.1			59.3							
Nakchamik	44	18.4		43.4	48.1	54.8	51.2	61.4	59.0	62.5	62.8	61.8					
PWS	56				52.6	53.5	55.6	56.7	58.8	56.4	58.8	61.0	61.6				
Sanak	30		31.5	35.7													
Shelikof	308		26.8	35.2	42.5	49.4		57.7	56.5	56.6	59.8						
Shumagins	80	14.4	29.7	37.4	46.0	47.9	61.4	60.3	59.1	59.2	59.7						
Kenai	14	18.4	26.7	31.7	48.5	50.4	53.5	55.2	60.6	58.2	59.2						
Yakutat	208					50.1	49.7	56.3	53.6		60.8		56.1				
average		**17.4**	**29.5**	**36.8**	**46.7**	**49.9**	**53.3**	**56.7**	**58.0**	**58.9**	**60.8**	**61.4**	**57.8**				

Table 5. -- Cont.

		Age															
Survey	**n**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**18**
2013																	
Alitak	51		31.5	32.1	50.0	53.3	54.0	59.7	57.5	61.6	62.5	74.0					
Barnabas	97	20.3	36.0	42.0	47.3	50.9	54.8	55.5	58.0	56.7	58.0	62.0	56.0				
Chiniak	62	21.0			52.0	51.5	54.7	55.7	56.7	53.7	56.0	58.0	60.0				
GOA shelf	352	17.8	31.0	40.4	46.2	51.9	54.3	55.4	56.5	59.0	58.0	61.0			61.0		
Izhut	13		36.3	42.0													
Marmot	16		34.1	38.0		53.0			60.3								
Morzhovoi	72	14.2				55.0		59.1	61.1	62.3	62.1	66.5	66.3	65.5	67.0	70.5	64.0
Nakchamik	60			44.0	50.0	53.3	54.3	54.1	57.8	64.0							
Pavlof	62	15.0	30.0	31.9			63.0	62.0	67.7	67.3	66.8	66.4	70.0	72.5	66.0		
PWS	55	17.8	29.1	42.0	46.4	52.0	54.6	58.6	57.7	55.0							
Sanak	97	14.3	31.4	43.0	44.6	55.0		53.8								73.0	
Shelikof	401	15.1	28.3	38.1	43.0	51.7	53.4	55.1	55.1	57.0							
Shumagins	58	13.5	34.6	45.5			56.6	59.7	60.0						68.0		
Kayak	40			42.7	47.1	49.6	53.0			57.0							
Yakutat	63		36.0	43.8	49.8	50.5	56.6	58.0	54.0				60.0				
average		**16.8**	**30.7**	**39.4**	**46.5**	**52.0**	**54.5**	**56.7**	**58.6**	**59.7**	**61.8**	**65.4**	**65.3**	**67.8**	**65.3**	**71.3**	**64.0**
2011																	
Alitak	86	19.0	30.1	37.6	48.2	54.5	58.1	59.5	60.5	59.0	70.0						
Barnabas	79			42.0	47.7	54.7	58.5	58.0		73.0							
Chiniak	112			37.0	47.9	53.0	53.8	57.7	67.0								
GOA shelf	334		32.0	38.6	44.9	49.8	53.3	55.0	50.7	63.3	61.5	63.0	62.1	60.3	61.0		
Mitrofania	52			39.1	45.4	50.3	56.0	53.0									
Morzhovoi	29		29.0		42.0	51.7	66.0	63.8	73.0	68.5	65.0	64.0	64.3	62.0		62.0	
Nakchamik	67		30.2	35.8	40.0	56.0	59.0										
Shelikof	328	16.1	27.0	37.6	45.2	50.0	53.8	55.4	54.4		56.5	58.0					
average		**16.1**	**28.1**	**37.4**	**45.6**	**51.6**	**54.9**	**57.2**	**57.1**	**65.3**	**62.0**	**63.1**	**62.6**	**61.1**	**61.0**	**62.0**	
2003																	
Alitak	79	16.3	29.4	39.2	42.6	44.8	50.5	54.5		54.5							
Barnabas	130		33.4	39.4	41.6	43.2											
Chiniak	75	17.3	34.2	38.7	44.4	47.0	55.0	60.7	60.0	64.0	63.0		64.0				
GOA shelf	566	17.3	30.2	37.1	38.7	46.1	52.5	55.2	55.3	54.7	59.0	60.0					
Marmot	84	18.6	34.2	37.8	44.0	52.7	55.0	63.0	64.6	64.2	65.5	63.0					
Nakchamik	28		28.8	34.5	38.0	43.0											
PWS	81	18.0	32.0	37.7	41.7	49.3	53.0	56.0									
Shelikof	269	16.7	26.8	33.1	35.1	40.6	47.0	49.8	51.0								
Shumagins	43	15.7	31.0	36.2	41.6	48.0	58.0	54.5	60.0								
average		**17.0**	**29.3**	**37.4**	**38.7**	**45.2**	**52.2**	**55.1**	**59.0**	**59.1**	**62.8**	**61.0**	**64.0**				
overall average		**17.2**	**29.7**	**37.6**	**42.6**	**45.8**	**53.0**	**56.2**	**58.3**	**59.6**	**61.3**	**63.1**	**63.0**	**64.0**	**64.7**	**69.0**	**64.0**

Table 6. -- Average walleye pollock weight (kg) by age for each area of the Gulf of Alaska shelf for all summer acoustic-trawl surveys. Ages were not determined from the 2005 summer GOA survey.

		Age															
Survey	**n**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**18**
2019																	
Alitak	39	0.05	0.18	0.43	0.55	0.55	0.94	1.63	2.48								
Barnabas	157	0.05	0.21	0.51			0.92	0.88	1.58								
Chiniak	52	0.05	0.18				0.81	0.91									
Marmot	66	0.05	0.20				0.74	0.83	0.72								
Mitrofania	20			0.70		0.55	0.81	0.73									
Morzhovoi	35	0.02	0.24			0.68	0.82	0.85	1.05								
PWS	2						0.81	0.98									
Resurrection Bay	24	0.03	0.50	0.57	0.62	0.56		0.84									
Sanak	63	0.03	0.14	0.30		0.63	0.52	0.64									
GOA Shelf	929	0.05	0.18	0.43	0.58	0.69	0.75	0.79	0.85	0.98	0.95				1.19		
Shelikof	410	0.03	0.11	0.32	0.57	0.76	0.79	0.85	0.79			1.42					
Shumagins	140	0.04	0.17	0.33			0.66	0.72	0.73								
average		**0.04**	**0.17**	**0.40**	**0.59**	**0.66**	**0.76**	**0.80**	**0.92**	**0.98**	**0.95**	**1.42**			**1.19**		
2017																	
Alitak	50	0.06			0.40	0.78	0.96	1.02	0.93		1.59						
Barnabas	162	0.07			0.60	0.71	0.96	1.21									
Chiniak	58	0.08			0.71	0.78		1.03									
Marmot	30	0.07				0.79	1.03	1.27	1.54								
Mitrofania	21				0.86	0.60		1.03					1.05				
Morzhovoi	25				0.55	0.83	0.98	0.86									
Nakchamik	42	0.04			0.63	0.66	0.73										
Pavlof	23			0.39		0.70	0.73										
Sanak	52				0.50	0.59				1.20							
Shelikof	223	0.04		0.43	0.60	0.69	0.84	1.08									
Shumagins	82	0.03			0.59	0.61	0.61										
GOA Shelf	#####	0.06	0.26		0.62	0.68	0.79	1.04	1.34		1.03	0.98					
average		**0.06**	**0.26**	**0.41**	**0.61**	**0.69**	**0.82**	**1.04**	**1.40**	**1.20**	**1.22**	**0.98**	**1.05**				
2015																	
Alitak	77	0.05	0.16	0.27	0.80	0.85	1.08	1.15	1.10	1.70	2.66	1.90					
Barnabas	102		0.36	0.46	1.19	1.04	1.43	1.23	1.46	1.67	1.75						
Chiniak	10			0.30		0.97		1.18		1.35							
GOA shelf	573	0.04	0.17	0.43	0.71	0.87	0.99	1.18	1.24	1.24	1.42	1.08	1.37				
Marmot	104	0.05	0.27	0.50	0.81	0.79	1.20	0.94			1.26						
Morzhovoi	70	0.03	0.25	0.44	0.58	0.65	0.82			1.30							
Nakchamik	44	0.05		0.65	0.81	1.17	0.99	1.57	1.35	1.77	1.67	1.37					
PWS	56				1.05	1.22	1.29	1.32	1.39	1.32	1.50	1.62	1.57				
Sanak	30		0.23	0.33													
Shelikof	308		0.15	0.33	0.58	0.87		1.24	1.20	1.16	1.33						
Shumagins	80	0.02	0.19	0.41	0.77	0.80	1.69	1.53	1.36	1.28	1.40						
Kenai	14					0.93	0.82	1.22	1.14		1.40		1.11				
Yakutat	208	0.05	0.15	0.25	0.91	0.99	1.14	1.19	1.63	1.34	1.51						
average		**0.04**	**0.20**	**0.39**	**0.78**	**0.91**	**1.10**	**1.25**	**1.30**	**1.41**	**1.51**	**1.53**	**1.35**				

Table 6. -- Cont.

		Age															
Survey	**n**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**18**
2013																	
Alitak	51		0.24	0.24	1.08	1.33	1.27	1.68	1.53	1.83	1.93	2.82					
Barnabas	97	0.06	0.40	0.60	0.97	1.16	1.36	1.34	1.58	1.53	1.70	2.28	1.53				
Chiniak	62	0.07			1.04	1.06	1.28	1.37	1.44	1.27	1.26	1.56	1.90				
GOA shelf	352	0.04	0.24	0.56	0.80	1.16	1.30	1.34	1.37	1.77	1.67	1.76			1.40		
Izhut	13		0.38	0.53													
Marmot	16		0.31	0.40		1.19			1.71								
Morzhovoi	72	0.02				1.42		1.56	1.82	1.73	1.74	2.06	2.04	2.02	2.10	2.56	1.54
Nakchamik	60			0.83	1.24	1.32	1.39	1.39	1.53	1.68							
Pavlof	62	0.03	0.21	0.27			2.13	1.88	2.58	2.40	2.33	2.22	2.54	2.58	2.22		
PWS	55	0.04	0.19	0.64	0.78	1.17	1.36	1.57	1.54	1.24							
Sanak	97	0.02	0.25	0.66	0.74	1.11		1.26								2.21	
Shelikof	401	0.02	0.17	0.45	0.66	1.12	1.18	1.25	1.22	1.27							
Shumagins	58	0.02	0.35	0.79			1.55	1.73	1.73						2.13		
Kayak	40			0.64	0.88	0.94	1.10			1.48							
Yakutat	63		0.37	0.66	0.98	0.97	1.42	1.40	1.06				1.50				
average		**0.04**	**0.23**	**0.51**	**0.83**	**1.16**	**1.32**	**1.43**	**1.60**	**1.67**	**1.83**	**2.14**	**2.06**	**2.21**	**1.82**	**2.44**	**1.54**
2011																	
Alitak	86	0.05	0.25	0.46	0.95	1.19	1.44	1.65	1.50	1.63	1.90						
Barnabas	79			0.62	0.94	1.28	1.61	1.47		2.09							
Chiniak	112			0.45	0.91	1.18	1.25	1.53	1.86								
GOA shelf	334		0.27	0.49	0.75	0.99	1.17	1.29	0.99	1.53	1.75	1.78	1.62	1.61	1.48		
Mitrofania	52			0.52	0.78	1.05	1.37	1.31									
Morzhovoi	29		0.18		0.57	1.03	1.81	1.83	2.49	2.10	1.83	1.44	1.64	1.53		1.54	
Nakchamik	67		0.20	0.37	0.54	1.07	1.16										
Shelikof	328	0.03	0.15	0.44	0.79	1.06	1.28	1.34	1.25		1.53	1.65					
average		**0.03**	**0.18**	**0.44**	**0.80**	**1.10**	**1.31**	**1.46**	**1.38**	**1.75**	**1.74**	**1.66**	**1.63**	**1.57**	**1.48**	**1.54**	
2003																	
Alitak	79	0.03	0.22	0.53	0.67	0.73	0.94	1.16		1.34							
Barnabas	130		0.30	0.50	0.60	0.67											
Chiniak	75	0.04	0.32	0.45	0.71	0.84	1.39	1.67	1.57	1.84	1.81		1.70				
GOA shelf	566	0.04	0.24	0.42	0.47	0.82	1.14	1.22	1.21	1.18	1.27	1.58					
Marmot	84	0.05	0.31	0.42	0.70	1.15	1.47	1.99	2.28	2.22	2.10	2.50					
Nakchamik	28		0.20	0.31	0.40	0.56											
PWS	81	0.04	0.28	0.45	0.60	1.01	1.08	1.23									
Shelikof	269	0.04	0.16	0.28	0.34	0.51	0.74	0.80	0.77								
Shumagins	43	0.03	0.23	0.37	0.54	0.82	1.24	1.17	1.20								
average		**0.04**	**0.21**	**0.43**	**0.48**	**0.77**	**1.10**	**1.21**	**1.58**	**1.64**	**1.76**	**1.89**	**1.70**				
overall average		**0.04**	**0.21**	**0.43**	**0.65**	**0.78**	**1.17**	**1.34**	**1.47**	**1.54**	**1.63**	**1.80**	**1.74**	**1.84**	**1.77**	**2.22**	**1.54**

Table 7. -- Pollock biomass (metric tons) by NMFS reporting area for all walleye pollock and age-7 walleye pollock for the 2019 summer Gulf of Alaska acoustic-trawl survey.

Reporting area	Geographic area	Total biomass	Age-7 biomass
Aleutian	Shelf	9,051.30	6,776.17
Total	Total	9,051.30	6,776.17
610	Shelf	98,088.13	68,520.37
	Sanak Trough	1,317.19	296.80
	Morzhovoi Bay	1,592.40	286.31
	Pavlof Bay	1,666.29	1,170.15
	Shumagin Islands	16,595.80	10,865.60
	Mitrofania	647.96	487.34
Total		119,907.76	81,626.58
620	Shelf	113,676.91	43,217.07
	Shumagin Islands	660.28	424.29
	Mitrofania	955.87	646.43
	Shelikof Strait	93,924.97	9,771.85
	Alitak	1,893.20	173.62
Total		211,111.22	54,233.27
630	Shelf	154,164.16	31,116.12
	Shelikof Strait	12,401.96	1,829.15
	Barnabas Trough	35,685.65	9,667.97
	Chiniak Trough	4,922.40	1,136.33
	Marmot Bay	2,791.74	95.95
	Resurrection Bay	315.73	7.09
Total		210,281.64	43,852.60
640	Shelf	43,204.14	12,379.65
Total	Total	43,204.14	12,379.65
649	Prince William Sound	15.73	11.87
Total	Total	15.73	11.87
Survey Total		593,571.79	198,880.13

Table 8. -- Pollock number (millions), biomass (thousands of metric tons), and relative estimation error by area for the summer 2011, 2013, 2015, 2017, and 2019 Gulf of Alaska acoustic trawl surveys. Shelf area estimated error value is for all shelf area transects combined.

	2011			2013			2015			2017			2019		
Area	Number	Biomass	est. error	Number	Biomass	est. error	Number	Biomass	est. error	Number	Biomass	est. error	Number	Biomass	est. error
Aleutian shelf										31.5	21.9		9.6	9.1	
Shumagin[a] Shelf	72.1	68.1		38.2	41.1		876.1	394.1		580.7	374.3		140.9	98.1	
Chirikof[b] Shelf	104.6	98.8	9%	39.8	42.8	15%	485.3	210.5	9%	383.1	254.3	7%	664.8	113.7	6%
Kodiak[c] Shelf	37.7	35.6		820.2	150.7		869.0	404.0		573.4	402.5		1,382.2	154.2	
Eastern[d] Shelf	not surveyed			471.2	34.6		140.7	57.3		96.6	71.6		414.8	43.2	
Sanak Trough	1.1	1.0	11%	1.3	0.9	23%	10.1	3.1	11%	5.6	3.7	10%	27.2	1.3	16%
Morzhovoi Bay	2.5	4.4	7%	6.5	5.8	20%	10.3	4.9	28%	2.1	1.6	20%	31.3	1.6	15%
Pavlof Bay	5.1	2.9	8%	45.1	2.2	18%	8.6	2.6	17%	2.1	1.4	17%	2.4	1.7	12%
Shumagin Islands	4.6	4.2	9%	1,644.2	33.6	14%	32.6	15.1	8%	229.5	15.2	10%	29.0	17.3	14%
Mitrofania Island	4.3	4.0	13%	132.4	2.5	24%	31.5	14.7	13%	71.0	42.0	13%	2.2	1.6	16%
Nakchamik Island	4.3	1.7	6%	6.9	8.9	13%	19.8	9.1	19%	0.6	0.4	16%	not surveyed		
Shelikof Strait	1,624.8	156.9	6%	4,671.3	423.0	6%	881.8	287.8	6%	546.4	70.1	11%	1,638.5	106.3	14%
Alitak/Deadman Bay	5.3	2.6	[e]	17.4	15.1	26%	13.7	7.2	16%/6%[f]	0.8	0.7	36%[f]	10.2	1.9	43%[f]
Chiniak Trough	35.6	38.4	7%	25.7	24.5	7%	82.8	35.0	6%	41.2	30.1	19%	25.9	4.9	8%
Barnabas Trough	29.5	33.8	10%	294.9	62.8	6%	187.3	88.9	17%	73.2	49.8	12%	215.3	35.7	10%
Marmot/Izhut Bay	not surveyed			104.7	9.0	7%	103.4	45.8	14%/16%[f]	3.7	2.4	21%	40.9	2.8	13%
Kenai Peninsula Bays	not surveyed			not surveyed			20.5	7.2	14%[f]	not surveyed			7.8*	0.3	46%[f]
Prince William Sound	not surveyed			199.5	16.1	9%	23.3	13.3	8%	not surveyed			<0.1	<0.1	22%
Kayak Island Trough	not surveyed			8.8	5.2	15%	included with shelf area			included with shelf area			included with shelf area		
Yakutat trough	not surveyed			101.4	5.4	13%	4.9	5.5	18%	included with shelf area			included with shelf area		
Total	1,982.6	453.0	6%	8,629.5	884.0	8%	3,801.8	1,606.2	8%	2,641.0	1,342.0	6%	4,643.1	593.6	6%

[a] Shumagin NPFMC area 610 - 159°-170°W

[b] Chirikof NPFMC area 620 - 154°-159°W

[c] Kodiak NPFMC area 630 - 147°-154°W

[d] Eastern NPFMC area 640 - 140°-147°W

[e] variance estimation not calculated

[f] 2D variance estimation for zig-zag transects

* Resurrection Bay was the only Kenai Peninsula Bay surveyed in 2019

Table 9. -- Trawl stations and catch data summary from the summer 2019 Gulf of Alaska shelf walleye pollock acoustic trawl survey aboard the NOAA ship *Oscar Dyson*.

Haul	area	Gear[a]	Date	Time	Duration	Start position		Depth (m)		Temp. (°C)		Walleye pollock		Other
no.		type	(GMT)	(GMT)	(minutes)	Lat. (N)	Long. (W)	gear	bottom	gear[b]	surface[c]	(kg)	number	(kg)
1^	GOA Shelf	LFS1421	1-Jun	21:20	26.7	57° 40.42	-151° 57.85	134	-	6.5	-	82.7	111	28.9
2	GOA Shelf	LFS1421	4-Jun	22:07	18.5	52° 32.41	-170° 7.75	155	238	5.0	6.7	429.6	473	17.7
3	GOA Shelf	LFS1421	5-Jun	6:23	11.5	52° 34.61	-169° 22.30	212	309	5.5	9.6	67.0	82	103.5
4^*	GOA Shelf	LFS1421	5-Jun	11:42	22.5	52° 41.75	-168° 39.26	221	934	-	7.8	-	-	-
5	GOA Shelf	LFS1421	6-Jun	1:23	18.5	53° 9.95	-167° 33.19	67	91	5.7	8.0	406.7	594	25.2
6	GOA Shelf	Methot	6-Jun	7:00	25.4	53° 13.90	-166° 50.60	52	146	-	8.8	-	-	11.2
7^	GOA Shelf	LFS1421	6-Jun	10:42	34.5	53° 10.00	-166° 47.15	192	339	5.7	8.5	-	-	-
8	GOA Shelf	LFS1421	6-Jun	19:50	40.6	53° 25.57	-166° 13.78	78	161	6.2	8.2	249.6	331	47.1
9	GOA Shelf	LFS1421	7-Jun	5:49	38.4	53° 33.52	-165° 34.67	203	289	5.8	8.0	107.6	144	48.2
10	GOA Shelf	LFS1421	7-Jun	17:12	16.9	53° 46.79	-164° 57.00	119	143	6.0	8.3	30.3	43	15.3
11*	GOA Shelf	LFS1421	8-Jun	7:08	19.5	53° 44.60	-164° 8.45	198	354	-	8.6	101.0	137	90.3
12	Sanak	LFS1421	9-Jun	7:30	32.5	54° 28.91	-162° 23.68	55	146	6.6	8.6	92.4	2353	27.0
13	Sanak	StereoDropCam	9-Jun	11:04	15.2	54° 23.00	-162° 13.97	58	61	-	8.1	-	-	-
14	Sanak	StereoDropCam	9-Jun	11:42	15.3	54° 22.97	-162° 14.26	57	59	-	8.2	-	-	-
15	Sanak	AWT	9-Jun	17:23	9.4	54° 29.78	-162° 31.55	93	145	5.6	8.6	423.2	9444	0.1
16	Sanak	LFS1421	9-Jun	20:17	40.6	54° 29.53	-162° 33.04	103	144	5.5	8.6	101.3	2352	4.0
17	Morzhovoi	LFS1421	10-Jun	6:18	4.9	54° 57.48	-162° 58.08	63	103	6.3	8.8	137.6	2579	0.5
18	GOA Shelf	LFS1421	10-Jun	23:26	10.6	54° 20.74	-160° 41.75	48	110	6.0	8.8	36.6	51	16.1
19	GOA Shelf	LFS1421	11-Jun	2:06	51.1	54° 20.39	-160° 42.60	68	112	6.3	9.1	109.1	145	97.6
20	GOA Shelf	LFS1421	11-Jun	7:15	18.8	54° 45.29	-161° 1.68	44	112	7.0	9.8	42.7	62	13.5
21	GOA Shelf	LFS1421	11-Jun	19:56	20.6	54° 48.88	-160° 16.79	59	83	6.2	8.9	71.4	110	34.5
22	GOA Shelf	Methot	12-Jun	2:24	30.5	54° 20.88	-159° 56.63	153	264	5.8	10.6	-	-	11.0
23	GOA Shelf	StereoDropCam	12-Jun	9:13	17.6	54° 36.13	-159° 19.14	-	83	-	10.3	-	-	-
24	GOA Shelf	StereoDropCam	12-Jun	9:57	15.2	54° 35.92	-159° 18.89	80	83	-	10.5	-	-	-
25	GOA Shelf	StereoDropCam	12-Jun	10:39	15.2	54° 35.84	-159° 19.19	80	83	-	10.2	-	-	-
26	GOA Shelf	LFS1421	12-Jun	16:31	29.6	54° 39.57	-158° 34.66	102	126	6.2	9.6	3.2	6	18.1
27	GOA Shelf	StereoDropCam	12-Jun	18:31	30.9	54° 38.56	-158° 33.70	124	128	-	9.1	-	-	-
28	GOA Shelf	LFS1421	12-Jun	22:18	23.1	55° 0.58	-158° 51.43	52	84	5.9	10.8	601.6	876	58.8
29#	Shumagins	LFS1421	13-Jun	3:01	0.8	55° 18.95	-159° 2.47	97	193	5.8	11.6	8.6	33	0.2
30	Shumagins	StereoDropCam	14-Jun	9:08	15.2	55° 7.64	-160° 14.03	60	63	-	9.5	-	-	-
31	Shumagins	StereoDropCam	14-Jun	9:46	15.2	55° 7.66	-160° 14.39	60	63	-	9.5	-	-	-
32	Shumagins	StereoDropCam	14-Jun	10:22	15.2	55° 7.41	-160° 13.90	58	61	-	9.5	-	-	-
33	Shumagins	StereoDropCam	14-Jun	10:56	15.3	55° 7.52	-160° 14.20	58	60	-	9.5	-	-	-
34	Shumagins	StereoDropCam	14-Jun	11:29	15.4	55° 7.66	-160° 14.29	58	60	-	9.5	-	-	-
35	Shumagins	StereoDropCam	16-Jun	11:13	15.3	55° 32.05	-159° 53.48	174	177	-	9.1	-	-	-
36	Shumagins	StereoDropCam	16-Jun	12:05	15.2	55° 31.64	-159° 53.87	175	178	-	8.8	-	-	-

Table 9. -- Cont.

Haul	area	Gear[a]	Date	Time	Duration	Start position		Depth (m)		Temp. (°C)		Walleye pollock		Other
no.		type	(GMT)	(GMT)	(minutes)	Lat. (N)	Long. (W)	gear	bottom	gear[b]	surface[c]	(kg)	number	(kg)
37	Shumagins	LFS1421	17-Jun	0:46	20.6	55° 25.77	-159° 8.15	96	158	6.1	9.5	23.1	35	5.0
38	Shumagins	LFS1421	17-Jun	4:17	36	55° 29.00	-159° 16.80	80	132	6.3	9.5	34.1	47	32.0
39	Shumagins	StereoDropCam	17-Jun	9:06	15.2	55° 21.35	-160° 11.99	84	84	-	7.8	-	-	-
40	Shumagins	StereoDropCam	17-Jun	9:41	15.3	55° 21.25	-160° 11.89	101	101	-	7.7	-	-	-
41	Shumagins	StereoDropCam	17-Jun	10:20	15.8	55° 21.19	-160° 11.54	116	113	-	7.8	-	-	-
42	Shumagins	StereoDropCam	17-Jun	10:58	8.4	55° 21.27	-160° 11.70	118	105	-	7.8	-	-	-
43	Shumagins	StereoDropCam	17-Jun	11:27	15.2	55° 21.40	-160° 12.26	94	93	-	7.8	-	-	-
44	Shumagins	LFS1421	17-Jun	15:02	28.6	55° 8.36	-160° 15.56	29	168	7.2	8.9	334.7	501	19.8
45	Shumagins	LFS1421	17-Jun	17:46	32	55° 8.59	-160° 19.86	165	218	6.1	8.0	387.1	1032	14.1
46	Shumagins	LFS1421	17-Jun	22:00	22.9	55° 14.03	-160° 10.37	147	224	6.3	8.5	572.6	1634	2.9
47	Shumagins	LFS1421	18-Jun	0:28	32.2	55° 11.19	-160° 14.81	63	197	6.5	8.7	39.0	57	41.1
48	Shumagins	LFS1421	18-Jun	4:52	18.1	55° 25.86	-160° 40.10	37	62	7.6	10.9	627.3	837	9.6
49	Shumagins	StereoDropCam	18-Jun	9:15	15.4	55° 34.91	-160° 2.19	159	162	-	9.7	-	-	-
50	Shumagins	StereoDropCam	18-Jun	10:13	15.2	55° 35.26	-160° 1.81	160	162	-	9.6	-	-	-
51	Shumagins	StereoDropCam	18-Jun	11:02	15.2	55° 34.94	-160° 1.42	158	160	-	9.5	-	-	-
52	Shumagins	LFS1421	18-Jun	17:35	30.9	55° 33.15	-159° 50.37	40	142	8.4	10.6	394.4	560	8.8
53	Shumagins	LFS1421	18-Jun	20:29	40	55° 31.96	-159° 51.85	64	174	7.7	10.7	323.8	455	4.5
54	Shelikof Strait	LFS1421	26-Jun	21:22	26	58° 33.32	-152° 59.17	81	161	6.8	11.2	70.9	1847	8.4
55	Shelikof Strait	AWT	27-Jun	2:55	32.5	58° 32.81	-152° 59.52	85	162	6.8	11.6	63.6	1316	65.4
56	Shelikof Strait	StereoDropCam	27-Jun	9:09	15.5	58° 13.27	-153° 4.91	-	120	-	12.1	-	-	-
57	Shelikof Strait	StereoDropCam	27-Jun	10:02	15.3	58° 13.18	-153° 4.92	-	123	-	12.1	-	-	-
58	Shelikof Strait	StereoDropCam	27-Jun	10:48	15.4	58° 13.43	-153° 4.87	-	101	-	12.1	-	-	-
59	Shelikof Strait	StereoDropCam	27-Jun	11:50	15.4	58° 13.24	-153° 4.93	-	114	-	12.0	-	-	-
60	Shelikof Strait	LFS1421	27-Jun	19:12	21.1	58° 8.90	-153° 33.71	92	201	6.8	10.9	63.6	1414	137.8
61	Shelikof Strait	LFS1421	28-Jun	5:42	46	57° 46.58	-154° 10.56	108	209	6.5	11.4	141.4	2621	73.7
62	Shelikof Strait	LFS1421	28-Jun	15:02	16.5	57° 36.13	-154° 32.01	67	132	7.0	11.5	89.1	1190	65.5
63	Shelikof Strait	AWT	28-Jun	23:25	20.6	57° 25.10	-154° 50.84	100	169	6.4	12.0	231.7	3994	13.6
64	Shelikof Strait	LFS1421	29-Jun	5:32	37.9	57° 25.19	-154° 50.78	103	174	6.4	11.9	74.6	848	30.3
65	Shelikof Strait	StereoDropCam	29-Jun	8:59	16	57° 9.34	-154° 42.96	-	73	-	12.0	-	-	-
66	Shelikof Strait	StereoDropCam	29-Jun	9:43	15.4	57° 9.32	-154° 43.01	-	73	-	12.1	-	-	-
67	Shelikof Strait	StereoDropCam	29-Jun	10:25	15.3	57° 9.31	-154° 42.65	-	72	-	12.3	-	-	-
68	Shelikof Strait	StereoDropCam	29-Jun	11:05	15.4	57° 9.32	-154° 42.61	-	72	-	12.3	-	-	-
69	Shelikof Strait	LFS1421	29-Jun	16:33	27.1	57° 15.83	-155° 9.26	102	238	6.3	11.8	85.5	2141	7.3
70	Shelikof Strait	AWT	29-Jun	21:10	24.3	57° 15.91	-155° 7.69	119	238	6.3	12.5	157.2	4151	2.4
71	Shelikof Strait	Methot	30-Jun	7:20	25.6	56° 57.13	-154° 56.53	78	85	6.8	12.3	-	-	19.6
72	Alitak	LFS1421	30-Jun	18:10	12.2	57° 3.19	-153° 56.62	118	158	4.6	14.1	1195.2	5952	36.8
73	Shelikof Strait	LFS1421	1-Jul	4:35	37.3	56° 51.18	-155° 45.68	100	286	6.3	12.5	111.8	1399	14.3

Table 9. -- Cont.

