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Results of the Acoustic-Trawl Survey of Walleye Pollock (*Gadus chalcogrammus*) in the Gulf of Alaska, June-August 2015 (DY2015-06)

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 2015. Previous surveys of the GOA have also been conducted by the MACE program during the summers of 2003, 2005, 2011, and 2013. The 2015 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 averaged 12.2° C, overall, approximately 1.6° C warmer than in 2013, which was the only other survey with comparable coverage. The pollock biomass estimate for the entire survey area was 1,606,171 metric tons (t). The majority of the pollock biomass was observed on the continental shelf (66%), Shelikof Strait (18%), east of Kodiak Island in Chiniak (2%) and Barnabas Troughs (6%), and in Marmot Bay (3%). The majority (79%) of the biomass in the survey area was from age-3 fish (~30-45 cm fork length [FL]). Fish weight at length was approximately 10% lower in fish greater than 40 cm FL in 2015 compared to the average weight of fish from surveys conducted in the GOA in summer of previous years. Backscatter was attributed to other species when trawl verification, frequency differentiation, or other methods made it possible. A biomass estimate was calculated for Pacific ocean perch (*Sebastes alutus*, 438,545 t), and euphausiid (primarily consisting of *Thysanoessa inermis*, but also including *T. spinifera*, *T. raschii*, and *Euphausia pacifica*) backscatter distribution and abundance relative to previous surveys was estimated.

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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 distribution and abundance of walleye pollock (*Gadus chalcogrammus*) in Alaska waters. Surveys are conducted annually in the Gulf of Alaska (GOA) during late winter and early spring to assess pre-spawning aggregations. AT surveys have been 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). A biennial schedule of expanded shelf-wide AT summer surveys to estimate walleye pollock distribution and abundance across the GOA were carried out in summers of 2003 and 2005. No GOA summer AT surveys were conducted 2007-2010, when AFSC leadership directed the MACE Program to survey the Bering Sea for four consecutive years due to recent declining abundance numbers for pollock in the region. A biennial survey cycle was resumed in summer 2011. Surveys were concluded short of original plans due to budgetary restrictions in 2003, and ship mechanical issues in 2005 and 2011. The 2013 (Jones et al. 2014) and 2015 surveys covered the shelf and selected bays and troughs from the Islands of Four Mountains to Yakutat Trough. Areas covered in all summer surveys include Shelikof Strait, Barnabas Trough, and Chiniak Trough. The Kenai Peninsula bays were also surveyed in 2015, which had not been surveyed during the summer GOA AT survey since 2003. Estimates of the distribution and abundance of walleye pollock, and when possible, for Pacific ocean perch (POP; *Sebastes alutus*) and capelin (*Mallotus villosus*), have been made for the area surveyed in each year. Since 2011, an estimate of the distribution and abundance of backscatter attributed to euphausiids (or ‘krill’, primarily consisting of *Thysanoessa inermis*, but also including *T. spinifera, T. raschii,* and *Euphausia pacifica*) has been provided.

This report presents the distribution and abundance estimates for walleye pollock, POP, and euphausiids based on the summer AT survey conducted during June through August 2015. Acoustic system calibration and water temperature observations results are also presented.

METHODS

The survey (cruise DY2015-06) was conducted between 11 June and 16 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 continental shelf depth contours and extend in a general north-south direction covering bottom depths of approximately 50 m to 1,000 m. Smaller 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, Nakchamik Island, Shelikof Strait, Alitak Bay, Barnabas Trough, Chiniak Trough, Marmot Bay including Izhut Bay, Prince William Sound, Kenai Peninsula bays, and Yakutat Trough. These areas were selected as likely pollock habitat for survey based on the presence of pollock in prior survey 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 inside the vessel 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 250 m,

[1] National Marine Fisheries Service (NMFS) 2013. NOAA protocols for fisheries acoustics surveys and related sampling (Alaska Fisheries Science Center), 23 p. Prepared by Midwater Assessment and Conservation Engineering Program, Alaska Fish. Sci. Center, Natl. Mar. Fish. Serv., NOAA. Available online: http://www.afsc.noaa.gov/RACE/midwater/AFSC%20AT%20Survey%20Protocols_Feb%202013.pdf

or 2-3 seconds in waters deeper than 250 m. Acoustic backscatter data were collected to a maximum of 1,000 m.

The EK60 echosounder was calibrated using the standard sphere method on 11 June and 13 August 2015. 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. The tungsten carbide sphere was replaced with a 64 mm diameter copper sphere for calibration of 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 measurements with the sphere placed in the center of the beam following the procedure described in Foote et al. (1987). After each sphere was centered on the acoustic axis, split-beam target-strength and acoustic measurements were collected to estimate transducer gains following methods of 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 fitting these data to a second-order polynomial model of the beam pattern using the ER60'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 (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 June and August calibrations were averaged in linear units to provide a final parameter set for data analysis (see results for details).

The EK60 acoustic data (.raw files) were logged at five frequencies using ER60 software (v. 2.4.3). Acoustic telegram data were also logged with Echoview Echolog 500 (v. 4.70.1.14256) software as a backup. Results presented in this report are based on post-processing the 38 kHz acoustic raw data using Myriax Echoview version 6.1.55 using a minimium integration threshold of –70 decibels (dB) re 1 m^{-1}. A Simrad ME70 multibeam sonar (Simrad 2007, Trenkel et al. 2008) was used in a 31-beam configuration (Weber et al. 2013) primarily during nighttime operations to evaluate the topography of the seafloor in various habitats. The ME70 is mounted on the hull 10 m forward of the centerboard at a depth of 6 m below the water surface. ME70 transmissions were synchronized with those of the EK60. Daytime ME70 data collection was discontinued entirely during Leg 2 and 3 due to the discovery of minor interference with 70, 120, and 200 kHz EK60 frequencies under some conditions. This interference does not impact the survey results presented here. The ME70 was calibrated on 11 June using a 25 mm diameter tungsten carbide sphere centered and swung through all 31 beams in the fan.

Trawl Gear and Oceanographic Equipment

Midwater and near-bottom acoustic backscatter was sampled using an Aleutian Wing 30/26 Trawl (AWT). The AWT is constructed with full-mesh nylon wings, and polyethylene mesh in the codend and aft section of the body. The headrope and footrope each measure 81.7 m (268 ft). Mesh sizes taper from 325.1 cm (128 in) in the forward section of the net to 8.9 cm (3.5 in) in the codends, which were fitted with a single 12 mm (0.5 in) codend liner. Near-bottom organisms, and some midwater backscatter, was sampled with 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 (5 in) in the forward portion of the net to 8.9 cm (3.5 in) in the codend. The PNE codend was also fitted with a single 12 mm (0.5 in) codend liner. The AWT and PNE are described in detail by Guttormsen et al. (2010). A twice-modified Marinovich midwater trawl with a 12 m headrope and footrope, 30 m bridle, and mesh sizes ranging from 6.35 cm (2.5 in; top and sides) to 1.91 cm (0.75 in; codend) with a 3 mm (1/8 in) liner was used in attempts to sample near-surface acoustic backscatter.

The AWT, PNE and Marinovich were all fished with 5 m^2 Fishbuster trawl doors each weighing 1,089 kg. Average trawling speed was approximately 1.6 m/sec (3.2 knots). Vertical net openings and headrope depths were monitored with either a Simrad FS70, third-wire netsonde, or a Furuno CN-24 acoustic-link netsonde attached to the headrope. The vertical net opening of the AWT ranged from 17.2 to 30.9 m (56 to 101 ft) and averaged 23.9 m (78 ft) while fishing. The vertical net opening of the Marinovich ranged from 3.8 to 7.0 m (13 to 23 ft) and averaged

5.4 m (18 ft) while fishing. The PNE vertical mouth opening ranged from 9 to 10 m (30 to 33 ft) and averaged 7.8 m (26 ft) while fishing.

A small mesh recapture net was sewn into the bottom panel of the AWT trawl approximately 26 m forward of the codend. The net recaptures organisms that escape from inside the trawl by exiting through the trawl meshes. Catch in the recapture net was recorded independently from the catch in the codend. These data are being used in ongoing work to estimate the trawl selectivity of the AWT and to gauge escapement of juvenile pollock and other small fishes (Williams et al. 2011). Recapture net data were not used to adjust trawl codend catches or other estimates reported here. The AWT trawl also included a CamTrawl stereo imager (Williams et al. 2010) attached to the starboard panel forward of the codend. 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 cannot be differentiated in the trawl catch, or when an aggregation is too dense to obtain an adequate sample without overfilling the net. When extremely dense aggregations are encountered the net can be towed with the codend open and species composition and lengths can be acquired from calibrated CamTrawl images. Images are viewed and annotated using procedures described in Williams et al. (2010).

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 trawl; 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 trawl was attached to a single cable fed through a stern-mounted A-frame. Real-time trawl 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 ~1.3 m/sec (2.5 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 AWT and PNE trawl headrope 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, and with Sippican Deep Blue expendable bathythermograph's (XBT) at various locations along the survey route. Sea surface temperature data (±2 ° C) were measured using the ship's calibrated Furuno T-2000 sea surface temperature system located mid-ship, approximately 1.4 m below the surface. These and other environmental data were recorded using the ship's Scientific Computing Systems (SCS).

Survey Design

The survey design consisted 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. In Deadman Bay within Alitak Bay, Izhut Bay, and Kenai Peninsula bays, zig-zag transects were used because the bays were narrow. Coverage and transect spacing were chosen to be consistent with previous surveys in each area where possible. Transect placement was randomized by moving previous survey transect starting points an amount less than the inter-transect distance, with subsequent transects evenly spaced from this point. 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., Simrad ME70 multibeam/EK60 sonar mini-grids for characterizing bottom type and rockfish abundance together with associated drop camera deployments, wideband acoustic collections on single species fish aggregations and methane bubble seeps, and a transducer system lowered over the side of the ship to measure target strength of diffusely spaced single-species aggregations).

Trawl hauls were conducted to aid in classifying the observed backscatter by species and size composition and to collect specimens of walleye pollock. Walleye pollock were sampled to determine sex, fork length (FL), body weight, age, gonad maturity, and pre-spawner ovary weights. Walleye pollock (except age-0 fish) and fishes other than capelin (*Mallotus villosus*) were measured to the nearest 1 mm fork length (FL) using an electronic measuring board (Towler and Williams 2010). Capelin and age-0 walleye pollock were measured to the nearest millimeter standard length (SL). Standard, fork, and total lengths were collected from eulachon and capelin on several occasions. When large numbers of juveniles mixed with adults were encountered in a haul, the predominant size groups were subsampled separately (e.g., age-1 vs. adults). For each trawl haul, sex and length measurements were collected for up to 400 randomly sampled individuals, and up to an additional 60 individuals were sampled for body weight, maturity, and age. Maturity was determined by visual inspection and was categorized as immature, developing, pre-spawning, spawning, or post-spawning[2]. An electronic motion-compensating scale (Marel M60) was used to weigh individual fish to the nearest 2 g. Trawl metadata (e.g., position, speed, environmental conditions) and biological measurements of the catch were electronically recorded in the Catch Logger for Acoustic Midwater Surveys (CLAMS) database.

The catch from Methot trawl hauls was transferred to a large bucket. 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, sorted into broad taxonomic groups, and re-weighed. A second subsample was weighed and preserved in a 5% buffered formalin solution for more detailed enumeration at the Polish Sorting Center in Szczecin, Poland.

Data Analysis

Data were analyzed using Echoview post-processing software (Version 6.1.55.27042). Fish abundance and distribution results presented here are based on 38 kHz acoustic backscatter integrated using a post-processing S_v integration threshold of -70 decibels (dB re $1m^{-1}$).

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[2] ADP Codebook. 2013.RACE Division, AFSC, NMFS, NOAA; 7600 Sand Point Way NE, Seattle, WA 98115. Available online http://www.afsc.noaa.gov/RACE/groundfish/adp_codebook.pdf

The bottom depth was estimated as the mean of sounder-detected bottom depths based on the five frequencies (Jones et al. 2011). Acoustic backscatter from 16 m below the surface to 0.5 m above the bottom (except where the bottom exceeded the 1,000 m lower limit of data collection) were used in further analyses. Acoustic data were binned at 0.5 nautical mile (nmi) horizontal by 10 m vertical resolution. Acoustic backscatter was assigned to species based primarily on trawl catch composition. If trawl catch verification of backscatter species composition was not possible, we assigned backscatter to species based on CamTrawl imagery, multi-frequency backscatter response (De Robertis et al. 2010), school morphology (e.g., rockfish tend to form "haystacks" near the seafloor), or experience from previous summer and winter cruises in the area (e.g., POP are more adept at avoiding the trawl than walleye pollock over the shelf break).

Walleye pollock length compositions were combined from trawl hauls into regional length strata based on geographic proximity, similarity of length composition, and backscatter characteristics. Mean fish weight-at-length for each 1 cm length interval was estimated from the trawl information when there were six or more walleye pollock were sampled in that length interval; otherwise, it was estimated using a linear regression of the natural logarithm of all length-weight data (De Robertis and Williams 2008).

Walleye pollock abundance was estimated by dividing the acoustic measurements of area backscattering coefficient at 38 kHz by the mean backscattering cross section of pollock (MacLennan et al. 2002) using an acoustic target strength (TS) to length relationship of TS = $20 \log_{10}(FL)-66$ (Traynor 1996). Numbers and biomass for each length stratum were estimated as in Honkalehto et al. (2008). Total abundance was estimated by summing the stratum estimates. Biomass estimates were also calculated for POP based on similar methodologies using the generic physoclist fish TS to length relationship for POP of TS = $20 \log_{10}(FL)-67.5$ (Foote 1987).

Walleye pollock otoliths were collected from all areas and stored in a 50% glycerin/thymol-water solution for later age determination. Otoliths were processed by AFSC Age and Growth Program researchers to determine the ages of individual fish. Length-at-age data were used to convert abundance-at-length estimates to abundance-at-age (see Appendix III). Briefly, abundance-at-length from the trawl catch is combined with an age-length matrix from otolith processing and the proportion at age for each length is determined. The proportioned length-at-age is multiplied by the abundance-at-length to obtain the abundance-at-age. For lengths where no specimens were collected, the proportion at age was derived using a Gaussian model approach fitting the likely age to length from historical data.

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):

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

Since 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 spacings) 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, Kenai Peninsula Bays, Izhut 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:

$$\textit{Relative estimation error}_{2\text{-}D} = \frac{\sqrt{variance_{mean} * area}}{biomass_{mean} * area} \quad , \qquad \text{(Eq. 3)}$$

and over several zig-zag survey areas as:

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

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 for 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). For reference, 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.

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

RESULTS and DISCUSSION

Acoustic System Calibration

An acoustic system calibration was conducted at the beginning of the survey and another at the end of survey (Table 1). 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 11 June and 13 August were averaged in the linear domain and used to scale final results. The end-of cruise sphere calibration for the 38-kHz system on 13 August revealed a 0.05 dB decrease in integration gain which would increase initial unadjusted backscatter values by 1.45%. A total of 23.5% of all 38 kHz backscatter for the entire GOA survey was classified as pollock.

Walleye Pollock Weight, Length, and Age

Weight at length was measured on 5,389 walleye pollock during the GOA survey (Table 2). Weight at length was observed to be similar throughout the survey areas, so fish from all areas were grouped into one weight at length key. Walleye pollock weight at length during the 2015 GOA survey was similar to previous surveys up to approximately 40 cm FL, but fish longer than 40 cm FL were approximately 10% lighter at length compared to the average weight of fish from previous summer surveys (Fig. 4).

Otoliths were collected from a total of 2,618 walleye pollock (Table 2), of which 1,676 were aged. Length at age was similar for all areas so a single length at age key was used for the entire survey. Length at age was similar to that in previous surveys in fish up to 11 years old (except age 4 and 5 fish in 2003) but 12-year-old fish (the oldest recorded in this survey) were slightly shorter than similar-aged fish from previous surveys (Table 3; Fig. 5). Additionally, mean weight at age in fish through age 10 was within one standard deviation of previous surveys (except age 4 fish in 2003), but fish averaged more than one standard deviation lighter than age 11 fish in 2013 and age 12 fish in all previous surveys (Table 4; Fig. 6).

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 15 June and 12 August. The survey area encompassed 154,088 km^2 (44,925 nmi^2) covering the shelf and shelf break between approximately the 50 and 1,000 m depth contours. Acoustic backscatter was measured along 3,219.7 km (1,738.5 nmi) of trackline on 43 transects spaced 46.3 km (25 nmi) apart.

Surface water temperatures across the GOA shelf ranged from 5.8° to 17.1° C, increasing from west to east with an overall average of 12.2° C, approximately 1.6° C warmer than in 2013 (Fig. 7). 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 7.5° C and averaged 6.6° C (Fig. 8), approximately 1.3° C warmer than in 2013. Bottom temperatures from 21 CTD and 46 XBT deployments on the shelf averaged 5.8° C with an average bottom depth of 229 m (Fig. 7), 0.7° C warmer than bottom temperatures from CTD deployments across the shelf but not necessarily the same locations in 2013.

Biological data and specimens were collected along the GOA shelf from 34 AWT hauls, two Marinovich trawls, and 18 PNE hauls, 9 of which were fished in midwater (Tables 5-7; Figs. 1-3). Walleye pollock was the most abundant species by weight (74.1%) and number (55.4%) caught in the midwater hauls (Table 6). Pacific ocean perch (POP) was the second most abundant species by weight (11.2%) captured in the midwater hauls. Pacific herring was the second most abundant species captured by number (32.1%) in the midwater hauls, but the majority of the herring caught were captured in two hauls (86% from haul 187 and 14% from 199). In the demersal hauls, Pacific ocean perch was the most abundant species by weight (84.0%) and number (90.2%; Table 7). Northern rockfish was the second most abundant species caught by weight (7.4%) and number (4.2%) in demersal hauls on the shelf. Fifty-six percent of the POP were caught in a single demersal haul (haul 124).

Walleye pollock observed on the GOA shelf ranged predominately in length from 30 to 48 cm in FL with a single major mode at 37 cm FL (Tables 8 and 9; Fig. 9). Pollock ranged in age from 1 to 12 with age-3 fish (the 2012 year class) comprising the vast majority by number (86%) and biomass (80%; Tables 10 and 11). Walleye pollock were distributed across the shelf with areas of greatest density south of Unimak Pass, between the Shumagin Islands and Shelikof Strait, south of the Trinity Islands, and east of the Kenai Peninsula on the northwest portion of Portlock Bank (Figs. 10-12). Pollock tended to be in the lower half the water column in waters < 250 m deep (Fig. 13).

The total walleye pollock biomass estimate for the GOA shelf was 1,065,871 metric tons (t; Table 12), approximately 66% of the total biomass observed in this survey and 3.5 times larger than the 2013 estimate for the shelf. The relative estimation error of the biomass resulting from the 1-D geostatistical analysis was 9.4%.

Sanak Trough

Sanak Trough (Fig. 1) was surveyed on 20 June along 87.4 km (47.2 nmi) of trackline on five transects spaced 7.4 km (4 nmi) apart encompassing a total area of 724.4 km^2 (211.2 nmi^2). Bottom depths in Sanak Trough ranged from 50 to 161 m. Surface temperatures in Sanak Trough averaged 9.0° C (Fig. 7), 2.1° C warmer than temperatures in 2013. The temperature at 100 m depth from SBE-39 probes on the fishing gear was 5.5° C (Fig. 8), 1.2° C warmer than in 2013.

One midwater AWT was conducted in Sanak Trough (Tables 2, 5, and 13; Fig. 1). A salmon shark in the AWT dominated the catch by weight (74.5%), but walleye pollock was the second most abundant species by weight (25.3%). Walleye pollock was the most abundant species caught by number (90.9%). Walleye pollock in Sanak ranged in length from 27 to 44 cm FL with a major mode at 31 cm FL (Tables 8 and 9; Fig. 9). Only fish aged 2 - 5 were caught in Sanak Trough, with age-3 fish most abundant by number (80%) and biomass (85%; Tables 10 and 11).

The walleye pollock biomass in Sanak Trough was fairly evenly distributed across the surveyed area (Fig. 10) and was most abundant at depths of 50-100 m, approximately 30 m above the seafloor (Fig. 13). The biomass estimate for Sanak Trough was 3,098 t (Table 12), roughly three times what was seen in both 2011 and 2013. The relative estimation error of the biomass based on the 1-D geostatistical analysis was 10.6%.

Morzhovoi and Pavlof Bays

Morzhovoi Bay and Pavlof Bay (Fig. 1) were surveyed on 20 and 21 June, respectively. Acoustic backscatter in Morzhovoi Bay was measured along 36.5 km (19.7 nmi) of trackline encompassing an area of 289.1 km^2 (84.3 nmi^2), and in Pavlof Bay along 35.9 km (19.4 nmi) of trackline encompassing an area of 281.3 km^2 (82 nmi^2). Transects in both bays (six in Morzhovoi and five in Pavlov) were spaced 7.4 km (4 nmi) apart and bottom depths ranged from 58 to 123 m. Morzhovoi and Pavlof Bays had average surface temperatures of 9.0° and 10.2° C, respectively (Fig. 7), on average 2.5° C warmer than temperatures in 2013 for both bays. Trawls in these areas did not extend to 100 m depth but temperatures in Pavlof at 90 m depth averaged 5.7° C (Fig. 8), approximately 1.6° C warmer than temperatures at a similar depth in 2013, and trawls in Morzhovoi Bay at 75 m had an average temperature of 5.7° C, approximately 1.1° C warmer than in 2013.

Biological data and specimens were collected in Morzhovoi Bay from two AWT midwater hauls (Tables 2, 5, and 14; Fig. 1). Walleye pollock was the most abundant species caught in the AWT hauls, contributing 95.3% by weight and 92.3% by number (Table 14). Pacific cod (*Gadus microcephalus*) was the second most abundant species by weight (3.5%) and capelin (*Mallotus villosus*) was the second most abundant species by number (2.3%). Walleye pollock in Morzhovoi Bay ranged from 15 to 73 cm with a dominant mode of 41 cm FL (Tables 8 and 9; Fig. 9). Age-3 pollock accounted for 75% of the total number and 68% of the total biomass in Morzhovoi Bay (Tables 10 and 11).

Backscatter in Morzhovoi Bay attributed to walleye pollock was fairly evenly scattered throughout the bay with the greatest density located in the south east corner over the deepest part of the bay (Fig. 10). Pollock were most abundant between 50 and 100 m depths approximately 12 m above the seafloor (Fig. 13). The biomass estimate for Morzhovoi Bay was 4,855 t, about

1,000 t greater than what was seen in Morzhovoi Bay in 2013 (Table 12). The relative estimation error of the biomass based on the 1-D geostatistical analysis was 27.8%.

One midwater AWT was conducted in Pavlof Bay (Tables 2, 5, and 15; Fig. 1). The catch in the AWT was dominated by walleye pollock with only a few individuals of three other species caught (Table 15). Walleye pollock lengths in Pavlof Bay ranged from 16 to 69 cm FL, with most fish in the 26 to 43 cm FL range and a major mode at 32 cm FL and a smaller mode at 37 cm FL (Tables 8 and 9; Fig. 9). Age-3 pollock accounted for 76% by number and 82% by biomass of the Pavlov totals (Tables 10 and 11).

Acoustic backscatter attributed to walleye pollock in Pavlof Bay was observed throughout the survey area but primarily near the mouth of the bay (Fig. 10). Pollock was most abundant between 50 and 100 m depths approximately 40 m above the seafloor (Fig. 13). The biomass estimate for Pavlof Bay was 2,576 t, slightly higher than in 2013 (Table 12). The relative estimation error of the biomass based on the 1-D geostatistical analysis was 16.9%.

Shumagin Islands

The West Nagai Strait, Unga Strait, Renshaw Point, and Shumagin Trough areas in the Shumagin Islands (Fig. 1) were surveyed from 22 to 24 June. Acoustic backscatter was measured along 280.2 km (151.3 nmi) of trackline from 25 transects encompassing an area of 2,088.1 km^2 (608.8 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 Shumagins Islands area ranged from 66 to 224 m. Surface water temperatures in the Shumagin Islands area averaged 10.5° C (Fig. 7), 2.2° C warmer than temperatures in 2013. Temperatures at 100 m depth from SBE-39 probes on the fishing gear in this area averaged 5.7° C (Fig. 8), approximately 1.4° C warmer than 2013.

Biological data and specimens were collected in the Shumagin Islands in five midwater AWT hauls (Tables 2, 5, and 16; Fig. 1). Walleye pollock was the most abundant species caught in AWT hauls by weight (98.1%) and number (60.2%; Table 16). Capelin was the second most abundant species caught by number (28.8%) and was primarily caught in a single haul (haul 28) in Shumagin Trough near the mouth of Stepovak Bay. Walleye pollock lengths ranged from 12 to 68 cm FL with the majority of fish in the 35 to 45 cm FL range and a mode of 39 cm FL (Tables 8 and 9; Fig. 9). These age-3 pollock accounted for 82% of the number and 76% of the biomass for the Shumagins total (Tables 10 and 11).

Unlike previous years when walleye pollock in the Shumagin Islands area were most abundant in the Unga Strait area and in Shumagin Trough, this year the greatest abundances were found near the mouth of Stepovak Bay and the outer West Nagai Strait areas (Fig. 10). Pollock were most abundant between 40 and 80 m depths approximately 60 m above the seafloor (Fig. 13). The biomass estimate of 15,074 t was approximately half of the 2013 biomass estimate (Table 12). The relative estimation error of the biomass based on the 1-D geostatistical analysis was 8.4%.

Mitrofania Island

The acoustic trawl survey near Mitrofania Island (Fig. 1) was conducted from 22 to 23 June along 86.3 km (46.6 nmi) of trackline from four transects spaced 14.8 km (8.0 nmi) apart encompassing an area of 1317.1 km^2 (384 nmi^2). Bottom depths near Mitrofania Island ranged from 74 to 171 m. Surface water temperatures near Mitrofania Island averaged 10.7° C (Fig. 7), 3.2° C warmer than temperatures in 2013. The temperature at 100 m depth from SBE-39 probes on the fishing gear was 6.1° C (Fig. 8), 1.6° C warmer than in 2013.

Biological data and specimens were collected from one midwater AWT haul in the Mitrofania area (Tables 2, 5, and 17; Fig. 1). Walleye pollock was the most abundant species caught, contributing 98.5% by weight, and 99.7% by number (Table 17). Chum salmon was the second most abundant species by weight (1.2%) in the hauls near Mitrofania. In Mitrofania, walleye pollock from trawls were between 27 and 66 cm FL with a mode at 39 cm (Tables 8 and 9; Fig. 9), representing age-3 fish.

Walleye pollock backscatter was highest on transects to the north and west of Mitrofania Island (Fig. 10). Pollock were most abundant between 40 and 70 m depths approximately 50 m above the seafloor (Fig. 13). The biomass estimate for the Mitrofania Island area was 14,742 t (Table 12), approximately six times more than in 2013 and twice the amount seen in 2011. The relative estimation error of the biomass based on the 1-D geostatistical analysis was 13.3%.

Shelikof Strait

The Shelikof Strait sea valley (Fig. 2) was surveyed from 7 to 13 July. Acoustic backscatter was measured along 16 transects spaced at 27.8 km (15 nmi) along 871.4 km (470.5 nmi) of trackline encompassing an area of 24,561.5 km^2 (7,161 nmi^2). Bottom depths in Shelikof Strait ranged from 61 to 325 m. Surface water temperatures in Shelikof Strait averaged 11.9° C (Fig. 7), 2.4° C warmer than surface temperatures in 2013. Water temperatures at 100 m depth from SBE-39 probes on the fishing gear averaged 6.2° C (Fig. 8), approximately 1.4° C warmer than in 2013.

Biological data and specimens were collected in Shelikof Strait from 11 AWTs (Tables 2, 5, and 18; Fig. 2). Walleye pollock was the most abundant species, making up 99.4% by weight and 99.6% by number of the total catch (Table 18). Pacific cod was the second most abundant species caught by weight, but they accounted for less than 1% of the catch. Walleye pollock in Shelikof Strait ranged in length from 24 to 65 cm FL with a mode of 35 cm FL (Tables 8 and 9; Fig. 9). Ages of walleye pollock from Shelikof Strait ranged from 2 to 12 years old, with age-3 fish most abundant by number (85%) and biomass (84%; Tables 10 and 11).

Walleye pollock were distributed fairly evenly throughout Shelikof Strait with more fish generally on the southern and eastern side of the trough (Fig. 11). In the western part of the Strait between Sutwik Island and the Semidi Islands pollock were also aggregated along the western side of the trough. Pollock were most abundant at depths of 50 to 150 m approximately 100 m above the seafloor (Fig. 13).

The biomass estimate for Shelikof Strait (287,804 t; Table 12) was the second highest in the summer time series (approximately half of the 2013 series high) and accounted for approximately 18% of the entire GOA summer survey pollock biomass. Approximately 84% of the biomass and 85% by number detected in Shelikof Strait were age-3 walleye pollock (Tables 10 and 11). The relative estimation error of the biomass based on the 1-D geostatistical analysis was 5.8%.

Nakchamik Island

The waters near Nakchamik Island (Fig. 2) were surveyed on 12 July. Near Nakchamik Island, acoustic backscatter was measured along 27.8 km (15 nmi) of trackline from four transects spaced 14.8 km (8.0 nmi) apart encompassing an area of 439.0 km^2 (128 nmi^2). Bottom depths near Nakchamik Island ranged from 65 to 269 m. Surface water temperatures near Nakchamik Island averaged 11.6° C (Fig. 7), 4.3° C warmer than in 2013. Water temperatures at 100 m depth from SBE-39 probes on the fishing gear were 7.5° C (Fig. 8), approximately 2.5° C warmer than in 2013.

Biological data and specimens were collected from one midwater AWT haul near Nakchamik Island (Tables 2, 5, and 19; Fig. 2). Walleye pollock was the most abundant species caught, contributing 97.5% by weight, and 73.2% by number (Table 19). Eulachon was the second most abundant species by weight (1.5%) and number (23.5%). Pollock captured in the trawl near Nakchamik ranged from 14 and 69 cm with modes at 29 and 43 cm FL (Tables 8 and 9; Fig. 9). Pollock ages ranged from age-1 to 12 with age-3 fish most abundant in number (51%) and biomass (44%; Tables 10 and 11).

Walleye pollock in Nakchamik were distributed throughout the region and were most abundant at depths of 60 -150 m and approximately 60 m above the seafloor (Fig. 13). The biomass estimate was 9,147 t (Table 12), approximately the same as was seen in 2013. The relative estimation error of the biomass based on the 1-D geostatistical analysis was 19.0%.

Alitak and Deadman Bay

Alitak Bay (Fig. 2) was surveyed on 15 and 16 July along six transects spaced 5.6 km (3.0 nmi) apart in the outer part of the bay and using a zig-zag pattern in the narrow inner Deadman Bay area. Acoustic backscatter was measured along 105.6 km (57 nmi) of trackline encompassing an area of 455.5 km^2 (132.8 nmi^2). Bottom depths ranged from 24 to 101 m in Alitak Bay and 71 to 174 m in Deadman Bay. Surface water temperatures in Alitak Bay averaged 12.0° C (Fig. 7), 2.1° C warmer than temperatures in 2013. Hauls in Alitak Bay were shallow and at 35 m depth was 11.0° C, 3.5° C warmer than in 2013. Surface temperatures in Deadman Bay averaged 12.7° C, only 0.3° C warmer than in 2013. Water temperatures at 100 m depth in Deadman Bay averaged 4.7° C (Fig. 8). Hauls in 2013 did not extend to 100 m depth in Deadman Bay but at 75 m depth were 1.9° C warmer in 2015 than in 2013.

Biological data and specimens were collected from one AWT haul in Alitak Bay and two AWT hauls in Deadman Bay (Tables 2, 5, and 20; Fig. 2). Walleye pollock made up 95.4% by weight and 96.0% by number of the catch from the AWT trawls (Table 20). The walleye pollock ranged from 18 to 72 cm FL with modes at 27, 35, and 50 cm FL (Tables 8 and 9; Fig. 9). Walleye pollock in Deadman Bay were found on average at a depth of 100 m and 25 m above the seafloor while pollock in Alitak's outer bay were found at an average depth of 47 m and approximately 10 m above the seafloor (Fig. 13). Ages of walleye pollock from Alitak and Deadman Bay combined ranged from 1 to 12 years old, with age-3 fish most abundant by number (37%) and biomass (24%) but contributing less overall compared to all other areas except the Kenai Peninsula Bays (Tables 10 and 11).

