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Results of the Acoustic-Trawl Survey of Walleye Pollock (*Gadus chalcogrammus*) in the Western/Central Gulf of Alaska, June-August 2011 (DY2011-03)

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Results of the Acoustic-Trawl Survey of Walleye Pollock (*Gadus chalcogrammus*) in the Western/Central Gulf of Alaska, June-August 2011 (DY2011-03)

by

Darin T. Jones, Sarah Stienessen, Kirsten A. Simonsen, and Michael A. Guttormsen

Resource Assessment and Conservation Engineering Division

Alaska Fisheries Science Center

National Marine Fisheries Service

National Oceanic and Atmospheric Administration

7600 Sand Point Way, NE

Seattle, WA 98115

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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) stock assessment survey of the western Gulf of Alaska (GOA) shelf to estimate the distribution and abundance of walleye pollock (*Gadus chalcogrammus*) in summer 2011. Previous partial surveys of the GOA were also conducted during the summers of 2003 and 2005 by MACE. The 2011 survey covered the shelf from the Islands of Four Mountains to the Chiniak Trough east of Kodiak Island including many associated bays and troughs. The biomass estimate for the entire survey area was 452,950 t. The majority of the adult pollock observed was located on the continental shelf (45%), Shelikof Strait (35%), and east of Kodiak Island in Chiniak (8%) and Barnabas Troughs (7%). Large numbers of age-1 walleye pollock (26% of Shelikof pollock biomass) were mixed with older fish in Shelikof Strait. Fish weight at length was similar to surveys conducted in the summer GOA in previous years. Backscatter was attributed to other species where possible. Biomass estimates were also calculated for capelin (*Mallotus villosus*, 27,920 t) and Pacific ocean perch (*Sebastes alutus*, 303,360 t), and relative abundance and distribution was estimated for euphausiids (primarily consisting of *Thysanoessa inermis*, but also including *T. spinifera*, *T. raschii*, and *Euphausia pacifica*).

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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 routinely conduct acoustic-trawl (AT) stock assessment surveys to estimate the distribution and abundance of walleye pollock (*Gadus chalcogrammus*). Surveys are conducted annually in the Gulf of Alaska (GOA) during late winter and early spring to assess pre-spawning aggregations, but have infrequently been conducted in this region during the summer. Several AT surveys were conducted in Chiniak and Barnabas Troughs east of Kodiak Island as part of multi-year studies 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). Large-scale biennial summer AT surveys were planned and conducted in the GOA in summer 2003 and 2005 but were curtailed due to budgetary restrictions in 2003 and vessel mechanical issues in 2005. Further, AFSC leadership decided that the biennial AT summer survey schedule should be revised to not survey the GOA on odd years, and instead survey the Bering Sea for four consecutive years beginning in 2007. Thus, no summer AT GOA survey was conducted in 2007-2010. This report presents the distribution and abundance estimates for walleye pollock and other identified species based on the summer AT survey conducted during June through August 2011. Acoustic system calibration and water temperature observations results are also presented.

METHODS

The survey (cruise DY2011-03) was conducted between 14 June and 12 August on the Gulf of Alaska shelf from 50-500 m depth extending from the Islands of Four Mountains to the Chiniak Trough east of Kodiak Island (Figs. 1 and 2). 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 from inshore bottom depths of $\geq$ 50 m to upper continental slope bottom depths of > 500 m. Smaller surveys were conducted in several bays and around islands including: Morzhovoi Bay, Sanak Trough, Pavlof Bay, the Shumagin Islands areas of Renshaw Point, Unga Strait, and West Nagai Strait, Mitrofania Island, Nakchamik Island, Shelikof Strait, Chiniak Trough, Barnabas Trough, and Alitak Bay. Original plans were to continue to survey the shelf east of Kodiak to Yakutat Bay, including Prince William Sound and Kenai Peninsula bays, but time lost to crew injuries and mechanical problems necessitated dropping all survey work east of Kodiak Island. 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 were collected with a Simrad EK60[2] scientific echo sounding system (Simrad 2008, Bodholt and Solli 1992). 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. Acoustic measurements were collected at 0.5 ms pulse length. A Simrad ME70 multibeam sonar (Simrad 2007, Trenkel et al. 2008) was mounted on the hull 10 m forward of the centerboard at a depth of 6 m below the water surface. Multibeam data were collected using the Simrad ME70 in a 31-beam configuration (Weber et al. 2013). To eliminate interference between the two instruments the ME70 was triggered to ping 0.68 seconds following the EK60, resulting in an effective ping interval for the EK60 of 1.35 seconds.

Calibrations of the EK60 and ME70 systems were conducted using standard spheres to measure acoustic system performance. During calibrations, the ship was anchored at the bow and stern. A tungsten carbide sphere (38.1 mm diameter) suspended below the centerboard-mounted

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[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

[2] Reference to trade names does not imply endorsement.

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. 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 were modeled by moving each sphere through a grid of angular coordinates and collecting target-strength data using the ER60's calibration utility (Simrad 2008). Acoustic system gain and beam pattern parameters measured during the June and August calibrations were used to provide a final parameter set for data analysis. For ME70 calibration, a 25 mm diameter tungsten carbide sphere was centered and swung through all 31 beams in the fan.

Split-beam acoustic data (.raw files) were logged at five frequencies using ER60 software (v. 2.2.1). Acoustic telegram data were also logged with Myriax Echolog 500 (v. 4.70.1.14256) software as a backup.