Haul	area	Gear[a]	Date	Time	Duration	Start position		Depth (m)		Temp. (°C)		Walleye pollock		Other
no.		type	(GMT)	(GMT)	(minutes)	Lat. (N)	Long. (W)	gear	bottom	gear[b]	surface[c]	(kg)	number	(kg)
74	Shelikof Strait	StereoDropCam	1-Jul	9:06	15.4	56° 57.90	-156° 17.94	-	152	-	12.0	-	-	-
75	Shelikof Strait	StereoDropCam	1-Jul	10:00	15.4	56° 57.90	-156° 17.15	-	159	-	12.2	-	-	-
76	Shelikof Strait	StereoDropCam	1-Jul	11:07	15.4	56° 57.92	-156° 17.67	-	154	-	12.1	-	-	-
77	Shelikof Strait	LFS1421	1-Jul	18:11	25	56° 34.52	-155° 43.32	135	229	6.2	12.5	290.8	4440	97.0
78	Shelikof Strait	AWT	1-Jul	22:06	10.3	56° 34.37	-155° 43.55	138	224	6.3	12.6	203.3	2540	13.5
79	Shelikof Strait	LFS1421	2-Jul	6:28	50.9	56° 37.93	-156° 2.61	217	294	5.9	12.3	143.2	1082	135.9
80	Shelikof Strait	LFS1421	2-Jul	14:58	7.3	56° 24.04	-156° 7.09	144	259	6.3	11.6	94.8	2348	7.6
81	Shelikof Strait	AWT	2-Jul	17:44	43.7	56° 24.32	-156° 6.06	157	259	6.3	11.6	178.0	4751	11.7
82	Shelikof Strait	LFS1421	3-Jul	7:46	51.4	55° 50.99	-156° 0.89	63	140	6.8	9.7	581.4	4059	206.4
83	Shelikof Strait	AWT	3-Jul	23:59	2.6	55° 51.10	-156° 2.57	65	130	7.9	10.0	405.5	3944	58.4
84	Shelikof Strait	LFS1421	4-Jul	2:07	3.8	55° 50.78	-156° 3.25	60	151	7.7	9.9	743.7	5096	44.1
85	GOA Shelf	LFS1421	4-Jul	17:36	1.5	55° 6.15	-158° 8.05	57	118	6.5	11.4	1614.6	11091	18.4
86	Mitrofania	LFS1421	5-Jul	6:55	37.3	55° 40.85	-159° 5.25	69	122	7.3	13.2	501.8	678	93.3
87	GOA Shelf	AWT	5-Jul	21:31	17.1	55° 0.81	-157° 16.12	73	174	6.8	11.6	939.3	12507	9.8
88	GOA Shelf	LFS1421	6-Jul	0:37	15.2	55° 2.47	-157° 17.23	52	124	7.5	11.6	427.9	12237	33.6
89	GOA Shelf	LFS1421	6-Jul	4:01	25.9	54° 58.70	-157° 14.69	198	241	5.2	11.8	529.7	1760	124.7
90	GOA Shelf	StereoDropCam	6-Jul	8:02	15.4	55° 4.76	-157° 6.93	-	228	-	11.3	-	-	-
91	GOA Shelf	StereoDropCam	6-Jul	8:48	15.4	55° 4.73	-157° 7.72	-	216	-	11.4	-	-	-
92	GOA Shelf	StereoDropCam	6-Jul	9:30	15.4	55° 4.65	-157° 7.67	-	219	-	11.2	-	-	-
93	GOA Shelf	StereoDropCam	6-Jul	10:16	15.4	55° 4.57	-157° 7.24	-	230	-	11.3	-	-	-
94	Shelikof Strait	AWT	6-Jul	23:28	1.3	55° 38.09	-156° 18.50	92	258	6.3	12.3	418.0	4301	29.9
95	Shelikof Strait	LFS1421	7-Jul	1:40	23.5	55° 37.52	-156° 16.04	119	254	6.2	12.5	260.9	3260	29.0
96	GOA Shelf	StereoDropCam	7-Jul	8:23	15.5	55° 27.13	-156° 0.55	-	196	-	10.7	-	-	-
97	GOA Shelf	StereoDropCam	7-Jul	9:20	15.3	55° 27.06	-156° 0.62	-	196	-	11.3	-	-	-
98	GOA Shelf	StereoDropCam	7-Jul	10:22	13.1	55° 27.18	-156° 0.38	-	200	-	11.4	-	-	-
99	GOA Shelf	StereoDropCam	7-Jul	11:02	14.3	55° 27.23	-156° 0.38	-	201	-	11.0	-	-	-
100	Shelikof Strait	AWT	7-Jul	16:08	0.6	55° 37.60	-156° 15.31	117	254	6.3	11.9	517.7	5082	3.3
101	Shelikof Strait	LFS1421	7-Jul	19:02	26.2	55° 36.49	-156° 14.32	136	248	6.2	11.8	262.2	3367	17.1
102	GOA Shelf	LFS1421	8-Jul	1:23	25.2	55° 31.91	-155° 47.17	129	218	6.1	12.2	239.4	976	55.9
103	GOA Shelf	AWT	8-Jul	4:58	19.3	55° 32.02	-155° 47.36	164	218	5.7	12.4	264.1	961	29.8
104	GOA Shelf	LFS1421	9-Jul	2:41	5.7	55° 59.21	-154° 0.51	145	253	6.1	12.1	878.2	1188	33.8
105	GOA Shelf	StereoDropCam	9-Jul	8:16	15.3	56° 22.87	-154° 3.44	-	70	-	10.6	-	-	-
106	GOA Shelf	StereoDropCam	9-Jul	8:54	15.3	56° 23.04	-154° 3.32	-	64	-	10.5	-	-	-
107	GOA Shelf	StereoDropCam	9-Jul	9:33	15.3	56° 23.24	-154° 2.92	-	62	-	10.9	-	-	-
108	GOA Shelf	StereoDropCam	9-Jul	10:10	15.2	56° 22.95	-154° 3.49	-	63	-	10.5	-	-	-
109	GOA Shelf	Methot	9-Jul	16:35	25.4	56° 28.45	-153° 35.09	124	136	6.2	11.7	-	-	9.6
110	GOA Shelf	LFS1421	9-Jul	21:28	32.8	56° 11.11	-153° 21.53	108	439	6.4	11.7	271.9	346	18.9
111	Barnabas	StereoDropCam	10-Jul	10:47	15.3	56° 27.25	-152° 49.42	-	52	-	11.6	-	-	-

Table 9. -- Cont.

Haul no.	area	Gear[a] type	Date (GMT)	Time (GMT)	Duration (minutes)	Start position Lat. (N)	Start position Long. (W)	Depth (m) gear	Depth (m) bottom	Temp. (°C) gear[b]	Temp. (°C) surface[c]	Walleye pollock (kg)	Walleye pollock number	Other (kg)
112	Barnabas	StereoDropCam	10-Jul	11:40	15.3	56° 27.13	-152° 49.31	-	53	-	11.6	-	-	-
113	Barnabas	StereoDropCam	10-Jul	12:15	15.2	56° 27.04	-152° 48.66	-	52	-	11.7	-	-	-
114	Barnabas	LFS1421	10-Jul	17:05	25.4	56° 24.94	-152° 34.72	165	270	6.3	11.7	35.6	69	63.5
115	Barnabas	LFS1421	10-Jul	20:48	3.8	56° 31.30	-152° 35.26	74	170	7.0	13.2	878.4	4801	63.6
116	Barnabas	AWT	10-Jul	22:56	8.2	56° 31.21	-152° 35.83	72	158	6.8	13.2	288.7	1494	59.3
117	Barnabas	AWT	11-Jul	2:11	7.3	56° 33.28	-152° 25.66	71	237	6.9	12.9	331.0	3121	131.3
118	Barnabas	LFS1421	11-Jul	4:11	2.7	56° 33.41	-152° 24.67	68	221	6.7	12.3	229.9	1558	99.1
119	Barnabas	StereoDropCam	11-Jul	7:32	15.3	56° 37.15	-152° 43.79	-	79	-	12.3	-	-	-
120	Barnabas	StereoDropCam	11-Jul	8:13	15.3	56° 37.03	-152° 43.84	-	80	-	12.3	-	-	-
121	Barnabas	StereoDropCam	11-Jul	8:55	15.2	56° 37.37	-152° 43.42	-	79	-	12.2	-	-	-
122	Barnabas	StereoDropCam	11-Jul	9:33	15.3	56° 37.02	-152° 44.11	-	79	-	12.2	-	-	-
123	Barnabas	StereoDropCam	11-Jul	10:30	15.3	56° 40.15	-152° 44.36	-	71	-	12.5	-	-	-
124	Barnabas	StereoDropCam	11-Jul	11:02	15.2	56° 39.66	-152° 44.97	-	73	-	12.5	-	-	-
125	Barnabas	StereoDropCam	11-Jul	11:39	15.3	56° 39.77	-152° 45.07	-	72	-	12.5	-	-	-
126	Barnabas	LFS1421	11-Jul	15:31	13	56° 45.52	-152° 28.08	77	168	6.5	12.7	311.1	3625	70.3
127	Barnabas	AWT	11-Jul	18:10	15.5	56° 45.16	-152° 29.08	90	164	6.4	12.7	242.0	2292	60.0
128	Barnabas	LFS1421	11-Jul	23:43	7	56° 52.66	-152° 24.32	80	151	6.5	12.5	873.9	12983	90.0
129	Barnabas	AWT	12-Jul	2:29	9.8	56° 53.15	-152° 22.52	76	128	6.6	12.5	904.2	13482	35.4
130	Barnabas	StereoDropCam	12-Jul	7:49	15.3	56° 58.25	-152° 18.45	-	79	-	12.3	-	-	-
131	Barnabas	StereoDropCam	12-Jul	8:24	15.2	56° 58.30	-152° 18.44	-	79	-	12.3	-	-	-
132	Barnabas	StereoDropCam	12-Jul	9:04	15.2	56° 58.55	-152° 18.09	-	78	-	12.2	-	-	-
133	Barnabas	StereoDropCam	12-Jul	10:35	15.2	57° 9.91	-152° 20.72	-	81	-	12.5	-	-	-
134	Barnabas	StereoDropCam	12-Jul	11:09	15.9	57° 9.53	-152° 20.89	-	82	-	12.5	-	-	-
135	Barnabas	StereoDropCam	12-Jul	11:49	15.2	57° 9.39	-152° 20.99	-	82	-	12.5	-	-	-
136	Barnabas	LFS1421	12-Jul	15:12	10.1	57° 5.86	-152° 25.31	122	151	6.4	12.3	698.5	1529	141.5
137	Barnabas	LFS1421	13-Jul	0:44	0.4	57° 6.19	-152° 22.97	62	117	7.5	12.5	851.7	16742	105.0
138	Barnabas	AWT	13-Jul	3:01	7.8	57° 6.32	-152° 22.11	56	98	7.5	12.1	171.7	2800	77.7
139	Barnabas	StereoDropCam	13-Jul	8:58	15.3	57° 14.86	-152° 40.25	-	54	-	12.3	-	-	-
140	Barnabas	StereoDropCam	13-Jul	9:38	15.3	57° 14.77	-152° 40.29	-	54	-	12.3	-	-	-
141	Barnabas	StereoDropCam	13-Jul	10:29	15.3	57° 14.70	-152° 40.00	-	54	-	12.5	-	-	-
142	Barnabas	StereoDropCam	13-Jul	11:02	15.2	57° 15.18	-152° 40.22	-	50	-	12.4	-	-	-
143	Barnabas	AWT	13-Jul	15:28	10.6	57° 17.17	-152° 31.47	57	104	8.7	12.0	6.1	31	233.3
144	Barnabas	LFS1421	13-Jul	18:06	10.1	57° 17.18	-152° 29.50	64	91	9.0	11.6	262.1	601	807.9
145	Chiniak	StereoDropCam	14-Jul	8:08	15.3	57° 20.75	-151° 23.47	-	142	-	11.6	-	-	-
146	Chiniak	StereoDropCam	14-Jul	8:46	15.2	57° 20.68	-151° 22.73	-	140	-	11.6	-	-	-
147	Chiniak	StereoDropCam	14-Jul	9:29	15.2	57° 20.83	-151° 22.94	-	141	-	11.7	-	-	-
148	Chiniak	StereoDropCam	14-Jul	10:09	15.3	57° 20.63	-151° 22.62	-	140	-	11.7	-	-	-
149	Chiniak	LFS1421	14-Jul	17:54	30.3	57° 25.71	-151° 27.40	133	169	6.8	11.6	908.5	3276	210.6

Table 9. -- Cont.

Haul no.	area	Gear type	Date (GMT)	Time (GMT)	Duration (minutes)	Start position		Depth (m)		Temp. (°C)		Walleye pollock		Other
						Lat. (N)	Long. (W)	gear	bottom	gear[b]	surface[c]	(kg)	number	(kg)
150	Chiniak	LFS1421	14-Jul	22:17	13.8	57° 26.62	-151° 30.59	59	153	7.6	11.1	660.2	3452	22.0
151	Chiniak	AWT	15-Jul	0:39	4.9	57° 26.02	-151° 28.31	58	164	7.6	11.4	351.2	1915	18.5
152	Chiniak	StereoDropCam	15-Jul	7:52	15.2	57° 40.40	-151° 44.24	-	66	-	11.3	-	-	-
153	Chiniak	StereoDropCam	15-Jul	8:27	15.2	57° 40.53	-151° 43.94	-	66	-	11.2	-	-	-
154	Chiniak	StereoDropCam	15-Jul	9:00	15.2	57° 40.53	-151° 43.99	-	66	-	11.2	-	-	-
155	Chiniak	StereoDropCam	15-Jul	9:34	15.2	57° 40.31	-151° 44.33	-	68	-	11.2	-	-	-
156	Chiniak	AWT	15-Jul	15:17	11.2	57° 37.78	-151° 49.58	71	127	9.4	11.2	48.2	350	332.5
157	Chiniak	LFS1421	15-Jul	18:38	15.2	57° 38.49	-151° 50.82	82	145	8.9	11.6	103.6	124	1071.4
158	Chiniak	LFS1421	15-Jul	22:27	4.1	57° 37.67	-151° 52.39	102	146	8.2	11.3	577.5	5945	310.6
159	Marmot	StereoDropCam	20-Jul	8:46	16.4	58° 1.21	-152° 31.50	-	202	-	13.4	-	-	-
160	Marmot	StereoDropCam	20-Jul	9:38	15.2	58° 1.07	-152° 31.88	-	203	-	13.2	-	-	-
161	Marmot	StereoDropCam	20-Jul	10:21	15.2	58° 0.96	-152° 31.39	-	201	-	13.3	-	-	-
162	Marmot	StereoDropCam	20-Jul	11:03	15.2	58° 0.92	-152° 31.42	-	201	-	13.3	-	-	-
163	Marmot	LFS1421	20-Jul	17:16	23.6	57° 56.90	-152° 38.41	52	110	9.6	12.2	-	-	15.3
164	Marmot	LFS1421	21-Jul	0:04	19.9	58° 0.57	-152° 30.81	121	191	7.5	13.2	343.2	5321	125.6
165	Marmot	LFS1421	21-Jul	5:31	28.3	57° 57.52	-152° 11.66	50	211	8.4	11.6	1.1	2	289.8
166	Marmot	StereoDropCam	21-Jul	10:02	15.2	58° 0.39	-152° 12.93	-	102	-	10.4	-	-	-
167	Marmot	StereoDropCam	21-Jul	10:42	15.2	58° 0.36	-152° 12.98	-	93	-	10.4	-	-	-
168	Marmot	StereoDropCam	21-Jul	11:23	15.2	58° 0.51	-152° 12.24	-	122	-	10.7	-	-	-
169	Marmot	StereoDropCam	21-Jul	12:08	15.5	58° 0.37	-152° 12.74	-	104	-	10.6	-	-	-
170	Marmot	StereoDropCam	21-Jul	12:53	15.3	58° 0.49	-152° 12.74	-	118	-	11.0	-	-	-
171	Marmot	LFS1421	21-Jul	20:16	43	58° 1.16	-152° 2.75	123	169	7.4	11.5	149.2	1260	519.3
172	GOA Shelf	LFS1421	22-Jul	4:08	29.7	58° 6.51	-151° 42.20	117	161	7.5	12.9	341.5	4909	271.7
173	GOA Shelf	LFS1421	22-Jul	16:07	12.7	57° 30.94	-150° 26.08	109	171	6.3	14.7	1268.2	6931	65.8
174	GOA Shelf	LFS1421	22-Jul	20:25	5.4	57° 43.69	-150° 42.23	66	91	8.3	13.0	-	-	206.5
175	GOA Shelf	LFS1421	23-Jul	1:23	23.1	58° 14.41	-151° 24.23	112	162	7.2	13.6	437.8	6069	354.4
176	GOA Shelf	AWT	23-Jul	17:04	4	58° 31.58	-151° 47.84	104	184	6.9	13.6	150.7	1702	146.5
177*	GOA Shelf	LFS1421	23-Jul	19:24	40	58° 31.19	-151° 47.50	134	180	-	13.8	175.2	2414	337.6
178	GOA Shelf	LFS1421	24-Jul	6:16	37.5	58° 51.64	-151° 13.42	114	143	6.5	13.8	1.3	2	45.5
179	GOA Shelf	StereoDropCam	24-Jul	9:38	15.2	58° 48.27	-151° 6.08	-	135	-	13.9	-	-	-
180	GOA Shelf	StereoDropCam	24-Jul	10:18	15.2	58° 48.45	-151° 5.40	-	137	-	13.6	-	-	-
181	GOA Shelf	StereoDropCam	24-Jul	10:59	15.3	58° 48.29	-151° 5.78	-	136	-	13.8	-	-	-
182	GOA Shelf	StereoDropCam	24-Jul	11:35	15.2	58° 48.35	-151° 5.43	-	138	-	13.8	-	-	-
183	GOA Shelf	StereoDropCam	24-Jul	12:20	15.3	58° 48.38	-151° 5.27	-	139	-	13.6	-	-	-
184	GOA Shelf	LFS1421	24-Jul	16:50	18	58° 24.28	-150° 37.18	49	71	10.0	12.5	-	-	620.2
185	GOA Shelf	LFS1421	24-Jul	22:36	35.8	57° 51.07	-149° 54.66	185	257	5.5	16.3	39.5	49	54.2
186	GOA Shelf	StereoDropCam	25-Jul	8:13	15.2	58° 12.54	-149° 20.12	-	106	-	12.8	-	-	-
187	GOA Shelf	StereoDropCam	25-Jul	8:49	15.2	58° 12.58	-149° 20.03	-	107	-	13.4	-	-	-

Table 9. -- Cont.

Haul	area	Gear[a]	Date	Time	Duration	Start position		Depth (m)		Temp. (°C)		Walleye pollock		Other
no.		type	(GMT)	(GMT)	(minutes)	Lat. (N)	Long. (W)	gear	bottom	gear[b]	surface[c]	(kg)	number	(kg)
188	GOA Shelf	StereoDropCam	25-Jul	9:35	15.2	58° 12.59	-149° 20.84	-	108	-	13.8	-	-	-
189	GOA Shelf	StereoDropCam	25-Jul	10:23	15.5	58° 12.62	-149° 25.16	-	100	-	14.3	-	-	-
190	GOA Shelf	StereoDropCam	25-Jul	10:57	15.2	58° 12.74	-149° 26.08	-	98	-	15.3	-	-	-
191	GOA Shelf	StereoDropCam	25-Jul	11:35	15.2	58° 12.79	-149° 25.22	-	100	-	14.5	-	-	-
192	GOA Shelf	StereoDropCam	25-Jul	12:18	20.3	58° 12.65	-149° 25.06	-	101	-	14.4	-	-	-
193	GOA Shelf	LFS1421	25-Jul	16:26	30.4	58° 30.39	-149° 46.99	118	141	6.5	14.0	1.3	1	691.0
194	GOA Shelf	Methot	26-Jul	4:14	32.2	59° 27.19	-150° 4.54	138	163	6.5	15.0	-	-	8.5
195	GOA Shelf	StereoDropCam	26-Jul	9:23	15.2	59° 9.56	-150° 6.40	-	133	-	14.4	-	-	-
196	GOA Shelf	StereoDropCam	26-Jul	9:58	15.2	59° 9.34	-150° 6.39	-	131	-	14.3	-	-	-
197	GOA Shelf	StereoDropCam	26-Jul	10:34	15.3	59° 9.63	-150° 6.39	-	133	-	14.5	-	-	-
198	GOA Shelf	StereoDropCam	26-Jul	11:10	15.2	59° 9.65	-150° 6.47	-	134	-	14.5	-	-	-
199	GOA Shelf	StereoDropCam	26-Jul	11:48	15.3	59° 9.44	-150° 6.26	-	131	-	14.6	-	-	-
200	GOA Shelf	LFS1421	26-Jul	16:09	40.7	59° 1.41	-149° 28.40	159	233	6.0	14.9	305.2	3737	21.2
201	GOA Shelf	AWT	26-Jul	19:21	31.2	59° 0.46	-149° 30.02	168	235	6.0	14.8	255.9	3710	41.9
202	GOA Shelf	LFS1421	26-Jul	23:59	15.4	58° 48.53	-149° 11.83	165	192	5.7	14.4	2.6	5	657.7
203	GOA Shelf	LFS1421	27-Jul	6:08	33.2	58° 19.01	-148° 34.71	197	277	5.3	15.7	247.9	294	157.2
204	GOA Shelf	LFS1421	27-Jul	15:26	10.6	58° 49.37	-148° 11.56	226	354	5.7	16.1	32.1	36	465.6
205	GOA Shelf	LFS1421	27-Jul	19:16	24.9	59° 1.78	-148° 29.84	180	232	6.2	15.8	366.4	1812	87.5
206	GOA Shelf	AWT	27-Jul	22:11	9.9	59° 1.45	-148° 30.01	171	230	6.4	15.8	570.9	3125	32.1
207	GOA Shelf	LFS1421	28-Jul	4:01	14.3	59° 22.55	-149° 0.38	138	190	6.2	15.3	191.6	4312	61.9
208	GOA Shelf	StereoDropCam	28-Jul	8:25	15.2	59° 33.35	-149° 26.58	-	156	-	14.2	-	-	-
209	GOA Shelf	StereoDropCam	28-Jul	9:12	15.3	59° 33.15	-149° 25.99	-	153	-	13.7	-	-	-
210	GOA Shelf	StereoDropCam	28-Jul	9:55	15.2	59° 33.50	-149° 26.43	-	161	-	13.8	-	-	-
211	GOA Shelf	StereoDropCam	28-Jul	10:51	15.2	59° 35.52	-149° 25.04	-	210	-	14.5	-	-	-
212	GOA Shelf	StereoDropCam	28-Jul	11:33	15.2	59° 35.27	-149° 24.68	-	204	-	14.5	-	-	-
213	GOA Shelf	StereoDropCam	28-Jul	12:23	15.3	59° 35.39	-149° 24.89	-	208	-	14.5	-	-	-
214	GOA Shelf	Methot	28-Jul	16:36	30.5	59° 38.63	-149° 22.89	134	236	-	14.5	-	-	27.5
215	Resurrection Bay	LFS1421	29-Jul	2:03	11.9	59° 53.11	-149° 29.75	119	233	6.5	13.6	143.2	3665	512.8
216	GOA Shelf	StereoDropCam	29-Jul	8:19	15.2	59° 53.29	-148° 40.57	-	87	-	14.8	-	-	-
217	GOA Shelf	StereoDropCam	29-Jul	8:54	15.2	59° 53.00	-148° 40.18	-	94	-	14.9	-	-	-
218	GOA Shelf	StereoDropCam	29-Jul	9:28	15.3	59° 53.40	-148° 40.59	-	84	-	15.0	-	-	-
219	GOA Shelf	StereoDropCam	29-Jul	10:14	15.2	59° 52.97	-148° 39.29	-	91	-	15.1	-	-	-
220	GOA Shelf	StereoDropCam	29-Jul	10:47	15.3	59° 53.42	-148° 39.52	-	81	-	14.9	-	-	-
221	GOA Shelf	StereoDropCam	29-Jul	11:21	15.2	59° 53.16	-148° 39.36	-	85	-	14.9	-	-	-
222	GOA Shelf	StereoDropCam	29-Jul	11:59	15.3	59° 53.36	-148° 39.53	-	82	-	14.9	-	-	-
223	GOA Shelf	LFS1421	29-Jul	14:46	33.1	59° 52.72	-148° 39.44	70	107	7.3	15.0	-	-	547.3
224	GOA Shelf	LFS1421	29-Jul	18:48	40.7	59° 39.46	-148° 21.02	129	186	6.4	14.8	119.5	2242	273.6

Table 9. -- Cont.

Haul	area	Gear[a]	Date	Time	Duration	Start position		Depth (m)		Temp. (°C)		Walleye pollock		Other
no.		type	(GMT)	(GMT)	(minutes)	Lat. (N)	Long. (W)	gear	bottom	gear[b]	surface[c]	(kg)	number	(kg)
225	GOA Shelf	AWT	29-Jul	21:59	40.6	59° 38.82	-148° 21.31	140	189	6.4	16.6	145.3	3417	184.5
226	GOA Shelf	Methot	30-Jul	3:12	36	59° 16.34	-147° 50.41	174	189	5.9	17.1	-	-	2.8
227	GOA Shelf	StereoDropCam	30-Jul	9:38	19.3	59° 21.10	-147° 1.72	-	194	-	14.2	-	-	-
228	GOA Shelf	StereoDropCam	30-Jul	10:23	15.2	59° 21.16	-147° 0.84	-	196	-	14.7	-	-	-
229	GOA Shelf	StereoDropCam	30-Jul	11:03	15.2	59° 21.18	-147° 1.04	-	195	-	15.0	-	-	-
230	GOA Shelf	StereoDropCam	30-Jul	11:46	15.3	59° 21.10	-147° 1.30	-	192	-	14.1	-	-	-
231*	GOA Shelf	LFS1421	30-Jul	14:56	15.4	59° 12.98	-146° 54.94	196	688	-	16.6	239.8	236	206.7
232	GOA Shelf	AWT	30-Jul	18:22	20.4	59° 25.45	-146° 55.19	116	197	6.6	15.6	390.4	1926	17.2
233	GOA Shelf	LFS1421	30-Jul	20:42	6	59° 25.80	-146° 54.35	119	196	6.5	15.7	467.5	2269	16.7
234	GOA Shelf	Methot	30-Jul	23:07	10.4	59° 29.26	-146° 53.54	154	175	-	15.8	-	-	3.2
235	GOA Shelf	LFS1421	31-Jul	2:07	10.8	59° 32.68	-146° 54.54	131	189	6.5	16.1	140.0	2719	18.7
236	GOA Shelf	AWT	31-Jul	4:32	11.2	59° 32.03	-146° 55.42	130	201	6.5	16.2	138.7	1276	72.0
237	GOA Shelf	StereoDropCam	31-Jul	7:50	15.2	59° 33.07	-146° 50.41	-	124	-	15.6	-	-	-
238	GOA Shelf	StereoDropCam	31-Jul	8:26	15.3	59° 32.77	-146° 49.96	-	120	-	15.3	-	-	-
239	GOA Shelf	StereoDropCam	31-Jul	9:01	15.3	59° 33.13	-146° 50.61	-	125	-	15.0	-	-	-
240	GOA Shelf	StereoDropCam	31-Jul	9:35	16.3	59° 33.01	-146° 50.42	-	123	-	14.6	-	-	-
241	GOA Shelf	StereoDropCam	31-Jul	10:36	15.2	59° 36.92	-146° 52.26	-	124	-	15.4	-	-	-
242	GOA Shelf	StereoDropCam	31-Jul	11:14	15.2	59° 36.88	-146° 52.82	-	125	-	15.3	-	-	-
243	GOA Shelf	StereoDropCam	31-Jul	11:56	15.3	59° 36.84	-146° 52.99	-	126	-	15.3	-	-	-
244	GOA Shelf	StereoDropCam	31-Jul	12:33	15.4	59° 36.80	-146° 52.34	-	123	-	15.2	-	-	-
245	Prince William Sound	LFS1421	31-Jul	23:31	17.5	60° 31.43	-146° 46.57	277	390	6.4	16.6	1.8	2	62.4
246	GOA Shelf	LFS1421	1-Aug	15:21	26.6	60° 16.23	-146° 9.74	27	58	12.2	15.3	-	-	557.5
247	GOA Shelf	LFS1421	1-Aug	21:33	18.9	59° 36.70	-146° 3.82	84	112	6.6	15.3	-	-	3000.0
248	GOA Shelf	LFS1421	2-Aug	5:41	8.8	59° 43.82	-145° 16.11	70	108	6.8	14.8	43.2	748	141.6
249	GOA Shelf	StereoDropCam	2-Aug	9:16	15.2	59° 50.71	-145° 28.34	-	101	-	14.1	-	-	-
250	GOA Shelf	StereoDropCam	2-Aug	9:51	15.2	59° 50.97	-145° 28.96	-	99	-	14.1	-	-	-
251	GOA Shelf	StereoDropCam	2-Aug	10:20	15.2	59° 50.86	-145° 28.60	-	100	-	14.2	-	-	-
252	GOA Shelf	StereoDropCam	2-Aug	10:51	15.2	59° 50.62	-145° 28.09	-	97	-	14.3	-	-	-
253	GOA Shelf	StereoDropCam	2-Aug	11:28	15.2	59° 50.75	-145° 28.23	-	95	-	14.4	-	-	-
254	GOA Shelf	LFS1421	2-Aug	16:15	25.3	60° 5.08	-145° 14.60	91	121	6.9	14.4	0.9	5	148.2
255	GOA Shelf	LFS1421	2-Aug	23:13	14.2	59° 32.39	-144° 26.35	241	297	5.3	15.1	143.5	156	283.0
256	GOA Shelf	StereoDropCam	3-Aug	8:21	15.3	59° 45.75	-144° 17.19	-	101	-	14.2	-	-	-
257	GOA Shelf	StereoDropCam	3-Aug	8:56	15.3	59° 46.11	-144° 17.16	-	98	-	14.2	-	-	-
258	GOA Shelf	StereoDropCam	3-Aug	9:45	15.5	59° 45.55	-144° 16.84	-	104	-	14.1	-	-	-
259	GOA Shelf	StereoDropCam	3-Aug	10:23	15.2	59° 45.90	-144° 17.14	-	101	-	14.2	-	-	-
260	GOA Shelf	Methot	3-Aug	16:40	2.4	59° 42.64	-143° 37.39	170	200	-	13.7	-	-	12.1

Table 9. -- Cont.