The total biomass estimate for the Alitak/Deadman Bay area was 7,244 t (Table 12), approximately half the amount that was seen in the 2013 survey. A total of 2,088 t (29%) of the overall biomass from this area was from Deadman Bay, similar to 2013 when 23% of the total biomass from this region was from Deadman Bay. The relative estimation error of the biomass in the outer bay based on the 1-D geostatistical analysis was 15.6%. The relative estimation error of the biomass in Deadman Bay based on the 2-D geostatistical analysis was 6.1%.

Marmot and Izhut Bays

Surveys in Marmot and Izhut Bays (Fig. 2) were conducted on 16-17 July. Acoustic backscatter in Marmot Bay was measured along 184.5 km (99.6 nmi) of trackline along 16 transects spaced 3.7 km (2.0 nmi) apart in the inner bay and Spruce Gully, and 7.4 km (4.0 nmi) apart in the outer bay, encompassing a total area of 1,121.6 km^2 (327 nmi^2). Izhut Bay was surveyed along 13.7 km (7.4 nmi) of zig-zag transects encompassing an area of 21.3 km^2 (6.2 nmi^2). Bottom depths ranged from about 60 to 297 m in Marmot Bay and from 79 to 187 m in Izhut bay. Average surface water temperatures in Marmot and Izhut Bays were 10.6° and 10.3° C, respectively (Fig. 7), 0.4° C and 3.4° C cooler, respectively, in 2015 than in 2013. Water temperatures at 100 m depth from SBE-39 probes on the fishing gear in Marmot Bay averaged 8.0° C (Fig. 8), approximately 1.7° C warmer than in 2013.

Biological data and specimens were collected from five AWT hauls in Marmot Bay (Tables 2, 5, and 21; Fig. 2). Walleye pollock was the most abundant species caught by weight and number in the AWT hauls in Marmot (97.8% and 99.7%, respectively; Table 21). Walleye pollock ranged in length from 18 to 67 cm FL with modes in Marmot Bay at 32 cm and 39 cm FL (Tables 8 and 9; Fig. 9). The majority of the fish smaller than 35 cm FL were caught in the inner part of the bay in haul 94. Walleye pollock from Marmot Bay ranged in age from 1 to 12 years old with age-3 fish most abundant by number (81%) and biomass (74%) in both areas (Tables 10 and 11).

Walleye pollock were detected throughout Marmot Bay with the greatest densities found in the outer bay (Fig. 11). Pollock were most abundant at depths of 90 to 130 m approximately 40 m above the seafloor (Fig. 13). The biomass estimate for Marmot Bay was 45,429 t, more than five times greater than previous estimate (Table 12). The relative estimation error of the Marmot biomass based on the 1-D geostatistical analysis was 13.7%. The biomass estimate for Izhut Bay was 374 t, approximately half the estimate from 2013. The relative estimation error of the biomass in Izhut Bay based on the 2-D geostatistical analysis was 16.1%.

Barnabas Trough

Barnabas Trough (Fig. 2) was surveyed from 18 to 20 July. Acoustic backscatter was measured along nine transects spaced 11.1 km (6 nmi) apart encompassing 227.6 km (122.9 nmi) (2,613.6 km^2; 762 nmi^2). Depths in Barnabas Trough ranged from 46 to 180 m. Surface water temperatures in Barnabas Trough averaged 12.6° C (Fig. 7), 1.9° C warmer than in 2013. Water temperatures at 100 m depth from SBE-39 probes on the fishing gear averaged 6.6° C (Fig. 8), approximately 1.3° C warmer than in 2013.

Biological data and specimens were collected from four AWT and two PNE hauls in Barnabas Trough (Tables 2, 5, 22 and 23; Fig. 2). Walleye pollock was the dominant species caught in the AWT hauls, contributing 98.5% by weight and 99% of the catch by number (Tables 22 and 23). Pacific cod was the second most abundant species caught by weight (0.6%), and northern sea nettles were the second most abundant species by number caught (0.4%) in AWT hauls Barnabas Trough. Pacific ocean perch were the most abundant species caught by weight and number (53.7% and 59.3%, respectively) in the PNE hauls in Barnabas Trough, and pollock were the second most abundant species (44.2% and 38.5%, respectively).

Pollock caught in Barnabas Trough ranged in size from 28 to 73 cm FL but were dominated by a single mode at 41 cm FL (Tables 8 and 9; Fig. 9). Fish ranged in age from 2 to 12 years old with age-3 fish most abundant by number (88%) and biomass (83%; Tables 10 and 11).

Large aggregations of adult walleye pollock were detected throughout Barnabas Trough (Fig. 11) and were most abundant at depths of 100 to 150 m approximately 20 m above the seafloor (Fig. 13). The biomass estimate for Barnabas Trough was 88,915 t (Table 12), approximately 6% of the entire GOA summer survey biomass estimate, the highest observed in the summer time series for this area (since 2003), and 40% greater than the amount seen in this area in 2013. The relative estimation error of the biomass based on the 1-D geostatistical analysis was 16.8%.

Chiniak Trough

Chiniak Trough (Fig. 2) was surveyed from 21 to 22 July. Acoustic backscatter was measured along nine transects spaced 11.1 km (6 nmi) apart covering 154.3 km (83.3 nmi) (1,769.8 km^2; 516 nmi^2) of trackline. Bottom depths ranged from 66 to 214 m in Chiniak Trough. Surface water temperatures in Chiniak Trough averaged 11.3° C (Fig. 7), 0.6° C warmer than in 2013. Water temperatures at 100 m depth from SBE-39 probes on the fishing gear averaged 7.4° C (Fig. 8), approximately 1.4° C warmer than in 2013.

Biological data and specimens were collected from 4 AWT hauls in Chiniak Trough (Tables 2, 5, and 24; Fig. 2). Walleye pollock was the dominant species caught, contributing 88.4% by weight and 97.5% by number to the catch (Table 24). Pollock caught in Chiniak Trough ranged in length from 16 to 62 cm FL, with a mode at 37 cm FL (Tables 8 and 9; Fig. 9). Fish ranged in age from 3 to 12 years old with age-3 fish most abundant by number (91%) and biomass (87%) in Chiniak Trough (Tables 10 and 11).

Dense aggregations of adult walleye pollock were detected in Chiniak Trough (Fig. 11) and were most abundant at approximately 100 m depth approximately 60 m above the seafloor (Fig. 13). The biomass estimate for Chiniak Trough was 34,980 t (Table 12) was similar to the 2011 estimate, and the second highest in the time series (since 2003) for this area. The relative estimation error of the biomass based on the 1-D geostatistical analysis was 5.8%.

Kenai Peninsula Bays

Bays along the Kenai Peninsula, including, from west to East, Port Dick, Nuka Passage, Nuka Bay, Harris Bay, Aialik Bay, Resurrection Bay, Day Harbor, Port Bainbridge, and Knight Passage (Fig. 3) were surveyed between 30 July and 5 August along 476.5 km (257.3 nmi) of trackline. All bays were surveyed using a zig-zag pattern and encompassed a total area of 1,262.9 km^2 (368.2 nmi^2). Bottom depths in the Kenai Peninsula Bays ranged from 72 to 586 m. Surface water temperatures in the Kenai Peninsula Bays averaged 15.6° C (Fig. 7). The temperature at 100 depth from SBE-39 probes on the fishing gear in the Kenai Peninsula Bays averaged approximately 6.9° C (Fig. 8). Kenai Peninsula Bays were not surveyed in 2013.

Biological collections were made with 8 midwater AWT and one near bottom PNE trawl (Tables 2, 5, 25 and 26; Fig. 3). Pollock was the most abundant species caught by weight and number (89.3 and 52.0%, respectively) in the AWT hauls, and eulachon was the second most abundant species (2.4% and 14.1%, respectively). Rougheye rockfish was the most abundant species caught by weight (46.0%) in the PNE and unidentified shrimp species were the most abundant by number (71.7%; Table 26). Pollock caught in the Kenai Peninsula Bays ranged in length from 15 to 66 cm FL and had modes at 19 cm, 25 cm, and 52 cm FL (Tables 8 and 9; Fig. 9). Pollock in the Kenai Peninsula Bays ranged from 1 to 12 years old with age-2 fish most abundant by number (41%) and age-3 fish most abundant in biomass (23%; Tables 10 and 11). Age-3 fish in the Kenai Peninsula Bays contributed less to the overall pollock numbers and biomass compared to all other areas.

Pollock backscatter was relatively low in the Kenai Peninsula bays, but it extended throughout the area. The densest backscatter attributed to pollock in the Kenai Peninsula Bays was found in Harris and Resurrection Bays (Fig. 12), with fish located on average at depths between 150 and 250 m and approximately 60 m above the seafloor (Fig. 13). The biomass estimate for the Kenai Peninsula Bays totaled 7,213 t (Table 12), almost 5 times greater than the biomass estimate for the Kenai Peninsula Bays in 2003. The relative estimation error based on the 2-D geostatistical analysis of the acoustic backscattering was 13.7%.

Prince William Sound and Trough South of Montague Island

Prince William Sound and the trough that extends south of Montague Island (Fig. 3) were surveyed from 5 to 8 August along 312.8 km (168.9 nmi) of trackline from 16 transects spaced at 14.8 km (8 nmi) encompassing an area of 4,748.4 km^2 (1,384.4 nmi^2). Bottom depths in Prince William Sound ranged from 90 to 747 m. Surface water temperatures in Prince William Sound averaged 16.5° C (Fig. 7), 0.8° C warmer than in 2013. The temperature at 100 depth from SBE-39 probes on the fishing gear in Prince William Sound averaged 7.0° C (Fig. 8), approximately 1.4° C warmer than in 2013.

Biological collections were made within Prince William Sound (PWS) from three AWT hauls, and in the trough south of Montague Island from five AWT hauls (Tables 2, 5, and 27; Fig. 3). Pollock was the most abundant species caught by weight (81.2%) in the AWT hauls and eulachon was the most abundant species caught by number (34.0%; Table 27). Walleye pollock caught in PWS ranged in length primarily from 45 to 65 cm FL with a mode of 57 cm FL and fish caught in the trough south of Montague Island ranged in length primarily from 30 to 45 cm FL with a mode of 37 cm FL (Tables 8 and 9; Fig. 9). Ages for pollock caught in both the sound and outer shelf ranged from 1 to 12 years old, and age-3 fish dominated in both number (68%) and biomass (47%; Tables 10 and 11).

As in 2013, backscatter in Prince William Sound was very sparse (Fig. 12), with most fish located in the trough south of Montague Island. Pollock were most abundant between depths of 100 to 300 m and approximately 74 m above the seafloor (Fig. 13). The biomass estimate for Prince William Sound is 13,308 t, of which only 5,596 t was within the sound proper, roughly the same as in 2013 (Table 12). The relative estimation error based on the 1-D geostatistical analysis of the acoustic backscattering was 7.6%.

Yakutat Trough

Yakutat Trough was surveyed 12 to 13 August along 118.2 km (63.8 nmi) of trackline from five transects spaced 22.2 km (12.0 nmi) apart encompassing an area of 2,720.3 km^2 (793.1 nmi^2; Fig. 3). Bottom depths in Yakutat Trough ranged from 139 to 350 m. Surface temperatures in Yakutat Trough averaged 16.0° C (Fig. 7), 0.5° C warmer than in 2013. The temperature at 100 m depth from SBE-39 probes on the fishing gear in Yakutat Trough averaged 7.2° C (Fig. 8), approximately 1.3° C warmer than in 2013.

In Yakutat Trough, biological collections were conducted with two AWT trawls (Tables 2, 5, and 28; Fig. 3). Pacific ocean perch was the most abundant species caught by weight (95.9%) and number, (96.2%; Table 28). Walleye pollock was the second most abundant species caught by weight (2.2%) and number (1.3%) in the midwater hauls. Most of the walleye pollock caught in the AWT hauls ranged in length from 47 to 66 cm FL with a mode of 56 cm FL (Tables 8 and 9; Fig. 9). Pollock in Yakutat Trough ranged from 1 to 12 years old with age-6 fish most abundant in both number (23%) and biomass (22%; Table 10 and 11).

Backscatter was low and evenly distributed within Yakutat Trough (Fig. 12). Most pollock were located between depths of 200 to 300 m and approximately 40 m above the seafloor (Fig. 13). The biomass estimate for Yakutat Trough is 5,542 t (Table 12), approximately the same amount that was seen in 2013. The relative estimation error based on the 1-D geostatistical analysis of the acoustic backscattering was 17.6%.

Pollock Biomass by Management Area

The survey areas outlined above do not necessarily follow the boundaries of the North Pacific Fishery Management Council (NPFMC) management areas. Some areas, such as the expansive shelf survey, Mitrofania, and Shelikof Strait extend across multiple management areas. Because walleye pollock are managed by management area, we have also summarized the survey results based on these units. Table 29 presents the biomass of pollock within each management area, along with the geographic survey area from which they were derived, for all pollock and for age-3 fish (between ~30 and 45 cm FL).

The total walleye pollock biomass for the entire GOA summer acoustic-trawl survey was 1,606,171 t and spanned five different management areas. The relative estimation error of the overall biomass based on the 1-D geostatistical analysis was 7.8%. Overall, pollock were distributed fairly equally across areas 610, 620, and 630 with 27%, 30% and 39% in each area, respectively. However, unlike 2013 when the majority of pollock in the shelf survey area were detected in NPFMC management area 630, in 2015 approximately 37% of the walleye pollock biomass on the shelf was detected in the NPFMC management area 610, and approximately 38% were detected in management area 630 (Table 29). Roughly 20% of pollock on the shelf were detected in area 620 and only 5% were in area 640.

Approximately 79% of the total walleye pollock biomass in the entire GOA survey was attributed to age-3 fish (Table 29). NPFMC management area 649 had the lowest contribution of age-3 fish (4%) within which only 0.27% of the PWS biomass was age-3 pollock. Other areas with low percentages of age-3 pollock compared to the total biomass were Yakutat Trough (1%), Alitak/Deadman Bays (24%), and the Kenai Peninsula Bays (23%).

Multi-Year Survey Water Temperatures

The only areas that have been surveyed in all five summer GOA AT surveys 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 operations provide the only consistent means of comparing temperature among years in these places. Overall mean surface temperatures in 2015 were slightly lower compared to 2005 (Fig. 14, panel a) but not consistently in all areas (i.e., Barnabas Trough surface temperatures in 2015 were approximately 0.5° C higher than in any previous summer GOA AT survey, but temperatures in Chiniak and Shelikof in 2015 were slightly cooler than 2005 by 0.9° C and 0.4° C, respectively). Summer 2003 had the coolest average surface temperatures for all of these areas combined. Mean temperatures at 100 m depth in 2015 were the highest of the survey series (Fig. 14, panel b), but again, not consistently in all areas (i.e., 2015 temperatures at 100 m in Chiniak Trough were similar to 2005, Barnabas Trough was 0.6° C cooler than the high seen in 2005, and Shelikof was similar to the high for that area observed in 2003). The coolest mean temperatures at 100 m depth in all areas were recorded during the 2013 survey.

Non-pollock Backscatter

The GOA AT survey design is intended to encompass the geographic distribution of midwater 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. Because biennial summer acoustic trawl surveys of the Gulf of Alaska are planned, backscatter from these species is reported to establish a time series of relative abundances and distributions from the survey.

POP/Rockfish

Backscatter characterized as POP or other rockfishes based on trawl catches and backscatter morphology ("haystacks" on the bottom) was present throughout the shelf and in several of the bays (Figs. 15 and 16). Backscatter attributed to POP was primarily located on the outer shelf transects especially near the shelf break and in the Portlock Bank area. Aggregations typically extended from the seafloor to approximately 10 - 20 m off the seafloor and were localized and patchy. The frequency response was rather flat in that the response from all frequencies did not differ markedly from 38-kHz (cf. Fig. 4 in De Robertis et al. 2010). Several species of rockfishes were captured during trawl operations on the shelf with Pacific ocean perch, dusky rockfish, and northern rockfish comprising a total of 94.8% of the PNE catch by weight on the shelf, of which 88.6% were POP (Table 7). POP captured in trawl hauls ranged from 20 cm to 46 cm FL with a minor mode at 28 cm and a larger mode at 40 cm (Fig. 17). The majority of POP less than 33 cm FL were captured in two hauls (hauls 109 and 124). Backscatter attributed to POP made up 1.4% of the total backscatter for the entire survey, and backscatter designated as rockfish made up 0.7% of the entire backscatter from the survey. The biomass estimate for POP for the 2015 GOA survey area was 438,545 t, approximately 80% greater than the 2013 estimate. The relative estimation error of the biomass based on the 1-D geostatistical analysis was 12.3%.

Capelin

Unlike previous years no large aggregations of capelin were encountered during the GOA survey in 2015. Individuals were caught in trawls throughout the survey area but in insufficient enough quantities to designate any backscatter to capelin alone. The largest catch of capelin in a trawl was in the Shumagins Islands area in a near-bottom trawl (haul 28) that also caught age-1 pollock, Pacific herring, and eulachon. No abundance estimate for capelin was made.

Eulachon

Because eulachon lack swimbladders, they do not produce a very strong acoustic return (Gauthier and Horne 2004); therefore, they are generally only detected in our surveys when they are caught in trawls, Eulachon were caught in the largest numbers in the Kenai Peninsula Bays (hauls 163, 164, and 168) and Prince William Sound (hauls 173, 174 and 180), on the shelf near Kayak Island (hauls 192 and 195). Eulachon were not present in the Shumagins Islands and Shelikof Strait areas in large numbers as in 2013. The only place to the west of the Kenai Peninsula that eulachon were caught in large numbers was near Nakchamik Island (haul 77). No biomass estimate was calculated for eulachon.

Undifferentiated Surface Backscatter

A strong near-surface sound-scattering layer was prevalent throughout most of the summer GOA survey and it was particularly abundant on the shelf east of Prince William Sound and in Yakutat Trough (Fig. 18), unlike 2013 when the surface backscatter was most abundant on the shelf between the Shumagin Islands and Shelikof Strait. This sound scattering layer extended from the surface to over 200 m deep in some areas and comprised 54.7% of the total backscatter seen throughout the entire survey. The frequency response of this undifferentiated surface-associated backscatter was unlike that of capelin and rockfish/pollock and was also different from the typical response seen for euphausiids. Methot and Marinovich hauls in this layer were not effective at identifying the source of the backscatter, but catches did not contain abundant numbers of age-1+ pollock, rockfish, capelin, or eulachon.

Methot Hauls and Euphausiid Abundance

A total of 11 Methot hauls were conducted over the course of the 2 month survey. Of those, three were on the shelf, two were in the Shumagin Islands, and one each was conducted near Mitrofania Island, in the middle part of Shelikof Strait, in Marmot Bay, in Chiniak Trough, the PWS trough south of Montague Island, and Yakutat Trough. On average the Methot trawl was fished at a depth of 121 m below the surface and 72 m above the bottom. Catch composition (Table 30) by weight consisted primarily of euphausiids (69%; primarily consisting of *Thysanoessa inermis*, but also including *T. spinifera*, *T. raschii*, and *Euphausia pacifica*) and jellyfish (29%; mainly consisting of *Aequorea* sp.).

Backscatter attributed to euphausiids was found throughout the survey area, but it was patchy in distribution (Fig. 19). Areas of relatively high abundance included the Shelf transects (37% of backscatter), Shumagin Islands (20%), Shelikof Strait (19%), and Marmot Bay (9%). Of these survey areas, Shelikof Strait and the Shumagin Islands have exhibited high levels of euphausiid backscatter in previous surveys. Unlike previous years, Barnabas Trough and Chiniak Trough had relatively low levels of backscatter attributed to euphausiids in 2015. Though surveys since 2013 have covered the shelf from the Islands of Four Mountains to Yakutat, the index reported here is limited to areas that were consistently sampled in all years (Simonsen et al. 2016). There was a small decline in euphausiid backscatter from 2015 relative to 2013 (Fig. 19; see also Zador et al. 2015). Species composition from summer 2015 Methot trawls are to be reported elsewhere.

Additional Projects

Data collections in support of ongoing work that addresses rockfish assessment in untrawlable habitat on the GOA shelf were conducted during DY2015-06 (contact: Chris.Wilson@noaa.gov, 206-526-4163). Activities included surveying closely-spaced parallel transects within GOA bottom trawl survey grids which defined areas of untrawlable (n = 19) or trawlable (n = 19) bottom type. Data were collected from synchronized ME70 multibeam and EK60 echosounders with accompanying drop video camera deployments (n = 92) to record bottom type and assess abundance of rockfishes. Operations were conducted during nighttime hours and sampling operations for each grid cell took approximately 3 hours depending on the number of camera deployments at each site (2-3 each).

Acoustic measurements were also collected periodically using an MSI broadband echo sounding system (10 to 110 kHz) as well as 18, 38, 70, and 120 kHz Simrad EK80 wideband transceivers connected to the centerboard mounted transducers to evaluate the broadband frequency response of single species aggregations and methane bubbles emanating from the seafloor. Species targeted were pollock, POP, Pacific herring, myctophids, and euphausiids.

A lowered acoustic system for 38 kHz target-strength data collection on single species aggregations was deployed on a POP aggregation.

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). Whenever age-0 pollock were captured, a sample was frozen at -20° C for age and growth analysis (contact: Annette.Dougherty@noaa.gov, 206-526-6523). Tissue samples from several different fish species were collected for radio isotope analysis (contact: sam.c.wainright@uscga.edu, 860-444-8653). Results for these special projects are to be reported elsewhere.

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TABLES AND FIGURES

Table 1. -- Simrad EK60 38 kHz acoustic system description and settings used during the summer 2015 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.

		System settings	11 June Kalsin Bay Kodiak	13 Aug. Sea Otter Bay Yakutat	Final analysis parameters
Echosounder		Simrad ER60	--	--	Simrad ER60
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)		21.93	21.93	21.86	21.89
s_A correction (dB)		-0.60	-0.60	-0.58	-0.59
Integration gain (dB)		21.33	21.33	21.27	21.30
3 dB beamwidth	Along	6.87	6.87	6.78	6.83
	Athwart	7.28	7.28	7.19	7.24
Angle offset	Along	-0.05	-0.05	-0.06	-0.06
	Athwart	-0.07	-0.07	-0.03	-0.05
Post-processing S_v threshold (dB re 1 m^-1)		-70	--	--	--
Measured standard sphere TS (dB re 1 m^2)		--	-42.25	-42.39	--
Sphere range from transducer (m)		--	33.26	32.61	--
Absorption coefficient (dB/m)		0.0096	0.0096	0.0089	--
Sound velocity (m/s)		1476.0	1478.4	1487.9	--
Water temp at transducer (ºC)		--	8.3	12.3	--

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 2. -- Number of biological samples and measurements collected during the summer 2015 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
1	394	77	77	30	7						11/11
4	274	66	66	30							1/1
5	405	68	68	30	6						
9	297	60	60	31	5			2/2			1/1
10	480	63	63	30	5						
11	93	93	93	30	3						1/1
12	5	5	5	5	1	15/15					2/0
13	1	1	1			14/0					19/19
14	33	13	13	13							13/0
15	246	118	118	31							128/3
17	179	60	60	30	1	2/2	5/5				2/2
18	742	100	97	40	5	1/1		2/2			26/26
19	245	74	74	30		7/7		9/9			20/20
22	537	117	91	46	5	3/3	2/2	1/1			
23	284	65	65	20	1						
24	447	84	84	30	5						5/5
26	357	69	69	31	5						3/3
27	1										
28	110	110	53	30	2	8/8	4/4	8/8			5/5
29	315	60	60	30							1/1
30	280	60	40	30		9/9	12/12				8/8
35	304	46	46	30	5						2/2
36	3	3	3	3					6/0	2/2	167/75
37	27	27	27	27	2				27/27	22/22	23/23
42	406	67	67	38	3						
43	274	48	48	24	3						1/1
44	85	51	51	31					24/24		8/8
45	11	11	11	11	5				130/26	2/2	48/48
46	179	60	60	30	2						15/15
47	390	61	60	33	4		16/16				2/2
49	470	66	66	30	2						4/4
50	394	75	75	30	3						
51	254	36	36	6						2/2	1/1
57	432	62	62	30	5		4/4				6/6
60	474	60	60	30	5						2/2

Table 2. -- Cont.

Haul no.	Walleye pollock Lengths	Weights	Maturity	Otoliths	Ovaries	Capelin length/weight	Eulachon length/weight	Pacific herring length/weight	POP length/weight	Dusky rockfish length/weight	Other* length/weight
61	429	61	61	30	5			1/1			5/5
62	559	69	69	30	5						15/15
65	472	60	60	30	4			1/1			15/15
66											20/20
67	524	65	65	30	3						3/3
70	425	81	81	40	5			1/1			10/10
71	400	60	60	30	4						2/2
72	396	67	67	30	1						2/1
75	380	60	60	30	2			2/2			11/11
76	389	62	62	30	3						
77	493	78	61	44	7		11/11				25/25
78	340	61	61	30	1		10/10				2/2
79	2	2	2						184/25	1/1	25/25
82	6	6	6	6	2				82/0		10/10
83	329	56	56	30	2						3/3
84	311	60	60	30							5/5
85	119	54	49	36		1/1		10/10			28/28
86	383	61	61	30	5			13/12			38/37
87	555	51	51	30	6			2/2			10/10
88	323	60	60	30	1			1/1			6/6
89	370	60	60	22	1						2/2
90	452	32	32	32	2				3/3		9/9
93	281	62	60	32	2	4/4		1/1			2/2
94	340	40	40	20				3/3			1/1
95											19/19
96	357	50	50	25							11/11
97	109	20	20	20	2				148/22		6/6
98	264	43	43	20							15/15
101	355	61	61	30							23/22
102	355	60	60	30							7/7
103	295	42	41	25							11/11
104	393	49	49	30	6						18/18
109	1	1	1						287/46	1/1	4/4
110	446	61	61	25					114/40		11/11
112	162	60	60	30	1						15/15

Table 2. -- Cont.

Haul no.	Walleye pollock Lengths	Walleye pollock Weights	Walleye pollock Maturity	Walleye pollock Otoliths	Walleye pollock Ovaries	Capelin length/weight	Eulachon length/weight	Pacific herring length/weight	POP length/weight	Dusky rockfish length/weight	Other* length/weight
113	502	61	61	30	1						12/12
114											5/5
115	371	43	41	15				1/1			18/18
120											5/5
121									220/27		15/15
124	1	1	1						363/59	50/27	7/7
125	339	38	38	20			10/10				3/3
130	7	7	7	7					1/1		4/4
131	309	60	60	30					2/2		6/6
137											2/2
138	5	2	2	2			1/1		161/26	18/10	77/47
139	479	50	50	30							29/28
140	401	41	41	31	5	5/5	9/9				52/52
143	608	141	135	55	5	10/10	10/10	6/6			23/23
149	406	54	50	20	1		35/10		11/11	1/1	4/4
150	1	1							38/10	4/4	2/2
151	49	49	49	30	9			2/2	98/33	16/16	14/14
155	36	36	36	36	3			2/2	134/33	57/14	8/8
156	2	2						16/16	27/27	20/20	31/31
157	59	44	44	28	11	20/20					40/40
158	643	98	95	50						2/2	17/17
163	394	99	86	46	7	36/10	34/10	5/5			46/24
164	580	75	63	40	14	9/9	10/10	5/5	1/1		25/25
166	235	34	34	30	6				134/28		9/9
168	161	61	61	40			10/10				50/29
170	27	27	27	27	2		1/1	1/1			39/30
172	103	61	61	30	1						49/49
173	464	64	62	42	3		11/11	1/1			22/22
174	517	70	70	30	2		11/11	10/10			12/11
179											12/12
180	74	74	74	30	1	10/10	12/12	16/16			19/9
181	541	56	56	25					1/1		5/5
186	330	40	40	10	1		10/10		65/24		7/7
187	1	1	1			11/11		276/26	1/1		2/2
188	1					14/14	14/14				17/14

Table 2. -- Cont.

Haul no.	Walleye pollock Lengths	Walleye pollock Weights	Walleye pollock Maturity	Walleye pollock Otoliths	Walleye pollock Ovaries	Capelin length/weight	Eulachon length/weight	Pacific herring length/weight	POP length/weight	Dusky rockfish length/weight	Other* length/weight
191	377	51	51	20	1		41/10	2/2	4/4		2/2
192	565	44	38	14	2	20/11	10/10	1/1			9/9
193	273	40	40	10						1/1	5/5
195	478	59	59	30	2		10/10		13/13		32/32
196	420	40	40	9					102/46	61/31	15/15
199						40/10		249/25		1/1	18/18
200									143/37		7/7
201									1/1	5/5	28/16
205									259/25	3/3	
206											10/10
207	14	14	14	14	2		3/3		1/1		15/7
	30,216	5,389	5,206	2,618	239	239/160	306/226	650/175	2,785/624	269/165	1,730/1,391

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

Table 3. -- Average walleye pollock length (cm) at age (and sample size) for each area of the Gulf of Alaska shelf for four summer acoustic-trawl surveys. No age determinations are available for pollock captured in the 2005 summer GOA survey.

		Age															
Survey	**n**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**16+**
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**				
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**

Table 3. -- Cont.

Survey	n	Age 1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16+
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		**16.7**	**29.7**	**38.2**	**42.1**	**50.3**	**54.4**	**56.5**	**58.5**	**60.3**	**62.1**	**63.8**	**63.9**	**64.0**	**64.7**	**69.0**	**64.0**

Table 4. -- Average walleye pollock weight (kg) by age for each area of the Gulf of Alaska shelf for four summer acoustic-trawl surveys. No age determinations are available for pollock captured in the 2005 summer GOA survey.

		Age															
Survey	**n**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**16+**
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**				
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**

Table 4. -- Cont.