Trawl Gear and Oceanographic Equipment

Midwater and near-bottom acoustic backscatter was sampled using an Aleutian Wing 30/26 Trawl (AWT). This trawl was constructed with full-mesh nylon wings, and polyethylene mesh in the codend and aft section of the body. The headrope and footrope each measured 81.7 m (268 ft). Mesh sizes tapered 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.

A Multiple-Opening-and-Closing-Codend (MOCC) was affixed to the terminal end of the trawl for the first 11 AWT hauls, 7 of which obtained catch information from multiple codends that sampled in different depth layers. The MOCC allowed the collection of up to three discrete samples from targeted layers of the water column. This was facilitated by electronic controls in the wheelhouse and acoustic connections between the ship and the net for triggering individual nets to open and close. The MOCC was damaged approximately halfway through the survey and was replaced with a standard single codend for the remainder of the survey.

On or near-bottom backscatter was sampled with a poly Nor'eastern (PNE) bottom trawl, which is a 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.

Both the AWT and PNE were fished with 5 m^2 Fishbuster trawl doors each weighing 1,089 kg. Average trawling speed was approximately 1.7 m/sec (3.3 knots). Vertical net openings and 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 for the AWT ranged from 20 to 30 m (66 to 98 ft) and averaged 25 m (82 ft) while fishing. The PNE vertical mouth opening ranged from 6 to 10 m (20 to 33 ft) and averaged 7 m (23 ft) while fishing. Detailed trawl gear specifications are described in Guttormsen 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 hauling. 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. Average trawling speed for the Methot net was approximately 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, and conductivity-temperature-depth (CTD) observations collected with a Sea-Bird CTD (SBE-911plus) system at calibration sites, at predetermined stations, and at nightly opportunistic sites. Additional temperature-depth measurements were taken with Sippican Deep Blue XBTs at various locations along the survey route. Sea surface temperature data were also measured using the ship's 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). Ambient light levels were also measured with a sensor attached to the vessel's flying bridge and with a sensor attached to the AWT footrope.

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, zig-zag transects were used because of the narrowness of the bay. Coverage and transect spacing were chosen to be consistent with previous surveys in each area if possible. Transect placement was randomized by moving previous survey transect starting points an amount less than the intertransect distance, with subsequent transects laid out 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, trawl hauls for species classification, and work with other specialized sampling devices (e.g., a transducer system lowered over the side of the ship to measure target strength, and Simrad ME70 multibeam sonar mini-grids to characterize bottom type).

Trawl hauls were conducted to classify 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[3]. An electronic motion-compensating scale (Marel M60) was used to weigh individual fish to the nearest 2 g. Trawl station and biological measurements were electronically recorded in the Catch Logger for Acoustic Midwater Surveys (CLAMS) database.

The catch from a Methot trawl haul was transferred to a large bucket. Large organisms (such as jellyfish) and small fishes were removed, identified, weighed, and measured for length. The remainder of the plankton catch was placed on a 1-mm mesh screen and weighed. A subsample of the zooplankton mixture was then weighed and sorted into broad taxonomic groups, while a second subsample was weighed and preserved in a 10% buffered formalin solution for more detailed enumeration at the Polish Sorting Center in Szczecin, Poland.

Data Analysis

Data were analyzed using Myriax Echoview post-processing software (Version 4.90.75.18105). Fish abundance and distribution results presented in this report are based on 38-kHz acoustic backscatter integrated using a post-processing S_v threshold of –70 decibels (dB re $1m^{-1}$).

The bottom depth was estimated as the mean of sounder-detected bottom depths based on the five frequencies (Jones et al. 2011). Acoustic backscatter was recorded between depths of 16 m below the surface to 0.5 m above the bottom (except where the bottom exceeded the 500 m lower limit of data collection). 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

[3] 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

composition. If trawl verification of backscatter species composition was not possible, we assigned backscatter based on Cam-Trawl 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 assumed 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 length interval (cm) was estimated from the trawl information when there were six or more walleye pollock for a length interval; otherwise, it was estimated using a linear regression of the natural logs 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 regional 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 capelin and POP from select areas based on similar methodologies using a TS to length relationship for capelin of TS = 20 $\log_{10}$(length)-70.3 (Guttormsen and Wilson 2009) and the generic physoclist fish TS to length relationship for POP of TS = 20 log10(FL)-67.5 (Foote et al. 1987).

For age determinations, walleye pollock otoliths were collected from all areas and stored in a 50% glycerin/thymol-water solution. Otoliths were processed by AFSC Age and Growth Program researchers to determine individual fish ages. Length at age data were used to convert abundance-at-length estimates to abundance-at-age.

Relative 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 estimation variance to the product of the biomass estimate (kg) and the transect spacing for each survey area (nmi):

$$\textit{Relative estimation error} = \frac{\sqrt{variance}}{biomass * transect\ spacing}.$$

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* and then dividing by the sum of the products of the biomass and transect spacing for each area, assuming independence among estimation errors for each survey area (Rivoirard et al. 2000):

$$\textit{Relative estimation error}_{survey} = \frac{\sqrt{\sum_{j=1}^{n} variance_j}}{\sum_{j=1}^{n} biomass_j * transect\ spacing_j}.$$

For regions containing several different transect spacings, the estimation variance is summed for each unique transect spacing area.