Haul	area	Gear[a]	Date	Time	Duration	Start position		Depth (m)		Temp. (°C)		Walleye pollock		Other
no.		type	(GMT)	(GMT)	(minutes)	Lat. (N)	Long. (W)	gear	bottom	gear[b]	surface[c]	(kg)	number	(kg)
261	GOA Shelf	LFS1421	3-Aug	23:00	16.4	59° 39.34	-142° 47.54	246	370	5.7	15.1	76.2	79	164.3
262	GOA Shelf	AWT	4-Aug	2:25	16.4	59° 38.74	-142° 49.04	237	394	5.8	15.6	3.7	4	191.9
263	GOA Shelf	StereoDropCam	4-Aug	8:19	15.3	59° 53.57	-142° 28.22	-	93	-	13.6	-	-	-
264	GOA Shelf	StereoDropCam	4-Aug	8:49	15.2	59° 53.11	-142° 28.22	-	78	-	13.4	-	-	-
265	GOA Shelf	StereoDropCam	4-Aug	9:22	15.2	59° 53.44	-142° 28.21	-	91	-	13.5	-	-	-
266	GOA Shelf	StereoDropCam	4-Aug	9:49	15.2	59° 53.34	-142° 28.34	-	88	-	13.3	-	-	-
267*	GOA Shelf	LFS1421	4-Aug	14:47	10.4	59° 47.58	-141° 57.80	77	89	-	14.7	2.0	32	494.1

[a]LFS1421 = LFS trawl, AWT = Aleutian wing trawl, Methot = Methot trawl, StereoDropCam = camera drop on untrawlable areas.

[b]Temperature from SBE39 placed on headrope of trawls and on camera frame for stereo drop cam.

[c]shipboard sensor at 1.4 m depth.

^Test haul not used in survey.

#Haul aborted

*Haul has no SBE39 data

Table 10. -- Summary of catch by species in forty-one LFS1421 trawls conducted in midwater along the shelf break during the summer 2019 walleye pollock acoustic-trawl survey of the Gulf of Alaska shelf.

		Weight		Number	
Common name	Scientific name	kg	Percent	Nos.	Percent
walleye pollock	*Gadus chalcogrammus*	10,128.3	49.5	63,624	25.8
Chrysaora melanaster	*Chrysaora melanaster*	3,711.7	18.1	3,768	1.5
Pacific herring	*Clupea pallasii*	3,110.6	15.2	28,127	11.4
Pacific ocean perch	*Sebastes alutus*	2,281.5	11.2	3,617	1.5
dusky rockfish	*Sebastes variabilis*	347.1	1.7	173	0.1
capelin	*Mallotus villosus*	206.1	1.0	52,801	21.4
pink salmon	*Oncorhynchus gorbuscha*	150.5	0.7	114	<0.1
eulachon	*Thaleichthys pacificus*	129.2	0.6	4,077	1.7
giant grenadier	*Coryphaenoides pectoralis*	83.2	0.4	32	<0.1
chum salmon	*Oncorhynchus keta*	81.2	0.4	48	<0.1
chinook salmon	*Oncorhynchus tshawytscha*	45.0	0.2	25	<0.1
Aequorea sp.	*Aequorea* sp.	28.7	0.1	796	0.3
spiny dogfish	*Squalus suckleyi*	18.1	0.1	8	<0.1
Pacific cod	*Gadus macrocephalus*	16.6	0.1	3,182	1.3
silvergray rockfish	*Sebastes brevispinis*	16.2	0.1	8	<0.1
lions mane	*Cyanea capillata*	15.0	0.1	33	<0.1
lanternfish unid.	Myctophidae (family)	12.0	0.1	3,880	1.6
walleye pollock Age 0	*Gadus chalcogrammus*	11.2	0.1	4,969	2.0
euphausiid unid.	Euphausiacea (order)	9.0	<0.1	71,041	28.8
prowfish	*Zaprora silenus*	6.5	<0.1	352	0.1
northern rockfish	*Sebastes polyspinis*	6.5	<0.1	6	<0.1
redstripe rockfish	*Sebastes proriger*	6.1	<0.1	8	<0.1
squid unid.	Cephalopoda (class)	4.7	<0.1	1,446	0.6
egg yolk jelly	*Phacellophora camtschatica*	3.6	<0.1	7	<0.1
black rockfish	*Sebastes melanops*	2.7	<0.1	2	<0.1
northern smoothtongue	*Leuroglossus schmidti*	2.4	<0.1	707	0.3
sockeye salmon	*Oncorhynchus nerka*	2.4	<0.1	1	<0.1
arrowtooth flounder	*Atheresthes stomias*	2.4	<0.1	2	<0.1
salmon unid.	Oncorhynchus (genus)	2.3	<0.1	14	<0.1
coho salmon	*Oncorhynchus kisutch*	1.8	<0.1	1	<0.1
shrimp unid.	Malacostraca (class)	1.7	<0.1	1,264	0.5
jellyfish unid.	Scyphozoa (class)	1.7	<0.1	40	<0.1
Pacific Sand Lance	*Ammodytes personatus*	1.5	<0.1	206	0.1
Atka mackerel	*Pleurogrammus monopterygius*	1.2	<0.1	1	<0.1
fish larvae unid.	Actinopterygii (class)	0.6	<0.1	2,038	0.8
Aurelia sp.	*Aurelia* sp.	0.5	<0.1	1	<0.1
isopod unid.	Isopoda (order)	0.4	<0.1	365	0.1
sablefish	*Anoplopoma fimbria*	0.4	<0.1	1	<0.1

Table 10. -- cont.

Common name	Scientific name	Weight		Number	
		kg	Percent	Nos.	Percent
harlequin rockfish	*Sebastes variegatus*	0.3	<0.1	1	<0.1
Phacellophora sp.	*Phacellophora* sp.	0.3	<0.1	3	<0.1
comb jelly unid.	Ctenophora (phylum)	0.2	<0.1	10	<0.1
lamprey unid.	Petromyzontidae (family)	0.2	<0.1	3	<0.1
Berry armhook squid	*Gonatus berryi*	0.1	<0.1	2	<0.1
Lampanyctus sp.	*Lampanyctus* sp.	<0.1	<0.1	9	<0.1
Pacific lamprey	*Lampetra tridentata*	<0.1	<0.1	1	<0.1
magistrate armhook squid	*Berryteuthis magister*	<0.1	<0.1	1	<0.1
unsorted catch and debris	-	<0.1	<0.1	0	<0.1
viperfish unid.	Stomiidae (family)	<0.1	<0.1	1	<0.1
		20,451.8		246,816	

Table 11. -- Number-at-length estimates (millions) by area from acoustic-trawl surveys of walleye pollock during the 2019 summer GOA survey.

Length	Shelf	Sanak	Morzhovoi	Pavlof	Shumagins	Mitrofania	Shelikof	Alitak/ Deadman	Chiniak	Barnabas	Marmot	Resurrection Bay	PWS	Total
10	-	-	-	-	-	-	-	-	-	-	-	-	-	-
11	-	-	-	-	-	-	-	-	-	-	-	-	-	-
12	-	0.31	-	-	-	-	2.50	-	-	-	0.05	-	-	2.86
13	4.34	-	1.40	-	-	-	18.37	-	-	-	-	-	-	24.11
14	18.03	3.36	4.66	-	-	-	132.39	-	-	-	0.08	0.02	-	158.53
15	100.25	8.49	9.10	-	0.01	-	374.73	-	-	0.44	0.44	0.52	-	493.97
16	146.64	7.37	6.66	-	0.03	-	343.97	-	0.06	3.60	1.28	2.28	-	511.91
17	303.29	4.28	4.39	-	0.06	-	167.86	0.14	0.19	13.84	5.45	2.65	-	502.14
18	456.75	0.92	2.58	-	0.07	-	24.81	0.34	1.57	29.80	11.77	1.45	-	530.06
19	343.23	-	0.28	-	0.02	-	15.58	0.43	3.35	36.03	9.69	0.39	-	409.01
20	140.01	0.23	0.27	-	0.03	-	13.99	0.10	2.02	21.01	4.86	0.08	-	182.60
21	45.77	0.04	-	-	0.02	-	41.72	0.03	1.04	8.75	1.22	0.03	-	98.62
22	20.56	0.01	-	-	0.02	-	54.26	0.03	0.40	2.64	0.26	0.02	-	78.18
23	28.57	0.31	-	-	0.02	-	94.15	-	0.28	1.99	0.06	0.02	-	125.39
24	66.14	0.14	0.01	-	0.21	-	132.85	0.02	0.12	3.23	0.11	0.06	-	202.89
25	73.89	0.43	-	-	0.31	-	80.20	0.34	0.48	6.16	0.14	0.08	-	162.05
26	89.91	0.27	0.04	-	0.83	-	50.18	1.17	1.01	9.26	0.63	0.05	-	153.35
27	97.52	0.22	0.05	-	0.88	-	23.96	2.24	1.51	7.07	0.64	0.06	-	134.17
28	97.98	0.10	0.04	-	0.70	-	13.19	2.33	2.84	8.70	1.43	0.02	-	127.31
29	101.51	0.05	0.14	<0.01	0.43	-	6.98	1.52	3.12	10.06	1.04	-	-	124.86
30	76.58	0.02	0.16	-	0.35	-	5.53	0.47	2.92	12.67	0.82	-	-	99.53
31	36.73	-	0.24	-	0.43	-	5.00	0.13	1.58	7.52	0.55	-	-	52.19
32	24.95	-	0.24	-	0.48	-	3.76	-	0.72	4.90	0.11	-	-	35.16
33	14.05	-	0.24	<0.01	0.71	0.01	1.98	0.08	0.47	3.10	0.10	-	-	20.74
34	10.89	0.01	0.19	0.01	0.74	-	4.14	0.06	0.22	1.40	0.04	-	-	17.71
35	7.71	-	0.04	<0.01	0.47	-	3.15	0.06	0.03	1.38	-	<0.01	-	12.86
36	6.20	-	0.04	0.01	0.31	0.02	2.18	0.10	0.03	0.78	0.01	<0.01	-	9.68
37	3.91	<0.01	0.03	0.01	0.21	0.02	0.37	0.06	0.07	1.01	-	<0.01	-	5.70
38	2.97	<0.01	-	0.02	0.15	0.01	0.41	0.13	0.05	0.92	-	<0.01	-	4.66
39	2.46	-	0.01	0.01	0.09	0.01	1.08	0.06	-	0.80	-	<0.01	-	4.54
40	1.57	-	-	-	0.04	0.02	0.52	0.03	<0.01	0.66	-	0.01	-	2.85
41	3.68	-	-	0.01	0.12	0.03	0.38	0.05	-	1.26	-	0.01	-	5.52
42	6.04	0.02	-	0.06	0.41	0.04	0.42	0.03	0.02	0.39	-	<0.01	-	7.44
43	12.40	0.06	-	0.21	0.96	0.14	0.35	0.10	-	0.35	0.02	-	-	14.58
44	28.41	0.09	-	0.37	2.41	0.22	0.49	-	0.06	0.42	-	-	-	32.46
45	35.84	0.11	-	0.44	3.49	0.32	1.36	0.03	0.16	1.09	-	0.01	-	42.85
46	39.22	0.11	0.04	0.43	4.02	0.30	1.92	0.06	0.19	2.66	0.04	<0.01	0.01	48.99
47	41.80	0.12	0.03	0.39	3.99	0.32	1.83	-	0.21	2.16	-	-	-	50.86
48	38.16	0.05	0.10	0.26	2.37	0.28	1.31	-	0.23	2.95	0.03	-	-	45.73
49	31.01	0.03	0.02	0.09	1.72	0.17	0.99	0.02	0.34	1.57	0.03	<0.01	-	35.98

Table 11. -- Continued.

Length	Shelf	Sanak	Morzhovoi	Pavlof	Shumagins	Mitrofania	Shelikof	Alitak/	Chiniak	Barnabas	Marmot	Resurrection	PWS	Total
50	21.21	0.01	0.08	0.05	1.13	0.16	1.90	0.02	0.22	1.25	0.04	-	-	26.07
51	13.59	0.01	0.08	0.03	0.48	0.07	1.85	-	0.17	1.84	0.01	-	0.01	18.16
52	10.18	-	0.02	<0.01	0.13	0.05	1.35	0.02	0.12	0.49	-	-	-	12.37
53	3.22	-	0.01	<0.01	0.11	0.01	1.21	-	0.08	0.40	-	-	-	5.04
54	1.59	-	-	-	0.05	0.01	1.01	0.02	0.02	0.16	-	<0.01	-	2.87
55	1.43	-	0.01	<0.01	0.02	-	1.30	-	-	0.18	-	-	-	2.95
56	0.49	-	0.02	-	-	0.01	0.35	-	-	0.05	-	-	-	0.91
57	0.16	-	0.02	-	-	-	-	0.02	-	0.09	-	-	-	0.29
58	0.79	-	-	-	-	-	0.34	-	-	0.05	-	-	-	1.18
59	0.30	-	-	-	-	-	-	-	-	0.05	-	-	-	0.34
60	0.11	-	-	-	-	-	-	-	-	-	-	-	-	0.11
61	0.08	-	-	-	-	-	-	-	-	0.09	-	-	-	0.17
62	0.17	-	-	-	-	-	0.32	-	-	0.05	-	-	-	0.53
63	-	-	-	-	-	-	-	-	-	-	-	-	-	-
64	-	-	-	-	-	-	-	0.02	-	-	-	-	-	0.02
65	0.03	-	-	-	-	-	-	-	-	-	-	-	-	0.03
66	0.06	-	-	-	-	-	-	-	-	-	-	-	-	0.06
67	-	-	-	-	-	-	-	-	-	-	-	-	-	-
68	-	-	-	-	-	-	-	-	-	-	-	-	-	-
69	-	-	-	-	-	-	-	-	-	-	-	-	-	-
70	-	-	-	-	-	-	-	-	-	-	-	-	-	-
71	-	-	-	-	-	-	-	-	-	-	-	-	-	-
72	-	-	-	-	-	-	-	-	-	-	-	-	-	-
73	-	-	-	-	-	-	-	-	-	-	-	-	-	-
74	-	-	-	-	-	-	-	-	-	-	-	-	-	-
75	-	-	-	-	-	-	-	-	-	-	-	-	-	-
76	-	-	-	-	-	-	-	-	-	-	-	-	-	-
77	-	-	-	-	-	-	-	-	-	-	-	-	-	-
78	-	-	-	-	-	-	-	-	-	-	-	-	-	-
79	-	-	-	-	-	-	-	-	-	-	-	-	-	-
80	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Total	2,612.38	27.17	31.27	2.41	29.04	2.21	1,638.49	10.24	25.91	215.27	40.93	7.77	0.02	4,643.11

Table 12. -- Biomass-at-length estimates (metric tons) by area from acoustic-trawl surveys of walleye pollock during the 2019 GOA survey.

Length	Shelf	Sanak	Morzhovoi	Pavlof	Shumagins	Mitrofania	Shelikof	Alitak/ Deadman	Chiniak	Barnabas	Marmot	Resurrection Bay	PWS	Total
10	-	-	-	-	-	-	-	-	-	-	-	-	-	-
11	-	-	-	-	-	-	-	-	-	-	-	-	-	-
12	-	4.0	-	-	-	-	32.2	-	-	-	0.6	-	-	36.7
13	67.0	-	21.6	-	-	-	283.4	-	-	-	-	-	-	372.0
14	347.7	64.8	89.8	-	-	-	2,552.7	-	-	-	1.5	0.4	-	3,056.8
15	2,443.8	207.0	221.8	-	0.2	-	9,134.2	-	-	10.7	10.6	12.5	-	12,040.8
16	4,327.8	217.4	196.5	-	0.9	-	10,151.0	-	1.9	106.3	37.8	66.5	-	15,106.2
17	10,885.5	153.5	157.5	-	2.2	-	6,021.2	4.8	6.7	496.8	194.6	92.0	-	18,014.7
18	19,566.3	39.5	110.6	-	3.1	-	1,067.3	14.0	67.3	1,276.6	505.4	60.3	-	22,710.4
19	17,468.2	-	14.2	-	1.2	-	802.5	21.4	170.5	1,833.7	495.9	19.8	-	20,827.5
20	8,370.5	13.6	16.4	-	1.9	-	838.3	5.8	120.6	1,256.2	290.8	5.0	-	10,919.0
21	3,030.3	2.7	-	-	1.0	-	2,760.3	1.8	68.8	579.1	80.6	2.2	-	6,526.7
22	1,527.4	0.6	-	-	1.1	-	4,028.8	2.2	29.7	196.1	19.0	1.2	-	5,806.2
23	2,418.9	25.9	-	-	2.1	-	7,970.4	-	24.1	168.7	5.0	1.4	-	10,616.4
24	6,567.2	13.9	1.4	-	20.6	-	13,187.8	1.6	11.9	321.0	10.5	6.4	-	20,142.3
25	8,463.4	49.6	-	-	35.9	-	9,184.2	38.9	55.1	705.7	16.2	9.2	-	18,558.1
26	11,873.7	35.1	5.4	-	109.0	-	6,626.3	154.0	133.0	1,223.0	83.7	6.4	-	20,249.5
27	14,890.0	33.4	8.3	-	132.7	-	3,657.0	329.8	231.2	1,077.8	98.2	9.5	-	20,467.9
28	16,980.9	18.0	7.0	-	119.5	-	2,282.8	394.8	491.7	1,504.8	246.9	2.7	-	22,049.1
29	19,395.8	10.5	25.8	0.3	82.3	-	1,330.5	288.6	595.9	1,917.7	198.6	-	-	23,846.1
30	16,140.0	5.0	34.2	-	73.1	-	1,165.2	97.4	614.0	2,666.7	173.1	-	-	20,968.7
31	8,291.1	-	54.9	-	97.4	-	1,127.4	28.9	357.0	1,696.7	124.0	-	-	11,777.3
32	6,187.0	-	60.3	-	118.6	-	932.1	-	178.2	1,214.4	26.9	-	-	8,717.4
33	3,878.6	-	67.1	1.2	196.9	1.9	546.1	22.2	129.4	856.2	27.1	-	-	5,726.8
34	3,335.5	3.4	57.8	2.7	228.2	-	1,267.2	19.7	67.1	429.4	11.8	-	-	5,422.6
35	2,590.7	-	13.6	1.5	157.7	-	1,056.9	21.6	11.5	462.7	-	0.6	-	4,316.8
36	2,225.8	-	14.5	2.1	110.6	7.3	784.0	35.0	10.0	280.3	4.9	0.7	-	3,475.2
37	1,559.8	1.4	10.6	3.5	83.8	8.1	147.3	25.7	27.1	404.8	-	0.8	-	2,272.9
38	1,295.7	1.6	-	6.6	66.7	5.9	177.5	56.3	22.6	401.2	-	1.6	-	2,035.7
39	1,173.0	-	6.3	3.1	42.4	6.5	507.8	30.9	-	383.3	-	0.9	-	2,154.2
40	819.0	-	-	-	21.5	10.7	269.7	16.9	1.6	343.9	-	3.0	-	1,486.3
41	1,939.1	-	-	3.4	61.2	14.5	199.6	25.8	-	660.3	-	3.0	-	2,906.9
42	3,431.5	9.1	-	32.9	231.6	23.1	241.2	18.4	11.4	223.1	-	1.1	-	4,223.3
43	7,416.2	33.8	-	127.1	573.4	84.5	211.1	57.5	-	210.3	11.0	-	-	8,724.8
44	17,767.3	58.9	-	232.1	1,502.5	134.9	305.9	-	38.1	262.5	-	-	-	20,302.3
45	23,495.1	71.4	-	290.3	2,279.3	208.2	890.9	21.1	105.5	712.7	-	3.7	-	28,078.3
46	27,541.4	73.9	29.8	300.0	2,816.1	207.5	1,347.5	45.0	133.6	1,860.3	25.6	1.3	6.7	34,388.8
47	31,419.1	88.1	23.8	292.1	2,988.6	242.7	1,369.1	-	155.4	1,621.3	-	-	-	38,200.1
48	30,369.2	39.5	74.6	200.9	1,859.3	222.4	1,021.3	-	178.2	2,321.1	24.8	-	-	36,311.6
49	26,725.7	24.8	17.9	80.3	1,459.5	143.1	836.4	13.6	286.1	1,332.0	22.2	1.6	-	30,943.2

Table 12. -- Continued.

Length	Shelf	Sanak	Morzhovoi	Pavlof	Shumagins	Mitrofania	Shelikof	Alitak/	Chiniak	Barnabas	Marmot	Resurrection	PWS	Total
50	18,923.7	5.4	74.4	47.6	996.5	136.4	1,671.9	14.1	194.1	1,103.2	32.0	-	-	23,199.6
51	12,965.4	11.5	79.7	30.7	454.5	69.9	1,742.7	-	164.2	1,737.3	12.7	-	9.0	17,277.7
52	10,148.8	-	20.8	4.2	125.1	46.0	1,326.2	15.7	121.4	486.2	-	-	-	12,294.4
53	3,430.8	-	11.1	2.3	114.8	7.1	1,276.7	-	82.3	422.4	-	-	-	5,347.6
54	1,801.9	-	-	-	58.2	15.1	1,159.3	17.9	25.3	186.3	-	2.1	-	3,266.1
55	1,546.9	-	11.3	1.6	24.8	-	1,383.8	-	-	190.1	-	-	-	3,158.4
56	582.3	-	25.4	-	-	8.1	421.0	-	-	55.1	-	-	-	1,092.0
57	210.8	-	27.9	-	-	-	-	20.8	-	121.0	-	-	-	380.5
58	1,119.8	-	-	-	-	-	482.7	-	-	65.4	-	-	-	1,667.9
59	441.6	-	-	-	-	-	-	-	-	68.8	-	-	-	510.4
60	178.9	-	-	-	-	-	-	-	-	-	-	-	-	178.9
61	130.1	-	-	-	-	-	-	-	-	152.0	-	-	-	282.0
62	290.3	-	-	-	-	-	547.9	-	-	79.8	-	-	-	917.9
63	-	-	-	-	-	-	-	30.7	-	-	-	-	-	-
64	-	-	-	-	-	-	-	-	-	-	-	-	-	30.7
65	69.3	-	-	-	-	-	-	-	-	-	-	-	-	69.3
66	118.9	-	-	-	-	-	-	-	-	-	-	-	-	118.9
67	-	-	-	-	-	-	-	-	-	-	-	-	-	-
68	-	-	-	-	-	-	-	-	-	-	-	-	-	-
69	-	-	-	-	-	-	-	-	-	-	-	-	-	-
70	-	-	-	-	-	-	-	-	-	-	-	-	-	-
71	-	-	-	-	-	-	-	-	-	-	-	-	-	-
72	-	-	-	-	-	-	-	-	-	-	-	-	-	-
73	-	-	-	-	-	-	-	-	-	-	-	-	-	-
74	-	-	-	-	-	-	-	-	-	-	-	-	-	-
75	-	-	-	-	-	-	-	-	-	-	-	-	-	-
76	-	-	-	-	-	-	-	-	-	-	-	-	-	-
77	-	-	-	-	-	-	-	-	-	-	-	-	-	-
78	-	-	-	-	-	-	-	-	-	-	-	-	-	-
79	-	-	-	-	-	-	-	-	-	-	-	-	-	-
80	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Total	418,184.6	1,317.2	1,592.4	1,666.3	17,256.1	1,603.8	106,326.9	1,893.2	4,922.4	35,684.9	2,791.7	315.7	15.7	593,571.8

Table 13. -- Number-at-age estimates (millions) by area from acoustic-trawl surveys of walleye pollock during the 2019 summer GOA survey.

Age	Shelf	Sanak	Morzhovoi	Pavlof	Shumagins	Mitrofania	Shelikof	Alitak/ Deadman	Chiniak	Barnabas	Marmot	Resurrection Bay	William Sound	Total
1	1,542.29	25.01	29.33	-	0.24	-	1,136.84	1.02	7.85	110.07	34.25	7.41	-	2,894.31
2	720.51	1.54	1.02	0.01	5.11	0.01	469.09	8.20	14.91	76.20	6.21	0.32	-	1,303.12
3	64.53	0.04	0.47	0.10	2.67	0.13	13.82	0.65	1.32	11.83	0.31	0.02	<0.01	95.90
4	5.17	0.01	<0.01	0.04	0.35	0.04	0.59	0.06	0.02	0.75	<0.01	<0.01	<0.01	7.05
5	3.99	0.01	<0.01	0.04	0.31	0.03	0.18	0.01	0.01	0.36	<0.01	<0.01	<0.01	4.95
6	44.87	0.10	0.06	0.41	3.52	0.34	2.52	0.06	0.25	2.52	0.02	<0.01	<0.01	54.68
7	209.05	0.42	0.33	1.66	15.40	1.52	13.13	0.21	1.38	11.94	0.12	0.01	0.01	255.19
8	19.30	0.03	0.04	0.14	1.35	0.14	1.41	0.02	0.14	1.30	0.01	<0.01	<0.01	23.89
9	1.15	<0.01	0.01	<0.01	0.04	0.01	0.42	-	0.01	0.11	<0.01	-	-	1.75
10	1.25	<0.01	<0.01	<0.01	0.05	0.01	0.18	<0.01	0.01	0.12	<0.01	-	<0.01	1.63
11	0.05	-	<0.01	-	-	-	-	<0.01	-	0.01	-	-	-	0.07
12	-	-	-	-	-	-	-	-	-	-	-	-	-	-
13	-	-	-	-	-	-	-	-	-	-	-	-	-	-
14	0.20	-	-	-	-	-	0.32	-	-	0.05	-	-	-	0.56
Total	2,612.38	27.17	31.27	2.41	29.04	2.21	1,638.50	10.24	25.91	215.27	40.93	7.77	0.02	4,643.11

Table 14. -- Biomass-at-age estimates (metric tons) by area from acoustic-trawl surveys of walleye pollock during the 2019 summer GOA survey.

Age	Shelf	Sanak	Morzhovoi	Pavlof	Shumagins	Mitrofania	Shelikof	Alitak/ Deadman	Chiniak	Barnabas	Marmot	Resurrection Bay	Prince William Sound	Total
1	65,554.2	704.0	827.9	-	10.4	-	33,952.4	47.2	412.4	5,344.9	1,580.9	257.9	-	108,692.2
2	112,494.9	190.0	226.1	2.2	938.9	2.4	51,419.9	1,336.0	2,668.1	12,751.2	1,008.4	37.4	-	183,075.5
3	21,203.5	15.5	140.2	54.5	1,004.1	64.9	4,535.7	231.6	348.0	3,956.8	75.4	8.4	0.1	31,638.7
4	2,931.6	6.8	2.3	26.8	206.2	22.5	302.2	29.7	12.5	382.5	1.0	1.6	0.1	3,925.8
5	2,601.0	6.5	0.9	25.3	203.9	20.0	109.6	7.3	9.1	212.7	0.8	0.7	0.1	3,197.8
6	33,114.3	71.3	50.9	280.7	2,505.5	244.6	2,064.8	46.1	197.3	1,918.8	18.3	2.2	2.1	40,516.9
7	162,009.4	296.8	286.3	1,170.1	11,289.9	1,133.8	11,498.0	173.6	1,136.3	9,668.3	95.9	7.1	11.9	198,777.4
8	15,521.1	24.9	38.4	100.4	1,018.7	103.6	1,268.2	17.9	117.2	1,106.4	10.5	0.5	1.3	19,329.3
9	1,097.3	0.6	12.1	3.4	37.9	6.4	453.4	-	7.0	106.9	0.4	-	-	1,725.3
10	1,212.1	0.8	3.3	2.8	40.5	5.6	174.8	0.8	14.5	140.1	0.2	-	0.2	1,595.7
11	87.5	-	4.0	-	-	-	-	3.0	-	17.3	-	-	-	111.7
12	-	-	-	-	-	-	-	-	-	-	-	-	-	-
13	-	-	-	-	-	-	-	-	-	-	-	-	-	-
14	358.0	-	-	-	-	-	547.9	-	-	79.8	-	-	-	985.6
Total	418,184.6	1,317.2	1,592.4	1,666.3	17,256.1	1,603.8	106,326.9	1,893.2	4,922.4	35,685.6	2,791.7	315.7	15.7	593,571.8

Table 15. -- Summary of catch by species in two LFS1421 trawls conducted in midwater in the Sanak Trough during the summer 2019 walleye pollock acoustic-trawl survey of the Gulf of Alaska shelf.