Survey	n	Age 1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16+
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**	**0.22**	**0.46**	**0.64**	**1.04**	**1.30**	**1.40**	**1.58**	**1.67**	**1.79**	**1.87**	**1.82**	**1.84**	**1.77**	**2.22**	**1.54**

Table 5. -- Trawl stations and catch data summary from the summer 2015 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	Shelf	AWT	16-Jun	5:30	10	52 ° 57.67	167 ° 56.95	100	118	5.9	9.5	869.0	1,601	7.4
2	Shelf	StereoDropCam	16-Jun	9:26	15	53 ° 0.88	167 ° 57.28	114	114		8.0	-	-	-
3	Shelf	StereoDropCam	16-Jun	10:47	15	52 ° 59.54	167 ° 54.84	108	108		8.4	-	-	-
4	Shelf	PNE	16-Jun	17:19	15	53 ° 9.02	167 ° 19.94	87	114	5.8	8.0	106.4	274	0.4
5	Shelf	AWT	17-Jun	4:05	12	53 ° 35.59	166 ° 7.14	79	99	6.4	8.3	285.7	714	-
6	Shelf	StereoDropCam	17-Jun	10:39	15	53 ° 45.97	165 ° 40.76	82	82		6.6	-	-	-
7	Shelf	StereoDropCam	17-Jun	11:36	12	53 ° 44.05	165 ° 43.97	88	88		7.1	-	-	-
8	Shelf	StereoDropCam	17-Jun	12:35	10	53 ° 44.87	165 ° 47.49	119	119		7.6	-	-	-
9	Shelf	PNE	17-Jun	16:14	22	54 ° 0.32	165 ° 41.70	67	73		8.0	113.4	297	151.3
10	Shelf	PNE	17-Jun	19:39	15	53 ° 42.59	165 ° 27.77	100	127	6.3	7.1	326.1	734	0.1
11	Shelf	PNE	18-Jun	2:11	5	53 ° 48.22	164 ° 45.55	102	106	5.8	8.9	48.9	93	0.8
12	Shelf	AWT	18-Jun	5:21	21	53 ° 59.49	164 ° 54.28	75	84	6.6	8.1	6.1	5	1.9
13	Shelf	Marinovich	18-Jun	9:12	20	53 ° 59.33	164 ° 54.08	57	85	6.3	7.8	0.4	1	1.7
14	Shelf	Marinovich	18-Jun	17:12	42	54 ° 9.29	164 ° 14.37	29	79	6.8	8.5	6.4	13	10.0
15	Shelf	AWT	19-Jun	3:11	16	54 ° 21.26	163 ° 37.12	97	112	5.5	10.4	2,532.9	4,240	7.1
16	Shelf	Methot	19-Jun	23:03	49	54 ° 25.63	162 ° 7.68	128	139	5.4	11.0	-	-	0.6
17	Sanak	AWT	20-Jun	7:55	16	54 ° 39.94	162 ° 35.10	118	141	5.5	8.5	50.9	179	150.5
18	Morzhovoi	AWT	20-Jun	20:17	10	54 ° 55.50	162 ° 59.53	107	112	5.7	9.1	809.9	2,210	22.9
19	Morzhovoi	Marinovich	21-Jun	0:24	36	54 ° 46.89	163 ° 15.39	68	79	6.0	8.5	132.2	234	23.2
20	Morzhovoi	StereoDropCam	21-Jun	5:58	16	54 ° 55.82	162 ° 59.74	107	107	5.7	9.1	-	-	-
21	Morzhovoi	StereoDropCam	21-Jun	6:53	15	54 ° 54.63	162 ° 57.58	116	116	5.7	8.9	-	-	-
22	Pavlof	AWT	21-Jun	19:28	41	55 ° 18.69	161 ° 43.49	113	123	5.7	10.2	375.7	1,237	0.2
23	Shumagins	AWT	22-Jun	4:29	16	55 ° 2.78	160 ° 25.35	76	155	6.1	10.3	511.7	1,202	-
24	Mitrofania	AWT	22-Jun	17:12	17	55 ° 45.69	159 ° 3.35	68	109	6.5	10.0	720.4	1,565	11.2
25	Mitrofania	Methot	22-Jun	20:52	35	55 ° 37.69	159 ° 11.58	77	87	6.0	10.7	-	-	8.5
26	Shumagins	AWT	23-Jun	16:56	10	55 ° 24.69	159 ° 49.63	67	98	5.8	9.8	612.4	1,427	6.7
27	Shumagins	Methot	23-Jun	21:23	30	55 ° 31.75	159 ° 54.75	105	176	5.7	11.5	-	-	8.6
28	Shumagins	AWT	24-Jun	0:29	16	55 ° 33.11	159 ° 52.42	158	158	5.5	11.1	37.7	110	17.7
29	Shumagins	AWT	24-Jun	7:25	46	55 ° 35.83	160 ° 3.50	61	161	6.0	10.3	440.9	802	1.9
30	Shumagins	AWT	25-Jun	0:23	41	55 ° 9.75	160 ° 15.47	186	195	5.7	8.6	103.7	280	7.4
31	Shumagins	Methot	25-Jun	3:16	21	55 ° 10.96	160 ° 16.86	96	200	5.7	9.0	-	-	5.1
32	Shumagins	StereoDropCam	25-Jun	5:21	15	55 ° 11.68	160 ° 15.28	192	192	5.6	9.1	-	-	-
33	Shumagins	StereoDropCam	25-Jun	6:02	21	55 ° 11.41	160 ° 17.03	113	113	5.6	9.2	-	-	-
34	Shumagins	StereoDropCam	25-Jun	6:56	16	55 ° 9.72	160 ° 13.53	59	59		8.5	-	-	-
35	Shelf	AWT	25-Jun	18:56	47	54 ° 24.68	161 ° 19.76	64	110	6.0	10.0	460.5	732	3.9
36	Shelf	PNE	25-Jun	22:20	19	54 ° 23.56	161 ° 18.54	97	101	5.8	10.2	4.1	3	1,129.1
37	Shelf	PNE	26-Jun	5:31	10	54 ° 19.38	160 ° 27.77	126	126	5.8	10.3	31.4	28	462.3

Table 5. -- 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)
38	Shelf	StereoDropCam	26-Jun	9:36	15	54 ° 21.72	160 ° 40.56	116	116	5.9	9.8	-	-	-
39	Shelf	StereoDropCam	26-Jun	10:27	15	54 ° 22.86	160 ° 38.20	112	112	5.9	9.8	-	-	-
40	Shelf	StereoDropCam	26-Jun	12:45	16	54 ° 27.66	160 ° 30.26	144	144	5.5	9.8	-	-	-
41	Shelf	StereoDropCam	26-Jun	13:27	15	54 ° 26.20	160 ° 31.92	130	130	5.7	9.9	-	-	-
42	Shelf	AWT	26-Jun	17:07	9	54 ° 46.08	160 ° 49.55	79	109	5.6	9.7	451.2	1,021	-
43	Shelf	AWT	27-Jun	0:41	27	54 ° 41.65	159 ° 57.93	70	78	6.2	9.6	705.4	1,646	1.7
44	Shelf	AWT	27-Jun	5:20	53	54 ° 23.46	159 ° 43.79	211	237	5.3	10.6	87.1	85	53.7
45	Shelf	PNE	27-Jun	17:53	21	54 ° 32.55	159 ° 4.45	151	152	5.9	10.3	10.1	11	217.7
46	Shelf	AWT	27-Jun	21:03	62	54 ° 32.47	159 ° 5.10	115	155	5.8	10.5	178.7	179	26.2
47	Shelf	AWT	28-Jun	5:38	8	55 ° 5.94	158 ° 43.41	145	198	6.1	11.1	261.2	1,110	2.9
48	Mitrofania	StereoDropCam	28-Jun	11:29	15	55 ° 38.22	158 ° 47.56	163	163	5.6	10.8	-	-	-
49	Shelf	AWT	28-Jun	15:21	10	55 ° 54.10	158 ° 35.81	80	108	6.7	10.0	1,292.0	3,194	6.3
50	Shelf	AWT	28-Jun	20:19	14	55 ° 31.79	158 ° 17.79	110	142	6.1	10.8	213.2	457	2.1
51	Shelf	AWT	29-Jun	3:20	30	55 ° 0.21	157 ° 49.12	82	86	6.8	10.8	346.6	976	3.3
52	Shelf	StereoDropCam	29-Jun	9:37	6	54 ° 54.52	157 ° 41.77	133	133	5.8	10.7	-	-	-
53	Shelf	StereoDropCam	29-Jun	10:14	15	54 ° 54.50	157 ° 41.53	125	125	5.8	10.8	-	-	-
54	Shelf	StereoDropCam	29-Jun	10:55	15	54 ° 54.35	157 ° 39.87	125	125	5.9	10.9	-	-	-
55	Shelf	StereoDropCam	29-Jun	12:57	15	54 ° 57.13	157 ° 41.49	107	107	6.5	9.9	-	-	-
56	Shelf	StereoDropCam	29-Jun	13:41	15	54 ° 58.89	157 ° 39.93	82	82	6.6	10.5	-	-	-
57	Shelikof	AWT	7-Jul	22:07	17	58 ° 28.57	152 ° 59.51	153	181	6.7	11.8	1,941.9	5,411	8.1
58	Shelikof	StereoDropCam	8-Jul	10:16	15	57 ° 55.59	153 ° 50.78	204	204		10.8	-	-	-
59[#]	Shelikof	StereoDropCam	8-Jul	11:49		57 ° 56.77	153 ° 46.75		186	9.9	10.3	-	-	-
60	Shelikof	AWT	8-Jul	14:41	13	57 ° 54.05	153 ° 53.60	92	217	6.7	11.0	815.0	2,782	4.4
61	Shelikof	AWT	8-Jul	22:25	6	57 ° 45.60	154 ° 18.62	134	203	6.4	11.2	827.5	2,759	3.8
62	Shelikof	AWT	9-Jul	6:00	14	57 ° 29.56	155 ° 9.75	115	243	7.7	11.3	620.1	2,053	17.0
63	Shelikof	StereoDropCam	9-Jul	10:28	15	57 ° 24.99	155 ° 14.93	246	246	5.6	11.3	-	-	-
64	Shelikof	StereoDropCam	9-Jul	11:34	15	57 ° 26.46	155 ° 11.37	242	242	5.6	11.1	-	-	-
65	Shelikof	AWT	9-Jul	16:58	13	57 ° 10.14	154 ° 55.31	70	137	8.5	11.3	1,407.7	5,354	1.0
66	Shelikof	Methot	9-Jul	23:09	26	57 ° 5.31	155 ° 50.68	117	292	6.1	12.3	-	-	3.3
67	Shelikof	AWT	10-Jul	3:25	1	56 ° 56.79	155 ° 6.03	97	173	6.1	13.1	687.0	2,398	7.2
68	Shelikof	StereoDropCam	10-Jul	10:33	16	56 ° 51.47	156 ° 14.18	188	188	5.8	12.1	-	-	-
69	Shelikof	StereoDropCam	10-Jul	11:23	15	56 ° 51.54	156 ° 12.65	196	196	5.8	12.4	-	-	-
70	Shelikof	AWT	10-Jul	15:18	5	56 ° 56.40	156 ° 24.58	85	111	8.8	12.1	1,038.2	2,008	7.1
71	Shelikof	AWT	10-Jul	19:09	28	56 ° 39.76	156 ° 23.63	117	202	6.2	12.2	1,359.8	4,002	1.2
72	Shelikof	AWT	11-Jul	2:12	4	56 ° 19.31	156 ° 0.16	170	218	6.0	14.8	1,355.8	4,347	5.2
73	Shelikof	StereoDropCam	11-Jul	9:57	16	56 ° 29.04	156 ° 44.76	135	135	5.9	12.6	-	-	-
74	Shelikof	StereoDropCam	11-Jul	10:41	13	56 ° 28.59	156 ° 49.22	96	96	6.2	12.9	-	-	-
75	Shelikof	AWT	11-Jul	17:02	4	56 ° 3.73	156 ° 2.73	146	211	6.1	12.5	1,198.8	3,890	13.2

Table 5. -- 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)
76	Shelikof	AWT	11-Jul	23:21	12	55 ° 57.09	156 ° 47.56	91	134	6.7	12.3	313.9	864	0.8
77	Nakchamik	AWT	12-Jul	8:31	21	56 ° 25.23	157 ° 58.29	170	151	6.0	11.2	1,162.9	2,516	30.2
78	Shelf	AWT	12-Jul	19:54	13	55 ° 28.93	157 ° 24.79	65	90	6.6	11.3	244.8	466	5.5
79	Shelf	PNE	13-Jul	4:30	16	55 ° 18.35	156 ° 27.47	153	153	6.0	11.2	5.6	4	3,441.4
80	Shelf	StereoDropCam	13-Jul	11:24	17	55 ° 18.98	156 ° 25.79	160	160	6.0	11.3	-	-	-
81	Shelf	StereoDropCam	13-Jul	12:26	15	55 ° 17.78	156 ° 27.24	157	157	6.1	11.2	-	-	-
82	Shelf	PNE	13-Jul	22:41	6	55 ° 25.88	155 ° 45.15	276	364	4.8	11.2	4.6	6	65.7
83	Shelf	AWT	14-Jul	10:31	16	56 ° 1.94	154 ° 42.68	163	193	6.1	12.0	209.7	408	1.5
84	Shelf	AWT	14-Jul	19:50	2	56 ° 6.68	153 ° 49.31	185	229	5.6	12.3	1,941.5	4,749	8.5
85	Alitak	AWT	15-Jul	8:29	21	56 ° 47.38	154 ° 19.71	49	58	10.2	12.6	92.4	113	26.2
86	Alitak	AWT	15-Jul	17:07	15	57 ° 1.42	153 ° 58.24	111	161	5.5	12.8	1,552.2	6,541	43.8
87	Alitak	AWT	16-Jul	0:08	5	56 ° 56.76	154 ° 3.18	100	133	5.3	11.9	428.7	1,457	29.0
88	Marmot	AWT	16-Jul	16:47	3	58 ° 2.64	151 ° 41.50	92	150	8.1	11.1	977.2	1,948	4.8
89	Marmot	AWT	16-Jul	21:28	6	57 ° 56.63	151 ° 57.26	134	198	7.0	11.1	1,273.2	3,010	0.9
90	Marmot	AWT	17-Jul	2:56	14	58 ° 3.24	152 ° 4.12	140	153	7.4	10.8	1,912.8	4,191	128.3
91	Marmot	StereoDropCam	17-Jul	10:49	16	58 ° 0.96	152 ° 16.24	105	105		9.8	-	-	-
92	Marmot	StereoDropCam	17-Jul	11:50	15	58 ° 2.19	152 ° 12.76	151	151		9.8	-	-	-
93	Marmot	AWT	17-Jul	16:31	42	58 ° 1.85	152 ° 22.99	128	248	7.9	10.7	414.0	634	3.2
94	Marmot	AWT	17-Jul	23:34	1	58 ° 0.11	152 ° 34.37	117	175	8.0	11.3	1,654.4	5,469	1.6
95	Marmot	Methot	18-Jul	1:58	15	58 ° 5.75	152 ° 28.85	108	143	8.5	11.3	-	-	1.2
96	Shelf	AWT	18-Jul	16:27	2	56 ° 32.59	152 ° 27.69	152	273	6.5	12.3	2,292.8	5,768	20.2
97	Barnabas	PNE	19-Jul	0:38	7	56 ° 46.46	152 ° 22.50	173	173	6.1	12.1	128.6	109	723.8
98	Barnabas	AWT	19-Jul	2:40	1	56 ° 45.17	152 ° 28.13	144	171		12.3	501.3	1,099	27.5
99	Barnabas	StereoDropCam	19-Jul	8:46	3	56 ° 53.29	152 ° 37.14	147	147		12.6	-	-	-
100[#]	Barnabas	StereoDropCam	19-Jul	9:30		56 ° 53.74	152 ° 40.93		127			-	-	-
101	Barnabas	AWT	19-Jul	17:27	2	56 ° 57.66	152 ° 30.67	140	155	6.2	12.9	620.8	1,404	6.4
102	Barnabas	AWT	19-Jul	21:28	4	56 ° 59.77	152 ° 51.78	123	127	6.4	13.3	1,853.8	3,943	6.2
103	Barnabas	AWT	20-Jul	2:52	2	57 ° 8.35	152 ° 41.37	137	155	6.7	13.3	253.2	438	9.5
104	Barnabas	PNE	20-Jul	5:20	5	57 ° 7.85	152 ° 43.59	149	149	6.1	13.0	459.5	417	18.0
105	Barnabas	StereoDropCam	20-Jul	8:29	15	57 ° 6.03	152 ° 47.44	143	143		12.5	-	-	-
106	Barnabas	StereoDropCam	20-Jul	9:15	16	57 ° 6.10	152 ° 51.18	76	76		12.0	-	-	-
107[#]	Barnabas	StereoDropCam	20-Jul	10:10		57 ° 5.91	152 ° 49.73		126		12.0	-	-	-
108	Barnabas	StereoDropCam	20-Jul	10:29	14	57 ° 5.96	152 ° 49.92	125	125		12.0	-	-	-
109	Shelf	PNE	20-Jul	23:06	8	57 ° 8.42	151 ° 25.73	124	128	6.7	12.1	2.4	2	2,220.6
110	Shelf	AWT	21-Jul	2:05	18	57 ° 6.35	151 ° 23.02	215	245	5.2	11.9	1,079.6	1,594	102.6
111[#]	Chiniak	AWT	21-Jul	7:52		57 ° 9.17	151 ° 16.38		133		11.2	-	-	-
112	Chiniak	AWT	21-Jul	15:33	22	57 ° 16.18	151 ° 19.00	155	158	6.7	11.5	68.9	162	31.0
113	Chiniak	AWT	21-Jul	20:43	5	57 ° 28.25	151 ° 28.13	146	164	7.3	11.2	231.6	501	6.8
114	Chiniak	Methot	21-Jul	23:48	12	57 ° 34.24	151 ° 33.13	105	109	7.5	11.1	-	-	5.5

Table 5. -- 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)
115	Chiniak	AWT	22-Jul	2:21	7	57 ° 34.00	151 ° 48.91	123	154	7.5	12.3	979.9	2,399	130.6
116	Chiniak	StereoDropCam	22-Jul	8:45	16	57 ° 42.54	152 ° 2.01	141	141		11.6	-	-	-
117	Chiniak	StereoDropCam	22-Jul	9:40	16	57 ° 41.88	152 ° 6.45	167	167		11.7	-	-	-
118	Chiniak	StereoDropCam	22-Jul	12:04	15	57 ° 47.89	152 ° 2.46	106	106		11.2	-	-	-
119	Chiniak	StereoDropCam	22-Jul	12:49	15	57 ° 47.53	152 ° 6.22	72	72		11.4	-	-	-
120	Shelf	Methot	22-Jul	23:40	23	57 ° 36.79	150 ° 6.18	136	316	5.8	12.6	-	-	11.4
121	Shelf	PNE	23-Jul	4:15	15	57 ° 54.46	150 ° 40.60	117	118	7.1	11.1	-	-	616.2
122	Shelf	StereoDropCam	23-Jul	9:56	16	58 ° 10.40	151 ° 36.90	81	81		9.1	-	-	-
123	Shelf	StereoDropCam	23-Jul	10:47	16	58 ° 8.97	151 ° 32.70	152	152		10.4	-	-	-
124	Shelf	PNE	24-Jul	0:47	10	58 ° 47.39	151 ° 13.96	136	136	6.5	12.0	6.4	5	5,993.6
125	Shelf	AWT	24-Jul	3:43	15	58 ° 43.18	151 ° 6.42	144	179	6.4	13.4	504.5	1,180	12.4
126	Shelf	StereoDropCam	24-Jul	9:13	15	58 ° 38.76	150 ° 28.63	202	202		13.6	-	-	-
127	Shelf	StereoDropCam	24-Jul	10:23	15	58 ° 37.85	150 ° 32.13	210	210		13.6	-	-	-
128	Shelf	StereoDropCam	24-Jul	13:00	15	58 ° 32.43	150 ° 33.16	138	138		13.1	-	-	-
129	Shelf	StereoDropCam	24-Jul	13:45	15	58 ° 32.34	150 ° 36.93	139	139		13.1	-	-	-
130	Shelf	PNE	24-Jul	18:44	1	58 ° 6.90	149 ° 59.49	198	270	5.6	11.5	3.2	7	4.8
131	Shelf	PNE	24-Jul	21:02	16	58 ° 6.80	149 ° 59.01	207	267		11.8	142.1	308	12.0
132[$]	Shelf	AWT	24-Jul	23:12	13	58 ° 7.44	150 ° 0.53	224	248		11.6	-	-	-
133	Shelf	StereoDropCam	29-Jul	8:47	10	58 ° 9.51	149 ° 19.50	118	118		14.1	-	-	-
134	Shelf	StereoDropCam	29-Jul	9:20	15	58 ° 9.72	149 ° 19.24	114	114	6.6	14.1	-	-	-
135	Shelf	StereoDropCam	29-Jul	10:09	15	58 ° 8.70	149 ° 20.97	120	120	6.5	14.2	-	-	-
136	Shelf	StereoDropCam	29-Jul	10:58	15	58 ° 10.11	149 ° 22.51	108	108	6.6	14.1	-	-	-
137	Shelf	PNE	29-Jul	16:28	19	58 ° 6.83	148 ° 50.32	172	182	5.7	14.9	-	-	5.8
138	Shelf	AWT	29-Jul	21:26	50	58 ° 28.90	149 ° 33.41	137	153	6.7	13.8	1.0	2	350.3
139	Kenai	AWT	30-Jul	6:27	5	59 ° 16.96	151 ° 10.43	73	222	8.3	14.8	1,137.1	4,884	49.7
140	Kenai	AWT	30-Jul	8:21	25	59 ° 16.31	151 ° 7.91	202	259	7.4	14.8	157.6	448	66.0
141	Shelf	StereoDropCam	30-Jul	12:24	15	59 ° 8.91	150 ° 51.68	89	89	7.5	15.0	-	-	-
142	Shelf	StereoDropCam	30-Jul	13:15	15	59 ° 8.94	150 ° 48.30	144	144	7.1	14.8	-	-	-
143	Kenai	AWT	30-Jul	22:11	27	59 ° 28.53	150 ° 25.15	174	223	6.7	14.8	169.1	777	34.2
144	Shelf	StereoDropCam	31-Jul	8:18	15	59 ° 9.54	149 ° 30.79	160	160		15.0	-	-	-
145	Shelf	StereoDropCam	31-Jul	9:09	15	59 ° 8.27	149 ° 29.17	167	167	5.7	15.0	-	-	-
146	Shelf	StereoDropCam	31-Jul	11:04	15	59 ° 5.19	149 ° 25.84	183	183	5.5	15.0	-	-	-
147	Shelf	StereoDropCam	31-Jul	12:05	15	59 ° 7.39	149 ° 27.41	158	158	5.7	14.9	-	-	-
148	Shelf	StereoDropCam	31-Jul	13:17	15	59 ° 6.30	149 ° 24.15	161	161	5.7	15.0	-	-	-
149	Shelf	AWT	31-Jul	16:54	11	58 ° 57.87	149 ° 19.96	206	240	5.4	14.5	821.7	2,155	16.1
150	Shelf	PNE	31-Jul	22:11	13	58 ° 38.96	148 ° 45.93	167	167	5.5	15.4	-	1	57.2
151	Shelf	PNE	1-Aug	2:16	14	58 ° 30.68	148 ° 29.79	244	365	5.1	15.2	26.7	49	189.5
152	Shelf	StereoDropCam	1-Aug	8:38	15	59 ° 4.31	148 ° 4.80	140	140	5.8	15.9	-	-	-
153	Shelf	StereoDropCam	1-Aug	9:27	15	59 ° 2.53	148 ° 6.54	137	137		15.4	-	-	-

Table 5. -- Cont.

Haul no.	area	Gear[a] type	Date (GMT)	Time (GMT)	Duration (minutes)	Start position Lat. (N)	Long. (W)	Depth (m) gear	bottom	Temp. (°C) gear[b]	surface[c]	Walleye pollock (kg)	number	Other (kg)
154	Shelf	StereoDropCam	1-Aug	12:26	15	59 ° 3.93	148 ° 1.45	139	139	5.7	15.7	-	-	-
155	Shelf	AWT	1-Aug	16:05	12	59 ° 2.43	148 ° 21.40	170	213	5.9	14.6	33.8	36	699.9
156	Shelf	AWT	1-Aug	22:35	19	59 ° 33.41	149 ° 23.57	143	156	6.5	16.7	-	2	89.0
157	Kenai	PNE	2-Aug	3:22	15	59 ° 40.07	149 ° 53.89	203	208	6.2	15.3	37.6	44	162.8
158	Kenai	AWT	2-Aug	5:36	1	59 ° 37.29	149 ° 54.11	123	215		16.5	293.4	2,021	15.2
159	Kenai	StereoDropCam	2-Aug	9:17	15	59 ° 31.29	149 ° 48.91	197	197	6.2	16.2	-	-	-
160	Kenai	StereoDropCam	2-Aug	10:17	15	59 ° 31.77	149 ° 52.18	190	190	6.1	16.1	-	-	-
161	Kenai	StereoDropCam	2-Aug	12:58	15	59 ° 32.84	149 ° 45.43	174	174		16.3	-	-	-
162	Kenai	StereoDropCam	2-Aug	13:45	15	59 ° 33.47	149 ° 43.86	154	154	6.2	16.0	-	-	-
163	Kenai	AWT	2-Aug	18:04	16	59 ° 39.32	149 ° 41.62	246	285	6.0	15.3	454.0	736	56.5
164	Kenai	AWT	3-Aug	6:16	15	60 ° 0.40	149 ° 8.47	176	191	6.2	16.0	368.4	1,246	75.9
165[#]	Shelf	StereoDropCam	3-Aug			59 ° 49.16	148 ° 52.75	180	180	6.3				-
166	Shelf	AWT	4-Aug	4:36	8	59 ° 11.78	147 ° 30.70	206	276		15.0	313.2	359	1,171.4
167[#]	Shelf	StereoDropCam	4-Aug	11:47		59 ° 45.46	148 ° 22.52	132	132		14.9	-	-	-
168	Kenai	AWT	5-Aug	2:58	17	60 ° 3.92	147 ° 43.06	235	263	6.1	16.3	186.2	161	33.0
169*[$]	Kenai	AWT	5-Aug	10:15	47	60 ° 15.79	148 ° 7.87	50	449	7.8	11.8	-	-	-
170	PWS	AWT	5-Aug	22:37	51	60 ° 48.26	147 ° 24.68	291	462	6.1	16.5	36.5	27	15.5
171*[$]	PWS	AWT	6-Aug	9:18	24	60 ° 43.99	147 ° 9.62	61	384	6.9	16.4	-	-	-
172	PWS	AWT	6-Aug	19:26	46	60 ° 29.12	146 ° 58.56	279	389	6.1	17.5	129.4	103	19.6
173	PWS	AWT	7-Aug	2:31	17	60 ° 7.29	147 ° 1.80	235	279	6.4	16.5	338.6	628	47.9
174	PWS	AWT	7-Aug	6:06	12	60 ° 0.43	147 ° 13.36	121	176	7.1	15.8	368.2	937	67.7
175	PWS	StereoDropCam	7-Aug	9:30	15	59 ° 55.25	147 ° 10.08	204	204	5.9	16.1	-	-	-
176	PWS	StereoDropCam	7-Aug	10:15	15	59 ° 55.85	147 ° 11.85	170	170	6.4	15.9	-	-	-
177	PWS	StereoDropCam	7-Aug	11:18	15	59 ° 54.47	147 ° 13.45	116	116	6.9	16.0	-	-	-
178*[$]	PWS	AWT	7-Aug	12:35		59 ° 55.24	147 ° 11.06	62	196	8.2	15.9	-	-	-
179	PWS	Methot	7-Aug	17:24	22	59 ° 45.16	147 ° 12.72	139	161	6.7	15.8	-	-	4.1
180	PWS	AWT	7-Aug	23:23	54	59 ° 37.07	147 ° 12.74	192	199	5.9	15.5^	24.2	74	119.0
181	PWS	AWT	8-Aug	5:18	10	59 ° 21.14	147 ° 2.87	156	190	6.6	16.3	369.7	845	24.4
182	Shelf	StereoDropCam	8-Aug	8:15	13	59 ° 20.21	146 ° 47.05	173	173	5.8	15.5	-	-	-
183	Shelf	StereoDropCam	8-Aug	9:18	15	59 ° 21.59	146 ° 45.34	149	149	6.6	15.9	-	-	-
184	Shelf	StereoDropCam	8-Aug	12:12	15	59 ° 19.66	146 ° 43.81	167	167	6.0	15.3	-	-	-
185	Shelf	StereoDropCam	8-Aug	13:03	18	59 ° 20.04	146 ° 42.35	163	163	5.9	15.6	-	-	-
186	Shelf	AWT	8-Aug	15:59	14	59 ° 15.78	146 ° 43.51	180	199	6.1	15.6	151.3	330	67.0
187	Shelf	AWT	8-Aug	19:45	12	59 ° 33.13	146 ° 42.26	112	121	7.8	15.8	1.6	2	2,085.5
188	Shelf	AWT	9-Aug	7:20	13	59 ° 54.36	145 ° 54.13	86	96	7.7	16.1	-	-	18.8
189	Shelf	StereoDropCam	9-Aug	11:02	15	59 ° 45.82	145 ° 40.93	107	107	6.9	16.3	-	-	-
190	Shelf	StereoDropCam	9-Aug	12:33	15	59 ° 47.35	145 ° 42.60	108	108	7.2	16.1	-	-	-
191	Shelf	AWT	9-Aug	16:57	7	59 ° 29.37	145 ° 53.44	168	212	6.3	16.0	2,021.8	4,437	19.2
192	Shelf	AWT	10-Aug	1:06	16	59 ° 52.17	145 ° 3.71	168	185	6.4	16.3	126.5	563	30.1

Table 5. -- 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)
193	Shelf	AWT	10-Aug	15:46	1	59 ° 37.92	144 ° 14.94	189	247	6.1	15.5	117.6	273	20.0
194	Shelf	Methot	10-Aug	22:43	18	59 ° 41.90	143 ° 25.00	147	304	6.2	15.9	-	-	-
195	Shelf	AWT	11-Aug	0:56	18	59 ° 43.85	143 ° 25.28	286	310	5.0	16.0	207.3	478	116.6
196	Shelf	AWT	11-Aug	3:58	12	59 ° 35.17	143 ° 25.16	211	235	5.7	15.7	1,151.5	2,580	481.5
197	Shelf	StereoDropCam	11-Aug	11:15	15	59 ° 28.23	142 ° 9.57	189	189	5.8	16.0	-	-	-
198	Shelf	StereoDropCam	11-Aug	12:48	15	59 ° 29.06	142 ° 11.22	188	188	5.9	16.0	-	-	-
199	Shelf	AWT	11-Aug	22:19	45	59 ° 37.51	141 ° 45.94	132	140	7.0	16.3	-	-	259.7
200	Shelf	AWT	12-Aug	3:37	6	59 ° 12.05	141 ° 46.96	259	447	5.4	16.3	-	-	712.9
201	Shelf	PNE	12-Aug	5:35	21	59 ° 17.48	141 ° 46.29	190	197	5.9	16.4	-	-	-
202	Yakutat	StereoDropCam	12-Aug	9:00	18	59 ° 22.67	141 ° 32.90	186	186	6.1	16.1	-	-	-
203	Yakutat	StereoDropCam	12-Aug	9:49	16	59 ° 24.18	141 ° 34.61	185	185		16.1	-	-	-
204	Yakutat	StereoDropCam	12-Aug	11:35	15	59 ° 24.62	141 ° 36.28	182	182	6.1	16.3	-	-	-
205	Yakutat	AWT	12-Aug	15:49	2	59 ° 16.68	141 ° 31.79	235	316	5.7	16.3	-	-	614.6
206	Yakutat	Methot	12-Aug	18:44	20	59 ° 6.60	141 ° 3.76	174	195	6.1	16.2	-	-	8.9
207	Yakutat	AWT	13-Aug	1:31	6	59 ° 22.66	141 ° 8.70	285	295	5.5	16.6	13.9	14	8.6
208	Yakutat	StereoDropCam	13-Aug	6:45	19	59 ° 15.57	140 ° 59.98	174	174	6.2	16.5	-	-	-
209	Yakutat	StereoDropCam	13-Aug	7:43	15	59 ° 13.85	140 ° 59.87	175	175	6.0	16.5	-	-	-
210	Yakutat	StereoDropCam	13-Aug	8:33	15	59 ° 14.30	140 ° 58.11	178	178	6.1	16.5	-	-	-
211	Yakutat	StereoDropCam	13-Aug	9:24	15	59 ° 15.10	141 ° 1.49	172	172	6.1	16.5	-	-	-
212	Shelf	StereoDropCam	14-Aug	10:53	15	59 ° 5.55	140 ° 34.95	150	150	6.6	15.2^	-	-	-
213	Shelf	StereoDropCam	14-Aug	11:39	16	59 ° 7.29	140 ° 33.40	141	141	6.6	15.2^	-	-	-
214	Shelf	StereoDropCam	15-Aug	22:38	15	58 ° 24.54	148 ° 42.98	127	127	6.2	13.8^	-	-	-
215	Shelf	StereoDropCam	15-Aug	23:19	15	58 ° 24.68	148 ° 41.23	129	129	6.0	13.8^	-	-	-
216	Shelf	StereoDropCam	16-Aug	1:51	16	58 ° 17.22	148 ° 46.30	133	133	5.6	13.6^	-	-	-
217	Shelf	StereoDropCam	16-Aug	2:45	13	58 ° 18.72	148 ° 46.38	129	129	6.0	13.6^	-	-	-
218	Shelf	StereoDropCam	16-Aug	5:24	15	58 ° 14.30	149 ° 1.24	127	127	6.4	14.0^	-	-	-
219	Shelf	StereoDropCam	16-Aug	6:02	16	58 ° 15.26	148 ° 59.48	125	125	6.3	13.9^	-	-	-

[a]AWT = Aleutian wing trawl, PNE = Poly nor'eastern bottom trawl, Methot = Methot trawl, StereoDropCam = camera drop on un/trawlable areas to verify bottom type determined using ME70.

[b]Temperature from SBE26 placed on headrope of trawls and on camera frame for stereo drop cam.

[c]shipboard sensor at 1.4 m depth.

^ temperature from SBE26

* Experimental gear trawl.

$ Fished with open codend and CameraTrawl (no camera on haul 178).