Geostatistical methods were used for computation of estimation error as means to account for 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 the techniques of Ressler et al. (2012). These techniques have been applied successfully in the eastern Bering Sea and are, at this stage, still experimental in the GOA pending further validation work being conducted in conjunction with the 2013 summer GOA acoustic survey. Euphausiid backscatter at 120-kHz was identified using custom built programs in both Echoveiw (Myriax 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. Acoustic system settings for data collection were based on results from the 14 June calibration. The average of the logarithmic gain values from 14 June and 7 August was taken in the linear domain and used to scale final results. A total of 32% of all 38-kHz backscatter for the entire GOA survey was classified as pollock.

Walleye Pollock Weight, Length, and Age

Weight at length data were collected from 1,538 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 2011 GOA survey was similar to that of the 2003 and 2005 surveys (Fig. 3).

Otoliths were collected from a total of 1,333 walleye pollock (Table 2), of which 1,321 were aged. As in 2003, fish in Shelikof Strait were slightly smaller at age than fish from the other areas so a separate age key was used for Shelikof Strait. Length at age for all other areas was similar so all areas except Shelikof Strait were combined in a single length at age key.

Sea Water Temperatures

Surface water temperatures across the GOA shelf ranged from 5.2° to 11.5° C (average 8.2° C) increasing from west to east (Fig. 4). However inferences about patterns in these surface temperatures are confounded by the broad time span of the survey: sampling of the shelf was spread over 2 months and generally progressed from west to east. During this time water temperatures throughout the region were increasing to summer highs. Bottom temperatures and temperatures at the depths where most walleye pollock biomass occurred on the shelf (155 m) also increased from west to east and ranged from 4.4° to 8.3° C with an average of 5.3° C (Fig. 4).

Average surface temperatures in the bays and island regions that were surveyed likewise increased from west to east with survey timing but roughly fell into two groups (Fig. 5). Morzhovoi Bay, Pavlof Bay, the Shumagin Islands area, Mitrofania Island, and Nakchamik Island had average surface temperatures between 6.8 and 8.6° C with Morzhovoi Bay and Nakchamik slightly cooler than the others (Fig. 5). Shelikof Strait, Alitak Bay, Deadman Bay, Barnabas Trough, and Chiniak Trough were warmer than the other group of areas surveyed and averaged between 10.3°C and 11.8°C. Deadman Bay had the warmest surface temperature and coolest bottom temperature due to the long, narrow, and deep fjord-like characteristic of the bay. Bottom temperatures near the mouth of Alitak Bay were warmer than in all other areas presumably due to the bay’s shallow depth (65 m).

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

The GOA shelf from the Islands of Four Mountains to the western edge of Chiniak Trough east of Kodiak Island (Figs. 1 and 2) was surveyed between 17 June and 9 August. The survey covered the shelf and associated shelf break between the 35 and 500 m depth contours. Acoustic backscatter was measured along 2,485 km (1,342 nmi) of trackline with 36 transects spaced 37 km (20 nmi) apart encompassing an area of 92,055 km^2 (26,839 nmi^2).

Biological data and specimens were collected along the GOA shelf from 10 AWT hauls and 10 PNE hauls, 5 of which were fished in midwater (Tables 2-5; Figs. 1 and 2). Catch by weight in the midwater trawls was dominated by walleye pollock (94.8%) with Pacific ocean perch (POP; *Sebastes alutus*) the second most abundant species (2.4%) captured. Capelin was the most abundant species captured by number (60.3%) in the midwater hauls and walleye pollock was the second most abundant species by number (36.9%; Table 4).

Catch compositions in the demersal hauls on the shelf differed by location. Overall, Atka mackerel was the most abundant species caught in the demersal hauls by weight (43.9%) and number (43.5%; Table 5) but 84% of the Atka mackerel caught were from a single haul (haul 19). Pacific ocean perch was the second most abundant species caught in demersal hauls on the shelf (23.8% by weight, 29.1% by number), but 91% of the POP caught was from a single haul (haul 9). Walleye pollock was the third most abundant species in demersal hauls on the shelf (21.1% by weight, 15.4% by number) with 90% of the catch from 2 of the 4 hauls (hauls 1 and 2) from which it was caught (Table 5). Age-0 walleye pollock were captured in the PNE on the GOA shelf in hauls 18 (demersal) and haul 31 (pelagic).

The adult walleye pollock caught on the GOA shelf ranged in length from 31 to 73 cm FL with a mode of 45 cm FL (Table 6 and 7; Fig. 6). Walleye pollock on the shelf ranged in age from 1 to 17 years old with age-4 fish most abundant (Table 8 and 9). Capelin lengths ranged from 8 to 10 cm SL (average 9.8 cm SL) near Mitrofania Island, and on the south side of Kodiak Island capelin lengths ranged from 6 to 9 cm SL and averaged 7.2 cm SL. Lengths of POP on the shelf and ranged from 32 to 50 (average 39.5 cm FL) on all but one of the demersal hauls. POP lengths in the demersal haul south of the Shumagin Islands (haul 19) ranged from 18 to 32 cm FL and averaged 23.5 cm FL. Atka mackerel caught in haul 19 had a distinct bimodal length range, one ranging from 27 to 32 cm with a mode at 30 cm FL, and one from 41 to 51 cm with a mode at 48 cm FL.

Walleye pollock were generally evenly dispersed across the shelf (Figs. 7 and 8). The areas of greatest walleye pollock backscatter on the shelf transects were southeast of the Islands of Four Mountains, between Mitrofania and Nakchamik Islands, and near the mouth of Barnabas Trough. Very little backscatter was recorded in these areas in the two previous surveys. Most walleye pollock on the shelf were between 100 and 200 m deep in waters up to 500 m depth (Fig. 9).