		Weight		Number	
Common name	Scientific name	kg	Percent	Nos.	Percent
walleye pollock	*Gadus chalcogrammus*	193.8	86.2	4,705	1.9
euphausiid unid.	Euphausiacea (order)	21.5	9.6	237,183	98.0
pink salmon	*Oncorhynchus gorbuscha*	4.6	2.0	5	<0.1
chum salmon	*Oncorhynchus keta*	4.1	1.8	2	<0.1
Chrysaora melanaster	*Chrysaora melanaster*	0.4	0.2	1	<0.1
capelin	*Mallotus villosus*	0.4	0.2	23	<0.1
fish larvae unid.	Actinopterygii (class)	<0.1	<0.1	7	<0.1
		224.8		241,926	

Table 16. -- Summary of catch by species in one LFS1421 trawl conducted in midwater in Morzhovoi Bay during the summer 2019 walleye pollock acoustic-trawl survey of the Gulf of Alaska shelf.

		Weight		Number	
Common name	Scientific name	kg	Percent	Nos.	Percent
walleye pollock	*Gadus chalcogrammus*	137.6	99.6	2,579	98.8
euphausiid unid.	Euphausiacea (order)	0.2	0.1	0	<0.1
lions mane	*Cyanea capillata*	0.2	0.1	10	0.4
jellyfish unid.	Scyphozoa (class)	0.1	0.1	0	<0.1
Pacific herring	*Clupea pallasii*	0.1	<0.1	1	<0.1
fish larvae unid.	Actinopterygii (class)	<0.1	<0.1	10	0.4
isopod unid.	Isopoda (order)	<0.1	<0.1	10	0.4
		138.2		2,610	

Table 17. -- Summary of catch by species in nine LFS1421 trawls conducted in midwater in the vicinity of the Shumagin Islands during the summer 2019 walleye pollock acoustic-trawl survey of the Gulf of Alaska shelf.

		Weight		Number	
Common name	Scientific name	kg	Percent	Nos.	Percent
walleye pollock	*Gadus chalcogrammus*	2,736.1	95.2	5,158	7.9
capelin	*Mallotus villosus*	44.7	1.6	16,703	25.5
chinook salmon	*Oncorhynchus tshawytscha*	21.3	0.7	11	<0.1
smelt unid.	Osmeridae (family)	17.3	0.6	8,626	13.2
chum salmon	*Oncorhynchus keta*	12.8	0.4	8	<0.1
pink salmon	*Oncorhynchus gorbuscha*	12.6	0.4	11	<0.1
euphausiid unid.	Euphausiacea (order)	7.6	0.3	16,842	25.7
Chrysaora melanaster	*Chrysaora melanaster*	5.6	0.2	14	<0.1
Pacific cod	*Gadus macrocephalus*	3.1	0.1	1	<0.1
arrowtooth flounder	*Atheresthes stomias*	3.1	0.1	3	<0.1
salmon unid.	Oncorhynchus (genus)	2.8	0.1	9	<0.1
eulachon	*Thaleichthys pacificus*	2.7	0.1	101	0.2
fish larvae unid.	Actinopterygii (class)	1.4	<0.1	12,588	19.2
sockeye salmon	*Oncorhynchus nerka*	1.0	<0.1	1	<0.1
walleye pollock Age 0	*Gadus chalcogrammus*	1.0	<0.1	5,238	8.0
Aequorea sp.	*Aequorea* sp.	0.5	<0.1	4	<0.1
Pacific herring	*Clupea pallasii*	0.2	<0.1	2	<0.1
jellyfish unid.	Scyphozoa (class)	0.1	<0.1	143	0.2
squid unid.	Cephalopoda (class)	0.1	<0.1	26	<0.1
unsorted catch and debris	-	0.1	<0.1	<0.1	<0.1
isopod unid.	Isopoda (order)	<0.1	<0.1	13	<0.1
		2,873.9		65,502	

Table 18. -- Summary of catch by species in one LFS1421 trawl conducted in midwater near Mitrofania Island during the summer 2019 walleye pollock acoustic-trawl survey of the Gulf of Alaska shelf.

		Weight		Number	
Common name	Scientific name	kg	Percent	Nos.	Percent
walleye pollock	*Gadus chalcogrammus*	501.8	84.3	678	29.4
chinook salmon	*Oncorhynchus tshawytscha*	52.9	8.9	27	1.2
chum salmon	*Oncorhynchus keta*	23.3	3.9	12	0.5
Chrysaora melanaster	*Chrysaora melanaster*	11.8	2.0	16	0.7
arrowtooth flounder	*Atheresthes stomias*	2.5	0.4	2	0.1
lions mane	*Cyanea capillata*	1.1	0.2	34	1.5
walleye pollock Age 0	*Gadus chalcogrammus*	0.9	0.1	1,475	63.9
unsorted catch and debris	-	0.7	0.1	0	<0.1
capelin	*Mallotus villosus*	0.2	<0.1	40	1.7
jellyfish unid.	Scyphozoa (class)	0.1	<0.1	1	<0.1
isopod unid.	Isopoda (order)	<0.1	<0.1	23	1.0
		595.1		2,308	

Table 19. -- Summary of catch by species in twelve LFS1421 trawls conducted in midwater in Shelikof Strait during the summer 2019 walleye pollock acoustic-trawl survey of the Gulf of Alaska shelf.

		Weight		Number	
Common name	Scientific name	kg	Percent	Nos.	Percent
walleye pollock	*Gadus chalcogrammus*	2,170.5	76.9	27,686	69.0
Pacific herring	*Clupea pallasii*	322.5	11.4	3,642	9.1
eulachon	*Thaleichthys pacificus*	208.0	7.4	6,755	16.8
Chrysaora melanaster	*Chrysaora melanaster*	92.2	3.3	350	0.9
chum salmon	*Oncorhynchus keta*	8.8	0.3	6	0.0
chinook salmon	*Oncorhynchus tshawytscha*	4.8	0.2	5	0.0
lions mane	*Cyanea capillata*	4.3	0.2	58	0.1
capelin	*Mallotus villosus*	1.9	0.1	263	0.7
northern smoothtongue	*Leuroglossus schmidti*	1.7	0.1	304	0.8
lanternfish unid.	Myctophidae (family)	1.6	0.1	375	0.9
shrimp unid.	Malacostraca (class)	1.1	<0.1	388	1.0
pink salmon	*Oncorhynchus gorbuscha*	0.9	<0.1	1	<0.1
arrowtooth flounder	*Atheresthes stomias*	0.7	<0.1	1	<0.1
sablefish	*Anoplopoma fimbria*	0.6	<0.1	2	<0.1
prowfish	*Zaprora silenus*	0.5	<0.1	2	<0.1
coonstripe shrimp	*Pandalus hypsinotus*	0.2	<0.1	29	0.1
Aequorea sp.	*Aequorea* sp.	0.2	<0.1	5	<0.1
Staurophora mertensi	*Staurophora mertensi*	0.1	<0.1	23	0.1
jellyfish unid.	Scyphozoa (class)	0.1	<0.1	0	<0.1
isopod unid.	Isopoda (order)	0.1	<0.1	88	0.2
Hydrozoa	Hydrozoa (class)	0.1	<0.1	42	0.1
walleye pollock Age 0	*Gadus chalcogrammus*	0.1	<0.1	92	0.2
salmon unid.	Oncorhynchus (genus)	<0.1	<0.1	5	<0.1
squid unid.	Cephalopoda (class)	<0.1	<0.1	19	<0.1
Pacific cod	*Gadus macrocephalus*	<0.1	<0.1	3	<0.1
Octopus sp.	Octopoda (order)	<0.1	<0.1	1	<0.1
amphipod unid.	Amphipoda (order)	<0.1	<0.1	4	<0.1
		2,821.2		40,149	

Table 20. -- Summary of catch by species in one LFS1421 trawl conducted in midwater in Alitak Bay during the summer 2019 walleye pollock acoustic-trawl survey of the Gulf of Alaska shelf.

		Weight		Number	
Common name	Scientific name	kg	Percent	Nos.	Percent
walleye pollock	*Gadus chalcogrammus*	1,195.2	97.0	5,952	96.5
Pacific herring	*Clupea pallasii*	33.1	2.7	153	2.5
lions mane	*Cyanea capillata*	1.4	0.1	32	0.5
euphausiid unid.	Euphausiacea (order)	1.2	0.1	0	<0.1
eulachon	*Thaleichthys pacificus*	1.0	0.1	23	0.4
Chrysaora melanaster	*Chrysaora melanaster*	0.1	<0.1	9	0.1
jellyfish unid.	Scyphozoa (class)	<0.1	<0.1	0	<0.1
		1,232.0		6,169	

Table 21. -- Summary of catch by species in eight LFS1421 trawls conducted in midwater in the vicinity of the Barnabas Trough during the summer 2019 walleye pollock acoustic-trawl survey of the Gulf of Alaska shelf.

		Weight		Number	
Common name	Scientific name	kg	Percent	Nos.	Percent
walleye pollock	*Gadus chalcogrammus*	4,141.3	74.2	41,908	83.2
Pacific herring	*Clupea pallasii*	719.8	12.9	5,256	10.4
Chrysaora melanaster	*Chrysaora melanaster*	634.4	11.4	883	1.8
lions mane	*Cyanea capillata*	38.2	0.7	353	0.7
Pacific ocean perch	*Sebastes alutus*	18.7	0.3	17	<0.1
dusky rockfish	*Sebastes variabilis*	7.9	0.1	4	<0.1
pink salmon	*Oncorhynchus gorbuscha*	5.8	0.1	5	<0.1
chum salmon	*Oncorhynchus keta*	5.4	0.1	2	<0.1
jellyfish unid.	Scyphozoa (class)	2.4	<0.1	0	<0.1
walleye pollock Age 0	*Gadus chalcogrammus*	2.4	<0.1	1,487	3.0
Pacific sandfish	*Trichodon trichodon*	2.2	<0.1	11	<0.1
capelin	*Mallotus villosus*	1.3	<0.1	251	0.5
prowfish	*Zaprora silenus*	1.1	<0.1	98	0.2
Aequorea sp.	*Aequorea* sp.	0.6	<0.1	10	<0.1
Staurophora mertensi	*Staurophora mertensi*	0.3	<0.1	15	<0.1
Aurelia sp.	*Aurelia* sp.	0.3	<0.1	1	<0.1
isopod unid.	Isopoda (order)	0.1	<0.1	46	0.1
salp unid.	Thaliacea (class)	<0.1	<0.1	1	<0.1
comb jelly unid.	Ctenophora (phylum)	<0.1	<0.1	1	<0.1
Hydrozoa	Hydrozoa (class)	<0.1	<0.1	4	<0.1
		5,582.2		50,353	

Table 22. -- Summary of catch by species in four LFS1421 trawls conducted in midwater along the Chiniak Trough during the summer 2019 walleye pollock acoustic-trawl survey of the Gulf of Alaska shelf.

		Weight		Number	
Common name	Scientific name	kg	Percent	Nos.	Percent
walleye pollock	*Gadus chalcogrammus*	2,249.7	58.2	12,797	57.3
Chrysaora melanaster	*Chrysaora melanaster*	1,015.8	26.3	643	2.9
Pacific herring	*Clupea pallasii*	372.8	9.6	3,085	13.8
Pacific ocean perch	*Sebastes alutus*	172.4	4.5	197	0.9
lions mane	*Cyanea capillata*	33.4	0.9	331	1.5
walleye pollock Age 0	*Gadus chalcogrammus*	5.9	0.2	4,697	21.0
capelin	*Mallotus villosus*	5.7	0.1	478	2.1
pink salmon	*Oncorhynchus gorbuscha*	4.0	0.1	4	<0.1
eulachon	*Thaleichthys pacificus*	2.2	0.1	48	0.2
chinook salmon	*Oncorhynchus tshawytscha*	1.7	<0.1	2	<0.1
jellyfish unid.	Scyphozoa (class)	0.3	<0.1	0	<0.1
prowfish	*Zaprora silenus*	0.2	<0.1	22	0.1
Aequorea sp.	*Aequorea* sp.	0.1	<0.1	3	<0.1
squid unid.	Cephalopoda (class)	<0.1	<0.1	1	<0.1
sand lance unid.	Ammodytes (genus)	<0.1	<0.1	9	<0.1
Pacific cod	Gadus macrocephalus	<0.1	<0.1	3	<0.1
Octopus sp.	Ocotopoda (class)	<0.1	<0.1	1	<0.1
		3,864.2		22,321	

Table 23. -- Summary of catch by species in five LFS1421 trawls conducted in midwater in Marmot Bay during the summer 2019 walleye pollock acoustic-trawl survey of the Gulf of Alaska shelf.

		Weight		Number	
Common name	Scientific name	kg	Percent	Nos.	Percent
walleye pollock	*Gadus chalcogrammus*	834.9	40.6	11,492	25.4
Pacific herring	*Clupea pallasii*	442.9	21.5	4,259	9.4
Chrysaora melanaster	*Chrysaora melanaster*	315.7	15.4	322	0.7
Pacific ocean perch	*Sebastes alutus*	216.8	10.5	262	0.6
salmon shark	*Lamna ditropis*	72.0	3.5	1	<0.1
smelt unid.	Osmeridae (family)	66.5	3.2	18,522	41.0
chum salmon	*Oncorhynchus keta*	36.7	1.8	13	<0.1
walleye pollock Age 0	*Gadus chalcogrammus*	18.7	0.9	7,433	16.5
capelin	*Mallotus villosus*	16.1	0.8	2,526	5.6
chinook salmon	*Oncorhynchus tshawytscha*	15.6	0.8	16	<0.1
lions mane	*Cyanea capillata*	14.1	0.7	51	0.1
jellyfish unid.	Scyphozoa (class)	2.2	0.1	130	0.3
coho salmon	*Oncorhynchus kisutch*	1.6	0.1	1	<0.1
northern rockfish	*Sebastes polyspinis*	1.4	0.1	1	<0.1
Aequorea sp.	*Aequorea* sp.	1.0	<0.1	47	0.1
prowfish	*Zaprora silenus*	0.5	<0.1	32	0.1
isopod unid.	Isopoda (order)	0.1	<0.1	56	0.1
squid unid.	Cephalopoda (class)	<0.1	<0.1	6	<0.1
slender eelblenny	*Lumpenus fabricii*	<0.1	<0.1	1	<0.1
Pacific cod	*Gadus macrocephalus*	<0.1	<0.1	2	<0.1
fish larvae unid.	Actinopterygii (class)	<0.1	<0.1	1	<0.1
		2,056.6		45,174	

Table 24. -- Summary of catch by species in one LFS1421 trawl conducted in midwater in Resurrection Bay during the summer 2019 walleye pollock acoustic-trawl survey of the Gulf of Alaska shelf.

		Weight		Number	
Common name	Scientific name	kg	Percent	Nos.	Percent
Chrysaora melanaster	*Chrysaora melanaster*	506.5	77.2	453	10.2
walleye pollock	*Gadus chalcogrammus*	143.2	21.8	3,665	82.8
chinook salmon	*Oncorhynchus tshawytscha*	2.4	0.4	1	<0.1
dusky rockfish	*Sebastes variabilis*	1.7	0.3	1	<0.1
walleye pollock Age 0	*Gadus chalcogrammus*	0.6	0.1	197	4.5
Aequorea sp.	*Aequorea* sp.	0.5	0.1	17	0.4
lions mane	*Cyanea capillata*	0.4	0.1	2	<0.1
Pacific cod	*Gadus macrocephalus*	0.3	<0.1	79	1.8
Pacific herring	*Clupea pallasii*	0.2	<0.1	2	<0.1
prowfish	*Zaprora silenus*	0.1	<0.1	7	0.2
salmon unid.	Oncorhynchus (genus)	0.1	<0.1	1	<0.1
		655.9		4,425	

Table 25. -- Summary of catch by species in one LFS1421 trawl conducted in midwater in Prince William Sound during the summer 2019 walleye pollock acoustic-trawl survey of the Gulf of Alaska shelf.

		Weight		Number	
Common name	Scientific name	kg	Percent	Nos.	Percent
northern smoothtongue	*Leuroglossus schmidti*	33.4	52.0	12,411	76.2
Chrysaora melanaster	*Chrysaora melanaster*	11.4	17.7	30	0.2
lions mane	*Cyanea capillata*	3.8	6.0	5	<0.1
Pacific glass shrimp	*Pasiphaea pacifica*	2.8	4.4	2,560	15.7
chum salmon	*Oncorhynchus keta*	2.8	4.3	1	<0.1
squid unid.	Cephalopoda (class)	2.5	3.9	357	2.2
pink salmon	*Oncorhynchus gorbuscha*	2.3	3.6	1	<0.1
walleye pollock	*Gadus chalcogrammus*	1.8	2.8	2	<0.1
Aurelia sp.	*Aurelia* sp.	1.2	1.9	3	<0.1
lanternfish unid.	Myctophidae (family)	0.7	1.1	266	1.6
salmon unid.	Oncorhynchus (genus)	0.7	1.0	4	<0.1
Aequorea sp.	*Aequorea* sp.	0.6	0.9	19	0.1
Pacific cod	*Gadus macrocephalus*	0.1	0.2	31	0.2
walleye pollock Age 0	*Gadus chalcogrammus*	<0.1	0.1	10	0.1
amphipod unid.	Amphipoda (order)	<0.1	<0.1	338	2.1
euphausiid unid.	Euphausiacea (order)	<0.1	<0.1	205	1.3
fish larvae unid.	Actinopterygii (class)	<0.1	<0.1	31	0.2
snailfish unid.	Liparidae (family)	<0.1	<0.1	10	0.1
jellyfish unid.	Scyphozoa (class)	<0.1	<0.1	2	<0.1
		64.2		16,286	

Table 26. -- Summary of catch by species in 9 Methot trawls conducted during the summer 2019 walleye pollock acoustic-trawl survey of the Gulf of Alaska shelf.

		Weight		Number	
Common name	Scientific name	kg	Percent	Nos.	Percent
Chrysaora melanaster	*Chrysaora melanaster*	65.5	62.0	88	<0.1
euphausiid unid.	Euphausiacea (order)	30.9	29.3	424,298	97.0
Aequorea sp.	*Aequorea sp.*	3.2	3.0	82	<0.1
lions mane	*Cyanea capillata*	3.1	3.0	15	<0.1
egg yolk jelly	*Phacellophora camtschatica*	1.3	1.2	2	<0.1
jellyfish unid.	Scyphozoa (class)	0.5	0.4	486	0.1
copepod unid.	Maxillopoda (class)	0.3	0.3	10,929	2.5
fish larvae unid.	Actinopterygii (class)	0.3	0.3	1,065	0.2
Staurophora mertensi	*Staurophora mertensi*	0.2	0.2	0	<0.1
prowfish	*Zaprora silenus*	0.1	0.1	5	<0.1
Crab larvae	Decapoda (order)	<0.1	<0.1	210	<0.1
snail unid.	Gastropoda (class)	<0.1	<0.1	30	<0.1
unsorted shab	-	<0.1	<0.1	56	<0.1
isopod unid.	Isopoda (order)	<0.1	<0.1	21	<0.1
squid unid.	Cephalopoda (class)	<0.1	<0.1	8	<0.1
Hydrozoa	Hydrozoa (class)	<0.1	<0.1	5	<0.1
walleye pollock Age 0	*Gadus chalcogrammus*	<0.1	<0.1	8	<0.1
Octopus sp.	Octopoda (order)	<0.1	<0.1	1	<0.1
amphipod unid.	Amphipoda (order)	<0.1	<0.1	2	<0.1
flatfish larvae	Pleuronectiform larvae	<0.1	<0.1	1	<0.1
		105.5		437,312	

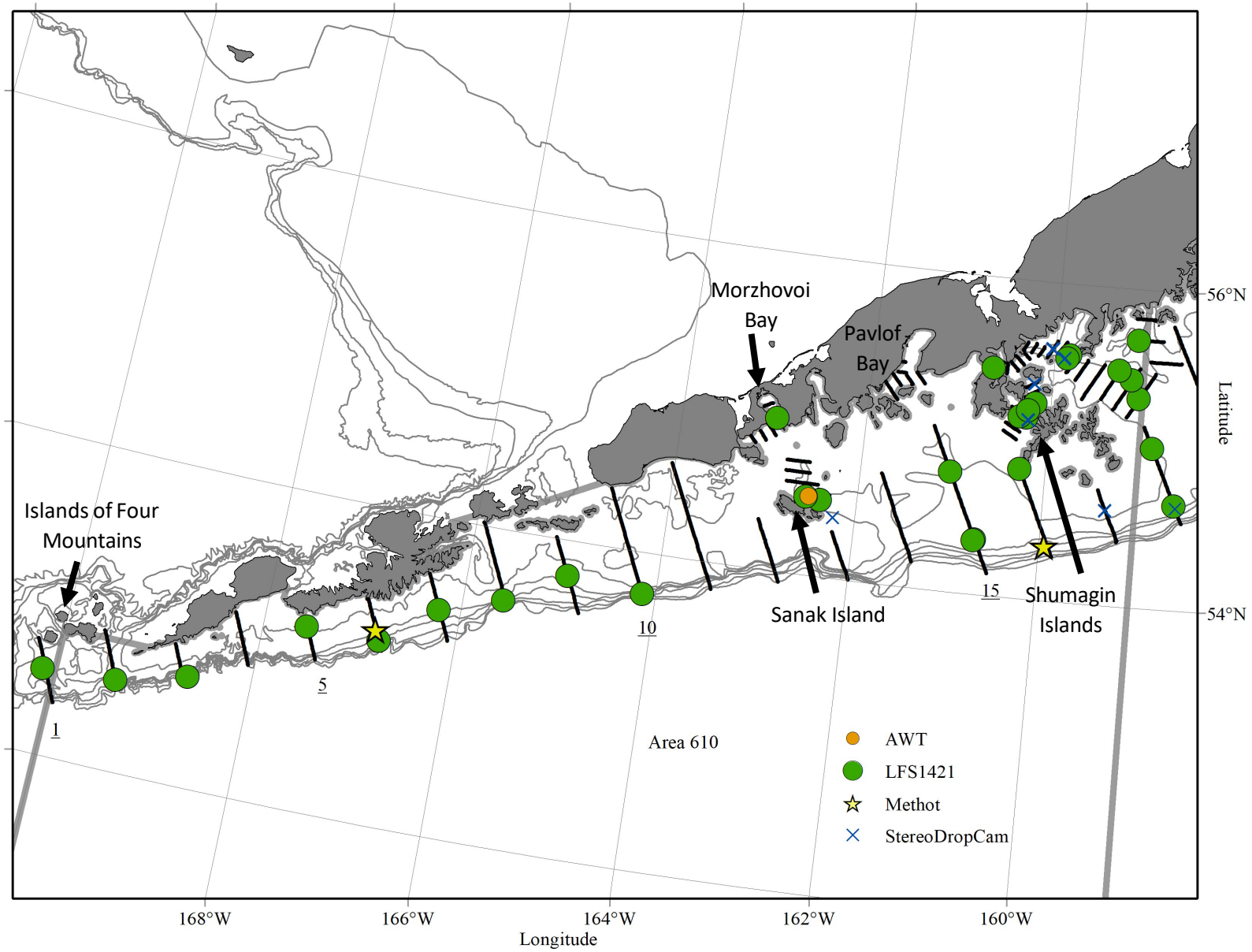


Figure 1. -- Transect lines and locations of LFS1421, Aleutian-wing trawl (AWT), Methot, and Stereo Camera (StereoDropCam) deployments from the summer 2019 acoustic-trawl survey of walleye pollock in the western Gulf of Alaska from the Islands of Four Mountains to the Shumagin Islands. Transect numbers are underlined. The boundary between NMFS reporting areas 610 and 620 is displayed.

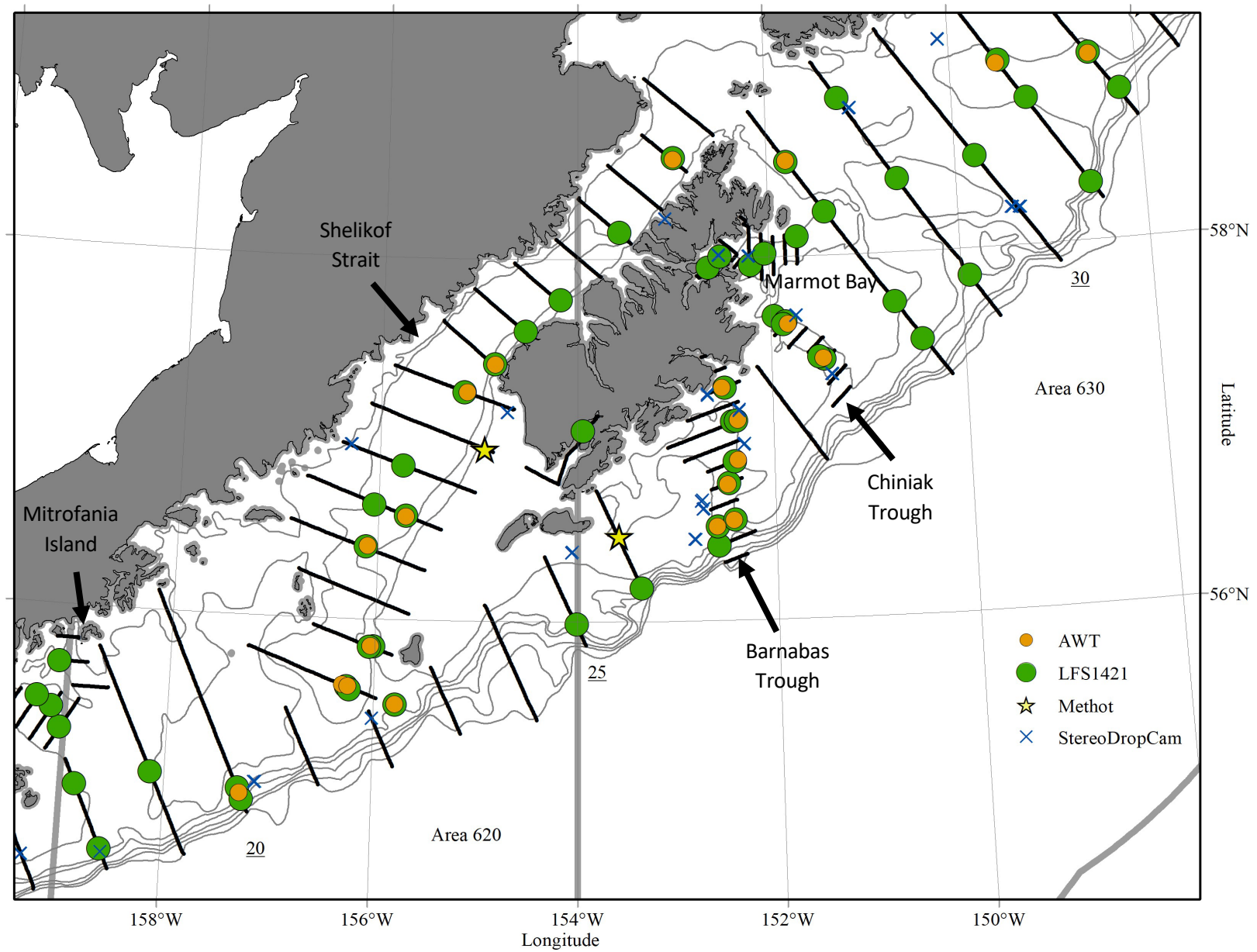


Figure 2. -- Transect lines and locations of LFS1421, Aleutian-wing trawl (AWT), Methot, and Stereo Camera (StereoDropCam) deployments from the summer 2019 acoustic-trawl survey of walleye pollock in the central Gulf of Alaska from the Shumagin Islands to eastern Kodiak Island. Transect numbers are underlined. The boundary between NMFS reporting areas 620 and 630 is displayed.