Gear malfunction, haul aborted

Table 6. -- Summary of catch by species in 34 Aleutian wing trawls, two Marinovich trawls, and nine Poly Nor'eastern trawls conducted in midwater during the summer 2015 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*	19,638.9	74.1	43,146	55.4
Pacific ocean perch	*Sebastes alutus*	2,966.3	11.2	3,907	5.0
Pacific herring	*Clupea pallasi*	2,301.8	8.7	24,997	32.1
light dusky rockfish	*Sebastes ciliatus*	730.9	2.8	412	0.5
chum salmon	*Oncorhynchus keta*	191.7	0.7	216	0.3
salmon shark	*Lamna ditropis*	150.0	0.6	1	<0.1
northern sea nettle	*Chrysaora melanaster*	120.2	0.5	122	0.2
fried egg jellyfish	*Phacellophora camtchatica*	64.7	0.2	22	<0.1
northern rockfish	*Sebastes polyspinis*	51.5	0.2	52	0.1
squid unident.	Cephalopoda (class)	46.2	0.2	1,134	1.5
chinook salmon	*Oncorhynchus tshawytscha*	37.4	0.1	23	<0.1
shortraker rockfish	*Sebastes borealis*	34.1	0.1	7	<0.1
Cyanea jellyfish unident.	*Cyanea* sp.	27.1	0.1	31	<0.1
eulachon	*Thaleichthys pacificus*	25.7	0.1	1,525	2.0
Pacific cod	*Gadus macrocephalus*	16.2	0.1	12	<0.1
lion's mane	*Cyanea capillata*	13.8	0.1	72	0.1
jellyfish unident.	Scyphozoa (class)	13.0	<0.1	50	0.1
redstripe rockfish	*Sebastes proriger*	9.9	<0.1	18	<0.1
magistrate armhook squid	*Berryteuthis magister*	8.9	<0.1	27	<0.1
arrowtooth flounder	*Atheresthes stomias*	8.7	<0.1	18	<0.1
lanternfish unident.	Myctophidae (family)	5.0	<0.1	561	0.7
Aequorea jellyfish unident.	*Aequorea* sp.	4.7	<0.1	17	<0.1
moon jellyfish	*Aurelia labiata*	4.1	<0.1	43	0.1
coho salmon	*Oncorhynchus kisutch*	3.2	<0.1	12	<0.1
Atka mackerel	*Pleurogrammus monopterygius*	2.7	<0.1	4	<0.1
flathead sole	*Hippoglossoides elassodon*	2.6	<0.1	1	<0.1
pink salmon	*Oncorhynchus gorbuscha*	1.7	<0.1	1	<0.1
capelin	*Mallotus villosus*	1.7	<0.1	417	0.5
Aurelia jellyfish unident.	*Aurelia* sp.	1.3	<0.1	4	<0.1
sablefish	*Anoplopoma fimbria*	0.4	<0.1	1	<0.1
comb jelly unident.	Ctenophora (phylum)	0.4	<0.1	22	<0.1
pandalid shrimp unident.	Pandalidae (family)	0.4	<0.1	156	0.2
lamprey unident.	Petromyzontidae (family)	0.1	<0.1	2	<0.1
isopod unident.	Isopoda (order)	0.1	<0.1	49	0.1
euphausiid unident.	Euphausiacea (order)	0.1	<0.1	734	0.9
snailfish unident.	Liparidae (family)	0.1	<0.1	3	<0.1
Pacific lamprey	*Lampetra tridentata*	<0.1	<0.1	1	<0.1
prowfish	*Zaprora silenus*	<0.1	<0.1	2	<0.1
Pacific sand lance	*Ammodytes hexapterus*	<0.1	<0.1	2	<0.1
fish larvae unident.	Chordata (phylum)	<0.1	<0.1	5	<0.1
tadpole sculpin	*Psychrolutes paradoxus*	<0.1	<0.1	1	<0.1
salps unident.	Thaliacea (class)	<0.1	<0.1	3	<0.1
rockfish unident.	*Sebastes* sp.	<0.1	<0.1	1	<0.1
eastern Pacific bobtail	*Rossia pacifica*	<0.1	<0.1	1	<0.1
flatfish larvae	Pleuronectiformes (order)	<0.1	<0.1	1	<0.1
snail unident.	Gastropoda (class)	<0.1	<0.1	9	<0.1
amphipod unident.	Amphipoda (order)	<0.1	<0.1	1	<0.1
		26,485.5		77,846.0	

Table 7. -- Summary of catch by species in nine Poly Nor'eastern bottom trawls conducted during the summer 2015 walleye pollock acoustic-trawl survey of the Gulf of Alaska shelf.

		Weight		Number	
Common name	Scientific name	kg.	Percent	Nos.	Percent
Pacific ocean perch	*Sebastes alutus*	11,967.6	84.0	22,268	90.2
northern rockfish	*Sebastes polyspinis*	1,059.3	7.4	1,030	4.2
light dusky rockfish	*Sebastes ciliatus*	483.7	3.4	296	1.2
arrowtooth flounder	*Atheresthes stomias*	327.8	2.3	424	1.7
Pacific cod	*Gadus macrocephalus*	134.0	0.9	143	0.6
walleye pollock	*Gadus chalcogrammus*	109.0	0.8	147	0.6
rex sole	*Glyptocephalus zachirus*	26.1	0.2	54	0.2
octopus unident.	*Cephalopoda (class)*	25.1	0.2	4	<0.1
chum salmon	Oncorhynchus keta	25.1	0.2	10	<0.1
fried egg jelly	*Phacellophora camtchatica*	21.4	0.2	2	<0.1
jellyfish unident.	*Scyphozoa (class)*	11.2	0.1	11	<0.1
Pacific halibut	Hippoglossus stenolepis	11.0	0.1	4	<0.1
Atka mackerel	*Pleurogrammus monopterygius*	9.9	0.1	10	<0.1
northern sea nettle	*Chrysaora melanaster*	6.0	<0.1	11	<0.1
sponge unident.	*Porifera (Phylum)*	4.9	<0.1		-
Dover sole	Microstomus pacificus	3.2	<0.1	2	<0.1
rock sole sp.	*Lepidopsetta sp.*	2.9	<0.1	3	<0.1
sea cucumber unident.	Holothuroidea (class)	2.2	<0.1	75	0.3
black rockfish	Sebastes melanops	2.1	<0.1	2	<0.1
yellow Irish lord	*Hemilepidotus jordani*	2.1	<0.1	2	<0.1
sea potato	*Styela rustica*	2.0	<0.1	56	0.2
yelloweye rockfish	*Sebastes ruberrimus*	1.5	<0.1	2	<0.1
silvergray rockfish	*Sebastes brevispinis*	1.5	<0.1	2	<0.1
starfish unident.	*Asteroidea (class)*	1.4	<0.1	33	0.1
shortspine thornyhead	Sebastolobus alascanus	1.2	<0.1	1	<0.1
flathead sole	*Hippoglossoides elassodon*	1.2	<0.1	3	<0.1
kelp greenling	*Hexagrammos decagrammus*	1.1	<0.1	1	<0.1
Cyanea jellyfish unident.	*Cyanea sp.*	1.1	<0.1	1	<0.1
sea urchin unident.	Echinoidea (class)	0.7	<0.1	15	0.1
snail unident.	*Gastropoda (class)*	0.6	<0.1	17	0.1
butter sole	Isopsetta isolepis	0.4	<0.1	1	<0.1
Aequorea jellyfish unident.	*Aequorea sp.*	0.4	<0.1	2	<0.1
Pacific lyre crab	Hyas lyratus	0.1	<0.1	2	<0.1
hermit sponge	*Suberites ficus*	0.1	<0.1	2	<0.1
shrimp unident.	*Decapoda (order)*	<0.1	<0.1	21	0.1
comb jelly unident.	*Ctenophora (phylum)*	<0.1	<0.1	3	<0.1
scallop unident.	*Pectinidae (family)*	<0.1	<0.1	3	<0.1
skate egg case unident.	Rajidae (family)	<0.1	<0.1	2	<0.1
flatworm unident.	Platyhelminthes (phylum)	<0.1	<0.1	2	<0.1
lampshells unident.	Brachiopoda (phylum)	<0.1	<0.1	3	<0.1
poacher unident.	Agonidae (family)	<0.1	<0.1	1	<0.1
isopod unident.	Isopoda (order)	<0.1	<0.1	3	<0.1
		14,248.0		24,674	

Table 8. -- Number-at-length estimates (millions) by area from acoustic-trawl surveys of walleye pollock during the 2015 summer GOA survey.

Length	Shelf	Sanak	Morzhovoi	Pavlof	Shumagins	Mitrofania	Nakchamik	Shelikof	Alitak/ Deadman	Chiniak	Barnabas	Marmot	Izhut	Kenai	PWS	Yakutat	Total
10	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
11	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
12	-	-	-	-	0.01	-	-	-	-	-	-	-	-	-	-	-	0.01
13	-	-	-	-	0.14	-	-	-	-	-	-	-	-	-	-	-	0.14
14	-	-	-	-	0.33	-	0.01	-	-	-	-	-	-	-	-	-	0.34
15	0.04	-	0.02	-	0.32	-	0.01	-	-	-	-	-	-	0.03	-	-	0.42
16	-	-	0.01	0.01	0.16	-	0.03	-	-	0.01	-	-	-	0.16	-	-	0.39
17	0.09	-	0.03	0.08	0.11	-	0.05	-	-	-	-	-	-	0.36	-	-	0.72
18	0.13	-	0.04	0.08	0.08	-	0.02	-	0.11	0.01	-	0.03	<0.01	0.80	-	-	1.30
19	0.57	-	-	0.08	0.02	-	0.02	-	0.05	-	-	0.03	<0.01	0.91	0.01	<0.01	1.71
20	0.53	-	-	0.07	<0.01	-	0.01	-	0.11	-	-	-	-	0.53	0.01	-	1.25
21	0.22	-	-	0.03	-	-	-	-	-	0.09	-	-	-	0.23	-	-	0.56
22	0.40	-	-	0.01	-	-	0.04	-	-	0.07	-	-	-	0.23	-	-	0.76
23	1.25	-	-	0.02	-	-	-	-	0.03	-	-	-	-	0.59	-	-	1.88
24	2.00	-	-	-	-	-	-	0.59	0.11	-	-	-	-	1.43	-	-	4.13
25	5.87	-	-	-	-	-	0.17	0.22	0.35	-	-	-	-	1.67	-	-	8.28
26	8.84	-	0.01	0.03	0.03	-	0.46	0.60	0.70	-	-	-	-	1.56	0.06	-	12.29
27	6.28	0.11	0.02	0.05	0.10	0.08	1.20	0.86	1.01	-	-	0.06	<0.01	1.11	-	-	10.88
28	6.79	0.06	0.11	0.10	0.13		1.78	2.62	0.64	0.07	0.15	0.30	<0.01	0.89	0.01	-	13.65
29	8.22	0.45	0.14	0.24	0.23	0.15	1.86	7.31	0.47	-	0.01	1.64	0.01	0.76	0.08	-	21.58
30	10.79	0.79	0.34	0.75	0.10	0.15	1.66	21.19	0.22	0.22	0.03	3.76	0.03	0.75	0.08	-	40.85
31	23.57	1.30	0.55	0.89	0.23	0.38	1.16	60.70	0.17	0.39	0.31	6.23	0.05	0.58	0.54	-	97.04
32	45.48	1.13	0.39	1.31	0.45	0.75	0.70	114.79	0.28	1.43	0.89	7.34	0.06	0.49	0.58	-	176.09
33	80.51	1.02	0.43	1.16	0.70	0.68	0.50	157.26	0.60	2.83	4.01	5.71	0.05	0.59	0.99	<0.01	257.04
34	122.89	1.02	0.26	0.56	0.96	0.98	0.50	156.84	0.76	4.77	6.06	4.59	0.04	0.46	1.25	<0.01	301.92
35	175.78	1.08	0.36	0.49	1.65	1.36	0.25	115.30	0.92	7.64	11.45	3.70	0.03	0.34	2.18	<0.01	322.52
36	239.43	0.96	0.43	0.46	2.50	1.28	0.33	76.51	0.75	11.78	17.33	4.93	0.04	0.35	2.13	<0.01	359.23
37	298.58	0.85	0.77	0.61	4.15	3.09	0.17	47.37	0.43	13.83	19.56	7.61	0.06	0.28	2.84	<0.01	400.20
38	294.67	0.57	0.96	0.55	4.78	4.00	0.12	30.93	0.25	10.99	20.02	9.52	0.08	0.29	2.05	<0.01	379.79
39	279.81	0.23	1.05	0.46	4.71	5.50	0.54	22.25	0.09	10.59	21.00	11.31	0.09	0.20	1.55	<0.01	359.38
40	240.02	0.28	1.15	0.27	3.39	4.00	1.04	18.56	0.08	7.35	20.80	9.39	0.08	0.19	1.14	<0.01	307.75
41	152.31	0.11	0.70	0.14	2.25	3.62	0.91	12.61	0.08	4.00	21.31	7.62	0.06	0.15	0.86	<0.01	206.74
42	102.02	0.11	0.42	0.05	1.68	2.19	1.04	9.93	0.06	2.73	18.82	6.11	0.05	0.18	0.41	<0.01	145.81
43	67.04	-	0.46	0.02	0.51	1.43	1.24	4.97	0.08	1.17	9.84	3.92	0.03	0.20	0.37	<0.01	91.30

Table 8.--Continued.

Length	Shelf	Sanak	Morzhovoi	Pavlof	Shumagins	Mitrofania	Nakchamik	Shelikof	Alitak	Chiniak	Barnabas	Marmot	Izhut	Kenai	PWS	Yakutat	Total
44	37.67	0.06	0.39	0.01	0.30	0.53	0.79	3.06	0.18	0.41	6.78	1.73	0.01	0.17	0.15	<0.01	52.24
45	25.49	-	0.23	-	0.22	0.30	0.70	1.66	0.28	0.17	2.97	0.93	0.01	0.23	0.10	<0.01	33.32
46	19.01	-	0.20	-	0.18	0.08	0.25	2.61	0.56	0.06	0.51	0.39	<0.01	0.23	0.07	<0.01	24.16
47	12.11	-	0.17	-	0.07	-	0.17	2.41	0.23	-	1.21	0.07	<0.01	0.16	0.19	0.13	16.91
48	7.81	-	0.09	-	0.21	0.15	0.12	1.54	0.54	0.11	0.23	0.42	<0.01	0.29	0.21	0.13	11.86
49	10.47	-	0.10	-	0.08	0.10	0.04	1.31	0.80	0.06	0.33	0.21	<0.01	0.35	0.49	0.29	14.63
50	11.31	-	0.02	-	0.16	0.12	-	0.96	0.39	0.55	0.19	0.33	<0.01	0.31	0.55	0.39	15.26
51	10.71	-	0.04	-	0.07	-	0.04	1.24	0.32	0.34	0.36	0.27	<0.01	0.34	0.34	0.24	14.32
52	8.53	-	0.03	-	0.20	0.04	0.08	0.61	0.47	-	0.67	0.19	<0.01	0.35	0.47	0.36	12.01
53	5.42	-	0.02	-	0.04	0.04	0.04	0.42	0.16	0.06	0.21	0.37	<0.01	0.21	0.45	0.40	7.84
54	5.35	-	0.04	-	0.18	0.08	0.08	0.35	0.28	0.17	0.33	0.64	0.01	0.22	0.49	0.41	8.63
55	6.35	-	-	-	0.12	0.14	0.21	0.45	0.22	0.23	0.19	0.48	<0.01	0.21	0.50	0.40	9.50
56	6.41	-	-	-	0.13	0.06	0.12	0.47	0.07	0.06	0.19	0.32	<0.01	0.22	0.51	0.50	9.06
57	6.36	-	0.05	-	0.11	0.10	0.12	1.02	0.22	0.06	0.20	0.61	0.01	0.16	0.40	0.37	9.78
58	7.62	-	0.01	0.01	0.19	0.02	0.04	0.87	0.23	-	0.33	0.37	<0.01	0.10	0.33	0.27	10.39
59	4.06	-	0.07	-	0.12	0.06	0.12	0.86	0.11	0.07	0.37	0.25	<0.01	0.14	0.20	0.18	6.62
60	4.96	-	0.04	-	0.11	0.02	0.17	0.38	0.12	0.25	0.20	0.48	<0.01	0.09	0.18	0.18	7.18
61	1.88	-	0.02	0.01	0.14	0.04	0.21	-	0.07	0.06	0.20	0.12	<0.01	0.18	0.29	0.27	3.48
62	2.69	-	-	0.01	0.10	-	0.17	0.16	0.01	0.17	0.02	0.37	<0.01	0.08	0.14	0.14	4.05
63	0.19	-	-	-	0.05	0.02	0.08	0.03	0.01	-	0.01	0.07	<0.01	0.07	0.05	0.05	0.65
64	0.53	-	0.04	-	0.04	-	0.17	-	-	-	0.20	-	-	0.02	0.03	<0.01	1.06
65	1.00	-	-	-	-	-	0.08	0.03	-	-	<0.01	-	-	0.02	0.03	<0.01	1.18
66	0.83	-	0.01	0.01	0.01	0.02	0.08	-	-	-	0.01	0.05	<0.01	0.05	-	<0.01	1.07
67	-	-	-	-	-	-	0.08	-	0.06	-	-	0.07	<0.01	-	-	-	0.22
68	0.01	-	-	-	0.03	-	0.04	-	-	-	-	-	-	-	-	-	0.08
69	-	-	-	0.01	-	-	0.04	-	-	-	-	-	-	-	-	-	0.05
70	0.22	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.22
71	-	-	-	-	-	-	-	-	0.01	-	-	-	-	-	-	-	0.01
72	-	-	-	-	-	-	-	-	0.01	-	-	-	-	-	-	-	0.01
73	-	-	0.02	-	-	-	-	-	-	-	0.01	-	-	-	-	-	0.04
74	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
75	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
76	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
77	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
78	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
79	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
80	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Total	2,371.13	10.13	10.29	8.57	32.60	31.54	19.85	881.84	13.68	82.76	187.30	102.51	0.84	20.50	23.30	4.91	3,801.77

Table 9. -- Biomass-at-length estimates (metric tons) by area from acoustic-trawl surveys of walleye pollock during the 2015 GOA survey.

Length	Shelf	Sanak	Morzhovoi	Pavlof	Shumagins	Mitrofania	Nakchamik	Shelikof	Alitak/ Deadman	Chiniak	Barnabas	Marmot	Izhut	Kenai	PWS	Yakutat	Total
10	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
11	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
12	-	-	-	-	0.2	-	-	-	-	-	-	-	-	-	-	-	0.2
13	-	-	-	-	2.1	-	-	-	-	-	-	-	-	-	-	-	2.1
14	-	-	-	-	5.9	-	0.1	-	-	-	-	-	-	-	-	-	6.0
15	0.9	-	0.5	-	7.0	-	0.2	-	-	-	-	-	-	0.7	-	-	9.2
16	-	-	0.4	0.4	4.8	-	0.9	-	-	0.3	-	-	-	4.8	-	-	11.7
17	3.2	-	1.3	2.8	3.9	-	1.7	-	-	-	-	-	-	13.1	-	-	25.9
18	5.7	-	1.8	3.3	3.6	-	0.7	-	4.5	0.5	-	1.4	<0.1	34.5	-	-	56.0
19	29.8	-	-	4.3	1.0	-	0.8	-	2.7	-	-	1.7	<0.1	47.4	0.8	0.4	89.0
20	31.2	-	-	4.1	0.3	-	0.5	-	6.2	-	-	-	-	31.1	0.4	-	73.8
21	14.6	-	-	1.8	-	-	-	-	-	5.7	-	-	-	14.9	-	-	37.0
22	32.3	-	-	1.1	-	-	3.3	-	-	6.0	-	-	-	18.3	-	-	61.0
23	113.6	-	-	1.6	-	-	-	-	2.8	-	-	-	-	53.7	-	-	171.7
24	206.4	-	-	-	-	-	-	60.4	11.3	-	-	-	-	147.8	-	-	425.9
25	691.9	-	-	-	-	-	19.5	25.9	40.9	-	-	-	-	196.6	-	-	974.9
26	1,174.5	-	0.9	4.5	4.3	-	60.5	80.2	93.2	-	-	-	-	206.6	8.3	-	1,633.1
27	910.6	16.4	3.0	7.4	15.0	10.9	174.1	124.1	146.0	-	-	8.7	0.1	160.9	-	-	1,577.3
28	1,092.9	9.1	18.0	16.5	20.2	-	286.6	422.1	102.4	12.0	23.4	48.5	0.4	143.5	1.6	-	2,197.3
29	1,481.9	81.6	25.2	43.0	41.3	27.2	335.8	1,316.6	84.5	-	2.4	295.4	2.4	136.2	14.6	-	3,888.0
30	2,228.7	163.7	70.7	155.1	21.1	31.1	342.2	4,378.0	44.5	46.4	5.4	775.8	6.4	154.3	16.7	-	8,440.2
31	5,323.0	294.1	124.8	200.4	51.9	85.1	261.9	13,710.1	37.7	89.2	71.0	1,406.5	11.6	130.4	122.4	-	21,920.2
32	11,451.5	285.1	98.9	330.8	113.9	189.8	177.3	28,905.7	71.1	360.0	223.3	1,848.1	15.2	124.3	145.8	-	44,341.0
33	22,110.3	279.8	119.3	318.6	192.4	186.3	136.5	43,182.4	165.8	777.0	1,100.6	1,567.5	12.9	161.0	271.6	0.3	70,582.3
34	36,291.7	300.9	76.1	166.2	282.3	289.4	146.7	46,310.5	224.0	1,407.1	1,789.4	1,355.0	11.2	135.8	368.0	0.6	89,154.8
35	57,918.4	354.4	118.0	163.0	544.3	447.1	81.9	37,988.4	303.1	2,516.4	3,773.6	1,219.3	10.0	110.9	716.7	0.5	106,266.0
36	85,402.9	343.2	152.1	164.3	892.5	457.0	118.2	27,286.5	267.4	4,199.3	6,181.2	1,757.2	14.5	126.4	759.7	3.6	128,126.0
37	116,664.9	331.8	300.7	240.0	1,620.8	1,207.5	64.7	18,505.5	166.5	5,401.8	7,640.0	2,974.7	24.5	107.8	1,110.1	3.7	156,365.0
38	124,198.5	238.6	403.4	230.1	2,015.9	1,683.9	52.4	13,037.9	107.0	4,633.0	8,436.4	4,011.2	33.0	124.1	865.1	2.6	160,073.1
39	127,440.5	103.1	478.1	209.8	2,143.1	2,506.4	245.2	10,132.6	39.5	4,824.8	9,562.7	5,151.5	42.4	88.8	704.8	5.9	163,679.2
40	117,722.5	138.8	563.1	133.9	1,664.7	1,959.3	507.7	9,099.8	39.5	3,603.9	10,201.9	4,602.8	37.9	92.5	559.3	8.3	150,935.8
41	79,158.8	58.8	364.8	70.9	1,167.9	1,880.4	473.5	6,553.8	41.9	2,076.4	11,071.8	3,961.5	32.6	75.4	449.4	7.3	107,445.2
42	56,592.9	62.8	232.2	28.4	929.4	1,212.3	574.2	5,506.9	33.1	1,514.8	10,437.1	3,387.2	27.9	100.5	229.7	6.9	80,876.2
43	40,340.7	-	279.1	10.3	305.2	861.9	747.7	2,993.3	50.3	701.5	5,919.9	2,360.0	19.4	121.3	224.3	5.3	54,940.3

Table 9.-- Continued.

Length	Shelf	Sanak	Morzhovoi	Pavlof	Shumagins	Mitrofania	Nakchamik	Shelikof	Alitak/ Deadman	Chiniak	Barnabas	Marmot	Izhut	Kenai	PWS	Yakutat	Total
44	23,889.2	35.9	249.2	4.4	189.3	334.3	498.5	1,941.0	113.3	260.0	4,296.7	1,095.2	9.0	108.3	92.3	5.6	33,122.3
45	17,101.6	-	156.0	-	149.3	202.4	472.5	1,115.7	186.1	114.3	1,990.4	624.9	5.1	155.6	69.2	12.9	22,356.0
46	13,569.9	-	145.4	-	128.9	53.8	177.4	1,861.9	403.2	39.3	361.0	281.2	2.3	166.6	51.9	2.1	17,245.0
47	9,245.7	-	127.2	-	56.6	-	126.6	1,841.9	176.9	-	926.9	56.0	0.5	122.5	141.4	96.1	12,918.3
48	6,420.0	-	78.3	-	173.3	124.4	102.5	1,273.4	448.7	90.9	186.3	346.0	2.8	238.6	170.3	106.9	9,762.3
49	9,031.1	-	88.1	-	70.3	87.2	35.8	1,133.3	689.8	47.7	289.8	179.0	1.5	303.1	424.7	246.4	12,627.7
50	10,397.7	-	20.3	-	148.7	106.9	-	883.6	363.0	504.1	171.8	303.7	2.5	283.9	506.3	357.4	14,049.8
51	10,181.5	-	41.8	-	65.9	-	39.4	1,181.6	307.2	319.1	342.3	252.1	2.1	326.8	326.0	232.8	13,618.5
52	8,440.8	-	28.7	-	198.6	40.0	82.2	610.2	470.4	-	664.3	190.4	1.6	351.0	462.2	358.8	11,899.3
53	5,676.3	-	23.3	-	44.5	42.7	43.9	440.6	167.4	58.3	227.5	396.3	3.3	218.6	471.8	427.7	8,242.2
54	5,779.6	-	47.5	-	193.5	87.1	89.5	379.1	303.0	184.0	358.2	691.3	5.7	233.5	526.8	446.2	9,325.1
55	7,217.5	-	-	-	140.1	161.1	236.4	518.0	248.5	257.3	220.8	542.4	4.5	238.9	568.7	457.8	10,812.0
56	7,946.5	-	-	-	159.2	74.8	153.7	587.0	82.4	68.1	235.4	390.5	3.2	272.0	632.8	619.6	11,225.3
57	7,960.9	-	63.7	-	133.2	126.2	155.6	1,278.2	281.3	69.0	244.7	764.4	6.3	203.2	497.6	457.8	12,242.1
58	9,890.1	-	9.0	9.0	252.0	26.3	54.1	1,130.3	302.3	-	435.9	478.1	3.9	127.3	428.5	352.2	13,499.0
59	5,368.7	-	87.0	-	154.4	79.8	164.0	1,138.2	139.0	98.8	487.6	326.4	2.7	188.6	260.2	243.8	8,739.3
60	7,022.5	-	62.3	-	150.7	28.6	234.9	539.2	163.7	347.6	288.5	673.6	5.5	128.8	259.1	256.8	10,161.8
61	2,806.0	-	33.1	10.4	215.0	60.7	311.6	-	104.9	82.8	298.6	178.5	1.5	277.9	434.7	407.7	5,223.4
62	4,131.2	-	-	10.7	156.1	-	255.0	239.9	10.7	262.1	31.3	563.8	4.6	129.9	218.0	212.9	6,226.1
63	312.2	-	-	-	81.6	33.5	137.7	42.2	23.2	-	20.3	121.8	1.0	114.9	90.1	88.4	1,066.8
64	910.4	-	75.9	-	67.8	-	286.1	-	-	-	337.4	-	-	32.6	54.2	54.9	1,819.5
65	1,890.0	-	-	-	-	-	157.2	48.2	-	-	7.7	-	-	30.6	51.5	50.0	2,235.3
66	1,486.1	-	25.0	12.5	17.6	36.3	149.1	-	-	-	14.6	81.7	0.7	96.4	-	1.5	1,921.4
67	-	-	-	-	-	-	178.4	-	128.5	-	-	157.8	1.3	-	-	-	466.0
68	15.6	-	-	-	72.4	-	93.2	-	-	-	-	-	-	-	-	-	181.2
69	-	-	-	16.3	-	-	97.2	-	-	-	-	-	-	-	-	-	113.5
70	545.1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	545.1
71	-	-	-	-	-	-	-	-	25.8	-	-	-	-	-	-	-	25.8
72	-	-	-	-	-	-	-	-	18.5	-	-	-	-	-	-	-	18.5
73	-	-	60.9	-	-	-	-	-	-	-	36.5	-	-	-	-	-	97.4
74	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
75	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
76	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
77	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
78	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
79	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
80	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Total	1,065,871.1	3,098.2	4,855.0	2,575.8	15,074.1	14,741.9	9,147.5	287,804.2	7,244.0	34,979.7	88,914.5	45,429.0	374.0	7,213.1	13,307.6	5,541.7	1,606,171.3

Table 10. -- Number-at-age estimates (millions) by area from acoustic-trawl surveys of walleye pollock during the 2016 summer GOA survey.

Age	Shelf	Sanak	Morzhovoi	Pavlof	Shumagins	Mitrofania	Nakchamik	Shelikof	Alitak/ Deadman	Chiniak	Barnabas	Marmot	Izhut	Kenai	PWS	Yakutat	Total
1	1.74		0.11	0.33	1.18		0.13		0.25	0.09		0.06	<0.1	2.95	0.02	0.01	6.92
2	97.17	1.88	0.81	1.58	1.02	0.92	5.68	107.11	3.22	2.26	2.73	8.91	0.07	8.43	0.93	<0.1	242.67
3	2,032.73	8.13	7.77	6.55	26.77	27.77	10.18	748.50	5.07	75.55	164.99	82.85	0.68	5.01	15.89	0.10	3,218.56
4	102.25	0.10	0.62	0.08	1.34	1.45	0.94	12.17	1.28	2.50	10.02	3.92	0.03	0.81	1.12	0.46	139.10
5	65.26	0.02	0.52	0.01	0.72	0.71	0.96	6.86	1.43	0.92	6.14	2.41	0.02	1.04	1.37	0.93	89.32
6	29.91		0.19	0.01	0.49	0.29	0.45	3.15	1.13	0.56	1.38	1.37	0.01	0.89	1.42	1.13	42.40
7	13.05		0.07	0.01	0.33	0.13	0.33	1.23	0.46	0.26	0.63	0.85	0.01	0.45	0.82	0.70	19.35
8	13.15		0.09	<0.1	0.32	0.13	0.44	1.37	0.39	0.27	0.64	0.95	0.01	0.39	0.80	0.71	19.63
9	9.29		0.07	0.01	0.25	0.09	0.37	0.88	0.27	0.20	0.46	0.70	0.01	0.31	0.56	0.51	13.98
10	5.18		0.05	0.01	0.14	0.04	0.28	0.45	0.12	0.12	0.24	0.37	<0.1	0.15	0.28	0.26	7.73
11	0.59		0.01	<0.1	0.02	0.01	0.07	0.04	0.03	0.02	0.03	0.07	<0.1	0.02	0.04	0.04	0.95
12	0.81		<0.1	<0.1	0.02	<0.1	0.02	0.07	0.01	0.01	0.02	0.05	<0.1	0.02	0.05	0.05	1.14
Total	2,371.13	10.13	10.29	8.57	32.60	31.54	19.85	881.84	13.68	82.76	187.30	102.51	0.84	20.50	23.30	4.91	3,801.77

Table 11. -- Biomass-at-age estimates (metric tons) by area from acoustic-trawl surveys of walleye pollock during the 2016 summer GOA survey.

Age	Shelf	Sanak	Morzhovoi	Pavlof	Shumagins	Mitrofania	Nakchamik	Shelikof	Alitak/ Deadman	Chiniak	Barnabas	Marmot	Izhut	Kenai	PWS	Yakutat	Total
1	102.3		3.77	15.6	28.4		4.80		13.0	5.0		2.8	0.0	148.0	1.1	0.3	330.0
2	23,335.4	420.7	182.57	347.2	257.7	246.7	993.95	26,583.1	506.3	667.7	879.8	2,099.8	17.3	1,139.1	242.5	0.3	57,915.5
3	849,270.0	2,619.7	3,300.91	2,115.1	11,437.8	12,360.5	3,999.22	240,901.9	1,729.3	30,578.1	74,194.2	33,790.6	278.2	1,663.0	6,201.8	53.5	1,274,493.6
4	60,389.0	46.0	398.00	34.5	785.1	817.3	618.05	6,973.7	1,039.1	1,299.5	5,684.9	2,291.7	18.9	654.9	829.5	420.3	82,300.5
5	49,582.7	11.8	374.24	4.5	566.6	504.9	706.38	5,273.4	1,241.1	724.2	4,183.6	1,839.4	15.1	927.6	1,296.5	930.5	68,182.6
6	29,509.4		181.62	8.8	528.5	297.2	498.41	3,029.8	1,097.4	567.4	1,323.0	1,469.2	12.1	929.5	1,527.0	1,246.0	42,233.0
7	15,505.3		85.13	9.9	428.0	156.9	460.58	1,460.5	512.3	312.6	763.1	1,064.5	8.8	551.8	983.2	857.1	23,221.5
8	16,721.1		118.07	7.2	418.3	163.3	659.99	1,716.1	495.4	345.1	847.1	1,229.1	10.1	496.8	1,001.6	899.5	25,063.8
9	12,193.5		109.97	8.9	345.2	123.5	572.56	1,124.6	373.8	262.9	613.7	933.5	7.7	420.0	716.9	657.5	18,479.9
10	7,379.4		83.07	22.7	215.5	56.5	484.22	603.5	165.4	175.3	339.2	514.9	4.2	219.3	383.8	360.3	11,067.1
11	818.6		17.35	0.6	35.7	9.6	123.91	48.3	54.4	23.1	54.4	121.5	1.0	35.0	57.9	54.3	1,375.0
12	1,064.4		0.32	0.9	27.3	5.5	25.41	89.3	16.4	18.7	31.6	72.1	0.6	28.2	65.8	62.0	1,509.1
Total	1,065,871.1	3,098.2	4,855.0	2,575.8	15,074.1	14,741.9	9,147.5	287,804.2	7,244.0	34,979.7	88,914.5	45,429.0	374.0	7,213.1	13,307.6	5,541.7	1,606,171.3

Table 12. -- Pollock number (millions), biomass (thousands of metric tons), and relative estimation error by area for the summer 2003, 2005, 2011, 2013, and 2015 Gulf of Alaska acoustic trawl surveys. Shelf area estimated error value is for all shelf area transects combined.