The walleye pollock biomass estimate for the GOA shelf area was 202,273 t (Table 10), 45% of the total walleye pollock biomass of the entire survey. The relative estimation error of the biomass based on the one-dimensional geostatistical analysis was 8.9%. Prior summer GOA shelf surveys did not cover the exact same geographic extent covered in 2011 (Fig. 10) so direct comparisons between years are not possible. However, in 2003 part of the shelf survey from the Shumagin Islands to Chiniak Trough covered 823 nmi of trackline (15,154 nmi^2) and resulted in a biomass estimate of 14,249 t. The similar area surveyed in 2011 was covered by 682 nmi of transects (13,640 nmi^2) and resulted in 131,213 t of walleye pollock. In 2005 the shelf survey covered the Islands of Four Mountains to the Shumagin Islands and continued farther offshore, but from the Shumagin Islands to Amatuli Trench the survey only covered the shelfbreak and deeper waters and did not cover the shelf. Table 10 lists the walleye pollock numbers and biomass for each of the three years surveyed by management area and survey. The number and biomass of walleye pollock in the shelf portion of the Shumagin INPFC area (610) was similar in 2005 and 2011 while in the Chirikof INPFC area (620) the number and biomass increased over the survey history to date. The number and biomass of walleye pollock in the shelf portion of the Shelikof INPFC area (630) have fluctuated with a high in 2003, a low in 2005, and intermediate amounts in 2011, but again, the sampling effort in each of the areas is not equivalent across years.

Fishing on backscatter located on the shelfbreak (bottom depths from 200 to 500 m) was attempted several times with very limited success and was generally not conducted frequently enough to classify the source of the backscatter with a high degree of confidence. These hauls were typically dominated by either pollock or rockfish. The multifrequency backscatter response of rockfish and walleye pollock is too similar to distinguished between the species using the method of De Robertis et al. (2010). Rather than simply classifying this backscatter as the uninformative title of 'fish', the backscatter sources were classified using a combination of nearby haul catches, school morphology, and experience from previous summer and winter cruises in the area. Using this approach, walleye pollock backscatter on the shelfbreak amounted to 5% of the total pollock backscatter for the shelf. Rockfish backscatter on the shelfbreak amounted to 16% of the total rockfish backscatter for the shelf. These results suggest walleye pollock are a relatively small part of the fish populations on the shelf. However, our walleye pollock abundance estimates could be underestimated if some of the backscatter identified as rockfish was from walleye pollock.

Morzhovoi and Pavlof Bays

Morzhovoi and Pavlof bays were surveyed on 22 and 25 June respectively. Acoustic backscatter in Morzhovoi Bay was measured along 85 km (46 nmi) of trackline on 12 transects encompassing an area of 312 km^2 (91 nmi^2), and in Pavlof Bay along 83.3 km (45 nmi) of trackline on 11 transects encompassing an area of 305 km^2 (89 nmi^2; Fig. 1). Transects in both bays were spaced 3.7 km (2 nmi) apart and ranged in depth from 40 to 140 m.

Biological data and specimens were collected in Morzhovoi Bay from one AWT haul in midwater and one PNE trawl on the bottom (Tables 2, 3, 11 and 12; Fig. 1). Walleye pollock was the most abundant species caught in the AWT haul in Morzhovoi Bay, contributing 98.5% by weight and 99.3% by numbers (Table 11). Walleye pollock was also the most abundant species caught in the PNE haul in Morzhovoi Bay contributing 65.8% by weight (Table 12). By numbers flathead sole was the most abundant species caught in the PNE haul in Morzhovoi Bay comprising 40.4% of the catch, while walleye pollock contributed 39.3%. Most of the walleye pollock captured in Morzhovoi Bay ranged from 57 to 73 cm with some smaller fish ranging from 14 to 55 cm (Tables 6 and 7; Fig. 6). Fish captured in Morzhovoi Bay ranged in age from 1 to 17 with major modes at age-6 and age-11 (Tables 8 and 9).

Backscatter in Morzhovoi Bay attributed to walleye pollock,diffuse and evenly distributed throughout the bay (Fig. 7), was observed to be at an average depth of 80 m and approximately 10 m off the bottom (Fig. 9). The biomass estimate for Morzhovoi Bay was 4,441 t (Table 10). The relative estimation error of the biomass based on the 1-D geostatistical analysis was 7.4%. Morzhovoi Bay was not surveyed in the 2003 or 2005 summer surveys.

One midwater AWT was conducted in Pavlof Bay (Tables 2, 3, and 13; Fig. 1). The catch in Pavlof Bay was dominated by walleye pollock with only a few other organisms caught (Table 11). Most of the walleye pollock captured in Pavlof Bay ranged from 27 to 46 cm FL (Tables 6 and 7; Fig. 6) and were between 2 and 5 years old with age-3 fish most abundant (Tables 8 and 9).

The majority of acoustic backscatter attributed to walleye pollock in Pavlof Bay was observed in the mouth of the bay (Fig. 7), at a depth of 90 m in water 104 m deep on average (Fig. 9). The biomass estimate for Pavlof Bay was 2,883 t (Table 10) with a relative estimation error of 8.3%. Pavlof Bay was not surveyed in the 2003 or 2005 summer surveys.