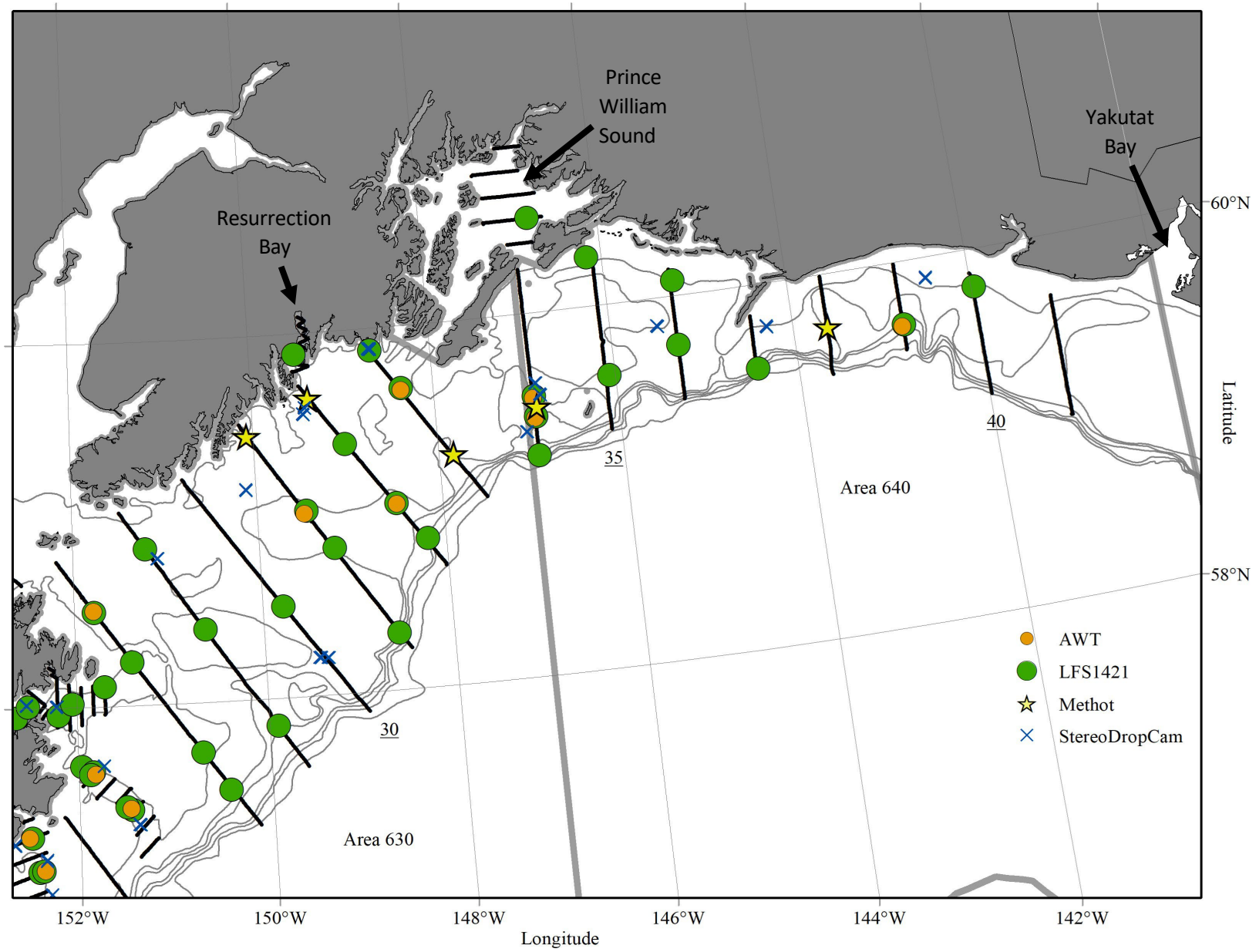


Figure 3. -- Transect lines and locations of LFS1421, Aleutian-wing trawl (AWT), Methot, and Stereo Camera (StereoDropCam) deployments from the summer 2019 acoustic-trawl survey of walleye pollock in the eastern Gulf of Alaska from eastern Kodiak Island to Yakutat Trough. Transect numbers are underlined. The boundaries between NMFS reporting areas 630 and 640 are displayed.

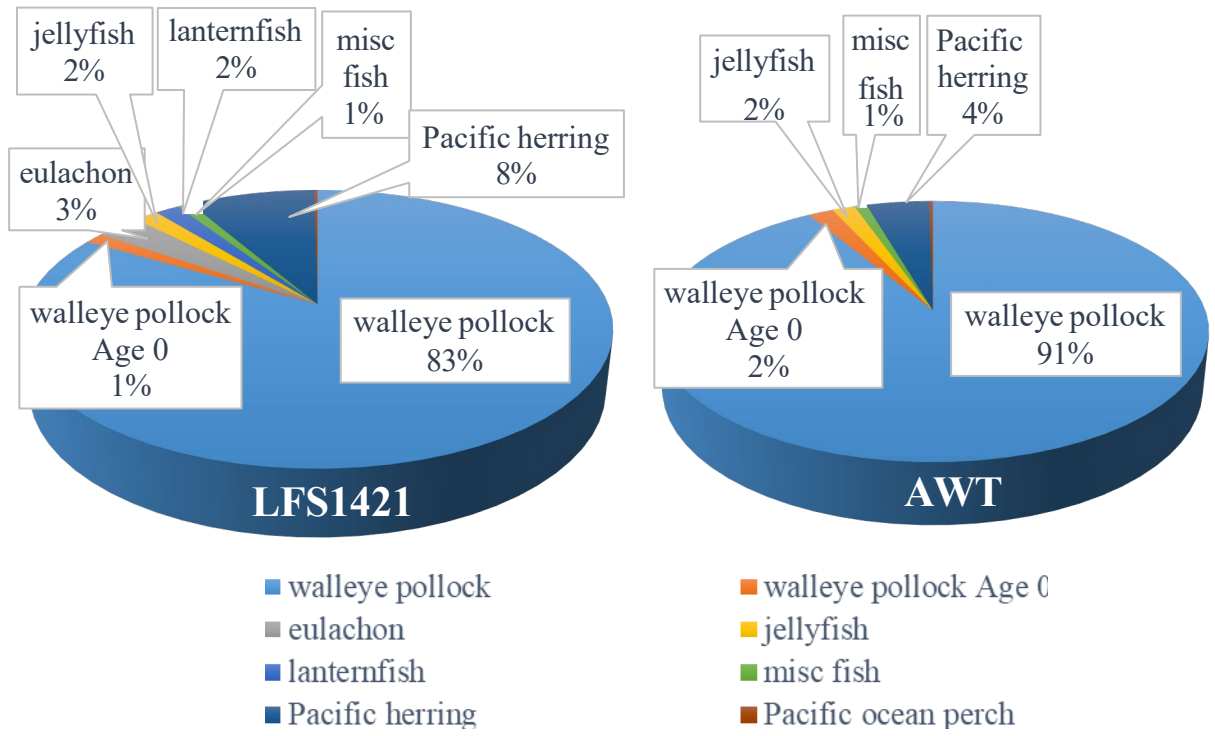


Figure 4. -- Percent of catch by species or group in 26 comparison hauls of LFS1421 and AWT trawls during the summer 2019 GOA AT survey. Groups comprising at least 1% of the total catch are labeled on the pie charts and all groups in the data are displayed with their respective group color.

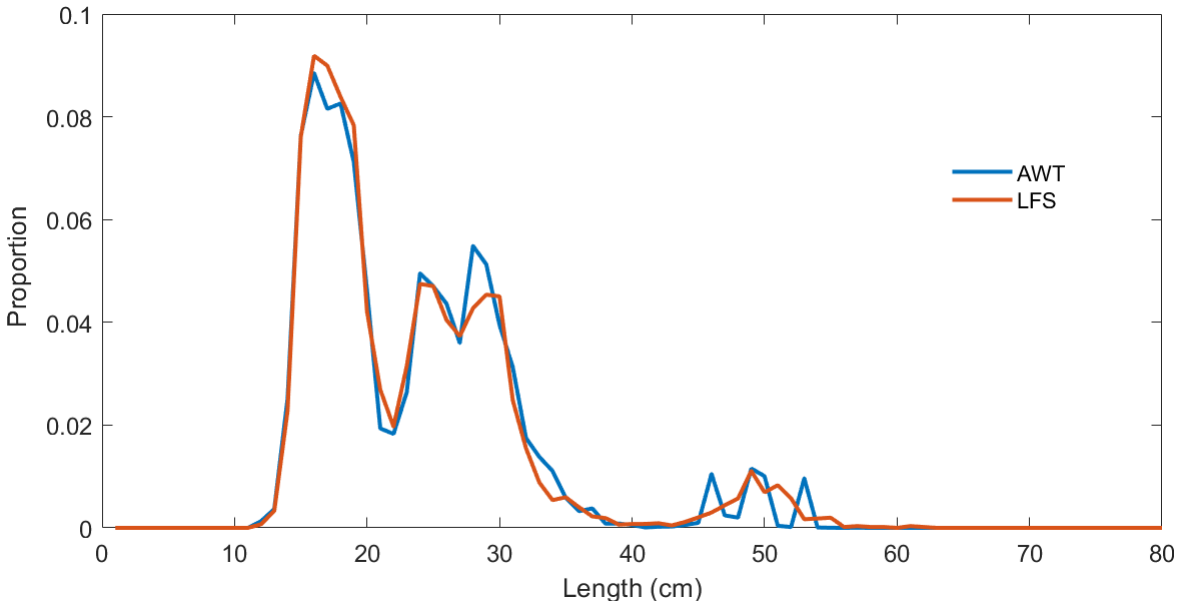


Figure 5. -- Proportion of walleye pollock at length from 26 comparison hauls of LFS1421 and AWT trawls during the summer 2019 GOA AT survey.

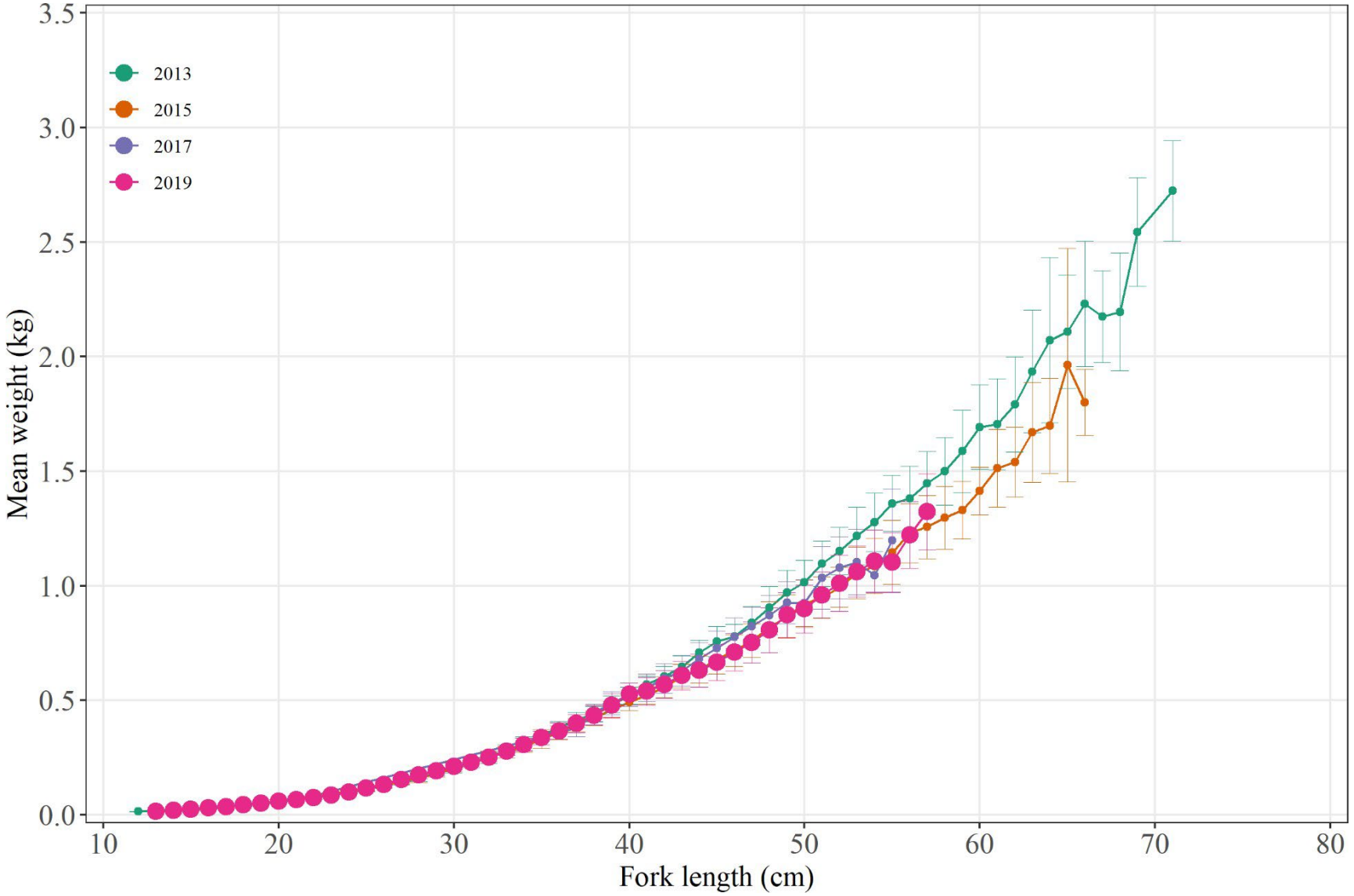


Figure 6. -- Mean weight (kg), and standard deviation, at length (cm) for all areas combined during GOA surveys conducted in summer 2013, 2015, 2017, and 2019. Only length classes containing at least six fish were plotted for each year.

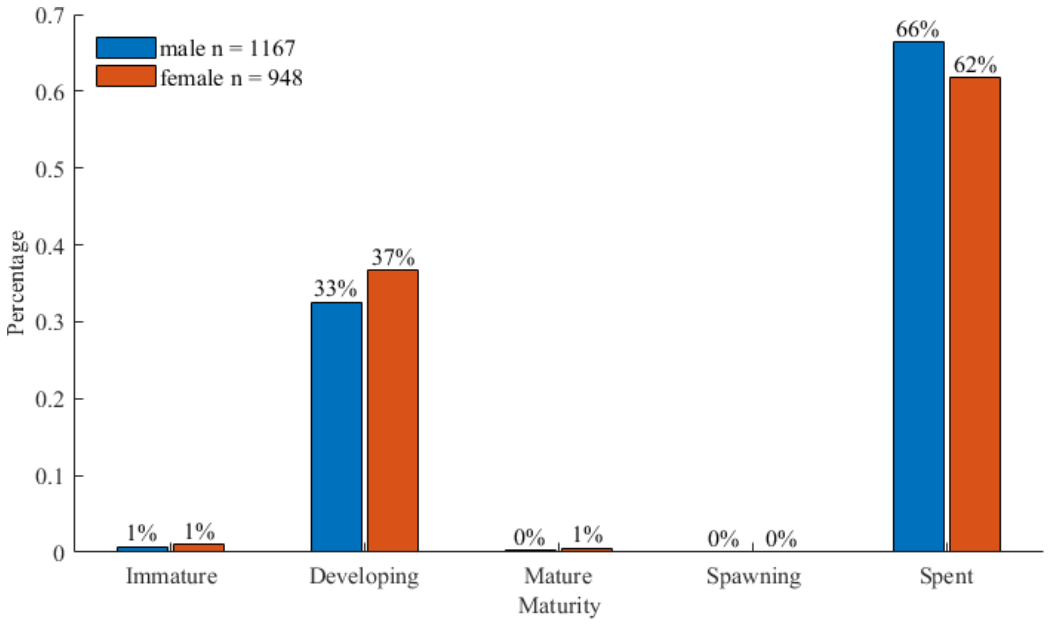


Figure 7. -- Maturity designation and percentage in each category of male and female walleye pollock examined from all trawls combined during the 2019 acoustic-trawl survey of the Gulf of Alaska.

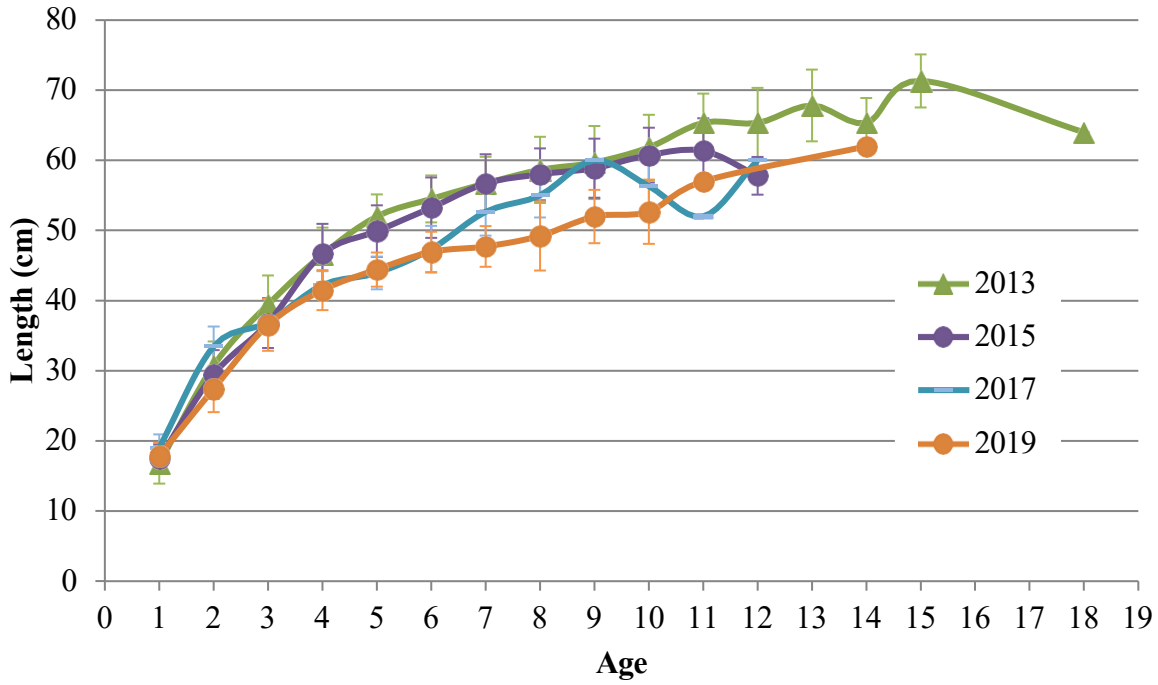


Figure 8. -- Average length (cm) at age (bars indicate 1 standard deviation) of walleye pollock from summer acoustic-trawl surveys in the Gulf of Alaska in 2013, 2015, 2017, and 2019.

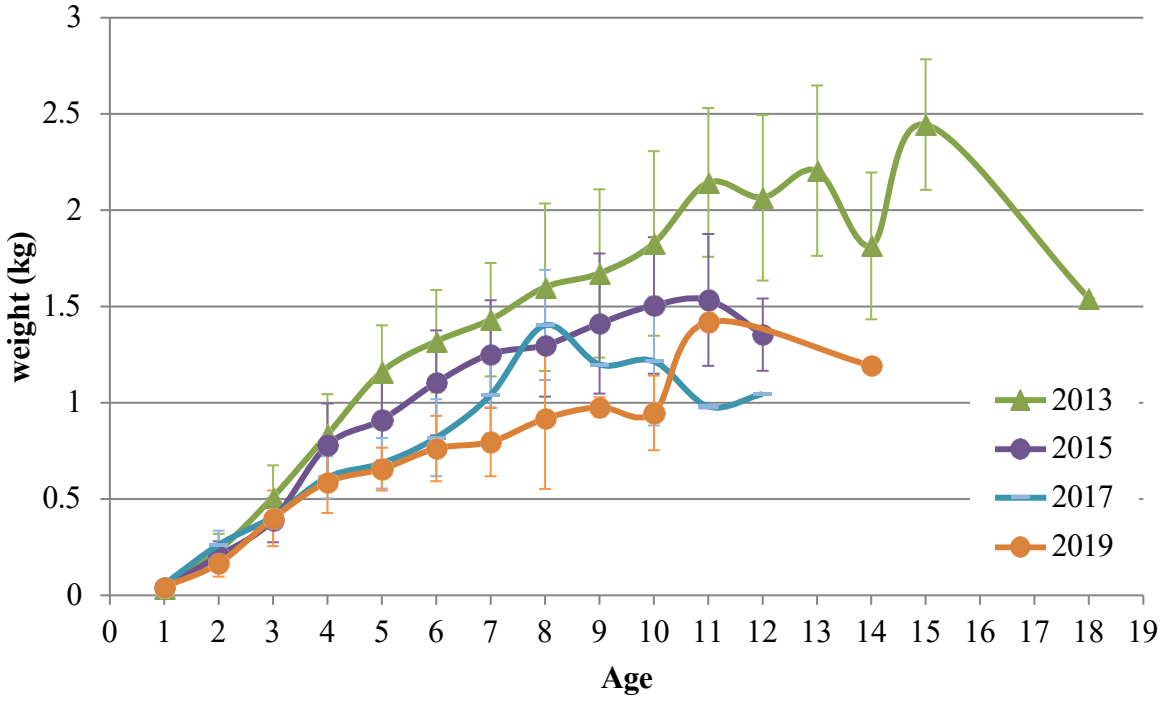


Figure 9. -- Average weight (kg) at age (bars indicate 1 standard deviation) of walleye pollock from summer acoustic-trawl surveys in the Gulf of Alaska in 2013, 2015, 2017, and 2019.

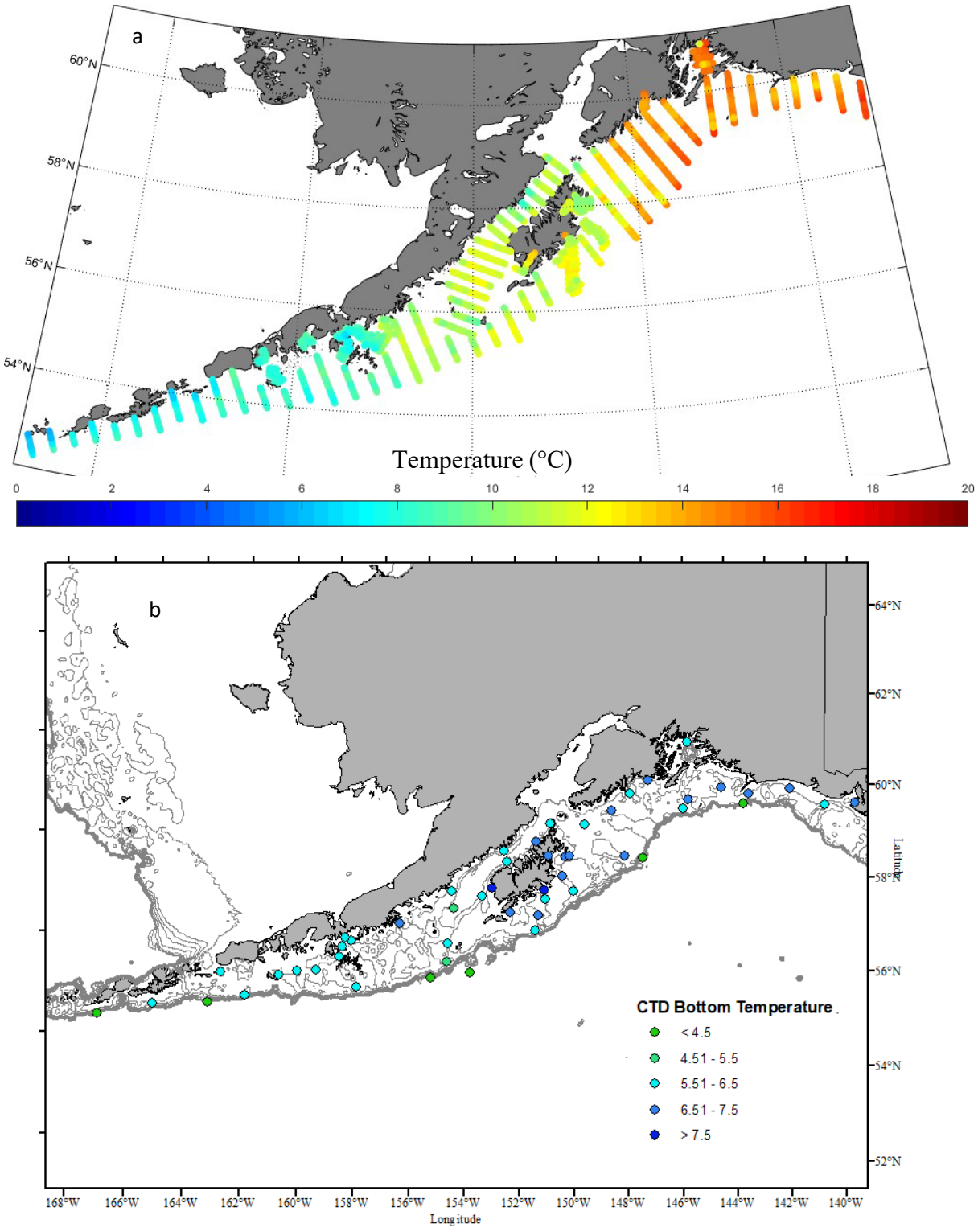


Figure 10. -- Temperature (°C) a) measured at the sea surface using shipboard surface temperature sensors along survey transects averaged at 0.5 nautical mile resolution, and b) near the seafloor using conductivity-temperature-depth (CTD) profilers during the summer 2019 acoustic-trawl survey of the GOA shelf.

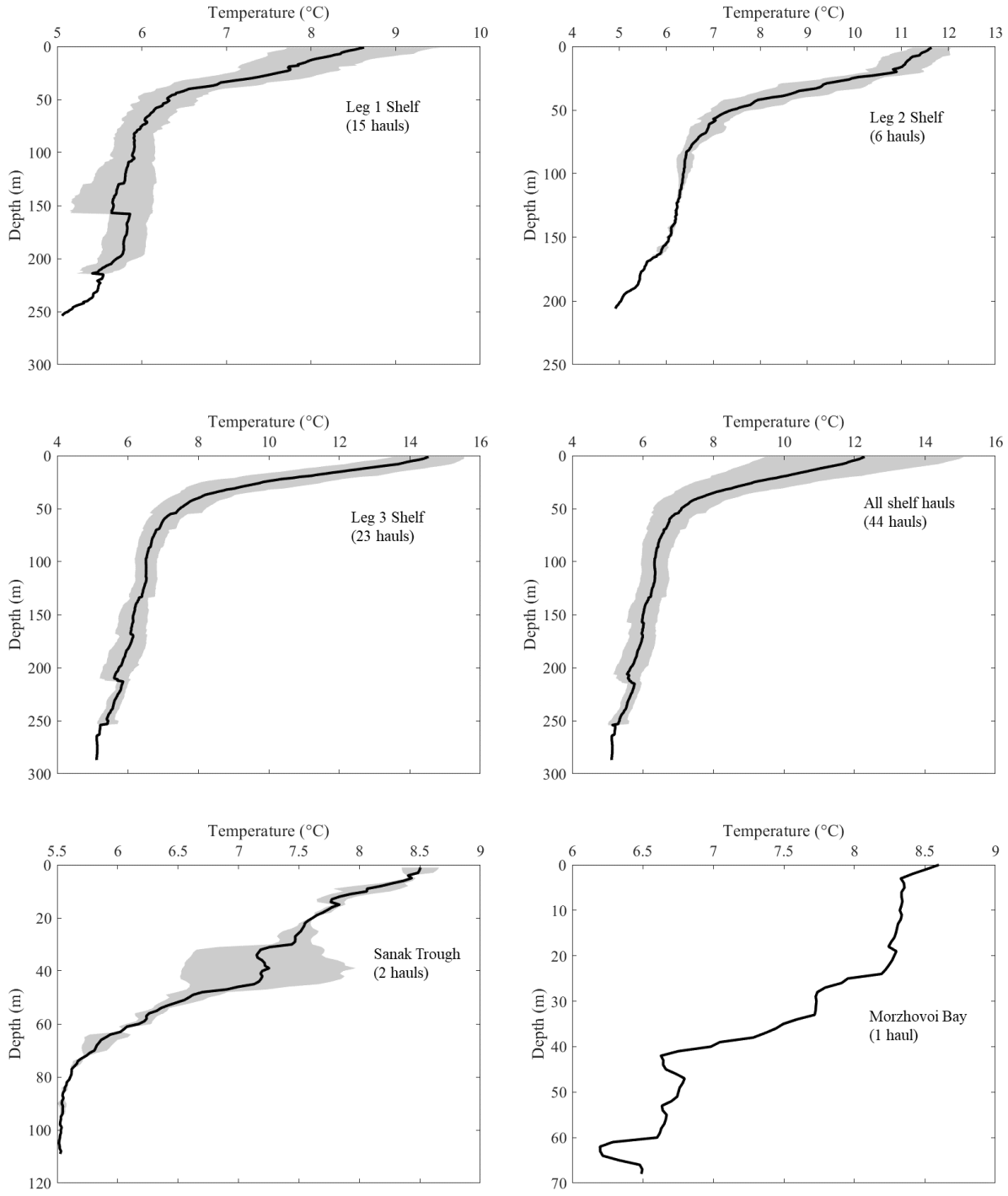


Figure 11. -- Average temperature (° C) at depth (m) by area from SBE-39 probes on the gear at sampling locations (and number of hauls with temperature data in each area) during the summer 2019 acoustic trawl survey of the Gulf of Alaska. The shaded area represents one standard deviation from mean.