	2003			2005			2011			2013			2015		
Area	Number	Biomass	est. error	Number	Biomass	est. error	Number	Biomass	est. error	Number	Biomass	est. error	Number	Biomass	est. error
Shumagin[a] Shelf	not surveyed			68.7	61.2		72.1	68.1		38.2	41.1		876.1	394.1	
Chirikof[b] Shelf	7.6	3.9	0.21	35.5	31.3	0.11	104.6	98.8	0.09	39.8	42.8	0.15	485.3	210.5	0.09
Kodiak[c] Shelf	484.7	53.1		24.5	21.9		37.7	35.6		820.2	150.7		869.0	404.0	
Eastern[d] Shelf	not surveyed			not surveyed			not surveyed			471.2	34.6		140.7	57.3	
Sanak Trough	not surveyed			not surveyed			1.1	1.0	0.11	1.3	0.9	0.23	10.1	3.1	0.11
Morzhovoi Bay	not surveyed			not surveyed			2.5	4.4	0.07	6.5	5.8	0.20	10.3	4.9	0.28
Pavlof Bay	not surveyed			not surveyed			5.1	2.9	0.08	45.1	2.2	0.18	8.6	2.6	0.17
Shumagin Islands	15.8	7.4	0.16	not surveyed			4.6	4.2	0.09	1,644.2	33.6	0.14	32.6	15.1	0.08
Mitrofania Island	<0.1	<0.1	[e]	not surveyed			4.3	4.0	0.13	132.4	2.5	0.24	31.5	14.7	0.13
Nakchamik Island	13.0	4.1	0.13	not surveyed			4.3	1.7	0.06	6.9	8.9	0.13	19.8	9.1	0.19
Shelikof Strait	693.8	151.3	0.09	1,291.2	81.6	[e]	1,624.8	156.9	0.06	4,671.3	423.0	0.06	881.8	287.8	0.06
Alitak/Deadman Bay	14.6	9.2	0.15	not surveyed			5.3	2.6	[e]	17.4	15.1	0.26	13.7	7.2	0.16/.06[f]
Chiniak Trough	29.0	14.0	0.11	12.9	15.1	0.14	35.6	38.4	0.07	25.7	24.5	0.07	82.8	35.0	0.06
Barnabas Trough	65.4	30.4	0.11	9.1	12.6	0.12	29.5	33.8	0.10	294.9	62.8	0.06	187.3	88.9	0.17
Marmot/Izhut Bay	17.2	8.3	0.18	not surveyed			not surveyed			104.7	9.0	0.07	103.4	45.8	0.14/0.16[f]
Amatuli Trench	78.7	23.1	[e]	not surveyed			not surveyed			included with shelf area			not surveyed		
Kenai Peninsula Bays	17.7	1.5	[e]	not surveyed			not surveyed			not surveyed			20.5	7.2	0.14[f]
Prince William Sound	29.9	14.7	0.14	not surveyed			not surveyed			199.5	16.1	0.09	23.3	13.3	0.08
Kayak Island Trough	not surveyed			not surveyed			not surveyed			8.8	5.2	0.15	included with shelf area		
Yakutat trough	not surveyed			not surveyed			not surveyed			101.4	5.4	0.13	4.9	5.5	0.18
Total	1,467.4	320.9		1,442.0	223.9		1,982.6	453.0		8,629.5	884.0	0.08	3,801.8	1,606.2	

[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

Table 13. -- Summary of catch by species in the Aleutian wing trawl conducted in midwater in Sanak Trough during the summer 2015 walleye pollock acoustic-trawl survey of the Gulf of Alaska shelf.

		Weight		Number	
Common name	Scientific name	kg	Percent	Nos.	Percent
salmon shark	*Lamna ditropis*	150.0	74.5	1	0.5
walleye pollock	*Gadus chalcogrammus*	50.9	25.3	179	90.9
eulachon	*Thaleichthys pacificus*	0.4	0.2	11	5.6
sturgeon poacher	*Podothecus acipenserinus*	0.1	0.1	2	1.0
capelin	*Mallotus villosus*	<0.1	<0.1	2	1.0
isopod unident.	Isopoda (order)	<0.1	<0.1	2	1.0
		201.4		197	

Table 14. -- Summary of catch by species in two Aleutian wing trawls conducted in midwater in Morzhovoi Bay during the summer 2015 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*	942.1	95.3	2,455	92.3
Pacific cod	*Gadus macrocephalus*	35.1	3.5	7	0.3
flathead sole	*Hippoglossoides elassodon*	6.7	0.7	16	0.6
starfish unident.	Asteroidea (class)	1.5	0.1	1	<0.1
arrowtooth flounder	*Atheresthes stomias*	0.9	0.1	1	<0.1
lion's mane	*Cyanea capillata*	0.8	0.1	34	1.3
Cyanea jellyfish unident.	*Cyanea* sp.	0.5	0.1	5	0.2
Pacific herring	*Clupea pallasi*	0.2	<0.1	11	0.4
jellyfish unident.	Scyphozoa (class)	0.2	<0.1	37	1.4
capelin	*Mallotus villosus*	0.1	<0.1	61	2.3
Pacific sand lance	*Ammodytes hexapterus*	<0.1	<0.1	9	0.3
eelpout unident.	Zoarcidae (family)	<0.1	<0.1	1	<0.1
shrimp unident.	Decapoda (order)	<0.1	<0.1	1	<0.1
hermit crab unident.	Paguridae (family)	<0.1	<0.1	1	<0.1
fish larvae unident.	Chordata (phylum)	<0.1	<0.1	5	0.2
sculpin unident.	Cottidae (family)	<0.1	<0.1	3	0.1
euphausiid unident.	Euphausiacea (order)	<0.1	<0.1	11	0.4
		988.3		2,659	

Table 15. -- Summary of catch by species in the Aleutian wing trawl conducted in midwater in Pavlof Bay during the summer 2015 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*	375.7	100.0	1,237	99.4
eulachon	*Thaleichthys pacificus*	0.1	<0.1	2	0.2
capelin	*Mallotus villosus*	0.1	<0.1	4	0.3
Pacific herring	*Clupea pallasi*	<0.1	<0.1	1	0.1
		375.8		1,244	

Table 16. -- Summary of catch by species in the five Aleutian wing trawls conducted in midwater in the Shumagins Islands during the summer 2015 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*	1,706.3	98.1	3,821	60.2
Pacific herring	*Clupea pallasi*	6.9	0.4	456	7.2
chinook salmon	*Oncorhynchus tshawytscha*	6.4	0.4	3	<0.1
capelin	*Mallotus villosus*	5.7	0.3	1,831	28.8
eulachon	*Thaleichthys pacificus*	3.6	0.2	177	2.8
chum salmon	*Oncorhynchus keta*	3.6	0.2	2	<0.1
arrowtooth flounder	*Atheresthes stomias*	3.3	0.2	7	0.1
Pacific cod	*Gadus macrocephalus*	3.1	0.2	2	<0.1
northern sea nettle	*Chrysaora melanaster*	0.8	<0.1	1	<0.1
squid unident.	Cephalopoda (class)	0.1	<0.1	31	0.5
jellyfish unident.	Scyphozoa (class)	<0.1	<0.1	1	<0.1
euphausiid unident.	Euphausiacea (order)	<0.1	<0.1	15	0.2
		1,740.0		6,347	

Table 17. -- Summary of catch by species in the Aleutian wing trawl conducted in midwater near Mitrofania Island during the summer 2015 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*	720.4	98.5	1,565	99.7
chum salmon	*Oncorhynchus keta*	8.8	1.2	4	0.3
black rockfish	*Sebastes melanops*	2.4	0.3	1	0.1
		731.5		1,570	

Table 18. -- Summary of catch by species in 11 Aleutian wing trawls conducted in midwater in Shelikof Strait during the summer 2015 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*	11565.6	99.4	35,869	99.6
Pacific cod	*Gadus macrocephalus*	21.7	0.2	7	<0.1
chum salmon	*Oncorhynchus keta*	14.2	0.1	6	<0.1
squid unident.	Cephalopoda (class)	11.2	0.1	14	<0.1
chinook salmon	*Oncorhynchus tshawytscha*	10.7	0.1	7	<0.1
jellyfish unident.	Scyphozoa (class)	4.8	<0.1	17	<0.1
lion's mane jellyfish	*Cyanea capillata*	4.1	<0.1	19	0.1
Pacific herring	*Clupea pallasi*	1.0	<0.1	5	<0.1
northern sea nettle	*Chrysaora melanaster*	0.9	<0.1	18	<0.1
eulachon	*Thaleichthys pacificus*	0.2	<0.1	8	<0.1
isopod unident.	Isopoda (order)	0.1	<0.1	49	0.1
capelin	*Mallotus villosus*	<0.1	<0.1	2	<0.1
		11,634.6		36,021	

Table 19. -- Summary of catch by species in the Aleutian wing trawl conducted in midwater near Nakchamik Island during the summer 2015 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*	1162.9	97.5	2,516	73.2
eulachon	*Thaleichthys pacificus*	18.4	1.5	809	23.5
Pacific cod	*Gadus macrocephalus*	6.7	0.6	2	0.1
flathead sole	*Hippoglossoides elassodon*	4.4	0.4	13	0.4
arrowtooth flounder	*Atheresthes stomias*	0.2	<0.1	1	<0.1
jellyfish unident.	Scyphozoa (class)	0.2	<0.1	9	0.3
shrimp unident.	Decapoda (order)	0.2	<0.1	64	1.9
squid unident.	Cephalopoda (class)	<0.1	<0.1	9	0.3
isopod unident.	Isopoda (order)	<0.1	<0.1	13	0.4
		1193.1		3,436	

Table 20. -- Summary of catch by species in three Aleutian wing trawls conducted in midwater in Alitak Bay during the summer 2015 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*	2,073.3	95.4	8,117	96.0
jellyfish unident.	Scyphozoa (class)	53.3	2.5	112	1.3
pink salmon	*Oncorhynchus gorbuscha*	13.6	0.6	13	0.2
Cyanea jellyfish unident.	*Cyanea* sp.	13.3	0.6	60	0.7
squid unident.	Cephalopoda (class)	13.2	0.6	66	0.8
Pacific herring	*Clupea pallasi*	4.7	0.2	61	0.7
Pacific sandfish	*Trichodon trichodon*	0.6	<0.1	11	0.1
northern sea nettle	*Chrysaora melanaster*	0.2	<0.1	4	<0.1
Pacific tomcod	*Microgadus proximus*	<0.1	<0.1	1	<0.1
capelin	*Mallotus villosus*	<0.1	<0.1	1	<0.1
Pacific cod	*Gadus macrocephalus*	<0.1	<0.1	6	0.1
		2,172.3		8,452	

Table 21. -- Summary of catch by species in five Aleutian wing trawls conducted in midwater in Marmot Bay during the summer 2015 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*	6,231.5	97.8	15,252	99.7
longnose skate	*Raja rhina*	93.5	1.5	2	<0.1
chum salmon	*Oncorhynchus keta*	27.8	0.4	14	0.1
chinook salmon	*Oncorhynchus tshawytscha*	10.6	0.2	8	0.1
Pacific ocean perch	*Sebastes alutus*	5.3	0.1	6	<0.1
Pacific herring	*Clupea pallasi*	1.0	<0.1	8	0.1
northern sea nettle	*Chrysaora melanaster*	0.4	<0.1	5	<0.1
fried egg jellyfish	*Phacellophora camtchatica*	0.3	<0.1	1	<0.1
Cyanea jellyfish unident.	*Cyanea* sp.	0.2	<0.1	5	<0.1
capelin	*Mallotus villosus*	<0.1	<0.1	4	<0.1
		6,370.4		15,305	

Table 22. -- Summary of catch by species in four Aleutian wing trawls conducted in midwater in Barnabas Trough during the summer 2015 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*	3,229.2	98.5	6,894	99.0
Pacific cod	*Gadus macrocephalus*	18.9	0.6	5	0.1
chinook salmon	*Oncorhynchus tshawytscha*	9.5	0.3	8	0.1
northern sea nettle	*Chrysaora melanaster*	9.0	0.3	25	0.4
pink salmon	*Oncorhynchus gorbuscha*	5.5	0.2	4	0.1
Cyanea jellyfish unid	*Cyanea* sp.	2.8	0.1	16	0.2
jellyfish unident.	Scyphozoa (class)	2.5	0.1	6	0.1
lion's mane	*Cyanea capillata*	1.5	<0.1	6	0.1
		3,278.8		6,964	

Table 23. -- Summary of catch by species in two Poly Nor'eartern bottom trawls conducted in Barnabas Trough during the summer 2015 walleye pollock acoustic-trawl survey of the Gulf of Alaska shelf.

		Weight		Number	
Common name	Scientific name	kg	Percent	Nos.	Percent
Pacific ocean perch	*Sebastes alutus*	714.2	53.7	811	59.3
walleye pollock	*Gadus chalcogrammus*	588.1	44.2	526	38.5
jellyfish unident.	Scyphozoa (class)	12.1	0.9	16	1.2
arrowtooth flounder	*Atheresthes stomias*	7.1	0.5	8	0.6
Pacific cod	*Gadus macrocephalus*	5.0	0.4	3	0.2
chinook salmon	*Oncorhynchus tshawytscha*	2.7	0.2	1	0.1
flathead sole	*Hippoglossoides elassodon*	0.7	0.1	2	0.1
		1,329.9		1,367	

Table 24. -- Summary of catch by species in four Aleutian wing trawls conducted in midwater in Chiniak Trough during the summer 2015 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*	1,280.4	88.4	3,063	97.5
salmon shark	*Lamna ditropis*	112.0	7.7	1	<0.1
Cyanea jellyfish unid	*Cyanea* sp.	26.2	1.8	42	1.3
lion's mane	*Cyanea capillata*	9.6	0.7	20	0.6
Pacific cod	*Gadus macrocephalus*	8.2	0.6	2	0.1
fried egg jellyfish	*Phacellophora camtchatica*	5.5	0.4	1	<0.1
chum salmon	*Oncorhynchus keta*	2.8	0.2	1	<0.1
northern sea nettle	*Chrysaora melanaster*	1.6	0.1	9	0.3
chinook salmon	*Oncorhynchus tshawytscha*	1.6	0.1	1	<0.1
jellyfish unident.	Scyphozoa (class)	0.7	0.1		-
Pacific herring	*Clupea pallasi*	0.2	<0.1	1	<0.1
Aequorea jellyfish ur	Aequorea sp.	<0.1	<0.1	1	<0.1
		1,448.8		3,142	

Table 25. -- Summary of catch by species in eight Aleutian wing trawls conducted in midwater in the Kenai Peninsula Bays during the summer 2015 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*	2,765.8	89.3	10,294	52.0
eulachon	*Thaleichthys pacificus*	74.7	2.4	2,784	14.1
jellyfish unident.	Scyphozoa (class)	70.1	2.3	85	0.4
sockeye salmon	*Oncorhynchus nerka*	54.1	1.7	18	0.1
Pacific cod	*Gadus macrocephalus*	28.5	0.9	11	0.1
northern sea nettle	*Chrysaora melanaster*	20.8	0.7	22	0.1
pink salmon	*Oncorhynchus gorbuscha*	19.1	0.6	13	0.1
lion's mane	*Cyanea capillata*	8.9	0.3	15	0.1
shrimp unident.	Decapoda (order)	8.8	0.3	4,141	20.9
chum salmon	*Oncorhynchus keta*	8.2	0.3	3	<0.1
chinook salmon	*Oncorhynchus tshawytscha*	8.1	0.3	5	<0.1
magistrate armhook squid	*Berryteuthis magister*	6.6	0.2	14	0.1
squid unident.	Cephalopoda (class)	5.8	0.2	1,509	7.6
northern smoothtongue	*Leuroglossus schmidti*	3.4	0.1	642	3.2
light dusky rockfish	*Sebastes ciliatus*	3.3	0.1	2	<0.1
Pacific herring	*Clupea pallasi*	3.3	0.1	33	0.2
fried egg jellyfish	*Phacellophora camtchatica*	2.0	0.1	1	<0.1
capelin	*Mallotus villosus*	1.7	0.1	91	0.5
Pacific ocean perch	*Sebastes alutus*	0.9	<0.1	1	<0.1
smooth lumpsucker	*Aptocyclus ventricosus*	0.6	<0.1	1	<0.1
moon jellyfish	*Aurelia labiata*	0.5	<0.1	3	<0.1
coho salmon	*Oncorhynchus kisutch*	0.3	<0.1	3	<0.1
arrowtooth flounder	*Atheresthes stomias*	0.3	<0.1	1	<0.1
Pacific sandfish	*Trichodon trichodon*	0.1	<0.1	1	<0.1
isopod unident.	Isopoda (order)	0.1	<0.1	50	0.3
lanternfish unident.	Myctophidae (family)	<0.1	<0.1	45	0.2
comic snailfish	*Careproctus comus*	<0.1	<0.1	3	<0.1
snailfish unident.	Liparidae (family)	<0.1	<0.1	7	<0.1
prowfish	*Zaprora silenus*	<0.1	<0.1	2	<0.1
Alaska eelpout	*Bothrocara pusillum*	<0.1	<0.1	1	<0.1
eelpout unident.	Zoarcidae (family)	<0.1	<0.1	1	<0.1
		3,096.1		19,802	

Table 26. -- Summary of catch by species in the Poly Nor'eastern bottom trawl in the Kenai Peninsula Bays during the summer 2013 walleye pollock acoustic-trawl survey of the Gulf of Alaska shelf.

		Weight		Number	
Common name	Scientific name	kg	Percent	Nos.	Percent
rougheye rockfish	*Sebastes aleutianus*	92.1	46.0	33	3.6
jellyfish unident.	Scyphozoa (class)	43.6	21.8	61	6.6
walleye pollock	*Gadus chalcogrammus*	37.6	18.8	59	6.4
Pacific cod	*Gadus macrocephalus*	20.4	10.2	8	0.9
shrimp unident.	Decapoda (order)	3.2	1.6	659	71.7
arrowtooth flounder	*Atheresthes stomias*	1.4	0.7	2	0.2
eulachon	*Thaleichthys pacificus*	1.3	0.6	-	-
flathead sole	*Hippoglossoides elassodon*	0.5	0.2	1	0.1
capelin	*Mallotus villosus*	0.2	0.1	42	4.6
squid unident.	Cephalopoda (class)	0.1	<0.1	24	2.6
isopod unident.	Isopoda (order)	<0.1	<0.1	18	2.0
snailfish unident.	Liparidae (family)	<0.1	<0.1	2	0.2
fish larvae unident.	Chordata (phylum)	<0.1	<0.1	4	0.4
northern smoothtongue	*Leuroglossus schmidti*	<0.1	<0.1	3	0.3
prowfish	*Zaprora silenus*	<0.1	<0.1	1	0.1
tadpole sculpin	*Psychrolutes paradoxus*	<0.1	<0.1	1	0.1
lanternfish unident.	Myctophidae (family)	<0.1	<0.1	1	0.1
		200.3		919	

Table 27. -- Summary of catch by species in eight Aleutian wing trawls conducted in midwater in Prince William Sound during the summer 2015 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*	1,266.7	81.2	2,615	24.2
northern sea nettle	*Chrysaora melanaster*	98.4	6.3	31	0.3
eulachon	*Thaleichthys pacificus*	69.0	4.4	3,676	34.0
fried egg jellyfish	*Phacellophora camtchatica*	66.1	4.2	13	0.1
northern smoothtongue	*Leuroglossus schmidti*	9.4	0.6	1,247	11.5
squid unident.	Cephalopoda (class)	8.6	0.6	795	7.3
chum salmon	*Oncorhynchus keta*	7.9	0.5	2	<0.1
pink salmon	*Oncorhynchus gorbuscha*	6.5	0.4	4	<0.1
magistrate armhook squid	*Berryteuthis magister*	6.0	0.4	15	0.1
lion's mane	*Cyanea capillata*	4.9	0.3	7	0.1
chinook salmon	*Oncorhynchus tshawytscha*	4.8	0.3	4	<0.1
Pacific herring	*Clupea pallasi*	3.7	0.2	71	0.7
coho salmon	*Oncorhynchus kisutch*	1.8	0.1	1	<0.1
rock sole sp.	*Lepidopsetta* sp.	1.2	0.1	1	<0.1
Pacific cod	*Gadus macrocephalus*	1.2	0.1	4	<0.1
shrimp unident.	Decapoda (order)	1.1	0.1	1,379	12.7
pandalid shrimp unident.	Pandalidae (family)	0.9	0.1	644	5.9
Pacific ocean perch	*Sebastes alutus*	0.7	<0.1	1	<0.1
lanternfish unident.	Myctophidae (family)	0.6	<0.1	208	1.9
Aequorea jellyfish unident.	*Aequorea* sp.	0.6	<0.1	6	0.1
capelin	*Mallotus villosus*	0.5	<0.1	54	0.5
sidestripe shrimp	*Pandalopsis dispar*	0.1	<0.1	7	0.1
pallid eelpout	*Lycodapus mandibularis*	<0.1	<0.1	16	0.1
crested sculpin	*Blepsias bilobus*	<0.1	<0.1	1	<0.1
prowfish	*Zaprora silenus*	<0.1	<0.1	2	<0.1
isopod unident.	Isopoda (order)	<0.1	<0.1	9	0.1
amphipod unident.	Amphipoda (order)	<0.1	<0.1	13	0.1
eelpout unident.	Zoarcidae (family)	<0.1	<0.1	1	<0.1
		1,560.8		10,827	

Table 28. -- Summary of catch by species in the two Aleutian wing trawl conducted in midwater in Yakutat Trough during the summer 2015 walleye pollock acoustic-trawl survey of the Gulf of Alaska shelf.

		Weight		Number	
Common name	Scientific name	kg	Percent	Nos.	Percent
Pacific ocean perch	*Sebastes alutus*	610.8	95.9	1,000	96.2
walleye pollock	*Gadus chalcogrammus*	13.9	2.2	14	1.3
fried egg jellyfish	*Phacellophora camtchatica*	6.1	1.0	1	0.1
light dusky rockfish	*Sebastes ciliatus*	4.4	0.7	3	0.3
sockeye salmon	*Oncorhynchus nerka*	1.6	0.2	1	0.1
Aequorea jellyfish unident.	Aequorea sp.	0.2	<0.1	5	0.5
eulachon	*Thaleichthys pacificus*	0.1	<0.1	3	0.3
lanternfish unident.	Myctophidae (family)	<0.1	<0.1	8	0.8
squid unident.	Cephalopoda (class)	<0.1	<0.1	5	0.5
		637.1		1,040	

Table 29. -- Pollock biomass (metric tons) by NPFMC management area for all walleye pollock and age-3 walleye pollock (30-50 cm FL) for the 2015 summer Gulf of Alaska acoustic-trawl survey.

Management area	Geographic area	Total biomass	Age-3 biomass
610	Shelf	394,058.41	324,560.15
	Sanak Trough	3,098.17	2,619.70
	Morzhovoi Bay	4,855.03	3,300.91
	Pavlof Bay	2,575.80	2,115.02
	Shumagin Islands	15,074.09	11,437.76
	Mitrofania	6,290.40	5,274.27
Total		425,951.90	349,307.80
620	Shelf	210,549.01	168,374.53
	Mitrofania	8,451.47	7,086.24
	Nakchamik	9,147.48	3,999.22
	Shelikof Strait	240,613.92	201,273.54
	Alitak	7,244.03	1,729.27
Total		476,005.91	382,462.80
630	Shelf	403,982.66	309,710.99
	Shelikof Strait	47,190.24	39,628.38
	Barnabas Trough	88,914.46	74,194.18
	Chiniak Trough	34,979.67	30,578.12
	Marmot Bay	45,803.08	34,068.79
	Kenai Peninsula	4,866.20	1,386.00
	PWS shelf	6,579.74	5,278.83
Total		632,316.04	494,845.30
640	Shelf	57,281.07	46,624.33
	PWS shelf	1,131.80	908.03
	Yakutat Trough	5,541.66	53.48
Total	Total	63,954.52	47,585.84
649	PWS	5,596.06	14.98
	Kenai Peninsula	2,346.87	276.95
Total		7,942.92	292.14
Survey Total		1,606,171.29	1,274,493.88

Table 30. -- Summary of catch by species in 11 Methot trawls conducted during the summer 2015 walleye pollock acoustic-trawl survey of the Gulf of Alaska shelf.

		Weight		Number	
Common name	Scientific name	kg	Percent	Nos.	Percent
euphausiid unident.	Euphausiacea (order)	33.8	69.4	547,669	99.7
Aequorea jellyfish unident.	*Aequorea* sp.	8.5	17.5	70	<0.1
jellyfish unident.	Scyphozoa (class)	4.8	9.9	593	0.1
northern sea nettle	*Chrysaora melanaster*	0.4	0.9	5	<0.1
lion's mane	*Cyanea capillata*	0.2	0.5	2	<0.1
comb jelly unident.	Ctenophora (phylum)	0.2	0.5	13	<0.1
walleye pollock age 0	*Gadus chalcogrammus*	0.2	0.4	176	<0.1
fried egg jellyfish	*Phacellophora camtchatica*	0.2	0.3	1	<0.1
squid unident.	Cephalopoda (class)	0.1	0.2	115	<0.1
crab larvae unident.	Decapoda (order)	0.1	0.1	181	<0.1
Aurelia jellyfish unident.	*Aurelia* sp.	0.1	0.1	5	<0.1
rockfish unident.	*Sebastes* sp.	<0.1	0.1	35	<0.1
fish larvae unident.	Chordata (phylum)	<0.1	<0.1	21	<0.1
crustacean unident.	Crustacea (subphylum)	<0.1	<0.1	78	<0.1
copepod unident.	Copepoda (class)	<0.1	<0.1	104	<0.1
flatfish larvae	Pleuronectiformes (order)	<0.1	<0.1	23	<0.1
		48.7		549,091	

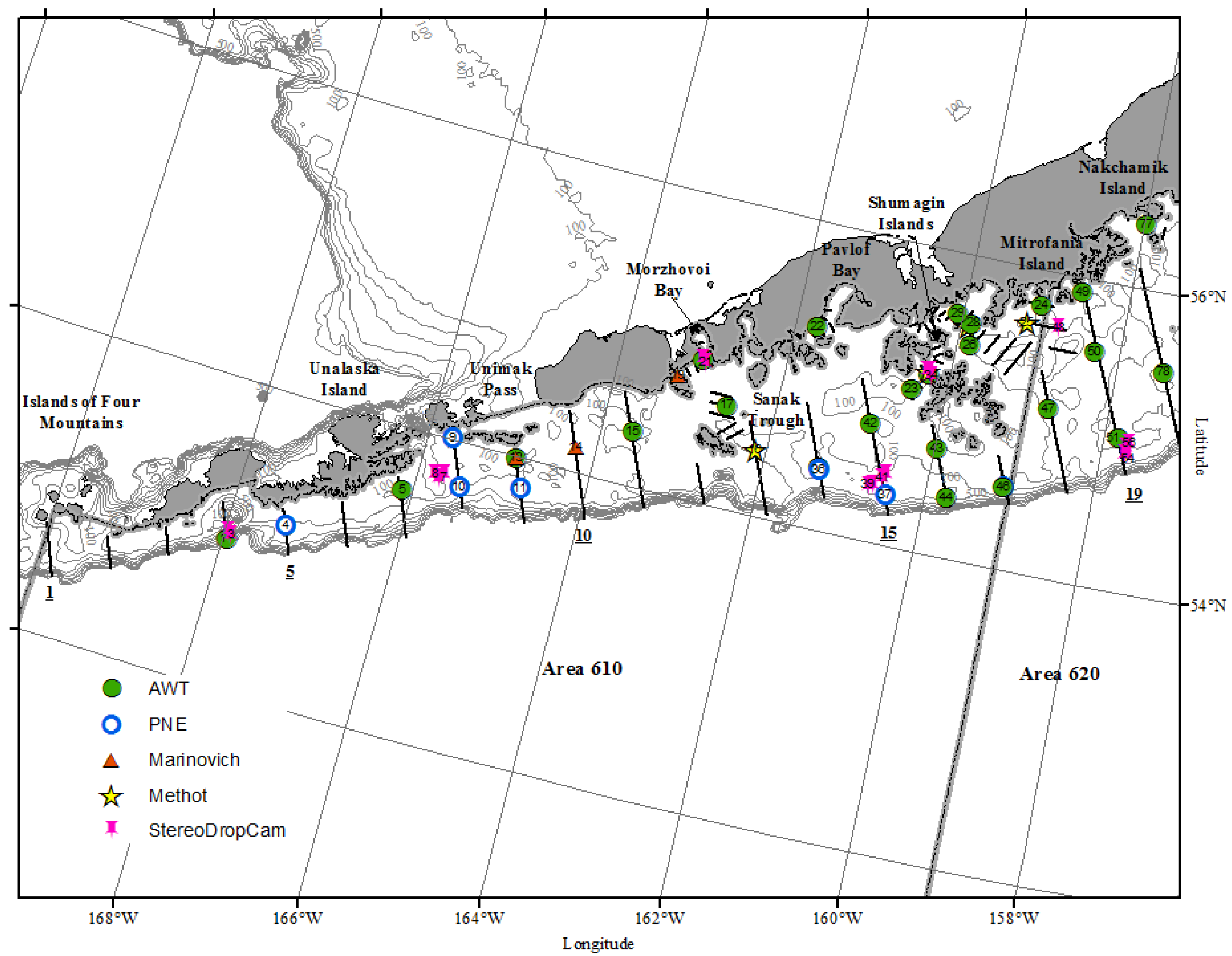

Figure 1. -- Transect lines and locations of Aleutian-wing trawl (AWT), poly-Nor'eastern trawl (PNE), Marinovich trawl, Methot hauls, and stereo drop camera deployments from the summer 2015 acoustic-trawl survey of walleye pollock in the western Gulf of Alaska from the Islands of Four Mountains to the Shumagin Islands. Transect numbers are underlined and haul numbers are on top of haul symbols. Boundary between NPFMC areas 610 and 620 is displayed.