Sanak Trough

Sanak Trough was surveyed on 23 June along 153.7 km (83 nmi) of tracklines on 9 transects spaced 3.7 km (2 nmi) apart encompassing an area of 679 km^2 (198 nmi^2; Fig. 1). Bottom depths ranged from 40 to 172 m.

No trawl activity was conducted in Sanak Trough because fish aggregations were not dense enough to fish on. Due to the lack of trawl activity in the Sanak Trough, the scant backscatter attributed to walleye pollock was designated a length distribution similar to that for pollock caught on the shelf.

The backscatter attributed to walleye pollock in Sanak Trough was diffuse and evenly scattered throughout the area (Fig. 7) at approximately 90 m deep in water up to 150 m deep (Fig. 9). The biomass estimate for Sanak Trough was 997 t. The relative estimation error of the biomass based on the 1-D geostatistical analysis was 10.8%. Sanak Trough was not surveyed in either the 2003 or 2005 summer surveys.

Shumagin Islands

The West Nagai Strait, Unga Strait, and Renshaw Point areas in the Shumagin Islands were surveyed from 7 to 8 July. During winter surveys these areas are combined with Shumagin Trough as the Shumagin Islands area, but on this survey the Shumagin Trough was surveyed with the wider spaced transects of the shelf and slope area due to time constraints. Any comparisons between winter and summer Shumagin Islands area results should take this difference in coverage into account. Acoustic backscatter was measured along 225.9 km (122 nmi) of tracklines encompassing an area of 936 km^2 (273 nmi^2; Fig. 2). Transects were spaced 4.6 km (2.5 nmi) apart in West Nagai Strait, and Unga Strait, and 3.7 km (2.0 nmi) apart east of Renshaw Point. Bottom depths did not exceed 220 m along any transect, and transects generally did not extend into waters less than about 50 m depth.

Biological data and specimens were collected in the Shumagin Islands in two midwater AWT hauls, one in Unga Strait used the MOCC at several depths, and one off Renshaw Point fished at only one depth (Tables 2, 3, and 14; Fig. 2). Overall, walleye pollock, age-2 to -17, was the most abundant species caught by weight (92.7%), followed by eulachon (5.3%), in the Shumagin Islands (Table 14). The walleye pollock and eulachon were all caught in the haul conducted off Renshaw Point. The walleye pollock ranged in length from 31 to 67 cm FL with multiple modes (Tables 6 and 7; Fig. 6) and eulachon were 11 to 19 cm FL and averaged 15 cm FL. Age-5 walleye pollock were most abundant in biomass but age-3 fish were more numerous (Tables 8 and 9). Euphausiids, which are normally too small to be caught in the AWT unless the meshes are blocked by other organisms, were captured in large numbers in the haul in Unga Strait. Excluding euphausiids, age-0 walleye pollock (3-4 cm SL), eulachon, and capelin (6-13 cm SL) were the most abundant species caught by numbers (~25% each) in the Shumagin Islands hauls (Table 14). Age-0 pollock were caught solely in the haul conducted in Unga Strait. Capelin were caught in both the Unga and Renshaw hauls, and displayed size variation between hauls. The haul in Unga Strait caught 6 cm SL capelin at 102 m depth and 7.1 cm SL at 40 m depth. The haul near Renshaw Point caught 12 cm SL capelin at 145 m depth.

Walleye pollock were distributed in scattered patches throughout the Shumagin Islands area (Fig. 7). Average walleye pollock depth was 135 m deep in water 160 m deep (Fig. 9). The 2011 biomass estimate of 4,173 t was only 57% of the 2003 summer survey estimate (7,370 t) when approximately 10% more area (304 nmi^2) was surveyed (Table 8). The relative estimation error of the biomass based on the 1-D geostatistical analysis was 8.8%. This area was not surveyed in summer 2005.

Mitrofania and Nakchamik Islands

Surveys near Mitrofania and Nakchamik Islands were conducted from 9 through 12 July. Acoustic backscatter in the vicinity of Mitrofania Island was measured along 61 km (33 nmi) of tracklines with the 4 transects spaced 6.5 km (3.5 nmi) apart encompassing an area of 394 km^2 (115 nmi^2; Fig. 2). Near Nakchamik Island acoustic backscatter was measured along 87 km (47 nmi) of trackline with the 9 transects spaced 5.6 km (3.0 nmi) apart encompassing an area of 487 km^2 (142 nmi^2). Bottom depths ranged from about 57 to 149 m near Mitrofania and from 55 to 275 m near Nakchamik.

Biological data and specimens were collected in Mitrofania and Nakchamik from one midwater AWT haul each (Tables 2, 3, 15 and 16; Fig. 2). Walleye pollock was the most abundant species caught in Mitrofania and Nakchamik, contributing 98.6% and 94.6% by weight and 88.6% and 70.2% by numbers in the two areas, respectively (Tables 15 and 16). Chum salmon were the second most abundant species by weight, and eulachon were the second most abundant species by numbers in both areas.

In Mitrofania, walleye pollock ranged from 32 to 64 cm with a mode of 46 cm (Tables 6 and 7; Fig. 6) and ranged in age from 2 to 15 with age-4 fish most abundant (Tables 8 and 9). In Nakchamik, almost all pollock captured were between 26 and 42 cm with a few larger fish ranging up to 60 cm (Tables 6 and 7; Fig. 6) and ranged in age from 2 to 13 with age-3 fish most abundant (Tables 8 and 9). Eulachon ranged in length from 15 to 19 cm FL at Mitrofania and 11 to 18 cm FL at Nakchamik.