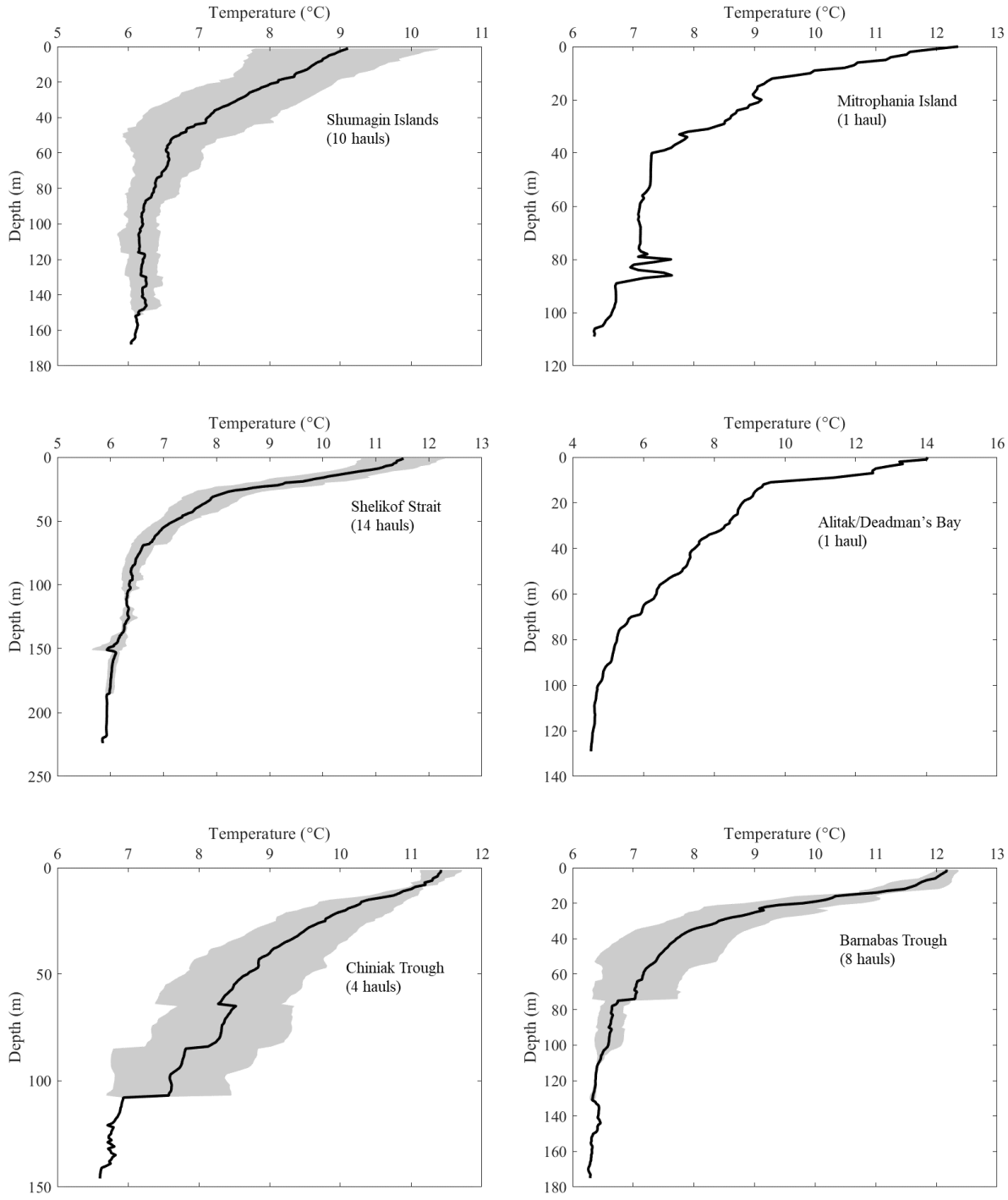


Figure 11. -- Cont.

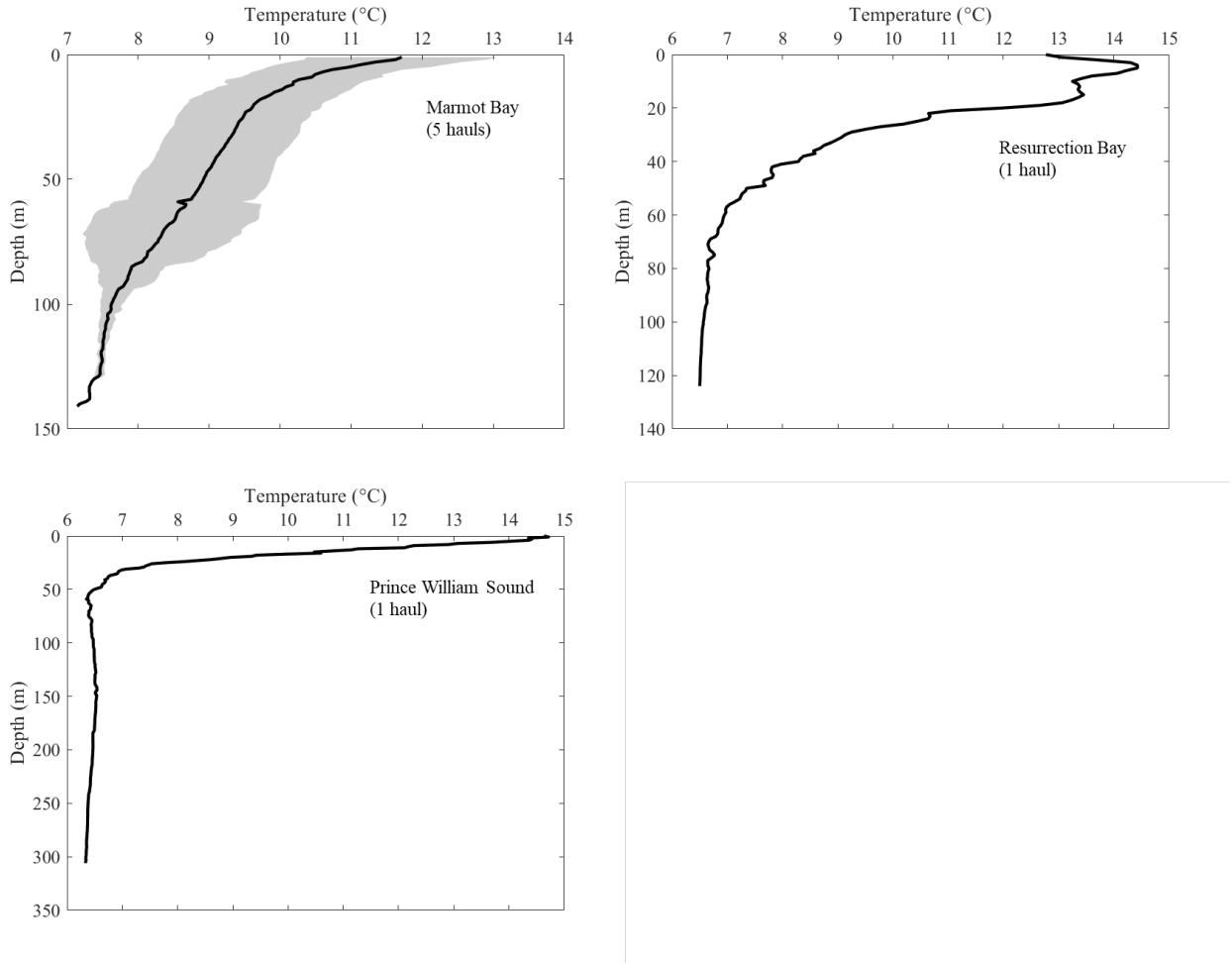


Figure 11. -- Cont.

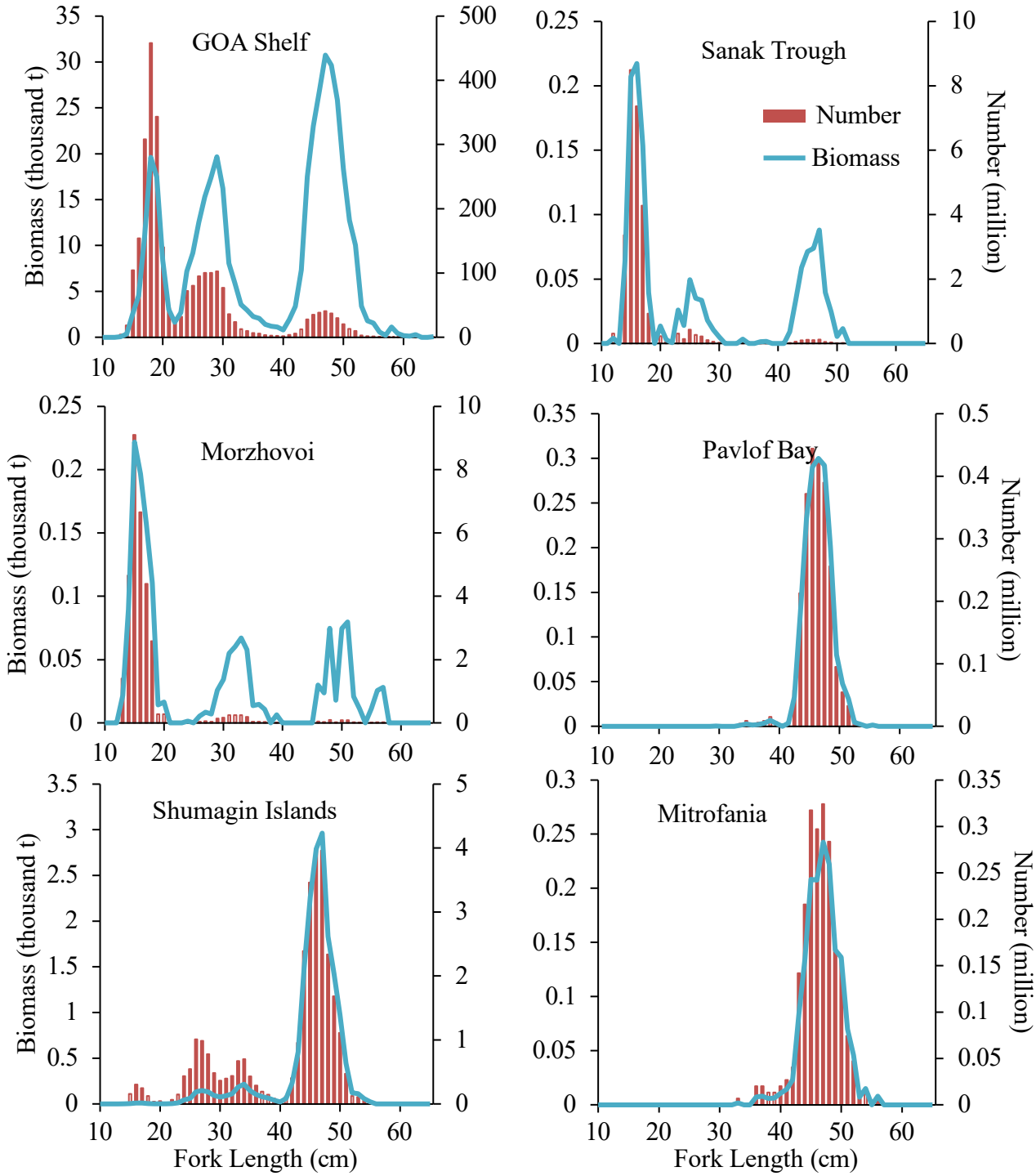


Figure 12. -- Walleye pollock biomass in thousand metric tons (blue line and primary y-axis) and numbers in millions (red bars and secondary y-axis) at length (cm) for each of the major survey areas in the 2019 summer GOA acoustic-trawl survey.

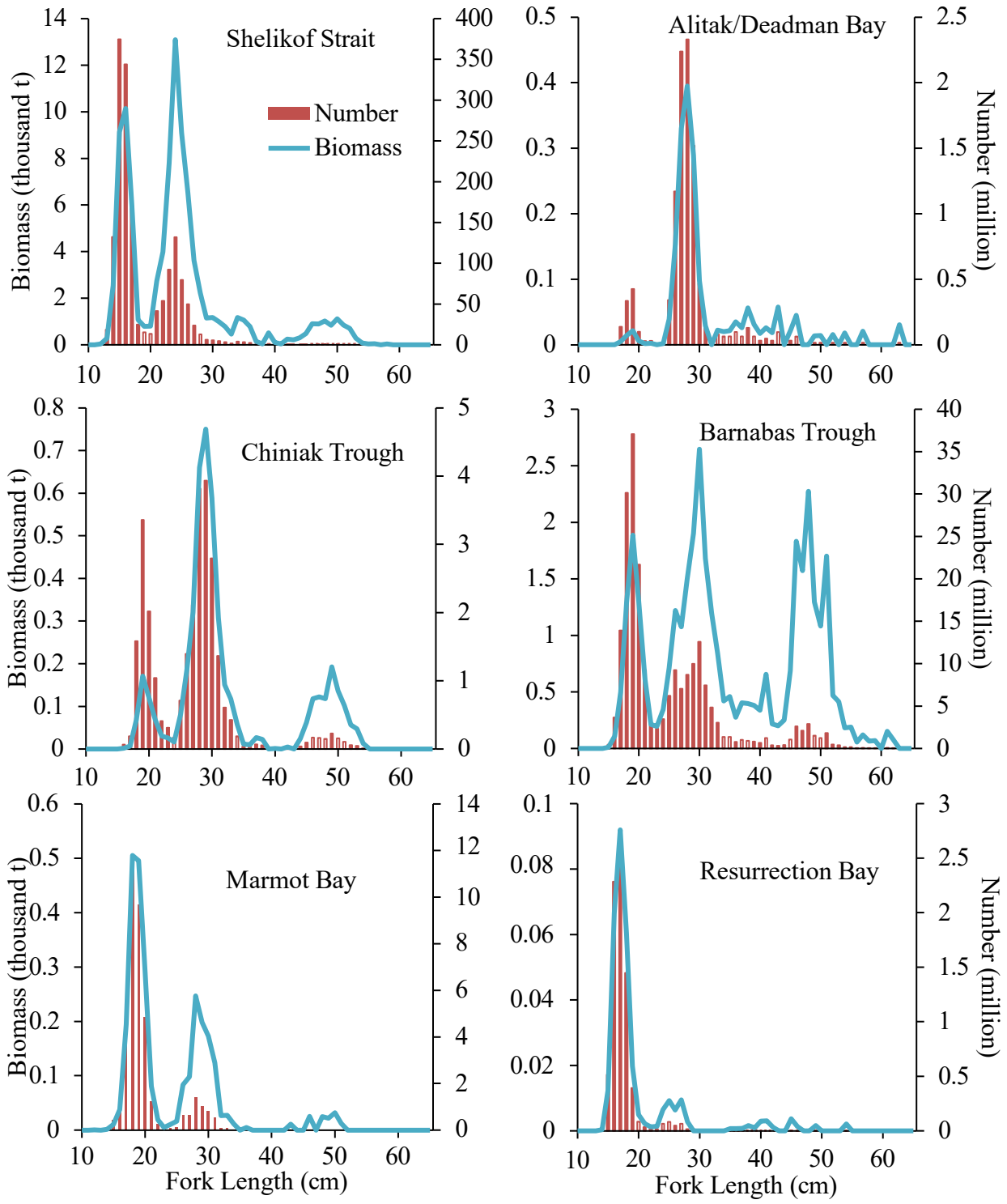


Figure 12. -- Continued.

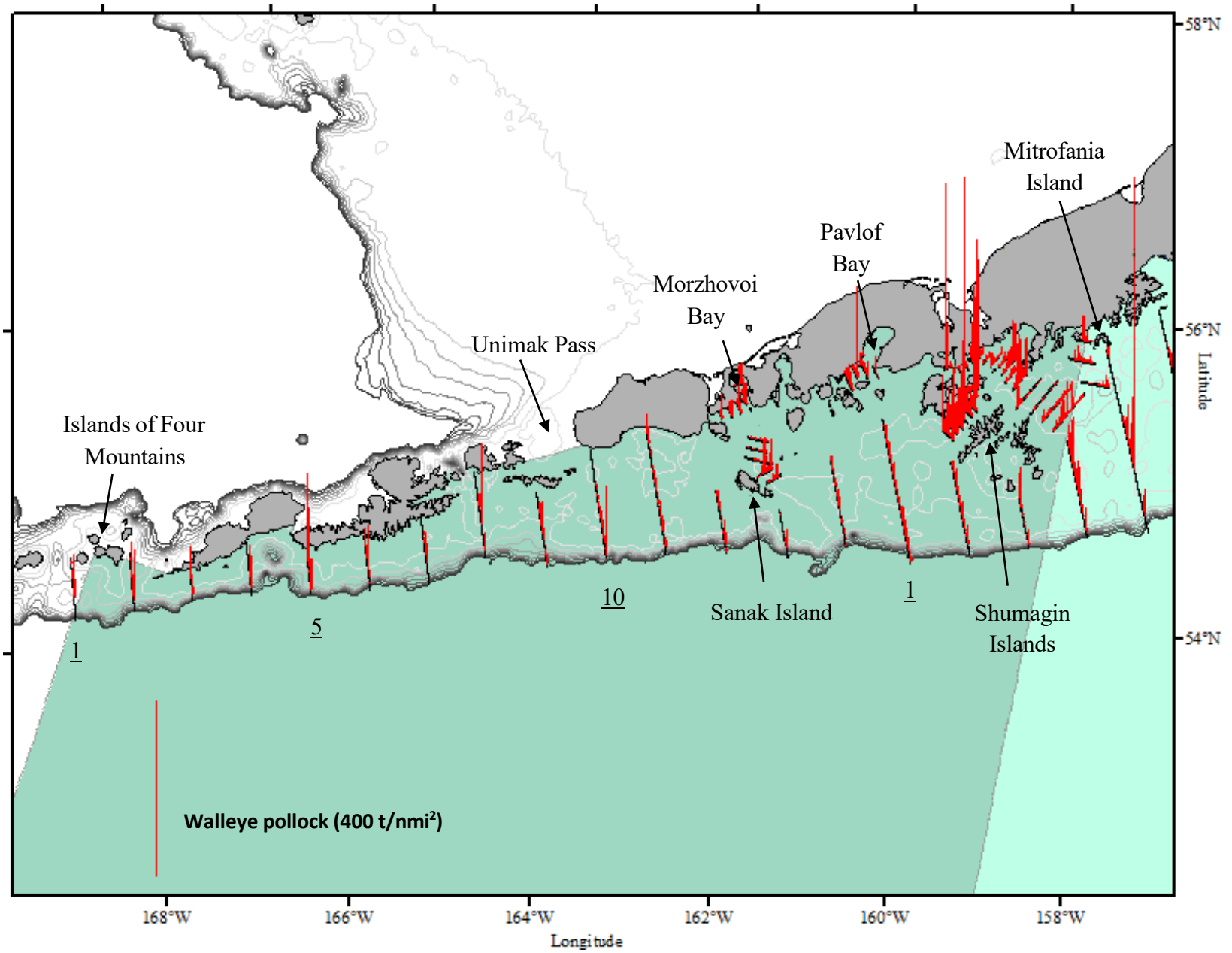


Figure 13. -- Density (t/nmi^2) of age 1+ walleye pollock (red vertical lines) along tracklines surveyed during the summer 2019 acoustic-trawl survey in the western GOA. Transect numbers are underlined. NPFMC areas 610 and 620 are indicated by different colored shading.

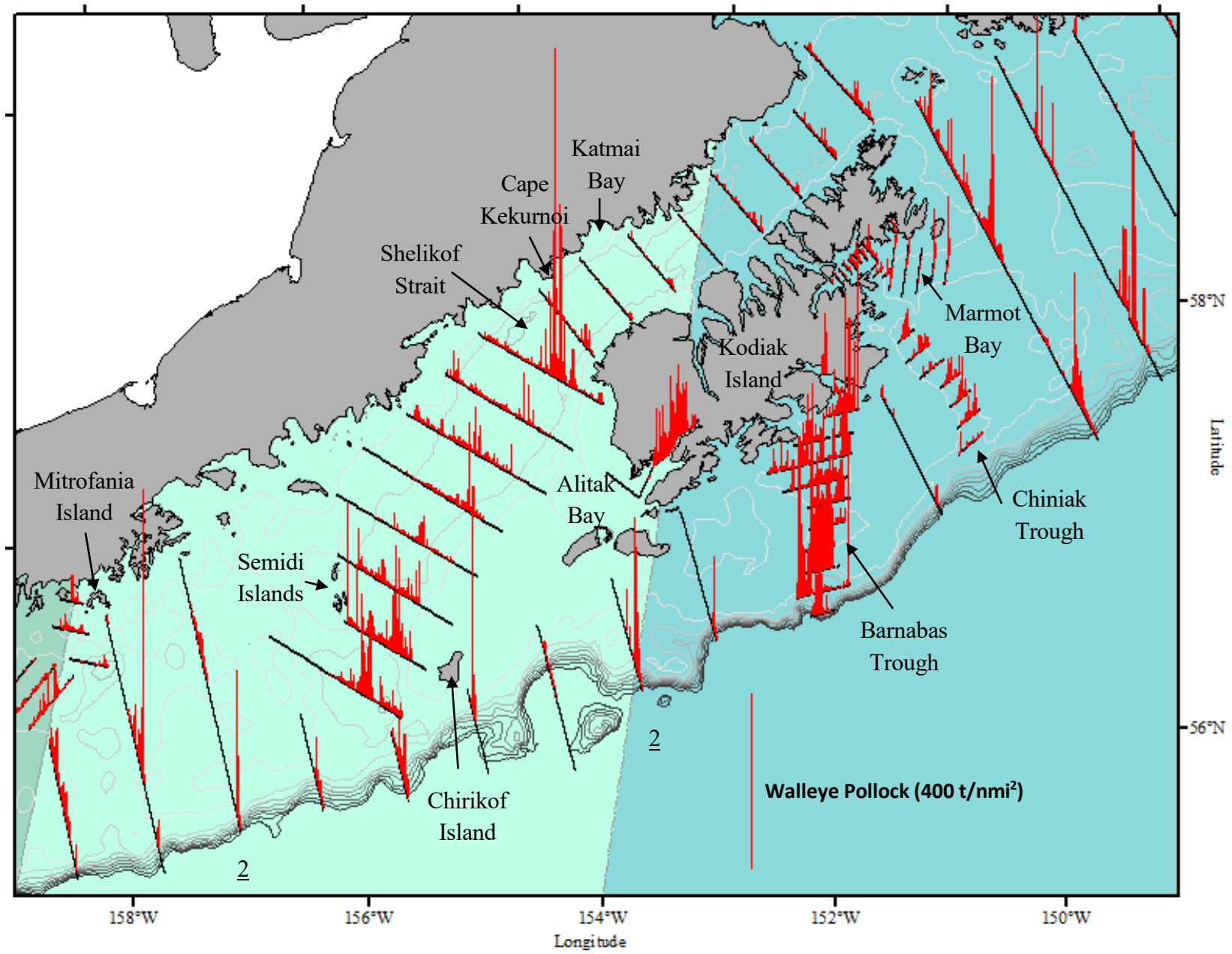


Figure 14. -- Density (t/nmi^2) of age 1+ walleye pollock (red vertical lines) along tracklines surveyed during the summer 2019 acoustic-trawl survey in the central GOA. Transect numbers are underlined. NPFMC areas 620 and 630 are indicated by different colored shading.

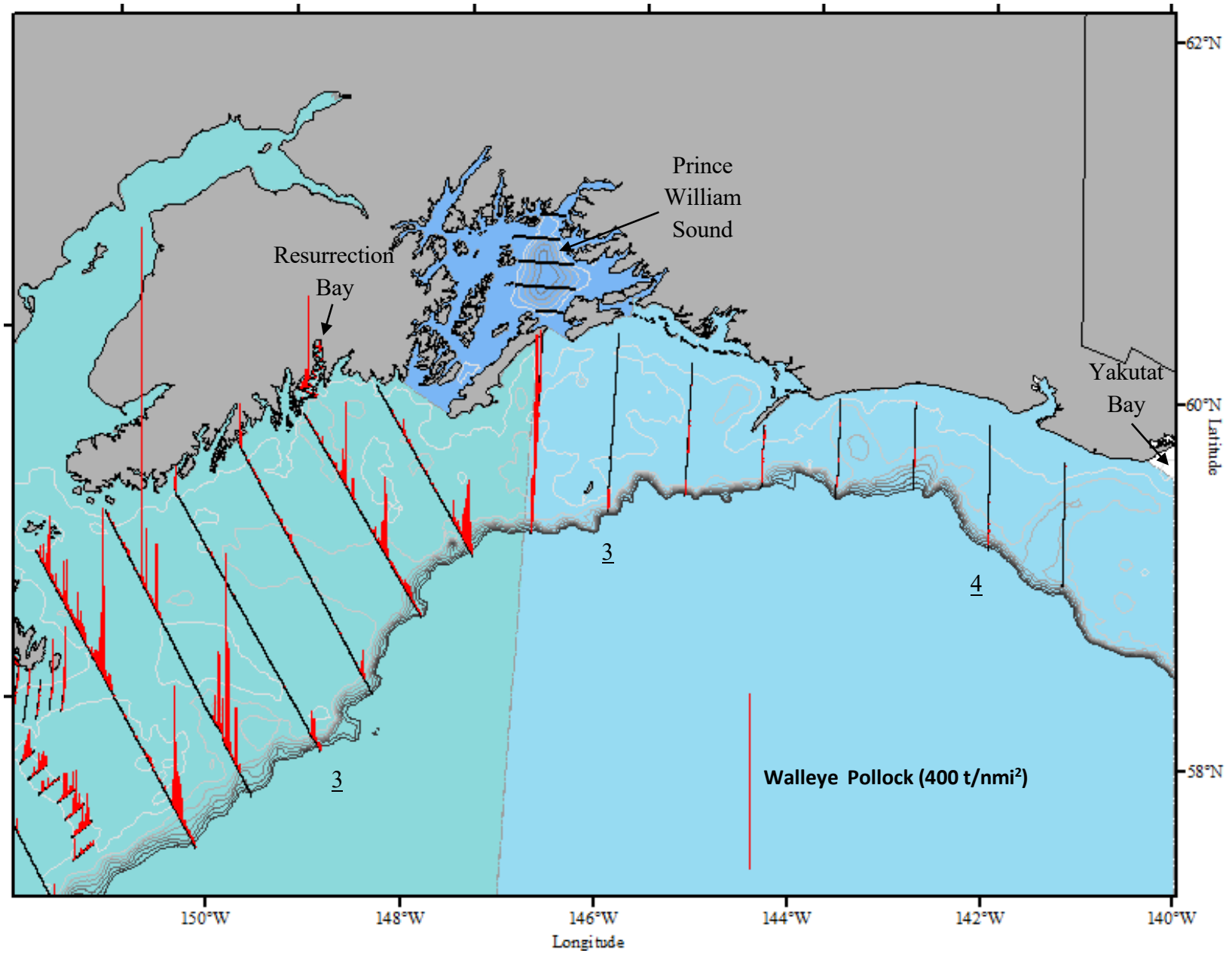


Figure 15. -- Density (t/nmi^2) of age 1+ walleye pollock (red vertical lines) along tracklines surveyed during the summer 2019 acoustic-trawl survey in the eastern GOA. Transect numbers are underlined. NPFMC areas 630, 640, and 649 are indicated by different colored shading.

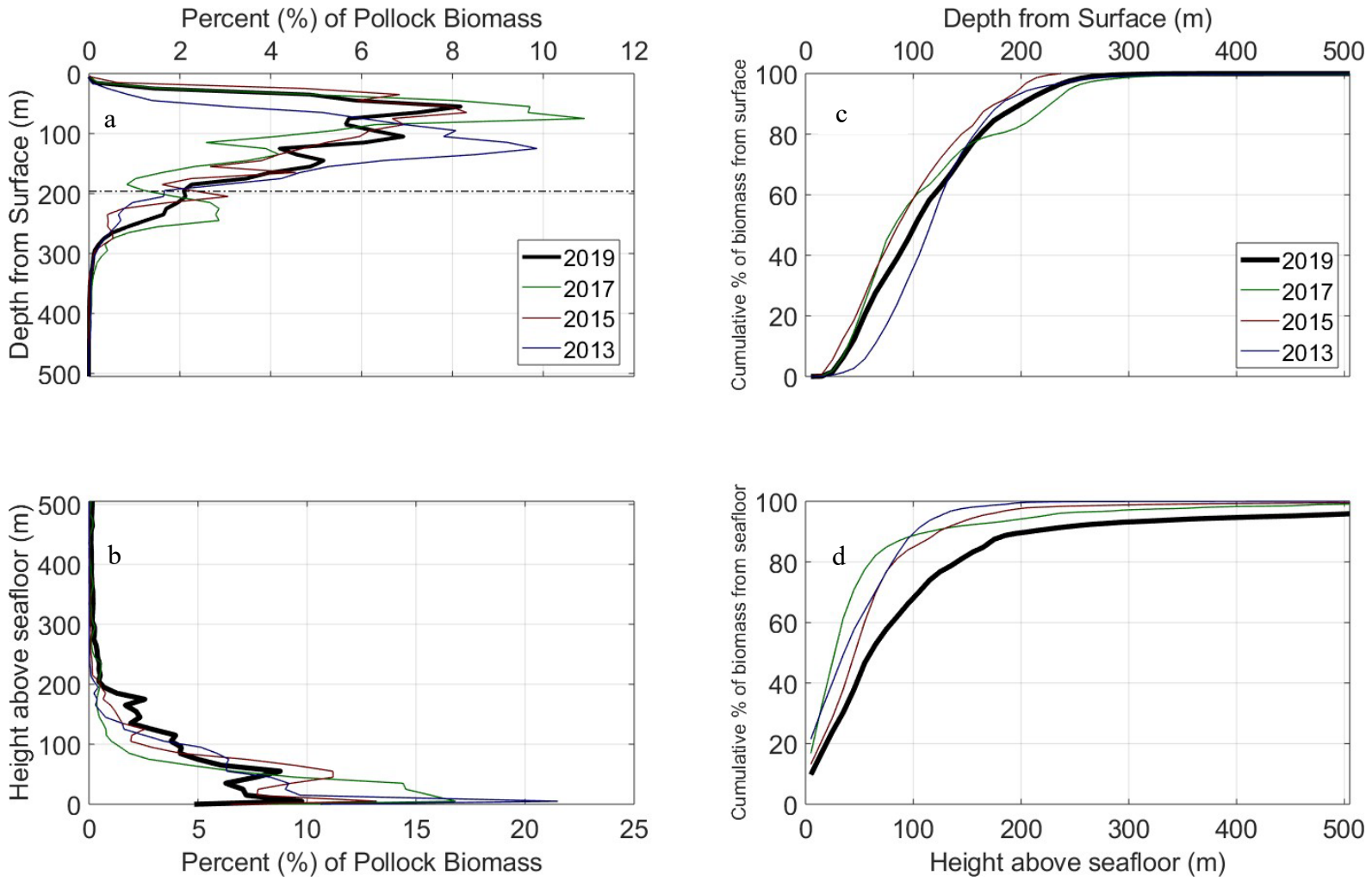


Figure 16. -- Percentage of all GOA survey pollock biomass at depth measured from the surface (a) and height above the seafloor (b) during summer Gulf of Alaska AT surveys conducted in 2019 (thick black) compared to 2013 (blue), 2015 (red), and 2017 (green). Cumulative percentage of pollock biomass referenced from the surface (c) and the seafloor (d) are also shown. All data are averaged in 10 m depth bins. Mean bottom depth for 2019 summer GOA survey is shown with a dashed black line in panel a.