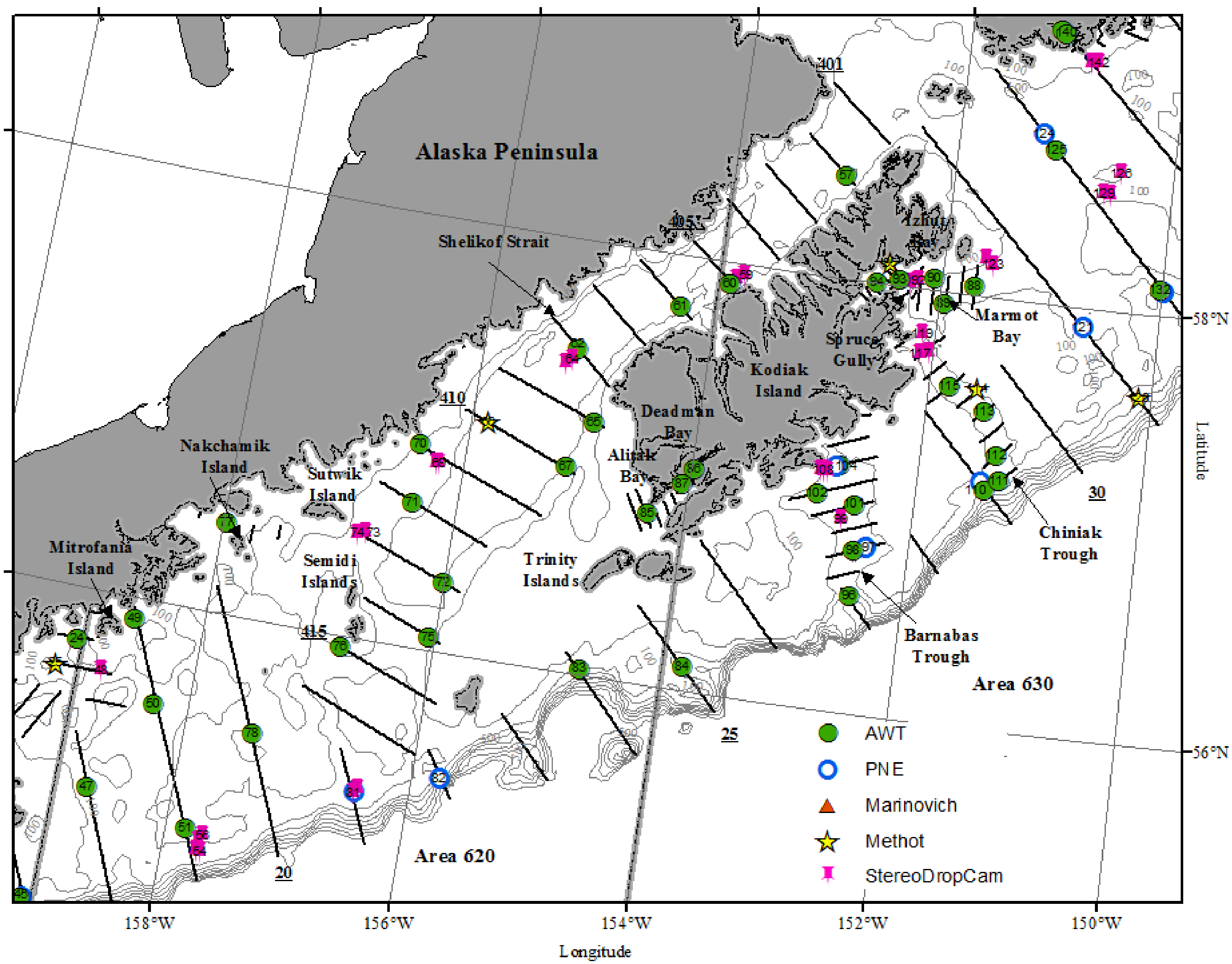

Figure 2. -- Transect lines and locations of Aleutian-wing trawl (AWT), poly-Nor'eastern trawl (PNE), Methot hauls, and Stereo drop camera deployments from the summer 2015 acoustic-trawl survey of walleye pollock in the central Gulf of Alaska from the Shumagin Islands to eastern Kodiak Island. Transect numbers are underlined and haul numbers are on top of haul symbols. Boundary between NPFMC areas 620 and 630 is displayed.

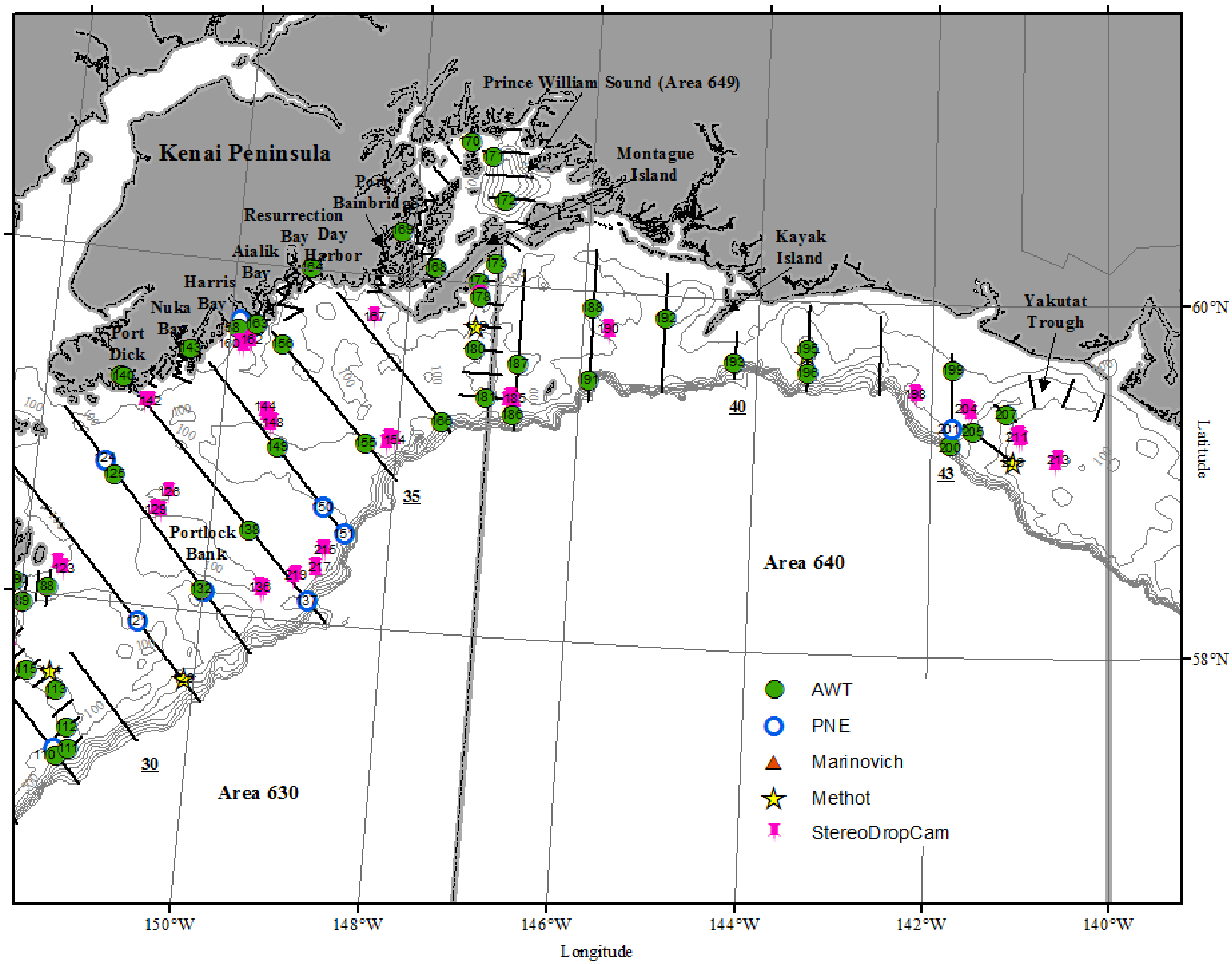

Figure 3. -- Transect lines and locations of Aleutian-wing trawl (AWT), poly-Nor'eastern trawl (PNE), Methot hauls, and Stereo drop camera deployments from the summer 2015 acoustic-trawl survey of walleye pollock in the eastern Gulf of Alaska from eastern Kodiak Island to Yakutat Trough. Transect numbers are underlined and haul numbers are on top of haul symbols. Boundaries between NPFMC areas 630, 640, and 649 are displayed.

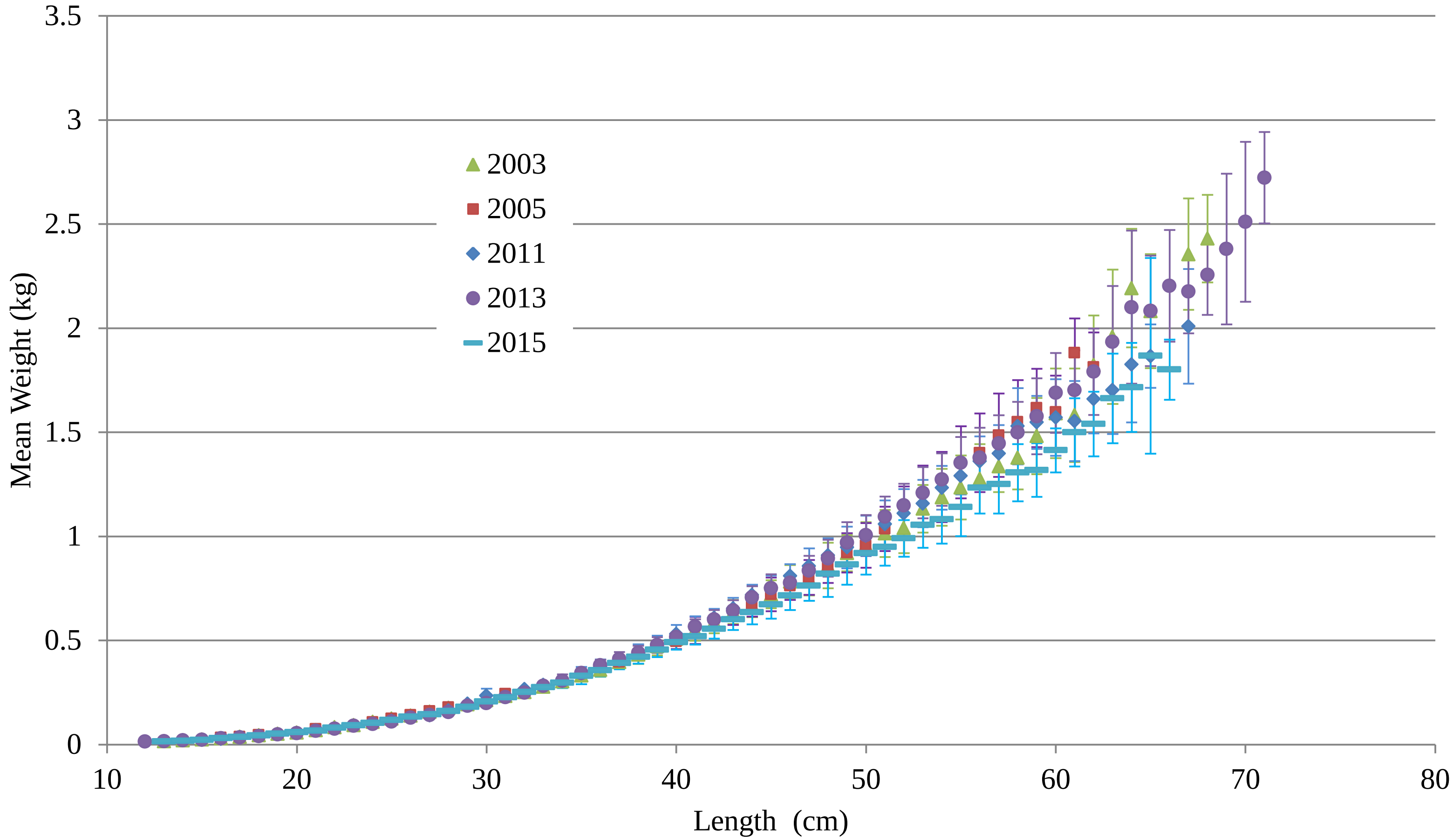

Figure 4. -- Mean weight (kg), and standard deviation, at length (cm) for all areas combined during GOA surveys conducted in 2003, 2005, 2011, 2013, and 2015. Only length classes containing at least six fish were plotted for each year.

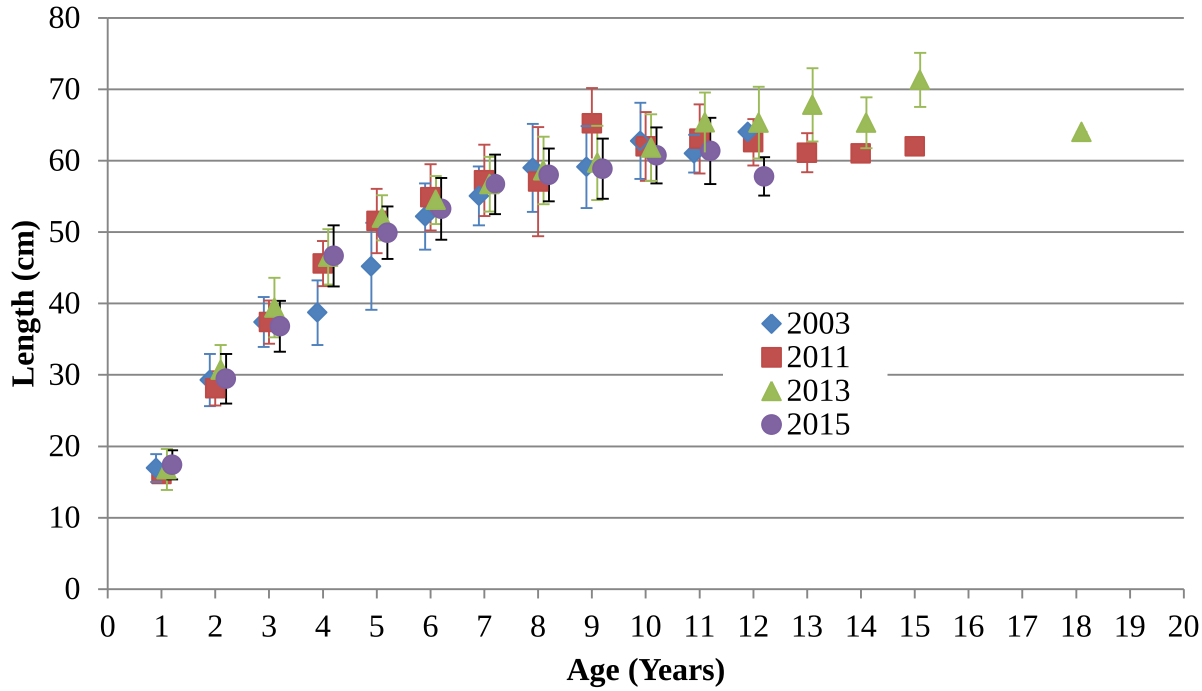

Figure 5. -- Average length (cm) at age (bars indicate 1 standard deviation) for walleye pollock from summer acoustic-trawl surveys in the Gulf of Alaska in 2003, 2011, 2013, and 2015.

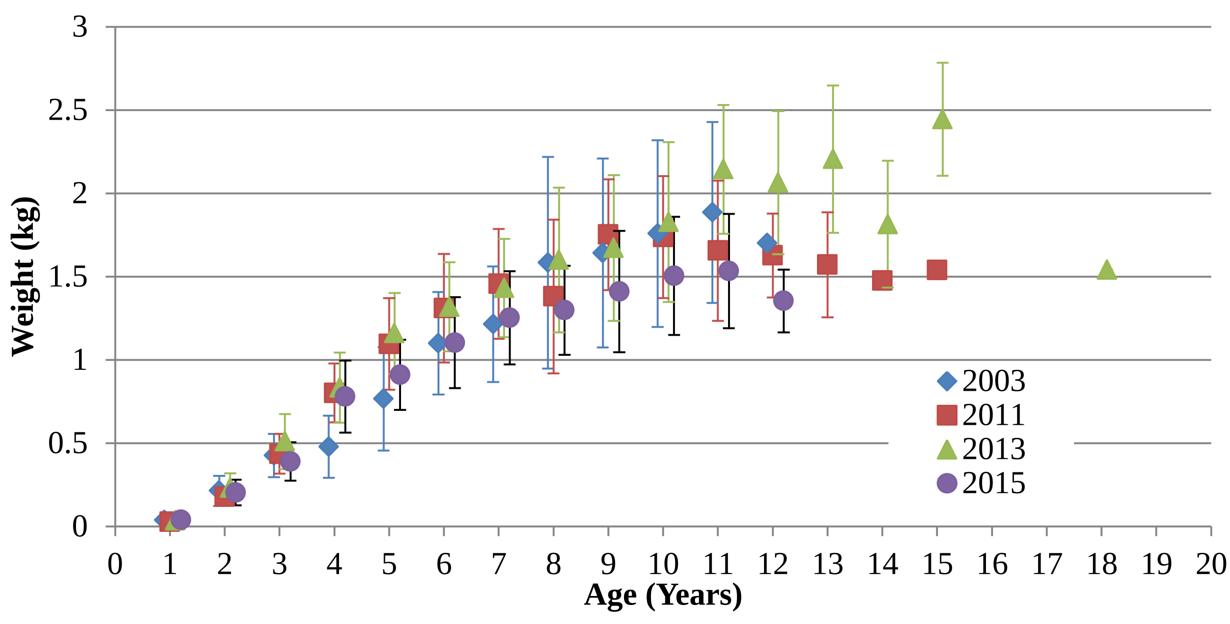

Figure 6. -- Average weight (kg) at age (bars indicate 1 standard deviation) for walleye pollock from summer acoustic-trawl surveys in the Gulf of Alaska in 2003, 2011, 2013 and 2015.

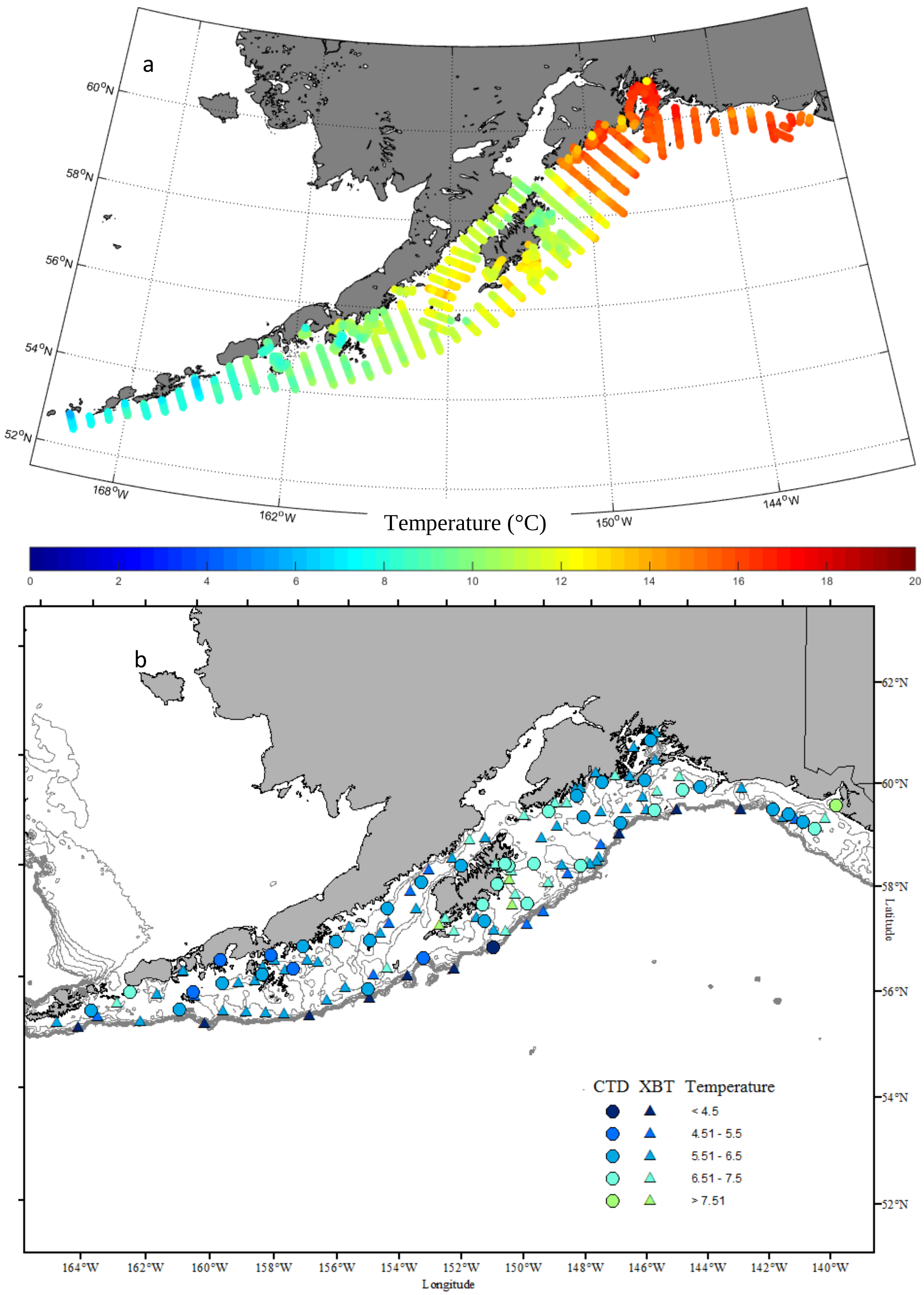

Figure 7. -- Temperature (°C) a) measured at the sea surface using shipboard surface temperature sensors along survey transects averaged at 1 nautical mile resolution, and b) near the seafloor using conductivity-temperature-depth profilers (CTD) and expendable bathythermographs (XBT) during the summer 2015 acoustic-trawl survey of the GOA shelf.

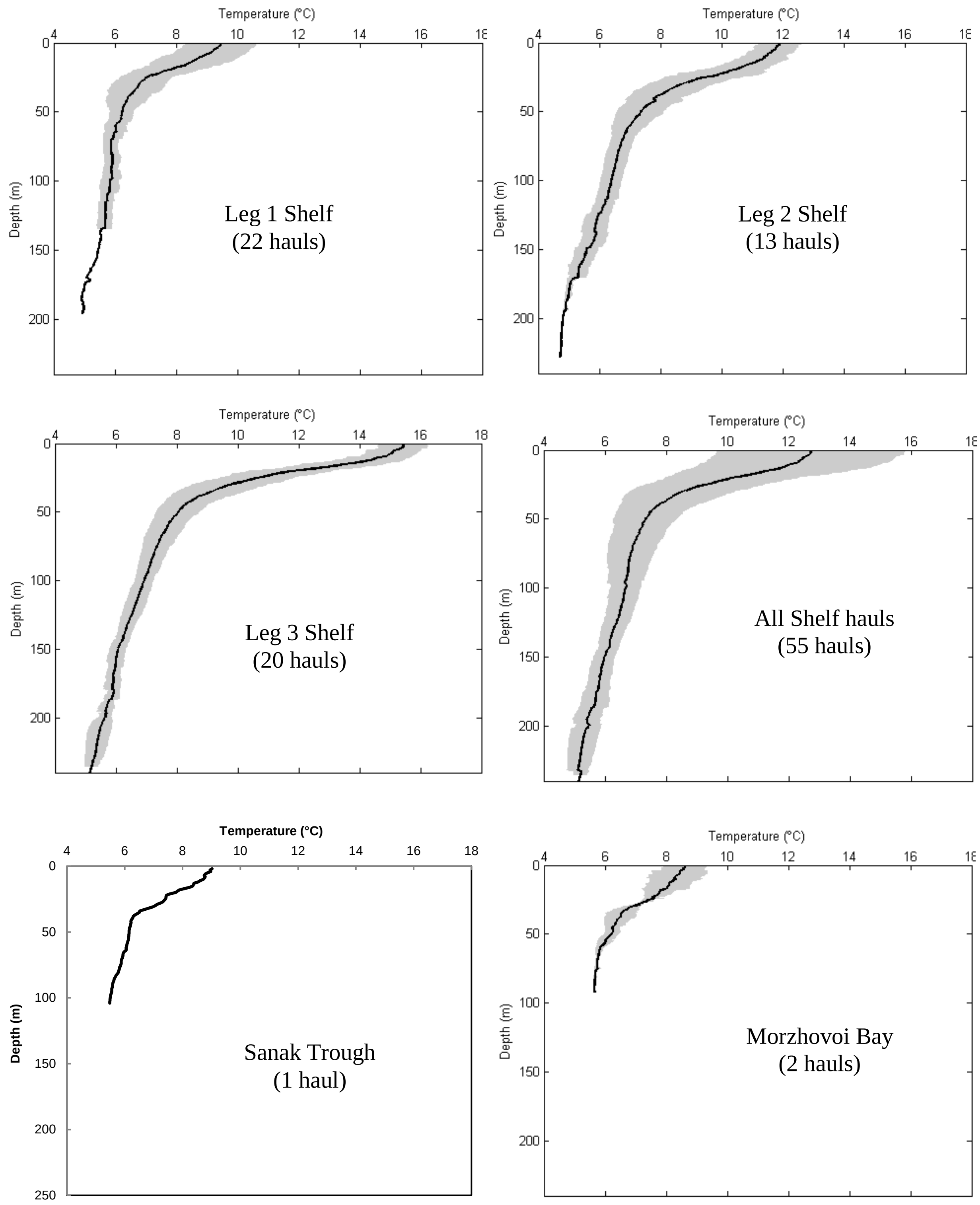

Figure 8. -- Average temperature (°C) at depth (m) by area from SBE-39 probes on the fishing gear at fishing locations (and number of hauls with temperature data in each area) during the summer 2015 acoustic trawl survey of the Gulf of Alaska. The shaded area represents one standard deviation from mean.

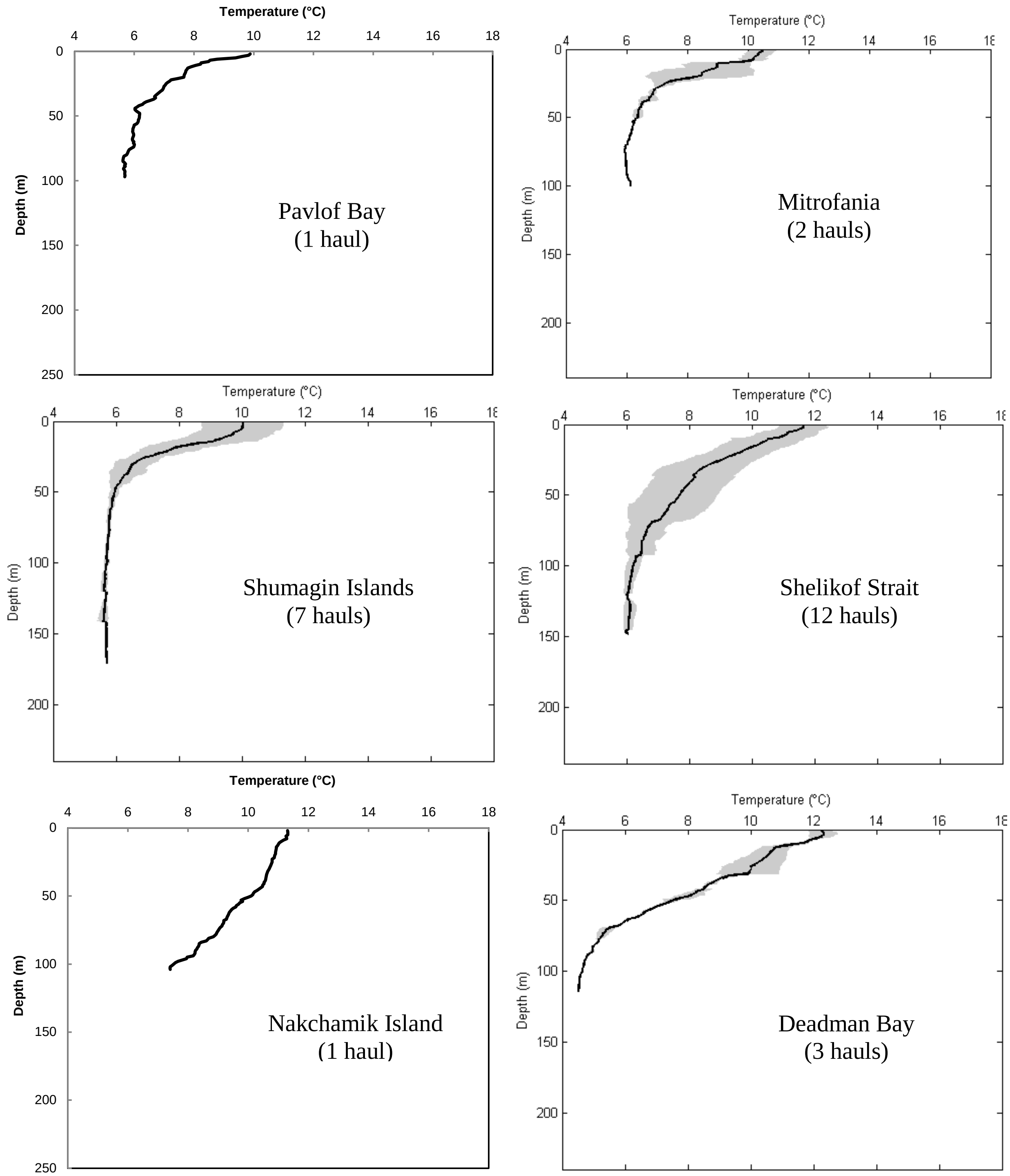

Figure 8. -- Cont.

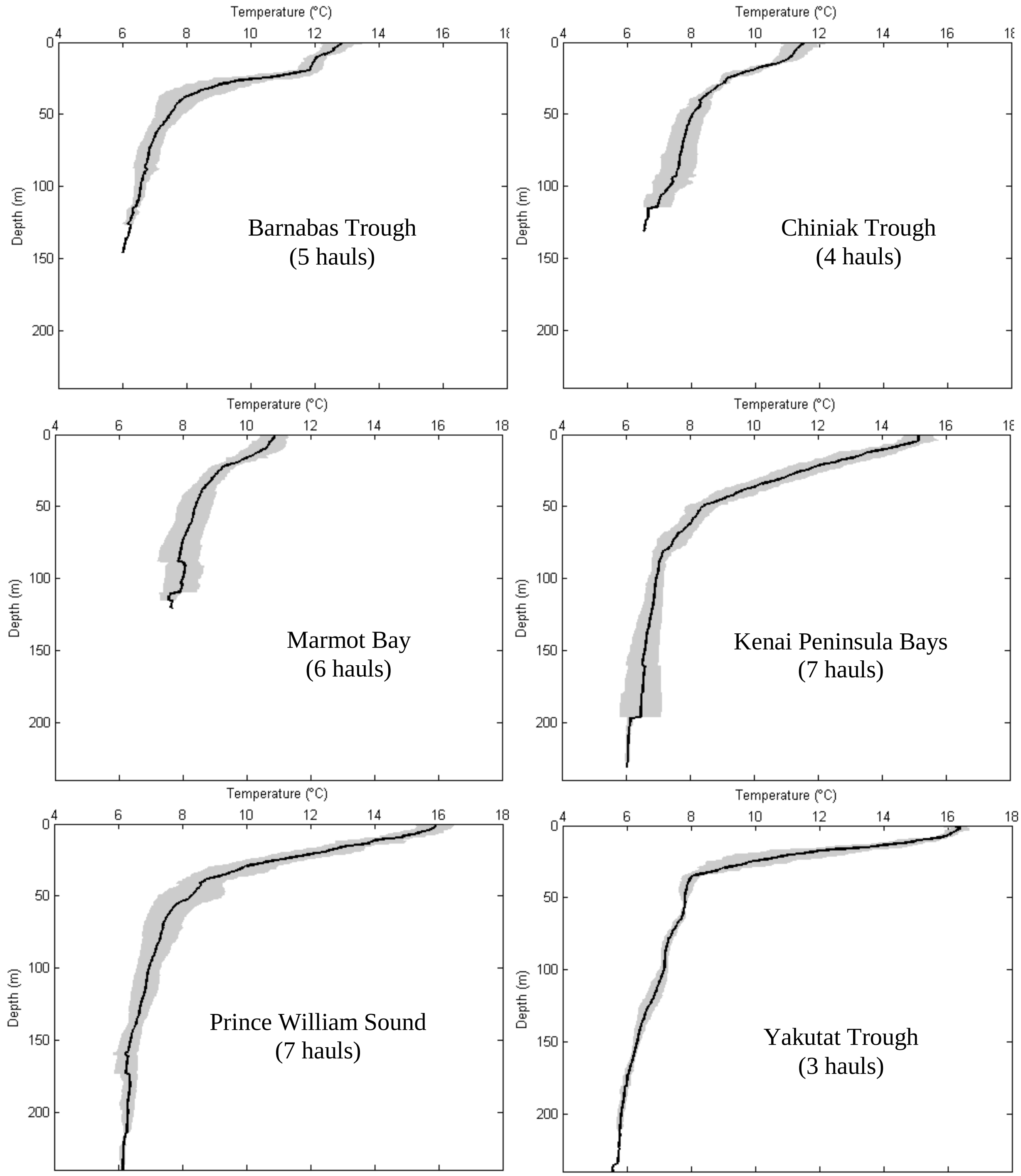

Figure 8. -- Cont.