Walleye pollock backscatter densities were highest on transects west and south of Mitrofania Island (Fig. 8). Most of the backscatter was located within 10 m of the sea floor over bottom depths of 100-150 m (Fig. 9). The biomass estimate in Mitrofania was 4,033 t. The relative estimation error of the biomass based on the 1-D geostatistical analysis was 12.7%. Mitrofania was surveyed in 2003 along 19.5 nmi of trackline (68 nmi^2) resulting in 11 t of pollock biomass (Table 10). The region was not surveyed in 2005.

Backscatter attributed to walleye pollock in Nakchamik was diffusely distributed throughout the region (Fig. 8) generally below 100 m depth in waters up to 300 m deep (Fig. 9). The biomass estimate was 1,736 t. The relative estimation error of the biomass based on the 1-D geostatistical analysis was 6.1%. Nakchamik was surveyed in 2003 along 45 nmi of trackline (133 nmi^2) resulting in 4,079 t of pollock biomass (Table 10). The region was not surveyed in 2005.

Shelikof Strait

The Shelikof Strait sea valley was surveyed from 16 to 21 July using 18.5 km (10 nmi) spacing for 20 transects and 37.0 km (20 nmi) spacing for the three transects in the northeast portion of the Strait. Acoustic backscatter was measured along 1,345 km (726 nmi) of tracklines encompassing an area of 27,251 km^2 (7,945 nmi^2; Fig. 2). Bottom depths did not exceed 325 m along any transect, and transects generally did not extend into waters of less than about 50 m depth.

Biological data and specimens were collected in Shelikof Strait from 8 AWT trawls and 1 PNE trawl conducted in midwater (Tables 2, 3, and 17; Fig. 2). Walleye pollock and eulachon were the most abundant species, contributing 91.7% and 6.8% by weight, respectively, and 67.4% and 31.6% by number, respectively, to the total catch (Table 17). Walleye pollock caught in Shelikof Strait ranged in length from 11 to 65 cm FL with major modes at 16 and 45 cm (Tables 6 and 7; Fig. 6). Ages of walleye pollock from Shelikof Strait ranged from 1 to 11 years old, with age-1 and -4 fish most abundant (Tables 8 and 9). Eulachon captured in Shelikof Strait ranged in length from 6 to 20 cm FL with a mode at 13 cm. The smallest eulachon (7-12 cm FL) were all from a single haul (haul 38) near Cape Ikolik on the western side of Kodiak Island.

The highest walleye pollock densities observed in Shelikof Strait were in the southern half of the Strait along the central to eastern side from western Kodiak Island to Chirikof Island (Fig. 8). Age-1 walleye pollock aggregations were denser in the southern half of the Strait compared to the northern half. Most age-1 walleye pollock were generally located 150-200 m from the surface in rather dense aggregations approximately 50 m above the seafloor (Fig. 9).
The biomass estimate for Shelikof Strait was 157,541 t (Table 10), 26% of which were age-1 walleye pollock (90% by numbers). The relative estimation error of the biomass based on the 1-D geostatistical analysis was 6.2%. An estimated 1.5 billion 1-year-old walleye pollock indicates that the 2010 year class was rather strong compared to recent years. In 2003, 648 nmi of trackline (8,377 nmi^2) were surveyed for a biomass estimate of 151,294 t, of which 5% were age-1 (Table 10) and in 2005, 390.5 nmi of trackline (5,420 nmi^2) were surveyed for a biomass estimate of 81,604 t, of which 56% were age-1.

Alitak/Deadman Bay

Alitak Bay was surveyed on 10 and 11 August along 8 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 Deadman Bay area. Acoustic backscatter was measured along 122 km (66 nmi) of tracklines encompassing an area of 583 km^2 (170 nmi^2; Fig. 2). Bottom depths ranged from 24 to 176 m.

A distinct backscattering layer and several smaller aggregations were detected in the outer mouth of Alitak Bay. However, a large group of feeding whales prevented adequate trawl sampling of these areas. Biological data and specimens were collected in the mouth of Alitak Bay from two PNE hauls, one in midwater and one demersal (Tables 2, 3, and 18; Fig. 2). Walleye pollock comprised 71.4% by weight but only 1.7% by numbers from the two PNE trawls (Table 18). Capelin (6-12 cm SL; average 7.3 cm) was the second most abundant species caught by weight (10.7%) but was the most abundant species by number (59.1%). Age-0 walleye pollock was the second most abundant species by numbers caught (19.7%). The age-0 walleye pollock caught at the mouth of Alitak Bay where primarily 4 to 8 cm SL and the few larger walleye pollock caught were in the 50 to 64 cm FL range. Because the number of pollock caught in the two PNE hauls at the mouth of Alitak Bay was so small (18 and 27, respectively) and the number of capelin was much higher (973 and 552, respectively), the backscatter at the mouth of Alitak Bay was not assigned to walleye pollock.

In Deadman Bay, within Alitak Bay, dense layers found primarily from 100 m to the seafloor at 175 m (Fig. 9) was sampled with one AWT haul conducted near the head of the Bay (Tables 2, 3, and 19; Fig. 2). Walleye pollock dominated the catch by weight and numbers (Table 19) and ranged in length from 28 to 61 cm with modes at 32 cm, 40 cm, and 47 cm FL (Tables 6 and 7; Fig. 6) with the majority of fish between 2 to 4 years old (Tables 8 and 9).