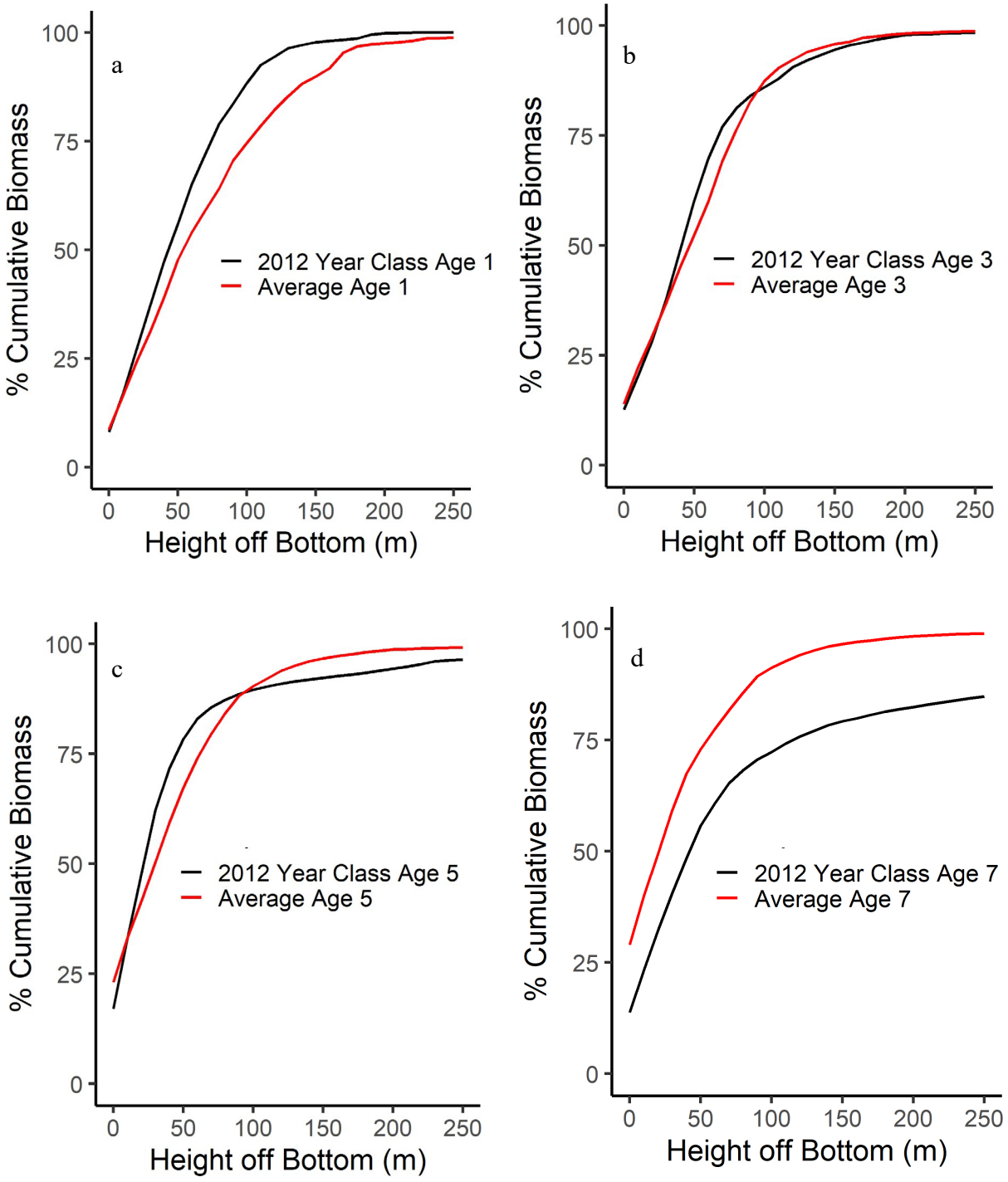


Figure 17. -- Cumulative percent of pollock biomass height off bottom during summer Gulf of Alaska acoustic trawl surveys for age 1 (a), 3 (b), 5 (c), and 7 (d) fish from the 2012 year class compared to the mean height off bottom for the respective age fish from the 2013, 2015, 2017 and 2019 GOA surveys. All data are averaged in 10 m depth bins.

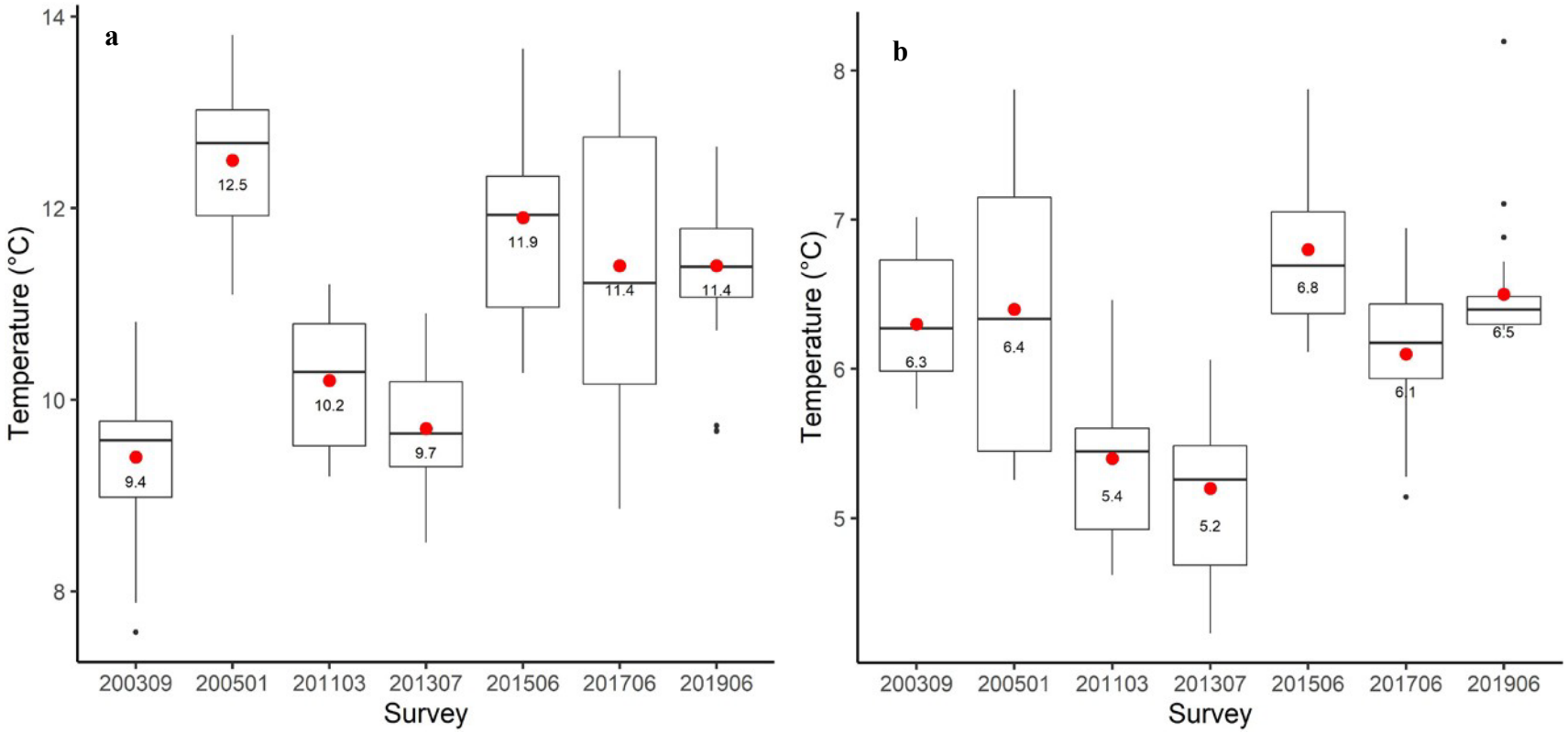


Figure 18. -- Temperatures (a) at the surface and (b) at 100 m depth from SBE-39 probes placed on the headrope of fishing gear in areas that were consistently surveyed (Barnabas Trough, Chiniak Trough, and Shelikof Strait) in the 2003, 2005, 2011, 2013, 2015, 2017, and 2019 GOA AT surveys. Boxes represent data within the 25th to 75th percentiles, whiskers bound the 9th to 91st percentile, black line represents the median, red dot represents the mean, and black dots represent outliers.

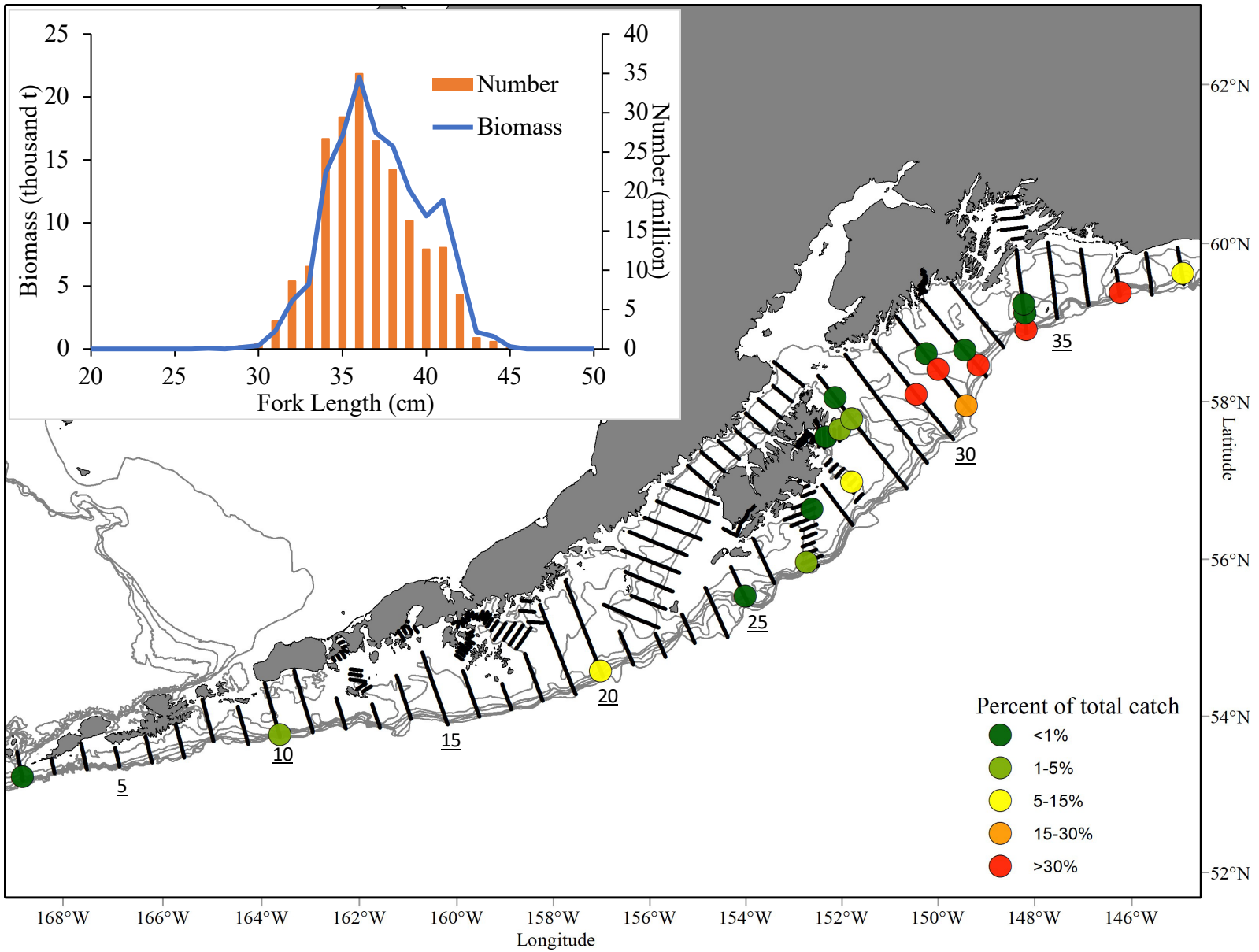


Figure 19. -- Hauls containing Pacific ocean perch during the summer 2019 Gulf of Alaska acoustic-trawl survey. Colors indicate the percent of catch (by number) that was composed of Pacific ocean perch at each haul location. Inset shows biomass and number of Pacific ocean perch at each cm fork length interval increment. Shelf transect numbers are underlined.

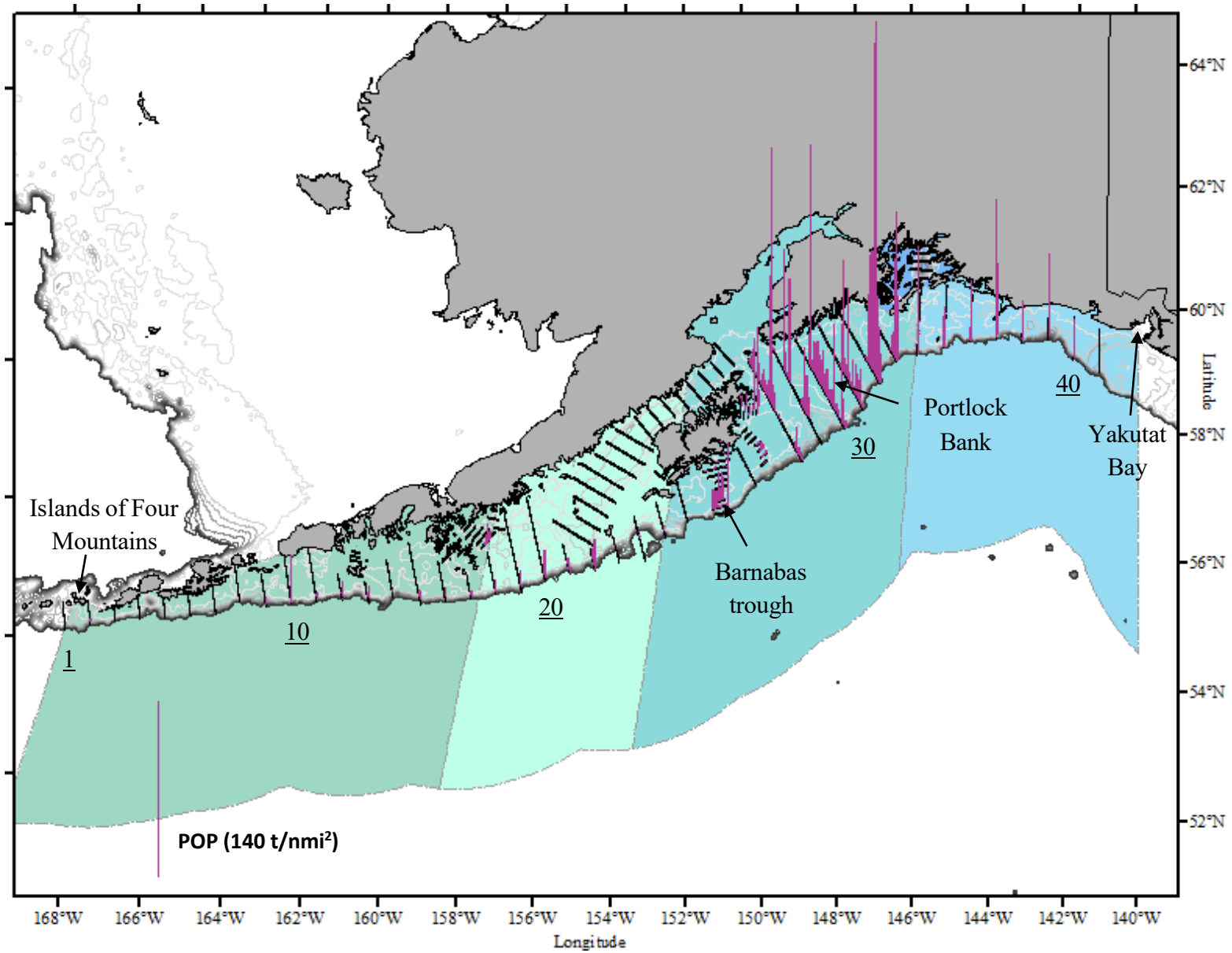


Figure 20. -- Density (t/nmi^2) of Pacific ocean perch (purple vertical lines) along tracklines surveyed during the summer 2019 acoustic-trawl survey of the GOA. Shelf transect line numbers are underlined. NPFMC areas are indicated by different colored shading.

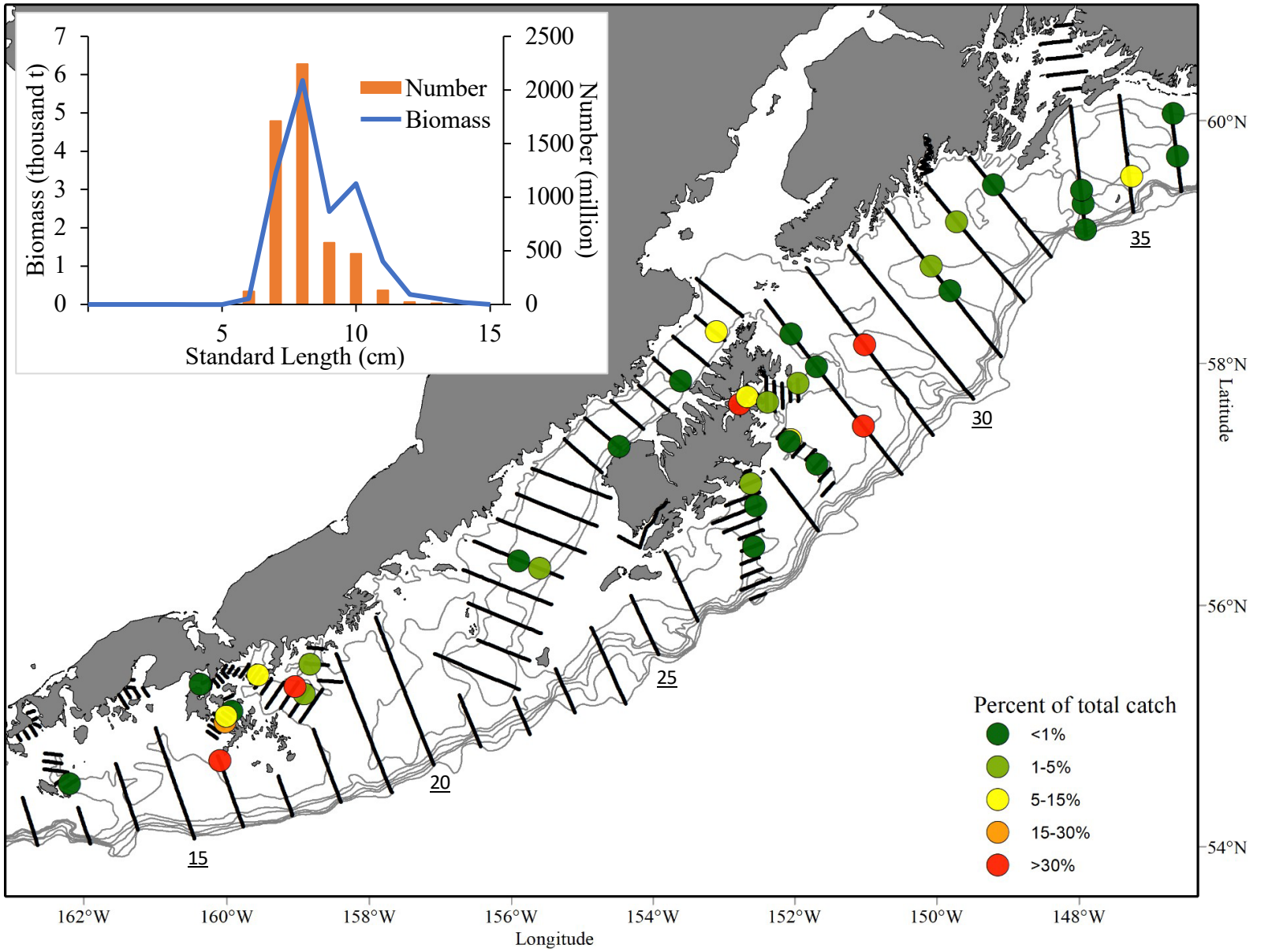


Figure 21. -- Hauls containing capelin during the summer 2019 Gulf of Alaska acoustic-trawl survey. Colors indicate the percent of catch (by number) that was composed of capelin at each haul location. Inset shows biomass and number of Pacific herring at each cm fork length interval increment. Shelf transect numbers are underlined.

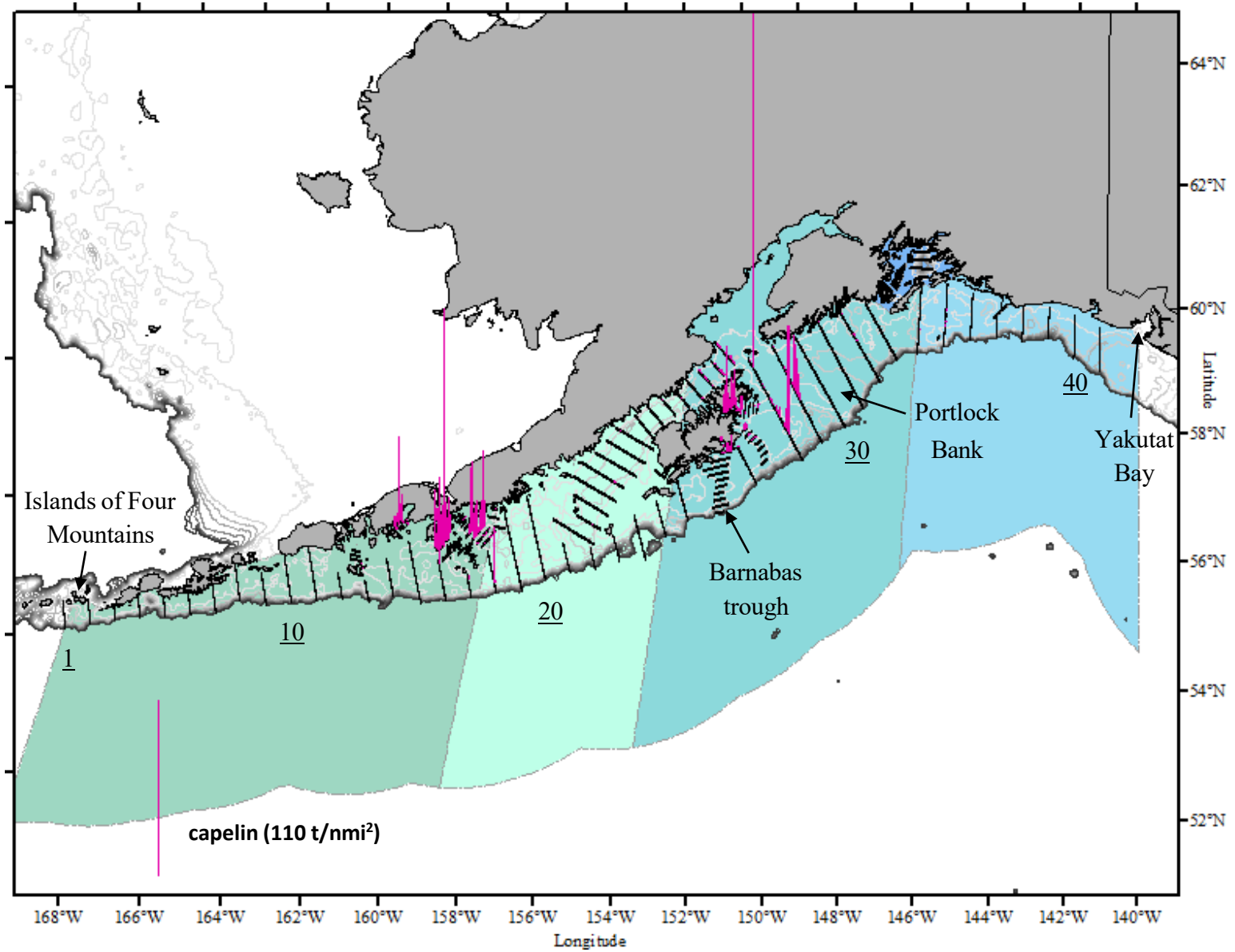


Figure 22. -- Density (t/nmi^2) of capelin (pink vertical lines) along tracklines surveyed during the summer 2019 acoustic-trawl survey of the GOA. Shelf transect line numbers are underlined. NPFMC areas are indicated by different colored shading.

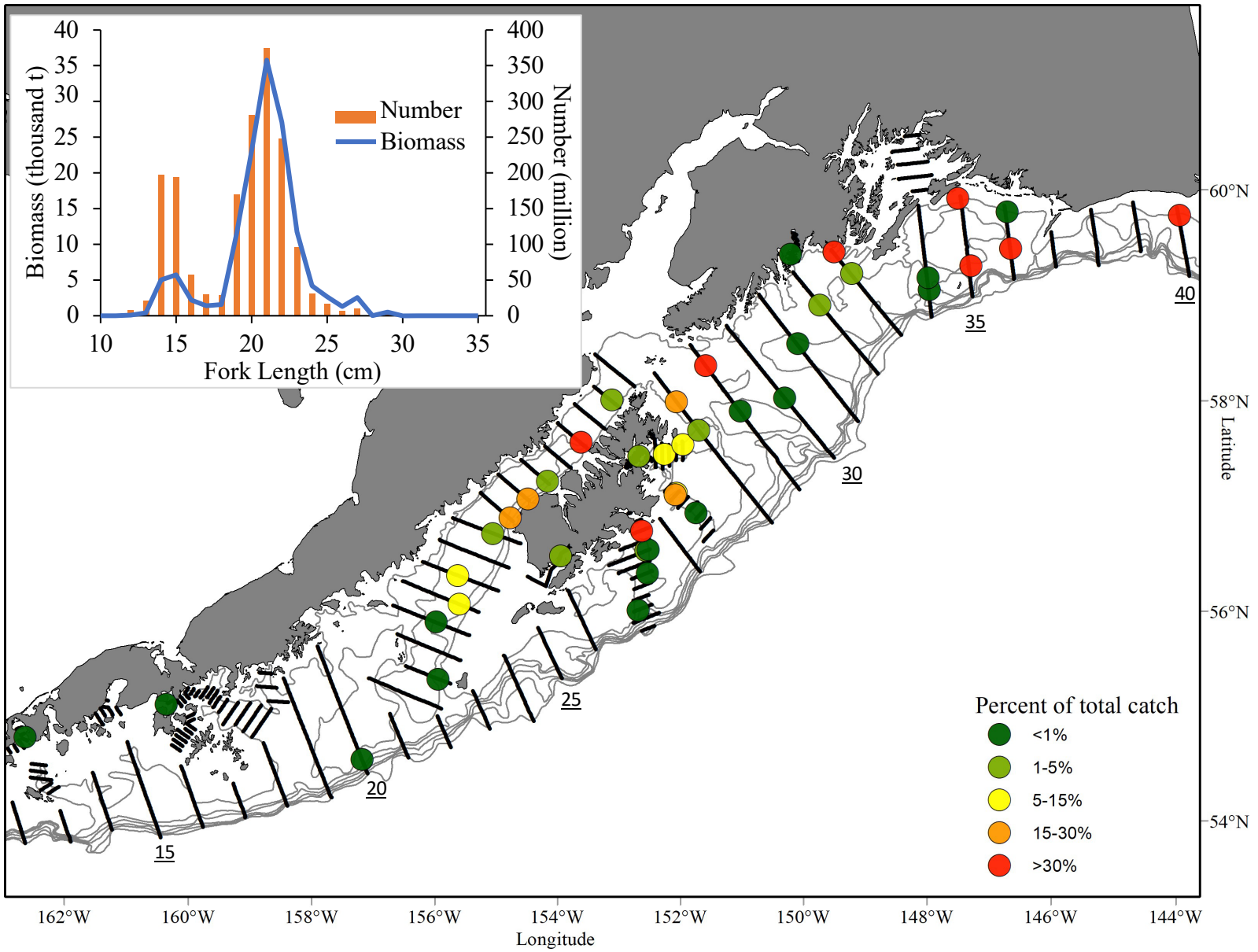


Figure 23. -- Hauls containing Pacific herring during the summer 2019 Gulf of Alaska acoustic-trawl survey. Colors indicate the percent of catch (by number) that was composed of Pacific herring at each haul location. Inset shows biomass and number of Pacific herring at each cm fork length interval increment. Shelf transect numbers are underlined.