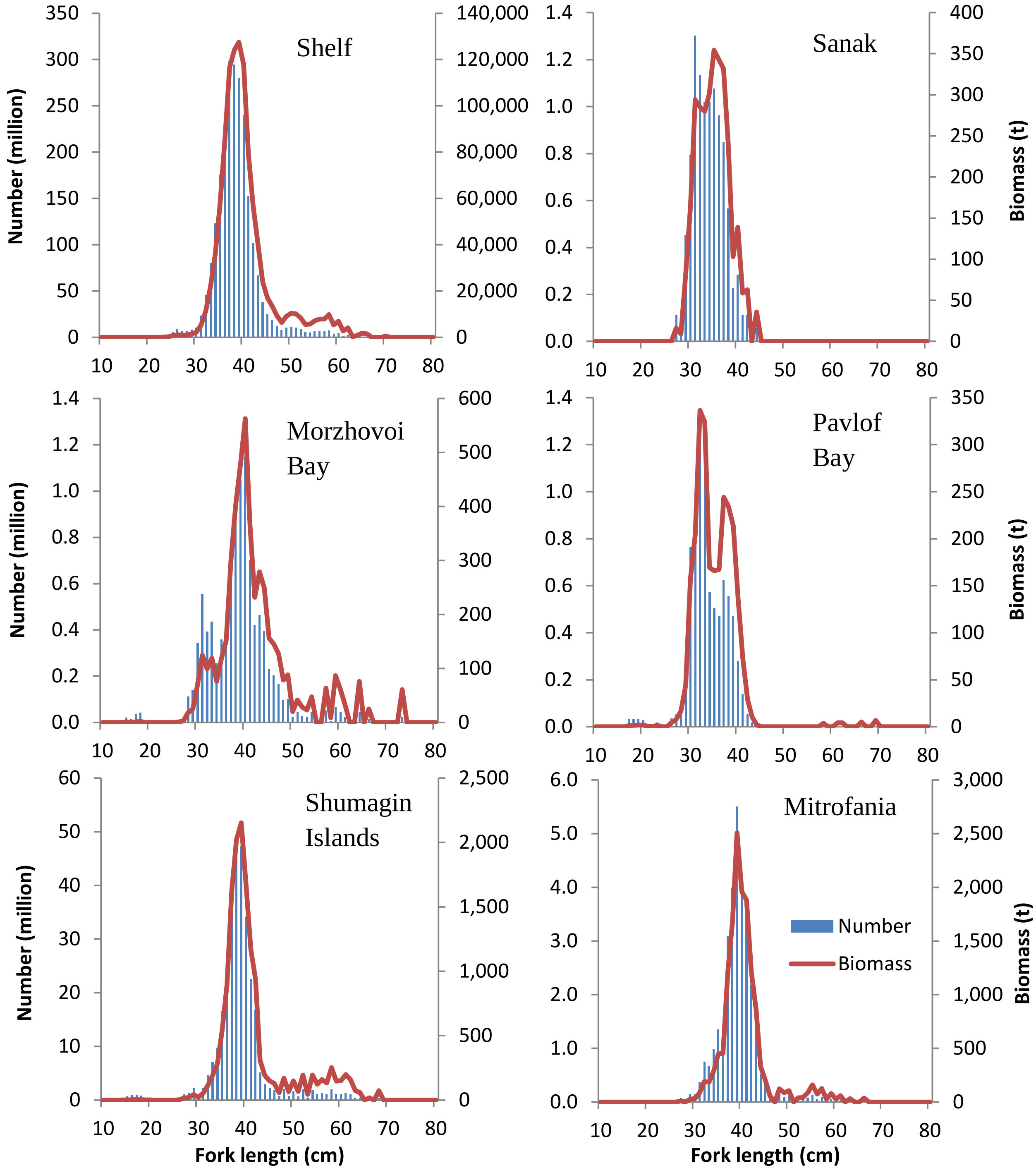

Figure 9. -- Walleye pollock numbers in millions (blue bars and primary y-axis) and biomass in metric tons (red line and secondary y-axis) at length (cm) for each of the major survey areas in the 2015 summer GOA acoustic-trawl survey.

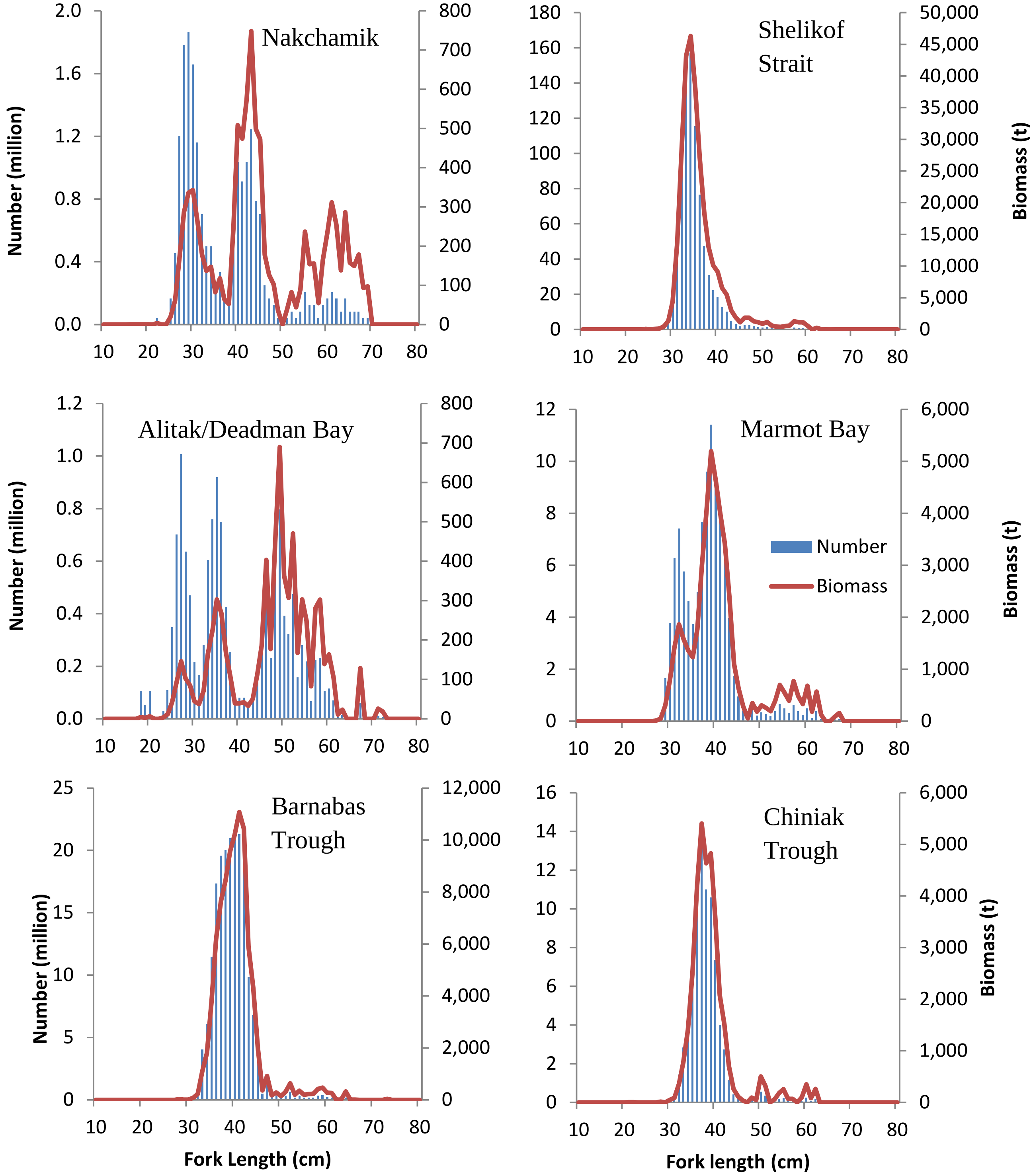

Figure 9. -- Continued.

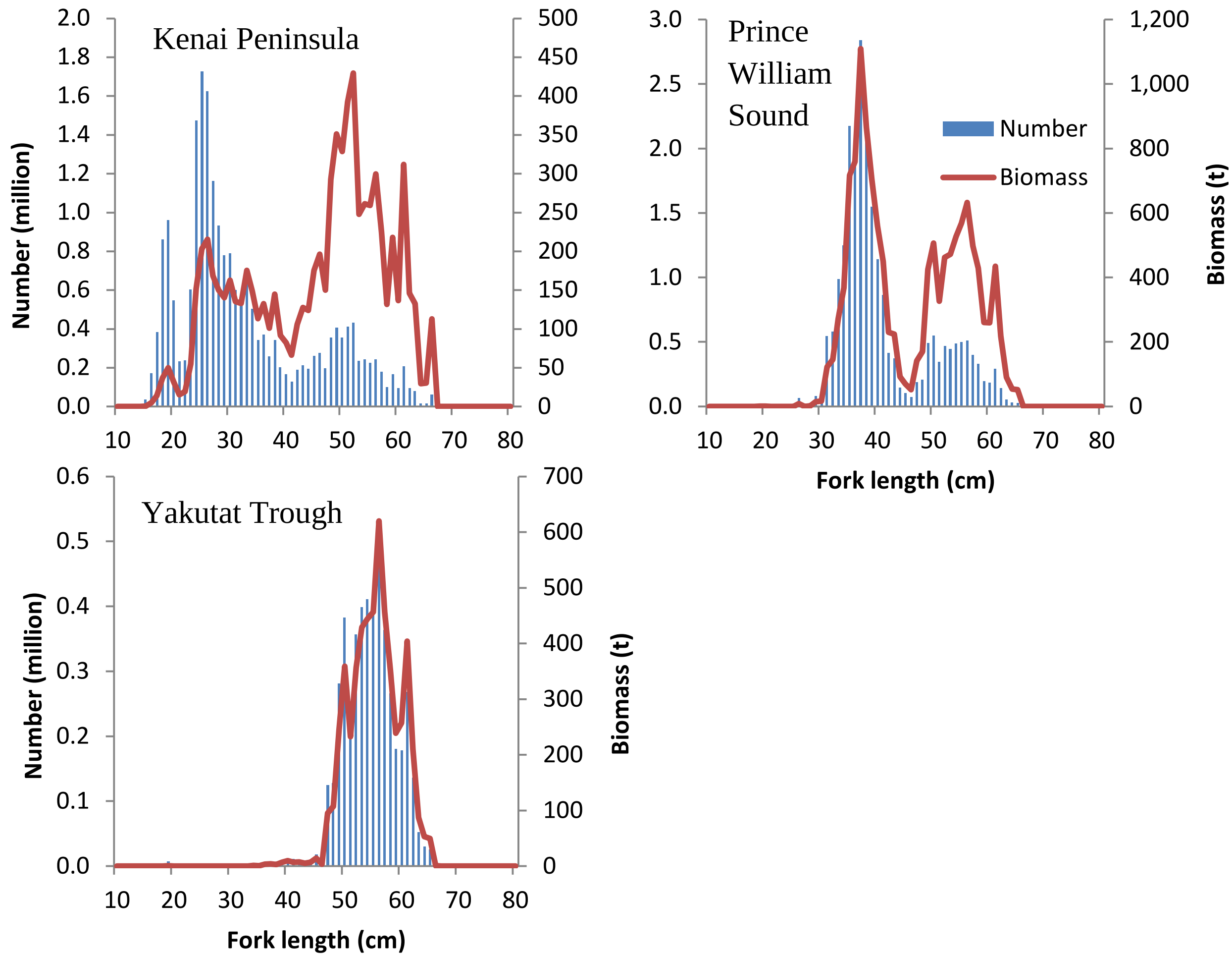

Figure 9. -- Continued.

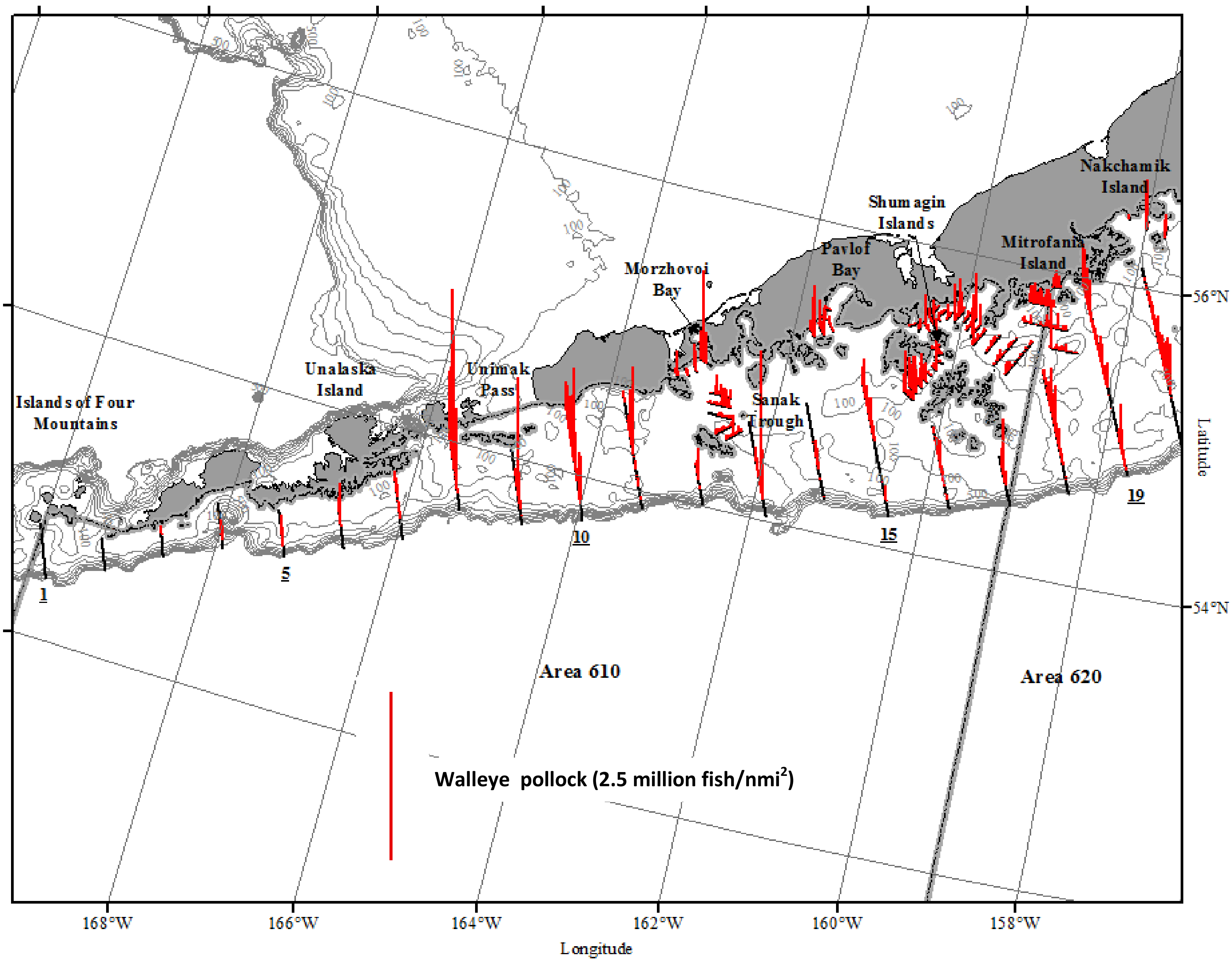

Figure 10. -- Density of walleye pollock (red vertical lines) along tracklines surveyed during the summer 2015 acoustic-trawl survey in the western GOA. Transect numbers are underlined. The boundary between NPFMC areas 610 and 620 is displayed.

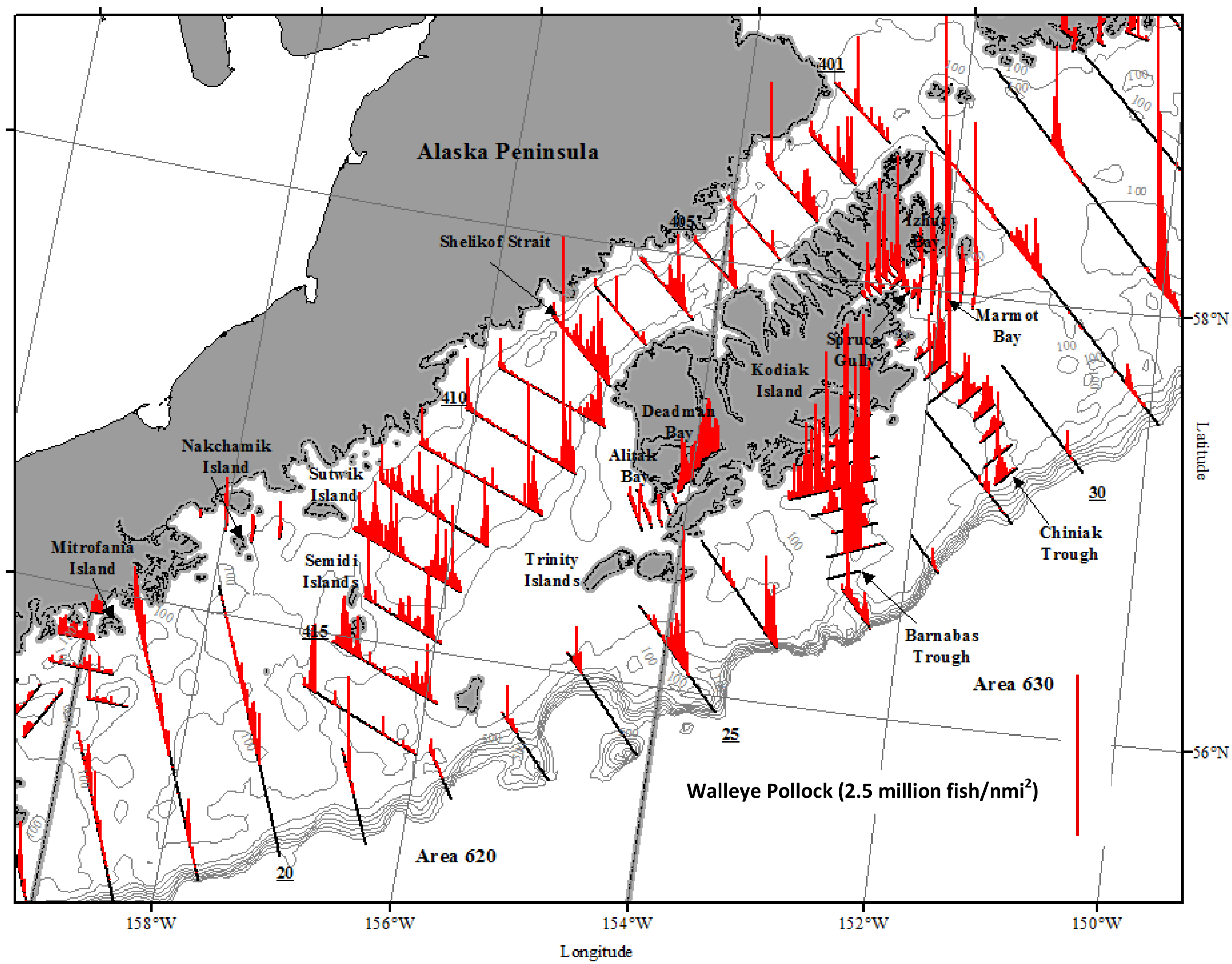

Figure 11. -- Density of walleye pollock (red vertical lines) along tracklines surveyed during the summer 2015 acoustic-trawl survey in the central GOA. Transect numbers are underlined. The boundary between NPFMC areas 620 and 630 is displayed.

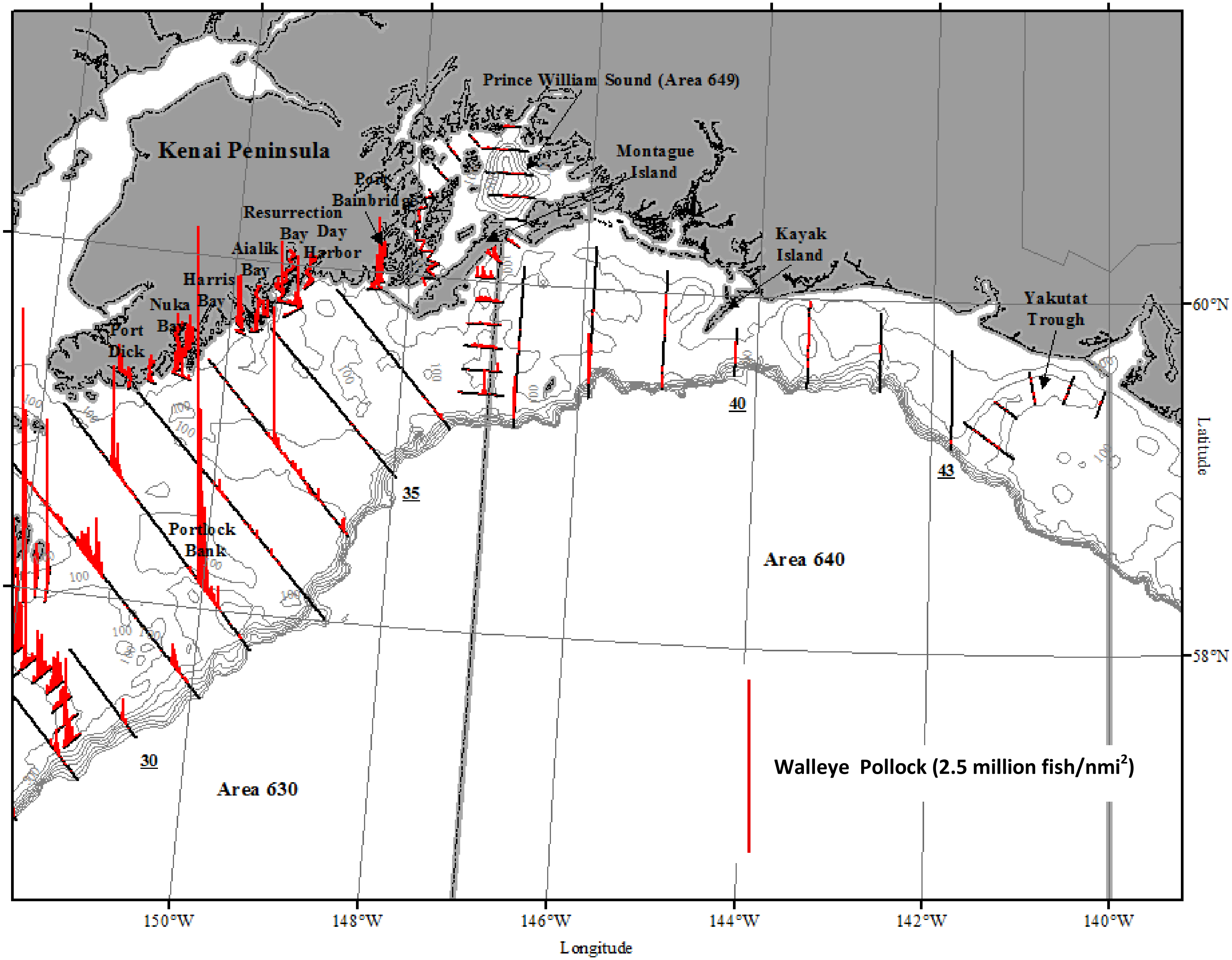

Figure 12. -- Density of walleye pollock (red vertical lines) along tracklines surveyed during the summer 2015 acoustic-trawl survey in the eastern GOA. Transect numbers are underlined. The boundaries between NPFMC areas 630, 640, and 649 are displayed.

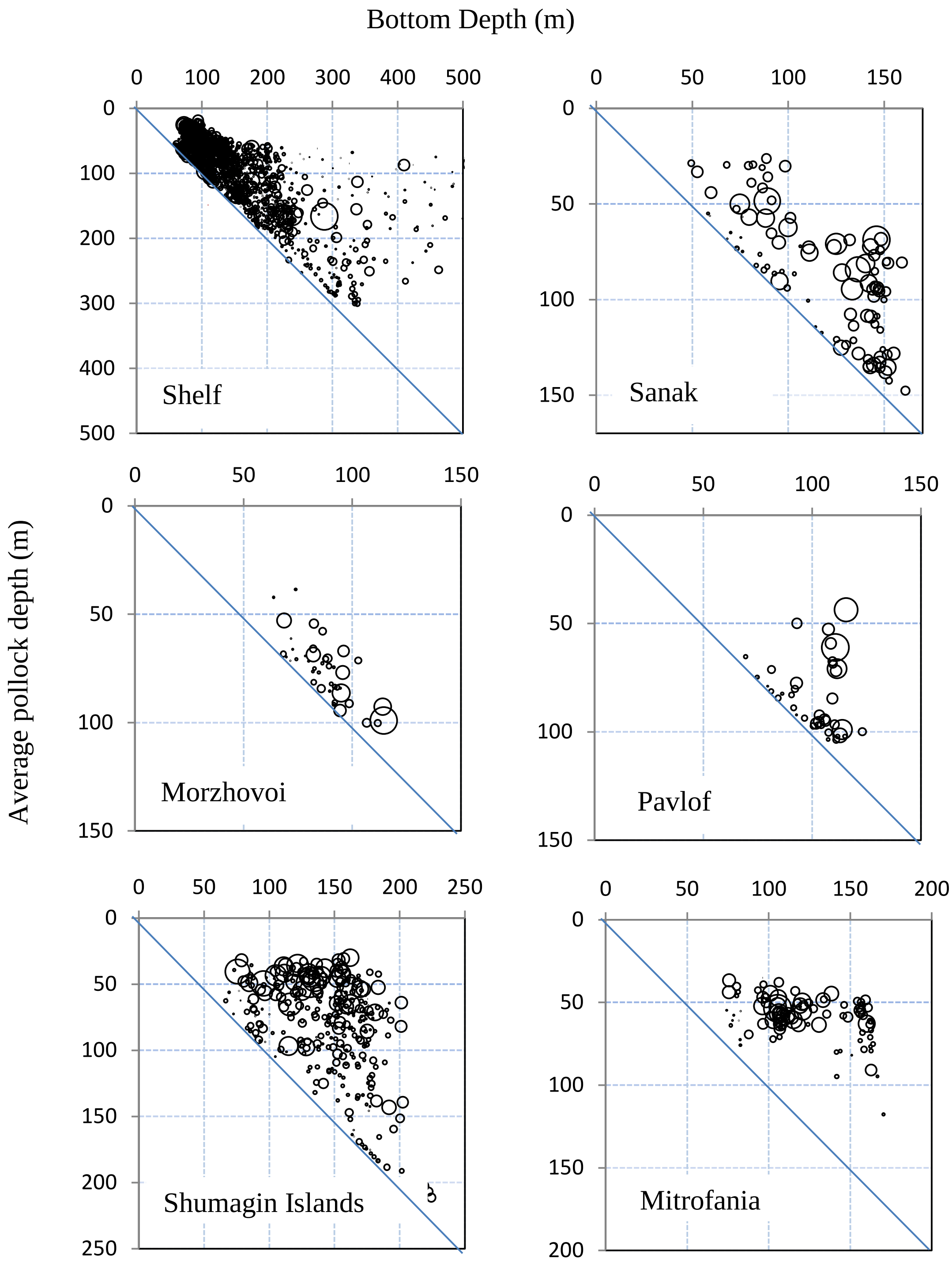

Figure 13. -- Mean pollock depth (weighted by biomass) versus bottom depth (m) for each 0.5 nmi of trackline from the summer 2015 GOA acoustic-trawl survey. Bubble size is scaled to the maximum biomass for each plot.

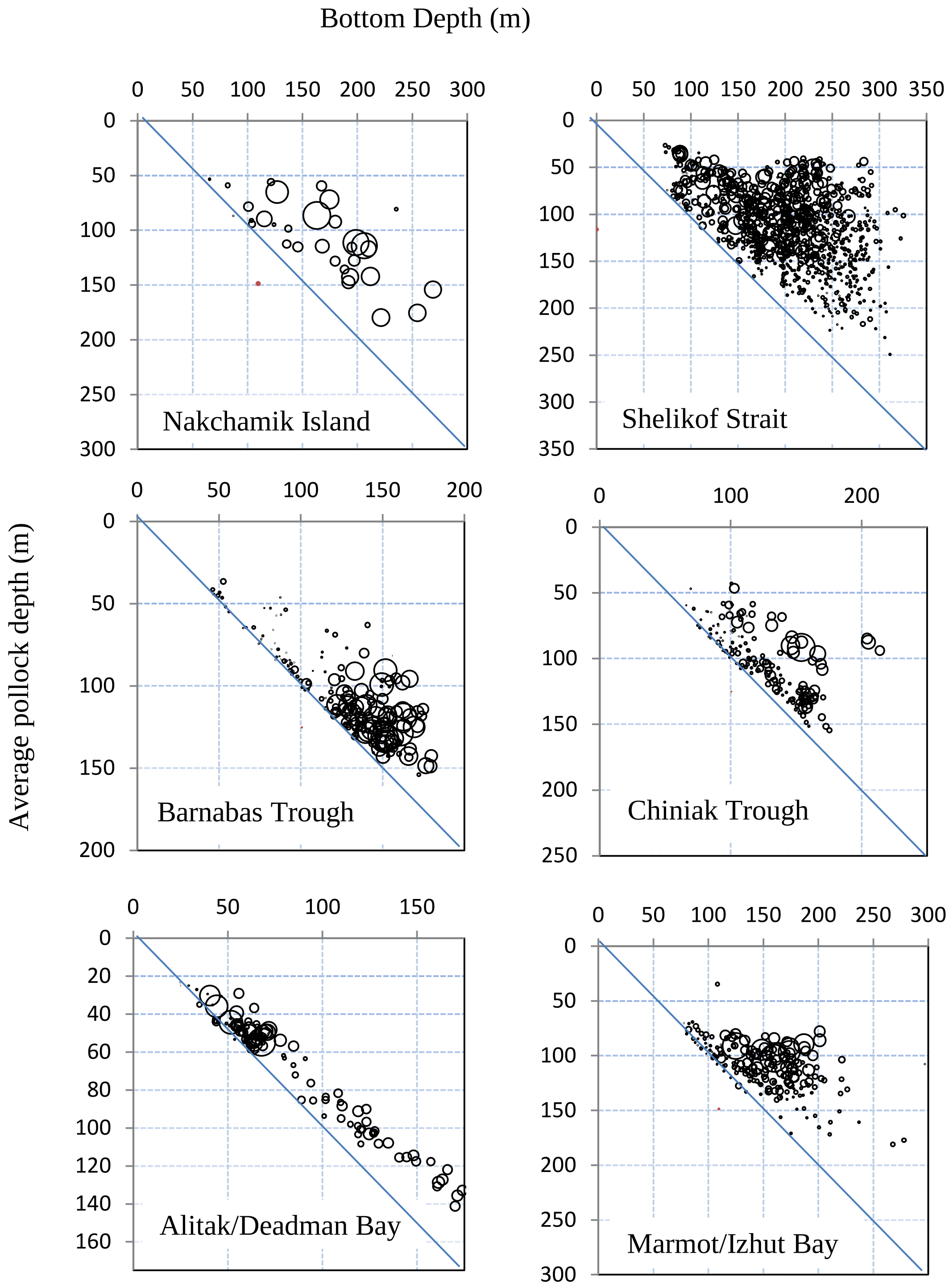

Figure 13. -- Continued.

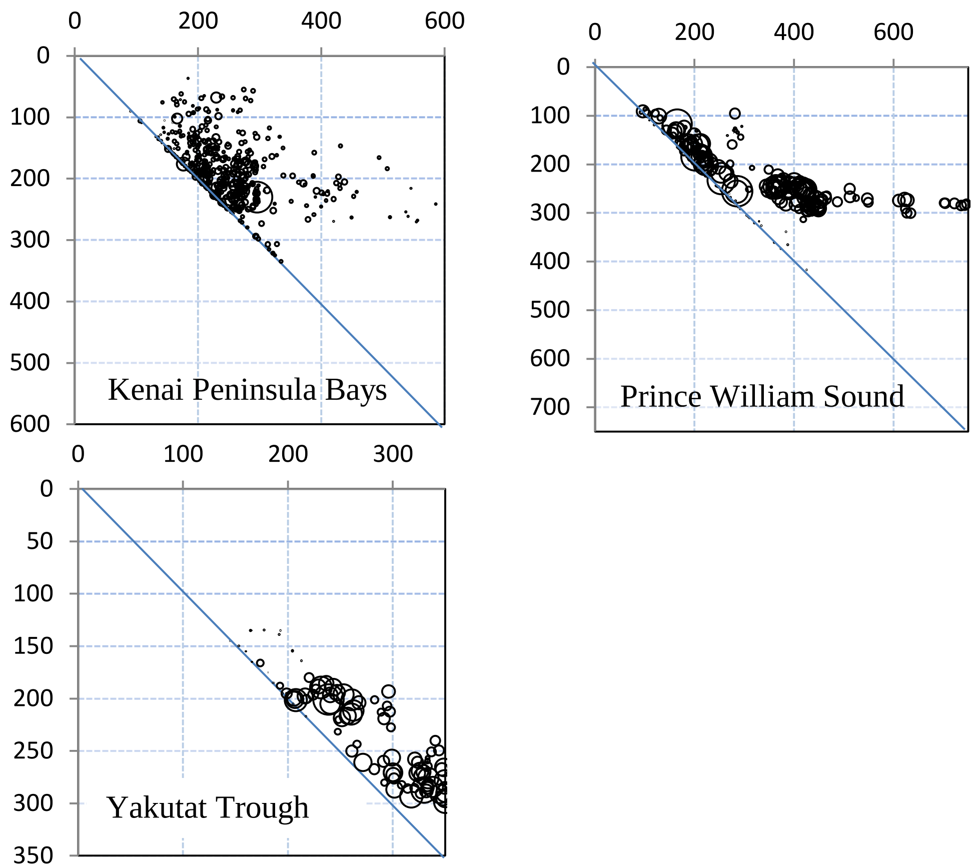

Figure 13. -- Continued.