The biomass estimate for the Alitak/Deadman Bay was 2,643 t. Even though the aggregation in Deadman Bay was very dense, the overall Deadman Bay biomass estimate was less than 1% of the entire summer survey biomass because of the small geographic area contained within the bay. In summer 2003, Alitak Bay was surveyed along 51.5 nmi (154 nmi^2) of trackline resulting in 9,227 t (Table 10), most of which occurred in the outer portion of Alitak Bay. Alitak Bay was not surveyed in summer 2005.

Chiniak and Barnabas Troughs

Chiniak Trough was surveyed on 7 and 8 August and Barnabas Trough was surveyed from 9 to 12 August. Acoustic backscatter was measured along 172 km (93 nmi) (1,924 km^2; 561 nmi^2) of trackline on 8 transects in Chiniak and 243 km (131 nmi) (2,696 km^2; 786 nmi^2) of trackline on 9 transects in Barnabas Trough (Fig. 2). Chiniak and Barnabas Trough transects were spaced 11.1 km (6 nmi) apart. Depths ranged from 57 to 243 m in Chiniak and in from 36 to 186 m in Barnabas.

Biological data and specimens were collected in Chiniak Trough from three AWT hauls, and two AWT hauls were conducted in Barnabas Trough (Tables 2, 3, 20 and 21; Fig. 2). Walleye pollock was the most dominant species caught, contributing 99.9% and 99.7% by numbers in both areas (Tables 20 and 21). Most of the walleye pollock captured in Chiniak Trough ranged in length from 31 to 69 cm with a major mode at 53 cm FL and a lesser mode at 36 cm (Tables 6 and 7; Fig. 6). Most of the walleye pollock captured in Barnabas Trough ranged in length from 41 to 64 cm with a mode at 48 cm (Tables 6 and 7; Fig. 6). Fish in both areas ranged in age from 1 to 17 years old with age-5 fish being most abundant (Tables 8 and 9). Eulachon were caught in Chiniak Trough in low numbers but they ranged in length from 9 to 21 cm FL with most of the individuals measuring 9 cm FL.

Large aggregations of adult walleye pollock were detected in Chiniak and Barnabas Troughs (Fig. 8) from 100 to 150 m deep in waters averaging approximately 150 m deep (Fig. 9).The biomass estimate for Chiniak Trough was 38,398 t, approximately 8% of the entire GOA summer survey biomass estimate. The relative estimation error of the biomass based on the 1-D geostatistical analysis was 7.4%. In 2003 Chiniak was surveyed along 181.5 nmi (544 nmi^2) of trackline and resulted in a biomass estimate of 13,985 t (Table 10). In 2005 76.5 nmi (459 nmi^2) of trackline were surveyed for a biomass estimate of 12,577 t.

The biomass estimate for Barnabas Trough was 33,835 t, approximately 7% of the entire GOA summer survey biomass estimate. The relative estimation error of the biomass based on the 1-D geostatistical analysis was 9.7%. In 2003 Barnabas was surveyed along 239 nmi (717 nmi^2) of trackline and resulted in a biomass estimate of 30,396 t (Table 10). In 2005 129 nmi (774 nmi^2) of trackline were surveyed for a biomass estimate of 15,055 t.

Pollock Biomass by Management Area

The survey areas outlined above do not necessarily follow the boundaries of the INPFC management areas. Some areas, such as the expansive shelf survey, Mitrofania, and Shelikof Strait extend across multiple management areas. Because walleye pollock are managed based on these management areas, we have also summarized the survey results based on these units. Table 22 presents the biomass of pollock within each management area, along with the geographic survey area from which they were derived, for fish less than or equal to 23 cm FL (age-1) and fish greater than 23 cm FL (age-2+).

The total walleye pollock biomass for the entire GOA summer acoustic-trawl survey was 452,950 t and spanned three different management areas. The relative estimation error of the biomass based on the 1-D geostatistical analysis was 6.0%. Area 620 contained the largest amount of age-2+ fish, with 51% of the total biomass from the survey and 47% of the biomass of fish age-2+. Area 620 also contained the largest amount of age-1 fish, with 89% of the age-1 biomass from the survey. The Shelikof Strait geographic area contained 28% of the age-2+ fish and 99.9% of age-1 fish of all the geographic areas within the survey. Overall age-1 fish made up 9% of the total biomass of the summer GOA survey.

Ancillary Acoustic Backscatter

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

Capelin

Several large aggregations of capelin were encountered on the GOA shelf east of Kodiak Island (Fig. 11) and where the predominant component of several hauls (hauls 31 and 45). Smaller aggregations were also observed in the northern section of West Nagai Strait and Unga Strait of the Shumagin Islands and interspersed with pollock in the mouth of Alitak Bay and the northeastern section of Shelikof Strait. Length compositions of capelin varied by area and haul and ranged from 6 to 13 cm as previously described in the catch for the shelf and the Shumagins area. Capelin backscatter was primarily classified on the basis of trawl catches. Capelin backscatter may have a somewhat different frequency response (Fig. 11) than that expected for pollock (Fig. 7), though it is not clear that these taxa can easily be distinguished on this basis (cf. Fig. 4 in De Robertis et al. 2010). Backscatter attributed to capelin made up a total of 2% of the backscatter for the entire survey. The total capelin biomass for the summer survey was estimated at 27,920 t. The relative estimation error of the biomass based on the 1-D geostatistical analysis was 27.9%.