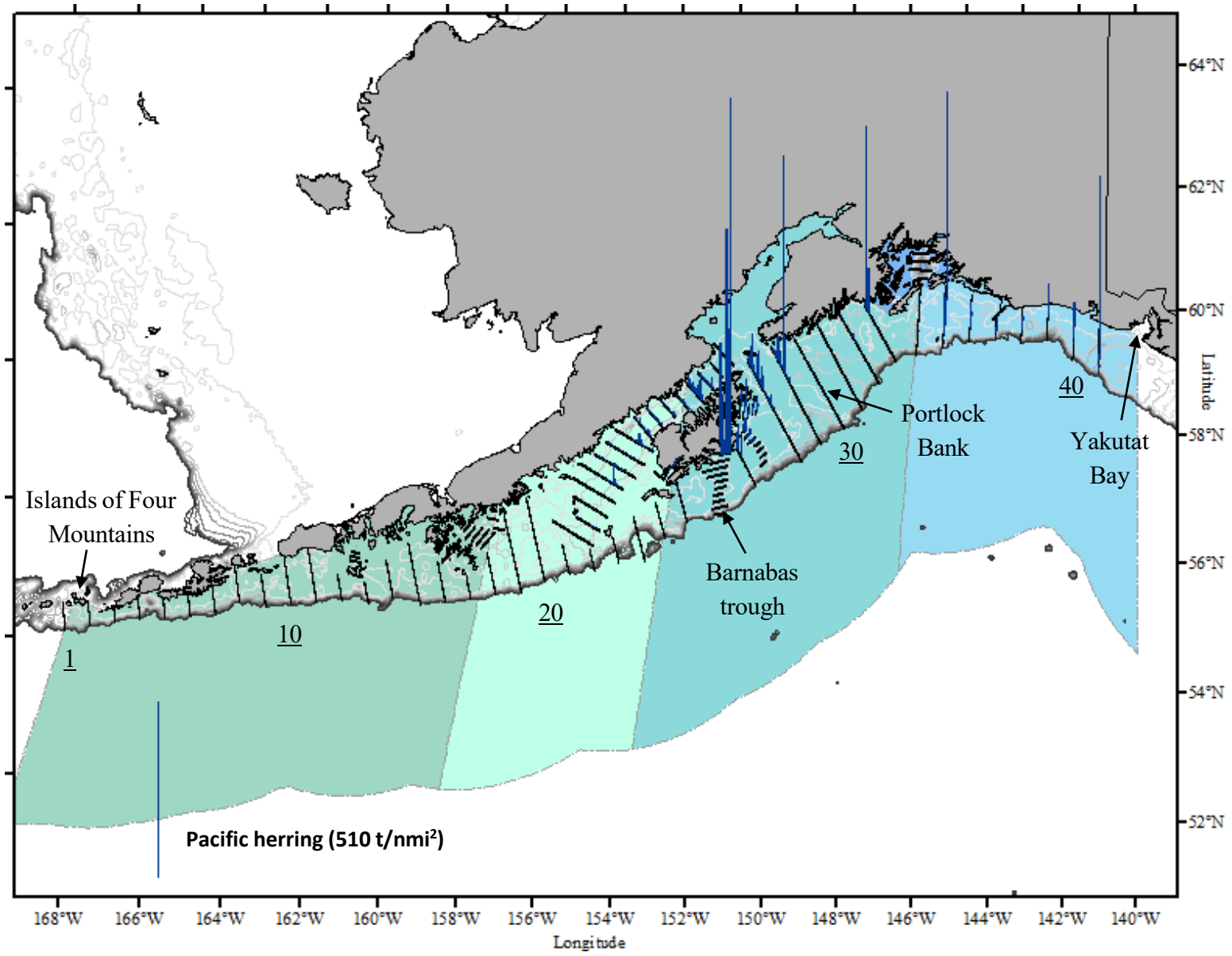


Figure 24. -- Density (t/nmi^2) of Pacific herring (blue vertical lines) along tracklines surveyed during the summer 2019 acoustic-trawl survey of the GOA. Shelf transect line numbers are underlined. NPFMC areas are indicated by different colored shading.

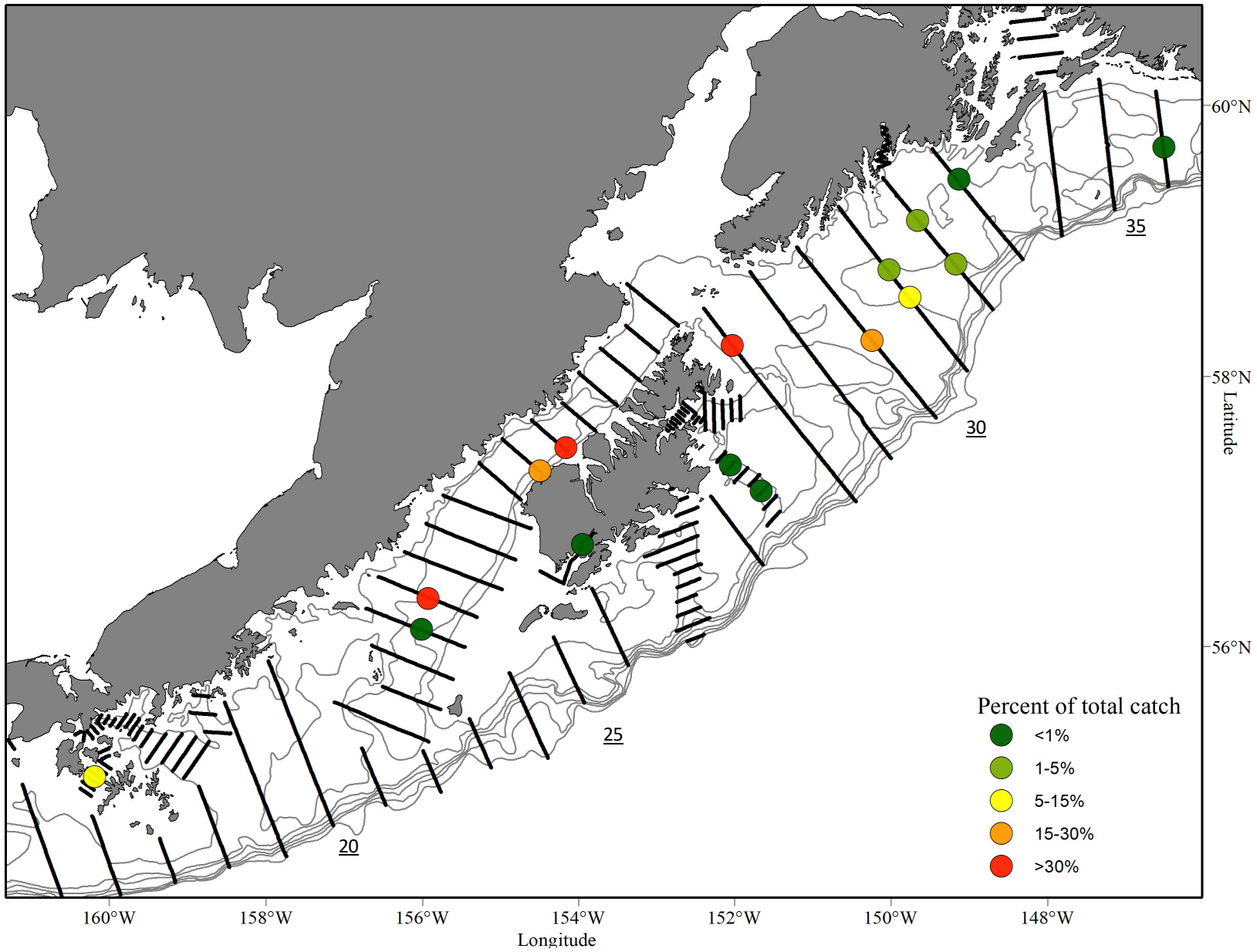


Figure 25. -- Hauls containing eulachon during the summer 2019 Gulf of Alaska acoustic-trawl survey. Colors indicate the percent of catch (by number) that was composed of eulachon at each haul location.

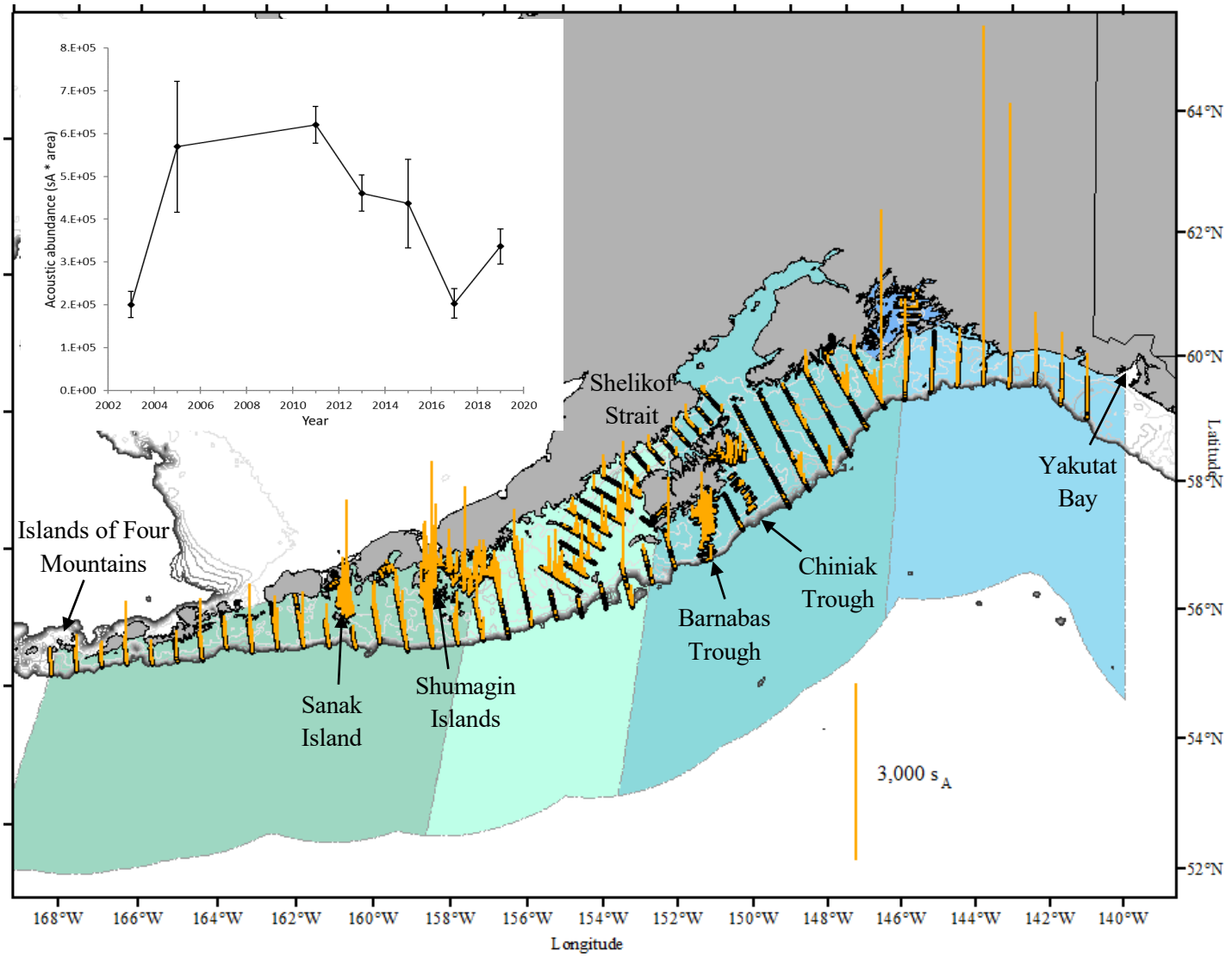


Figure 26. -- Distribution and strength of backscatter (s_A, m^2 nmi^{-2}) at 120-kHz attributed to euphausiids along tracklines surveyed during the summer 2019 acoustic-trawl survey of the GOA. Inset shows acoustic backscatter estimate of euphausiid abundance from areas that were consistently surveyed in the summer Gulf of Alaska acoustic-trawl surveys (Shelikof Strait, Barnabas Trough, and Chiniak Trough). Error bars are approximate 95% confidence intervals computed from geostatistical estimates of relative estimation error (Petitgas 1993). NPFMC areas are indicated by different colored shading.

TABLES AND FIGURES

APPENDIX I. ITINERARY

Leg 1

31 May	Acoustic sphere calibration in Kalsin Bay, Kodiak Island
1 June	Net testing near Kodiak while awaiting crew arrival
2 June	Depart Kodiak, AK
3 June	Transit to survey start area
4-9 June	Acoustic-trawl survey of the GOA shelf (Transects 1-13)
9-10 June	Acoustic-trawl survey of Sanak Trough (Transects 101-105)
10 June	Acoustic-trawl survey of Morzhovoi Bay (Transects 151-156)
10-13 June	Acoustic-trawl survey of the GOA shelf (Transects 14-18)
13 June	Acoustic-trawl survey of Shumagin Islands area (Transect 275)
13 June	Acoustic-trawl survey of Pavlof Bay (Transects 201-206)
14-18 June	Acoustic-trawl survey of Shumagin Islands area (Transects 251-274)
19 June	Conducting trawl warp repairs offshore
19-20 June	Transit to Kodiak
20-25 June	In port Kodiak

Leg 2

26 June	Transit to survey resume point
26-30 June	Acoustic-trawl survey of Shelikof Strait (Transects 401-410)
30 June	Acoustic-trawl survey of Alitak Bay (Transect 451)
1-4 July	Acoustic-trawl survey of Shelikof Strait (Transects 411-415)
4 July	Acoustic-trawl survey of the GOA shelf (Transect 19)
5 July	Acoustic-trawl survey of Mitrofania area (Transects 301-303)
5-6 July	Acoustic-trawl survey of the GOA shelf (Transects 20-21)
6-7 July	Acoustic-trawl survey of Shelikof Strait (Transect 416)
7-9 July	Acoustic-trawl survey of the GOA shelf (Transects 22-26)
10-13 July	Acoustic-trawl survey of Barnabas Trough (Transects 501-512)
14 July	Acoustic-trawl survey of the GOA shelf (Transect 27)
14-16 July	Acoustic-trawl survey of Chiniak Trough (Transects 551-557)
16 July	Transit to Kodiak, AK
16-19 July	In port Kodiak, AK

Leg 3

20 July	Transit to survey resume point
20-22 July	Acoustic-trawl survey of Marmot Bay (Transects 601-616)
22-28 July	Acoustic-trawl survey of the GOA shelf (Transects 28-32)
28-29 July	Acoustic-trawl survey of Resurrection Bay (Transect 650)
29-31 July	Acoustic-trawl survey of the GOA shelf (Transects 33-34)
31 July-1 Aug.	Acoustic-trawl survey of Prince William Sound (Transects 701-705)
1-4 Aug.	Acoustic-trawl survey of the GOA shelf (Transects 35-41)
5 Aug.	Acoustic sphere calibration in Yakutat Bay, AK
6-7 Aug.	Transit to Kodiak, AK
7 Aug.	In Kodiak, AK. End of survey

APPENDIX II. SCIENTIFIC PERSONNEL

Leg I (30 May - 20 June)

Name	Position	Organization
Patrick Ressler	Chief Scientist	AFSC
Darin Jones	Fishery Biologist	AFSC
Rick Towler	Computer Spec.	AFSC
Mike Levine	Fishery Biologist	AFSC
Sandi Neidetcher	Fishery Biologist	AFSC
Matthew Phillips	Fishery Biologist	AIS
Ethan Beyer	Fishery Biologist	AIS

Leg II (25 June - 16 July)

Name	Position	Organization
Sarah Stienessen	Chief Scientist	AFSC
Taina Honkalehto	Fishery Biologist	AFSC
Kresimir Williams	Fishery Biologist	AFSC
Denise McKelvey	Fishery Biologist	AFSC
Matthew Phillips	Fishery Biologist	AIS
Jamie Gigante	Fishery Biologist	AIS
Erica Marlaine	Teacher at Sea	NOAA
Evan Reeve	Intern	AFSC
Nathan Battey	Intern	AFSC

Leg III (19 July - 7 Aug.)

Name	Position	Organization
Darin Jones	Chief Scientist	AFSC
Nate Lauffenburger	Fishery Biologist	AFSC
Abigail McCarthy	Fishery Biologist	AFSC
Scott Furnish	Computer Spec.	AFSC
Troy Buckley	Fishery Biologist	AFSC
Matthew Phillips	Fishery Biologist	AIS
Anna Hinson Briem	Fishery Biologist	AIS
Jessica Cobley	Teacher at Sea	NOAA
Ruth Drinkwater	Intern	AFSC

AFSC – Alaska Fisheries Science Center, Seattle, WA.
NOAA – National Oceanic and Atmospheric Administration, Teacher at Sea Program.
AIS – AIS Scientific and Environmental Services, Inc., Marion, MA.

APPENDIX III. ABUNDANCE CALCULATIONS

The abundance of target species was calculated by combining the echosounder measurements with size and species distributions from trawl catches and target strength (TS) to length relationships from the literature (see De Robertis et al. 2017 for details). The echosounder measures volume backscattering strength, which is integrated vertically to produce the nautical area scattering coefficient, s_A (units of m^2 nmi^{-2}; MacLennan et al. 2002). The backscatter from an individual fish of species *s* and at length *l* is referred to as its backscattering cross-section, $\sigma_{bs,s,l}$ (m^2), or in logarithmic terms as its target strength, $TS_{s,l}$ (dB re 1 m^2), where,

$$TS_{s,l} = 10 \log_{10} (\sigma_{bs,s,l}) \quad . \qquad \text{(Eq. i)}$$

The numbers of individuals of species *s* in length class *l* ($N_{s,l}$) captured in the nearest haul *h* were used to compute the proportion of acoustic backscatter associated with each species and length. First, the number of individuals in the catch were converted to a proportion ($P_{s.l,h}$)

$$P_{s,l,h} = \frac{N_{s.l,h}}{\sum_{s,l,h} N_{s.l,h}} \quad \text{, where } \sum_{s,l,h} P_{s,l,h} = 1 \quad . \qquad \text{(Eq. ii)}$$

In analyses where trawl selectivity was considered, the selectivity-corrected numbers $N_{s_{corr},l,h}$ were used in place of $N_{s,l,h}$ in Eq. ii. This correction corrects the catch for trawl escapement. The corrected catch is that expected for an unselective sampling device. Refer to the main text for a description of the selectivity corrections applied.

The mean backscattering cross section (an areal measure of acoustic scattering in m^2 – MacLennan et al., 2002) of species *s* of length class *l* is

$$\sigma_{bs_{s,l}} = 10^{(0.1 \cdot TS_{s,l})} \quad , \qquad \text{(Eq. iii)}$$

where TS is the target strength (dB re m^2) of species *s* at size *l* (Table 1).

The proportion of backscatter from species *s* of length class *l* in haul *h* ($PB_{s,l,h}$) is computed from the proportion of individuals of species *s* and length class *l* estimated from haul *h* ($P_{s,l,h}$) and their backscattering cross section,

$$PB_{s,l,h} = \frac{P_{s,l,h} \cdot \sigma_{bs_{s,l}}}{\sum_{s,l,h}(P_{s,l,h} \cdot \sigma_{bs_{s,l}})} \quad .$$

(Eq. iv)

The measured nautical area backscattering coefficient (s_A) at interval *i* was allocated to species *s* and length *l* as follows:

$$s_{A_{s,l,i}} = s_{A_i} \cdot PB_{s,l,h} \quad , \qquad \text{(Eq. v)}$$

where haul *h* is the nearest haul within a stratum assigned to represent the species composition in a given 0.5 nmi along-track interval *i*. The nearest geographic haul was determined by using great-circle distance to find the nearest trawl location (defined as the location where the net is at depth and begins to catch fish) out of the pool of hauls assigned to the same stratum (see above for details) closest to the start of interval *i*.

The abundance of species of length *l* in an area encompassing a series of transect intervals *i* was estimated from the area represented by that interval (A_i, nmi^2), the mean areal backscatter attributed to species *s* in given length/size class *l* ($s_{A_{s,l,i}}$, m^2 nmi^{-2}), and mean backscattering cross-section of species *s* at that size ($\sigma_{bs_{s,l}}$ m^2) as follows:

Numbers at length *l*: $N_{s,l} = \sum_i \left(\frac{s_{A,s,l,i}}{4\pi\sigma_{bs_{s,l,i}}} \cdot A_i \right)$,

(Eq. vi)

Biomass at length *l*: $B_{s,l} = \Sigma_i (W_{s,l} \times N_{s,l,i})$, (Eq. vii)

where $W_{s,l}$ is the mean weight-at-length for species s in each 1 cm length l derived from length-weight regressions. In the case of pollock, when five or more individuals were measured within a length interval, the mean weight at length was used. Otherwise (i.e., for length classes of pollock with <5 weight measurements, or other species), weight-at-length was estimated using a linear regression of the natural log-transformed length-weight data (De Robertis and Williams 2008).

The abundance at age was computed from $Q_{s,l,j}$, the proportion of j-aged individuals of species s in length class l, and the abundance of that species and age class in each surveyed interval follows

Numbers at age j: $N_{s,j} = \Sigma_i (Q_{s\,l,,j} \times N_{s,l})$, (Eq. viii)

Biomass at age j: $B_{s,j} = \Sigma_i (Q_{s,l,,j} \times B_{s,l})$. (Eq. ix)

APPENDIX IV. SELECTIVITY CORRECTION

To account for the size and species dependent loss of organisms though the midwater survey trawl meshes ahead of the codend, or "mesh selection", length compositions were adjusted to that which would be expected from an unselective sampler. Species-specific selectivity relationships describing the probability of retaining a given sized individual were used for the most abundant species, and other species were pooled in broad taxonomic groups. Trawl selectivity S_l for each cm length class (l) of all species or species group caught was estimated by analyzing the catch of the codend and that of small recapture nets mounted on the outside of the trawl during the current survey using methods similar to those presented in Williams et al. (2011). A generalized linear mixed effects model (GLMM) was fitted with a logistic link function and binomial error where variation between tows in selectivity was modeled with random effects. S_l was then computed as:

$$S_l = \left(1 + e^{2\log 3(LR_{50} - l)/SR}\right)^{-1} \quad , \qquad \text{(Eq. x)}$$

where LR_{50} is the length at which 50% of individuals were retained and SR is the selection range (i.e., range in length between 25% and 75% retention values).

These trawl selectivity estimates were then applied to the codend catch composition to correct the sample for escapement from the trawl as

$$N_{sp\_corr,l} = \frac{N_{sp,}}{S_l} \quad , \qquad \text{(Eq. xi)}$$

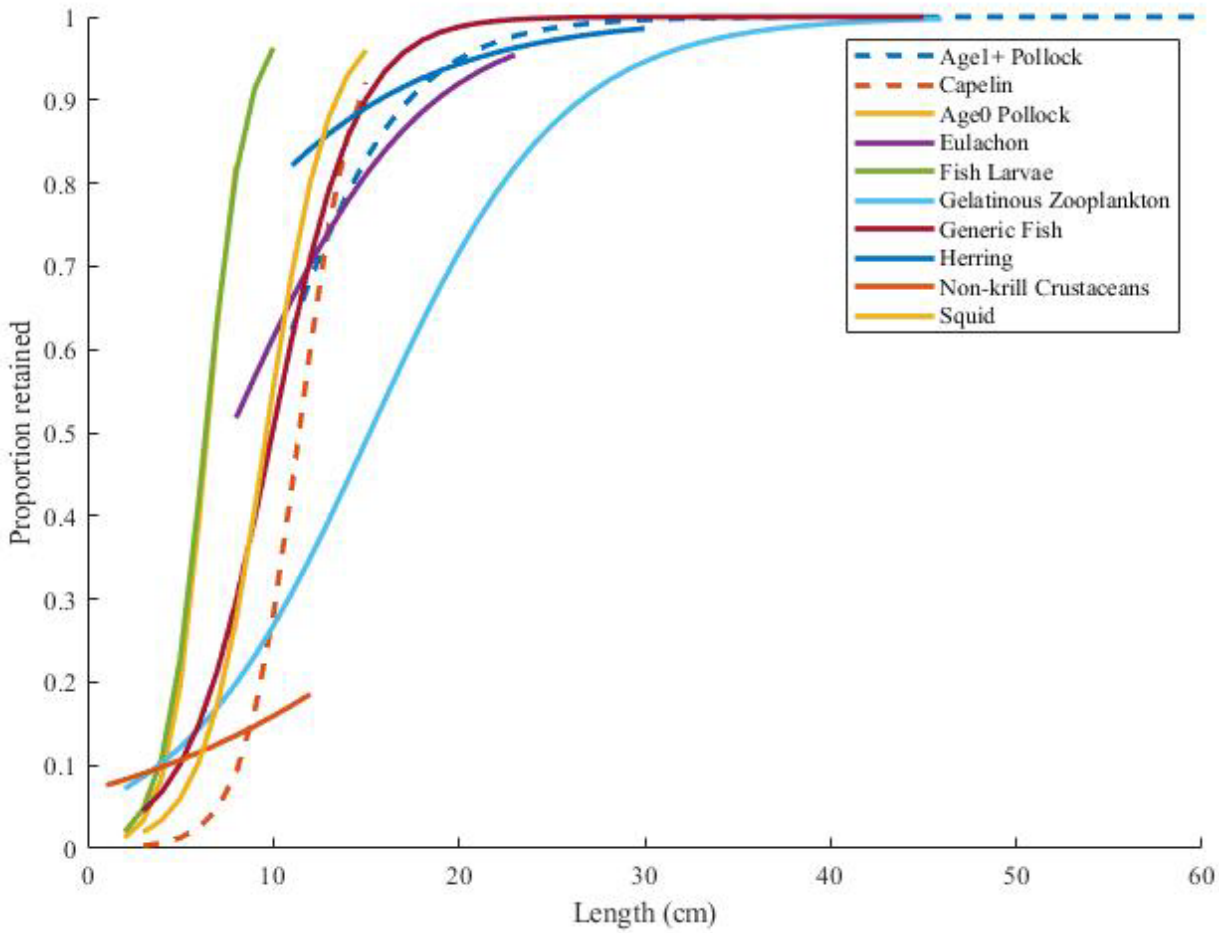
where $N_{sp\_corr,l}$ is the number of fish within a species that would be captured in an unselective sampler in the sampled population and $N_{sp,l}$ is the number of fish within that species in the 1 cm length class l in the trawl catch. In analyses with a selectivity correction applied, $N_{sp\_corr,l}$ was used in place of $N_{s,l}$ in the abundance calculations (see Appendix III, Eq. ii).

Selectivity curves for the most abundant taxa were estimated using the GLMM. Variance was estimated by multivariate normal resampling of selectivity parameters using the point estimates and variance-covariance matrix (n = 1,000). In the case of less abundant animals the catch data were too sparse for this approach. For less abundant groups, data were combined across all hauls and a model was fit to the cumulative GLM result. Variance for this approach was estimated by bootstrap (random sub-sampling with replacement) of the input data by haul (n = 1,000). The criteria for deciding which of these approaches was used was based on whether a selectivity group had at least ten hauls in which at least 20 individuals were encountered in the combined recapture nets. A simpler model estimating the ratio of biomass retained in the codend without length dependence was used for euphausiids because of their similar sizes, and reliable length estimates of retained individuals were not available, particularly from the codend where they were often damaged.

Selectivity curve estimates and their uncertainty are presented in Appendix Table A1 and Figure A1. For the GLMM some hauls with strong outlier estimates of selectivity were further excluded. For all curves, a minimum retention of 0.25% was enforced to prevent overlarge extrapolation errors with model values approaching 0%.

Table A1. -- Selectivity curve estimates of length at 50% retention (*LR*50) and selection range (*SR*) from either the generalized linear mixed effects model (GLMM) or cumulative GLM for species and groups of species captured in the codend and recapture nets during the 2019 GOA AT survey.

Selectivity group	Model used	Length at 50% retention (*LR*50)		*LR*50 95% resample range*	Selection Range (*SR*)	*SR* 95% resample range*	Length range in haul and recapture nets
Age 1+ Pollock	GLMM	9.14		6.16 - 11.22	8.14	6.36 - 11.03	11 - 60
Capelin	GLMM	11.39		9.84 - 15.39	3.23	2.20 - 6.22	3 - 15
Age 0 Pollock	cumulative GLM	6.44		5.51 - 7.65	2.25	1.58 - 3.30	2 - 8
Eulachon	cumulative GLM	7.64		-75.5 - 61.16	11.12	-60.87 - 129.18	8 - 23
Fish Larvae	cumulative GLM	6.36		5.91 - 19.33	2.43	1.96 - 11.90	2 - 10
Gelatinous zooplankton	cumulative GLM	15.2		10.28 - 18.65	11.34	5.01 - 16.31	2 - 46
Generic Fish	cumulative GLM	9.96		7.80 - 13.72	5	3.07 - 8.29	3 - 45
Herring	cumulative GLM	0.39		-176.94 - 157.04	15.3	-112.27 - 174.21	11 - 30
Non-krill Crustaceans	cumulative GLM	27.96		-199.46 - 184.19	23.71	-186.61 - 173.64	1 - 12
Squid	cumulative GLM	9.64		6.53 - 13.55	3.71	1.73 - 7.51	3 - 15



Appendix Figure A1. -- Selectivity functions estimated for the DY1906 survey using recapture nets. Selection function values are only plotted for length ranges encountered for each selectivity group.

U.S. Secretary of Commerce
Gina M. Raimondo

Under Secretary of Commerce for Oceans and Atmosphere
Dr. Richard W. Spinrad

Assistant Administrator, National Marine Fisheries Service. Also serving as Acting Assistant Secretary of Commerce for Oceans and Atmosphere, and Deputy NOAA Administrator
Janet Coit

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