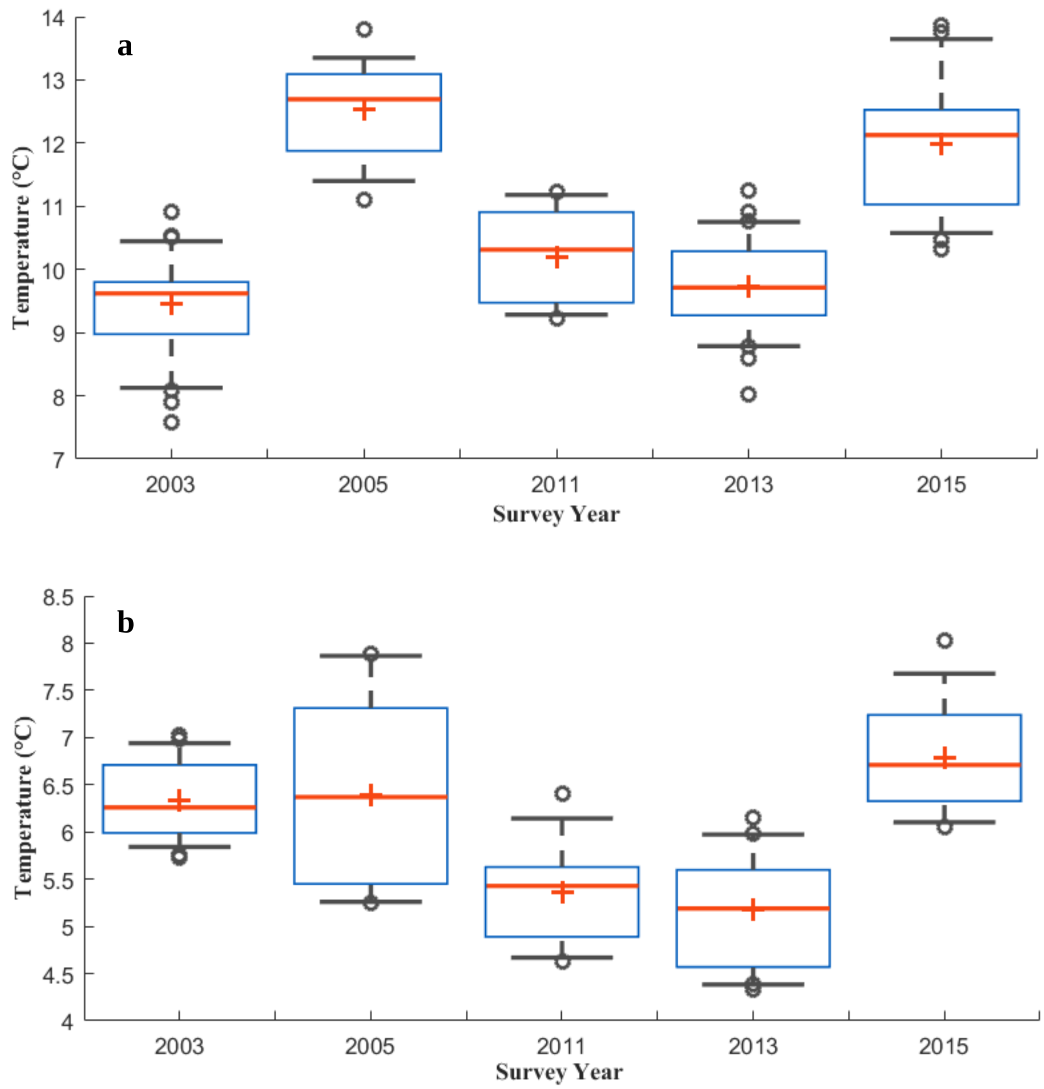

Figure 14. – Temperatures (a) at the surface and (b) at 100 m depth from SBE-39 probes placed on the headrope of fishing gear during the commonly surveyed areas of Barnabas Trough, Chiniak Trough, and Shelikof Strait of the 2003, 3005, 2011, 2013, and 2015 GOA AT surveys. Blue boxes represent data within the 25th to 75th percentiles, whiskers bound the 9th to 91st percentile, red line represents the median, red cross represents the mean, and circles represent outliers.

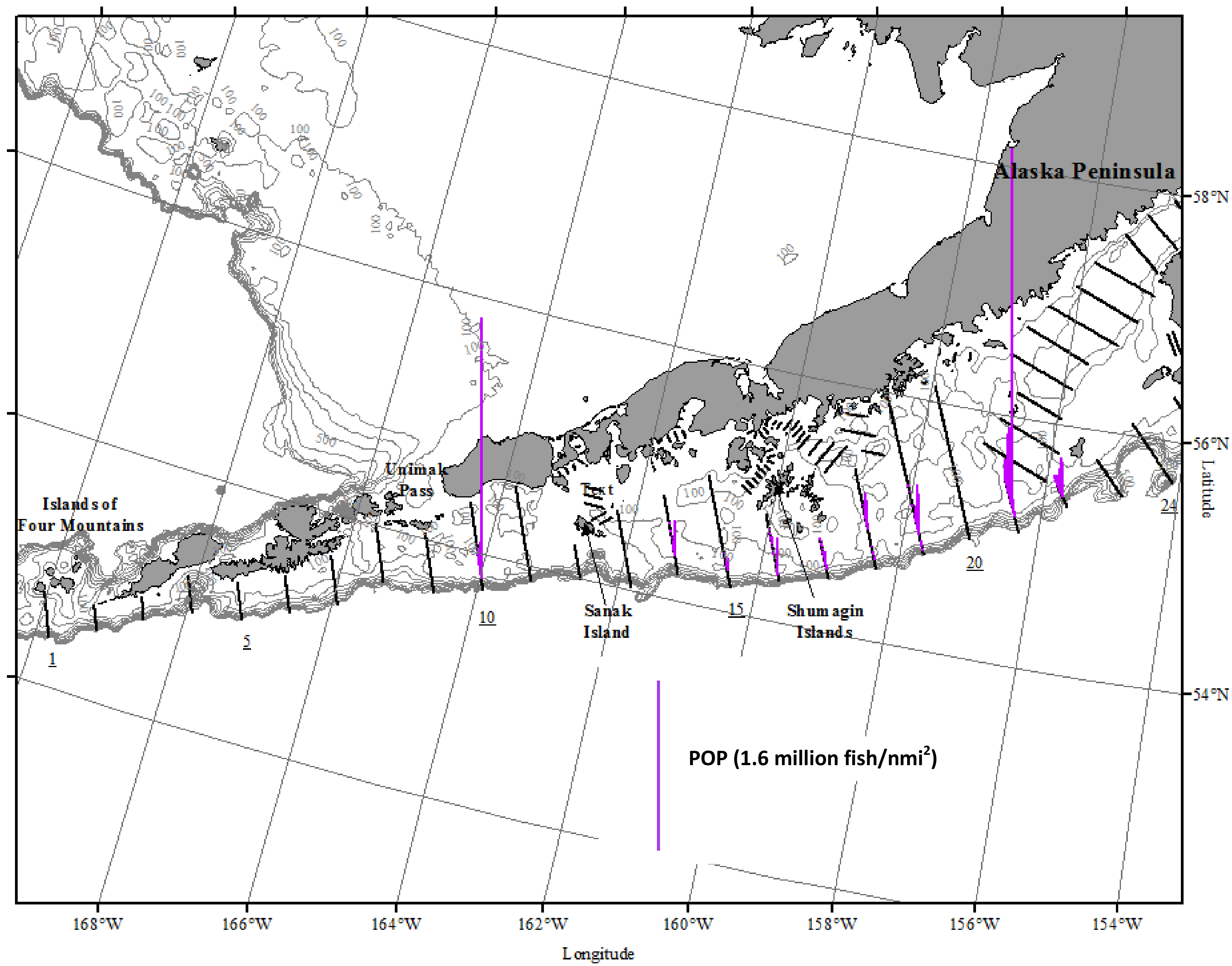

Figure 15. -- Distribution and density (purple vertical lines) of Pacific ocean perch along the western tracklines surveyed during the summer 2015 acoustic-trawl survey of the GOA. Shelf transect line numbers are underlined.

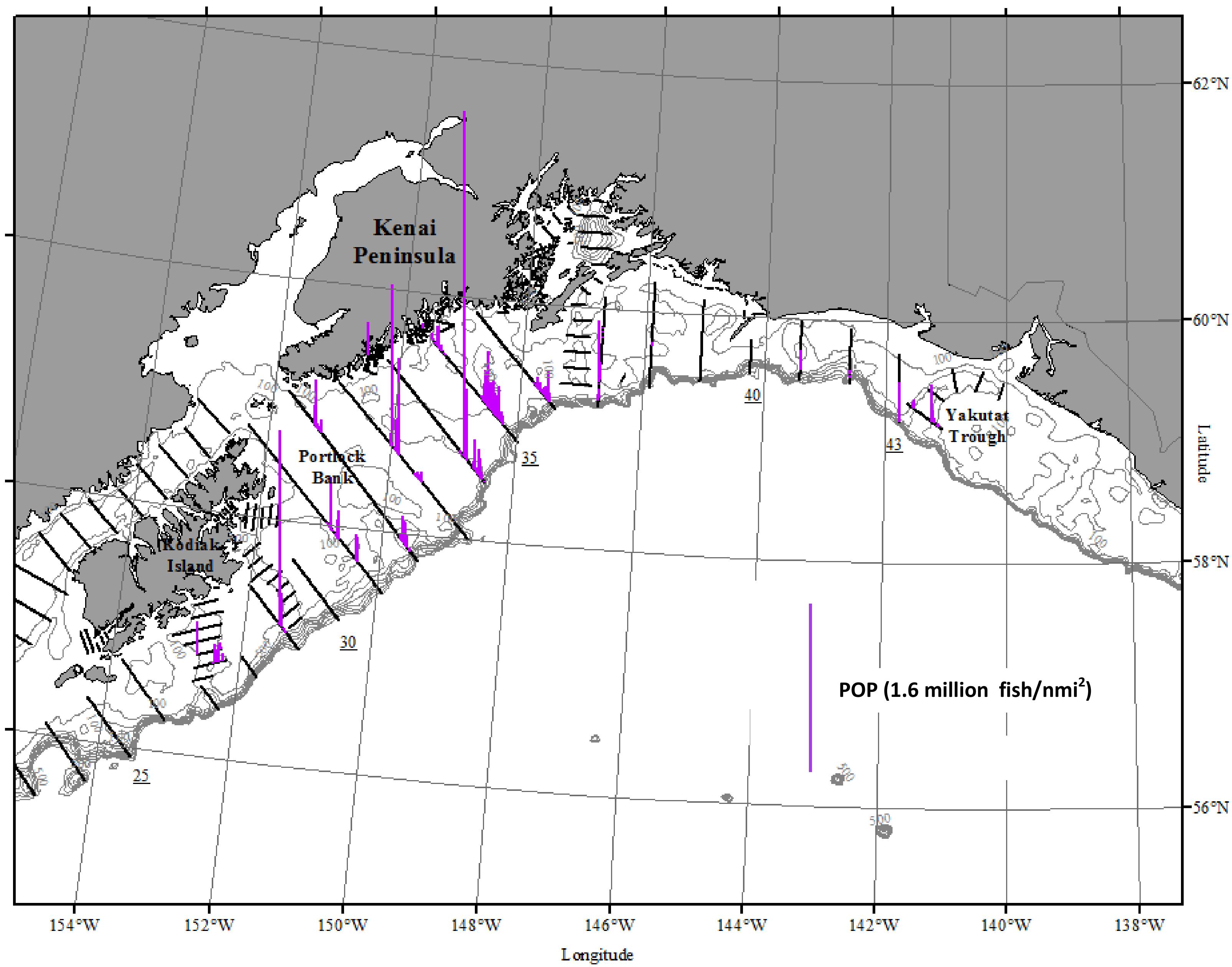

Figure 16. -- Distribution and density (purple vertical lines) of Pacific ocean perch along the eastern tracklines surveyed during the summer 2015 acoustic-trawl survey of the GOA. Shelf transect line numbers are underlined.

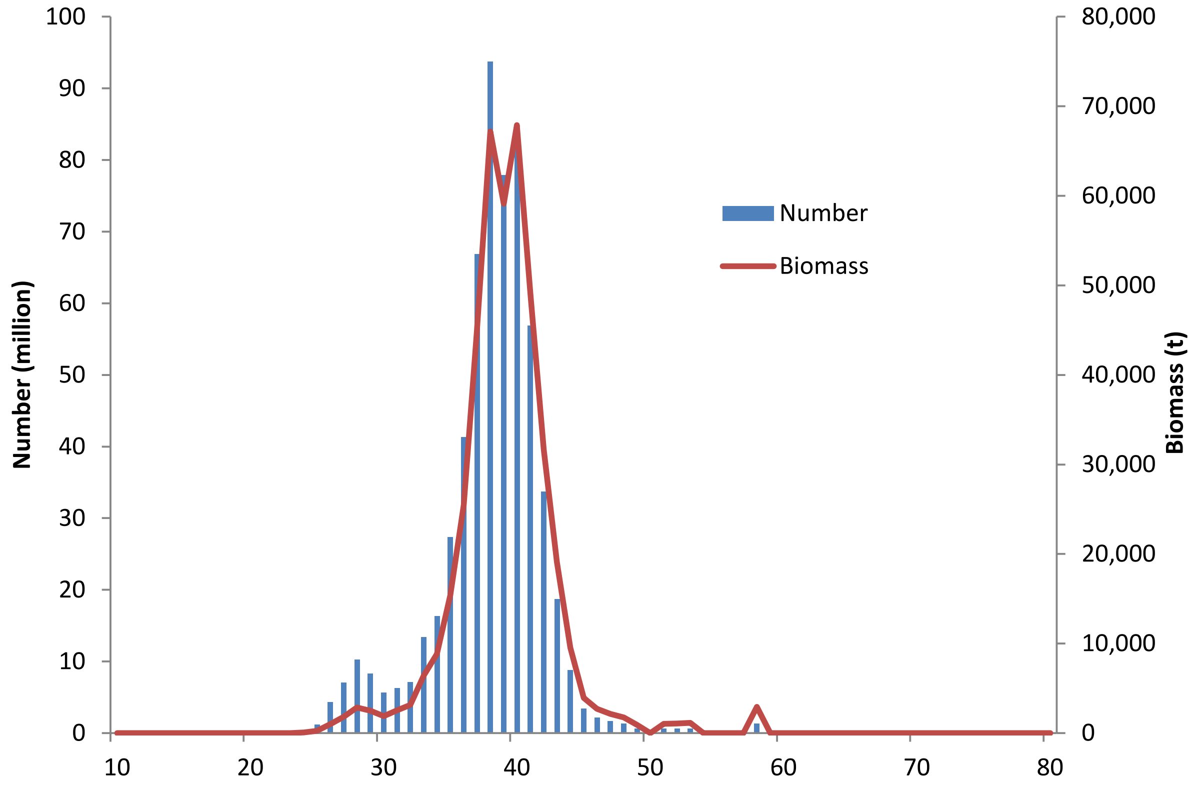

Figure 17. -- Pacific ocean perch numbers (blue bars and primary y-axis) and biomass in metric tons (red line and secondary y-axis) at length (cm) for the entire survey area in the 2015 summer GOA acoustic-trawl survey.

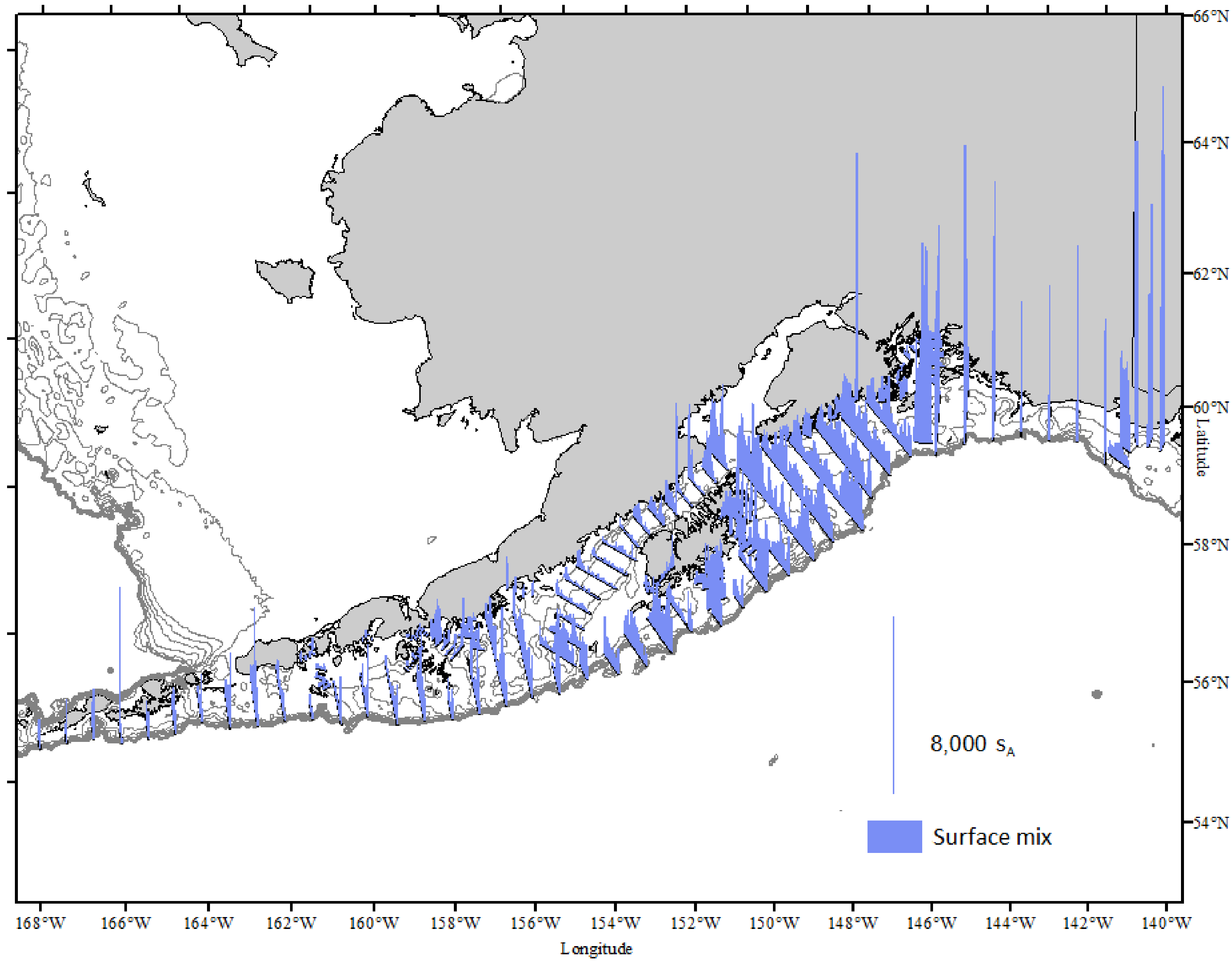

Figure 18. -- Distribution and strength of backscatter (s_A) attributed to undifferentiated surface mix along tracklines surveyed during the summer 2015 acoustic-trawl survey of the GOA.

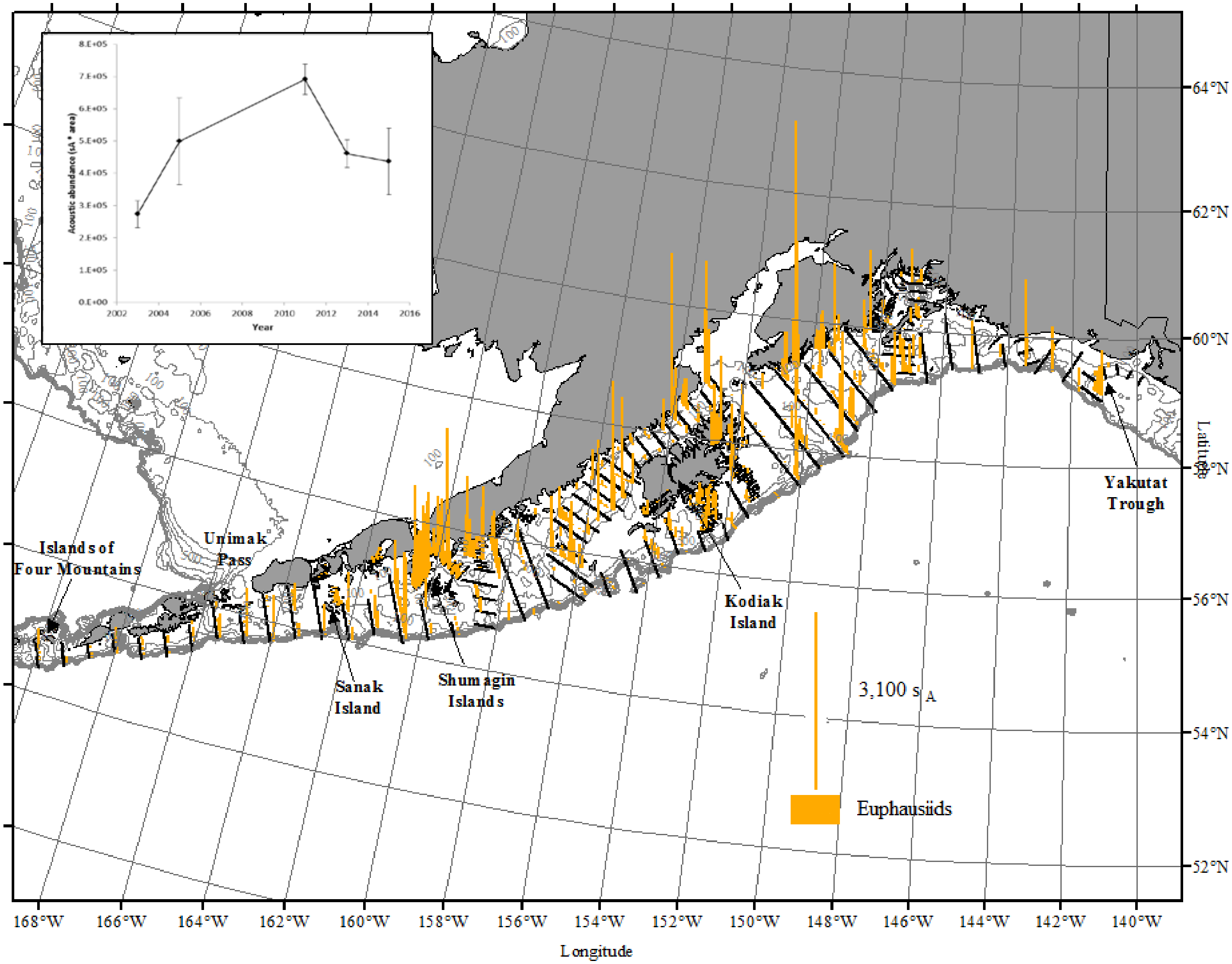

Figure 19. -- Distribution and strength of backscatter (s_A, m^2 nmi^{-2}) at 120-kHz attributed to euphausiids along tracklines surveyed in the entire GOA survey area during the summer 2015 acoustic-trawl survey of the GOA. Inset shows acoustic backscatter estimate of euphausiid abundance from common areas of Gulf of Alaska summer acoustic-trawl surveys. Error bars are approximate 95% confidence intervals computed from geostatistical estimates of relative estimation error (Petitgas 1993).

APPENDIX I. ITINERARY

<u>Leg 1</u>

11 - 13 June	Acoustic sphere calibration in Kalsin Bay, Kodiak Island
13 June	Depart Kodiak, AK
13 - 15 June	Transit to survey start area
15 - 20 June	Acoustic-trawl survey of the GOA shelf (Transects 1-13)
20 June	Acoustic-trawl survey of Sanak Trough (Transects 101-105)
20 June	Acoustic-trawl survey of Morzhovoi Bay (Transects 151-156)
21 June	Acoustic-trawl survey of Pavlof Bay (Transects 201-205)
22 - 24 June	Acoustic-trawl survey of Shumagins Islands area (Transects 251-275)
22 - 23 June	Acoustic-trawl survey of Mitrofania area (Transects 301-304)
25 - 29 June	Acoustic-trawl survey of the GOA shelf (Transects 14-19)
29 - 30 June	Transit to Kodiak
30 June - 6 July	In port Kodiak

<u>Leg 2</u>

6 July	Transit to survey resume point
7 - 13 July	Acoustic-trawl survey of Shelikof Strait (Transects 401-416)
12 July	Acoustic-trawl survey of Nakchamik area (Transects 351-354)
12 - 15 July	Acoustic-trawl survey of the GOA shelf (Transects 20-26)
15 - 16 July	Acoustic-trawl survey of Alitak Bay (Transects 551-556)
16 - 17 July	Acoustic-trawl survey of Marmot and Izhut Bay (Transects 601-617)
18 July	Acoustic-trawl survey of the GOA shelf (Transects 27-28)
18 - 20 July	Acoustic-trawl survey of Barnabas Trough (Transects 501-509)
20 - 21 July	Acoustic-trawl survey of the GOA shelf (Transect 29)
21 - 22 July	Acoustic-trawl survey of Chiniak Trough (Transects 451-459)
22 - 25 July	Acoustic-trawl survey of the GOA shelf (Transects 30-32)
25 July	Transit to Kodiak, AK
25 - 28 July	In port Kodiak, AK

<u>Leg 3</u>

28 July	Transit to survey resume point
29 - 30 July	Acoustic-trawl survey of the GOA shelf (Transects 33)
30 - 31 July	Acoustic-trawl survey of Kenai Peninsula bays (Transects 651-653)
31 July- 1 Aug.	Acoustic-trawl survey of the GOA shelf (Transects 34-35)
2 - 3 Aug.	Acoustic-trawl survey of Kenai Peninsula bays (Transects 654-658)
3 - 4 Aug.	Acoustic-trawl survey of the GOA shelf (Transects 36)
5 Aug.	Acoustic-trawl survey of Kenai Peninsula bays (Transects 659)
5 - 8 Aug.	Acoustic-trawl survey of Prince William Sound (Transects 701-716)
8 - 12 Aug.	Acoustic-trawl survey of the GOA shelf (Transects 37-43)
12 - 13 Aug.	Acoustic-trawl survey of Yakutat Trough (Transects 751-755)
13 - 14 Aug.	Acoustic sphere calibration in Sea Otter Bay, Yakutat, AK
14 - 16 Aug.	Transit to Kodiak, AK
16 Aug.	In Kodiak, AK. End of survey

APPENDIX II. SCIENTIFIC PERSONNEL

Leg I (11 - 30 June)

Name	Position	Organization
Patrick Ressler	Chief Scientist	AFSC
Darin Jones	Fishery biologist	AFSC
Scott Furnish	Computer Spec.	AFSC
Robert Levine	Fishery Biologist	OAI
Emily Collins	Fishery Biologist	PSMFC
Christopher Bassett	Postdoc. Research Associate	UW
Tom Weber	Acoustician	UNH
Nicholette Durkan	Teacher at Sea	NOAA
Vincent Colombo	Teacher at Sea	NOAA
Dianna Miller	Fishery Biologist	PIFSC

Leg II (6 - 25 July)

Name	Position	Organization
Taina Honkalehto	Chief Scientist	AFSC
Kresimir Williams	Fishery Biologist	AFSC
Robert Levine	Computer Spec.	OAI
Nathan Lauffenburger	Fishery Biologist	AFSC
Christopher Bassett	Postdoc. Research Associate	UW
Emily Collins	Fishery Biologist	PSMFC
Dane Kawano	undergraduate student intern	UW
Derek Arterburn	undergraduate student intern	UW
Andrea Schmuttermair	Teacher at Sea	NOAA

Leg III (28 July - 16 Aug.)

Name	Position	Organization
Darin Jones	Chief Scientist	AFSC
Denise McKelvey	Fishery Biologist	AFSC
Nathan Lauffenburger	Fishery Biologist	AFSC
Rick Towler	Computer Spec.	AFSC
Mackenzie Wilson	undergraduate student intern	UW
Emily Collins	Fishery Biologist	PSMFC
Cristina Veresan	Teacher at Sea	NOAA
Sandi Neidetcher	Fishery Biologist	AFSC

AFSC – Alaska Fisheries Science Center, Seattle, WA
PSMFC – Pacific States Marine Fisheries Commission, Portland, OR
NOAA – National Oceanic and Atmospheric Administration
OAI – Ocean Associates, Inc., Arlington, VA
PIFSC – Pacific Islands Fisheries Science Center, Honolulu, HI
UNH – University of New Hampshire - Center for Coastal & Ocean Mapping, Durham, NH
UW – University of Washington, Seattle, WA

APPENDIX III. DERIVING ABUNDANCE-AT-AGE USING AGE-LENGTH KEYS

Acoustic data processing results in abundance-at-length estimates, usually for each 1 cm length bin. To estimate the age composition of the fish population being assessed for abundance, abundance-at-length must be converted to abundance-at-age. A subset of fish from the trawl catches are sampled for age structures, producing a data set of combined length measurements and age estimates. These are used as a basis for computing an age-length key.

The first step in this process is to arrange the data in a length-age matrix (X), where rows represent length (i) in cm and columns represent age (j) in years. Each element then represents the frequency of individual fish samples with a length i and age j. The proportion of fish of each age that were observed for a given length is then computed across rows from the length-age matrix, yielding a new proportion matrix Pi,j, as

$$P_{i,j} = X_{i,j} / \sum_j X_{i,j} \quad . \tag{1}$$

The abundance-at-age is then computed as the matrix multiplication product of a row vector of abundance-at-length and the proportioned length-age matrix P.

Since the sample of fish that are aged is a subset of those measured for length, occasionally there are abundance estimates for length classes that did not have samples that were aged, and therefore using the above procedure results in a lower total abundance-at-age than the total abundance-at-length. The relative amount of this difference is usually small, as the more abundant length classes are likely to be sampled for age. Following is the description of a Gaussian modeling process that was derived to provide estimates of the age distribution for length classes with abundance estimates that are not present in the age sample.

A historic analysis of length-at-age data for walleye pollock has shown that the distribution of fish length at a given age follows an approximately normal distribution, especially for fish samples taken from distinct geographic regions and similar times of year. This allows for the use of Gaussian distributions to model the relationship between length and age.

First, a mean length (μ) and standard deviation (σ) of the aged fish sample is computed for each age class (j). A Gaussian approximation of matrix X is then computed as:

$$\hat{X}_{i,j} = \left(\frac{1}{\sigma_j \sqrt{2\pi}} e^{-\frac{(i-\mu_j)^2}{2\sigma_j{}^2}} \right) N_j \quad , \qquad (2)$$

where N is the number of fish sampled at age j. Because Gaussian models are asymptotic, a small but non-zero value for the distribution of length at a given age extends to the full length range being considered. As it is biologically impossible to encounter certain lengths of fish at certain ages (e.g., a 10 cm pollock with an age of 5 years) the modeled distribution of lengths-at-age are truncated using the minimum and maximum observed length for that age based on historic data. If there are insufficient samples in the aged fish set for a given age (common occurrence with larger, older fish) to derive a mean and standard deviation (e.g., N< 3), a mean and standard deviation based on historic data for that geographic area and season are used. Finally, a matrix $\hat{P}$ is computed using equation 1 but substituting $\hat{X}$ for X.

For length classes where the matrix P is not populated (e.g.,$\sum_i P_{i,j} = 0$), the matrix $\hat{P}$ is used instead. This method allows for historic data collected under similar circumstances to be used to "fill in" for missing age samples, allowing for the total abundance-at-age to equal abundance-at-length.