Rockfish/POP

Backscatter characterized as rockfishes based on trawl catches and backscatter morphology ("haystacks" on the bottom) was present throughout the shelf and in several of the bays (Figs. 12 and 13). Rockfish backscatter was noticeably absent from Shelikof Strait, Barnabas Trough, and Chiniak Trough. Aggregations typically extended from the seafloor to approximately 10 - 20 m off the seafloor and were localized and patchy. The multifreqency response was rather flat in that the response from all frequencies did not differ markedly from 38-kHz (Fig.12; cf. Fig. 4 in De Robertis et al. 2010). Several species of rockfishes were captured during trawl operations on the shelf including Pacific ocean perch, dusky rockfish, northern rockfish, and black rockfish. These rockfish species comprised a total of 28% of the PNE catch by weight on the shelf, of which 87% were POP (Table 5). Backscatter attributed to rockfishes made up 6.5% of the total backscatter for the entire survey, however, no backscatter was designated as POP specifically. If it is assumed that approximately 87% of the rockfish backscatter is from POP, the biomass estimate for POP for the 2011 GOA survey area would be 303,360 t. The relative estimation error of the biomass based on the 1-D geostatistical analysis was 8.3%.

Eulachon

Because eulachon lack swimbladders, they do not produce a very strong acoustic return (Gathier and Horne 2004); therefore they are generally only detected in our surveys when they are caught in trawls. Eulachon were encountered in the Mitrofania and Nakchamik areas, and in greater numbers in the Renshaw Point area of the Shumagin Islands (haul 22.1) and in two areas in

Shelikof Strait, in the northeast portion of the Strait next to Afognak Island (haul 34) and in the southern portion of the Strait to the west of Kodiak Island (hauls 38 and 40). In Shelikof Strait eulachon were often found deeper than the dense age-1 walleye pollock schools intermixed with lighter amounts of age-1 walleye pollock, but in at least one area (haul 40) eulachon and age-1 walleye pollock were found diffusely mixed below 150 m depth. Length compositions of eulachon varied slightly by area and haul as described in the catch for the Shelikof Strait. No biomass estimate was calculated for eulachon.

Undifferentiated Surface Mix

A thick layer of undifferentiated surface backscatter was prevalent throughout much of the summer GOA survey and was particularly abundant throughout the Shumagin Islands and Mitrofania areas (Figs. 14 and 15). This backscatter ranged from the surface to over 60 m deep and composed 51% of the total backscatter seen throughout the entire survey. The multifrequency response was between that of capelin and rockfish/pollock and was also different from the typical response seen for euphausiids. Methot hauls in this layer did not definitively identify the source which was probably a mixture of several species of gelatinous plankton or larval fishes, but did not contain age-1+ pollock, rockfish, capelin, or eulachon.

Methot Hauls and Euphausiid Abundance

A total of seven Methot hauls were conducted over the course of the 2 month survey. Of those, three were on the shelf, one was in west Nagai Strait of the Shumagin Islands, one was in the northern end of Shelikof Strait, and two were in Barnabas Trough. On average the Methot was fished at a depth of 99 m below the surface and 23 m above the bottom. Catch composition (Table 23 by weight consisted primarily of euphausiids (66%; primarily consisting of *Thysanoessa inermis*, but also including *T. spinifera*, *T. raschii*, and *Euphausia pacifica*) and jellyfish (25%; mainly consisting of *Chrysaora melanaster*).

Euphausiids were found throughout the survey area, but were patchy in distribution (Fig. 16). Transects were surveyed during daylight hours, when euphausiids aggregate lower in the water column. Therefore the majority of euphausiid backscatter was observed below 50 m depth, with the highest concentrations observed between 50 and 80 m depth (Fig. 17). Though the distribution was patchy across the GOA shelf, several “hot spots” in the relative abundance of euphausiids were identified. Two areas of highest relative abundance were Barnabus Trough and Deadman Bay, both of which had backscatter values roughly three times higher than all other survey areas (Fig. 16). Other hot spots included the Shumagin Islands, Mitrofania Island, Nakchamik Island, and Chiniak Trough. Of these survey areas, Chiniak Trough, Barnabas Trough, and Shelikof Strait have consistently contained high levels of euphausiid backscatter in previous surveys.

Additional Projects

Field tests of a non-extractive stereo camera-trawl (Cam-Trawl) system were successfully completed during the survey. The Cam-Trawl (Williams et al. 2010) consists of a stereo camera and strobe light system attached to the AWT in the small meshes forward of the codend. The device is designed to ultimately aid in depth-dependent, non-lethal sampling consisting of species identification, density, and length of animals as they pass by the camera and out through the rear of the open trawl. On this cruise, Cam-Trawl data were collected during survey tows and the codend was closed. Images are collected at a rate of 6 per second and stored on a computer contained within the Cam-Trawl housing. Data from the Cam-Trawl are downloaded following completion of each haul. Processing software allows species identification and counts to be entered for individual images which can subsequently be synchronized with the echogram from the trawl for visualization of where each species, and the majority of fish, are caught at different times and locations throughout the haul (Fig. 17).

A small-mesh pocket net was sewn into the bottom panel of the trawl approximately 26 m forward of the codend. The pocket net was used to gauge escapement of juvenile pollock and other small fishes from the net. Pocket net catch data were recorded similarly to, but separate from, the catch from the codend.

A lowered acoustic system for target-strength data collection was deployed on five occasions. Data collections following up on a North Pacific Research Board-funded rockfish assessment survey in untrawlable habitat on the GOA shelf (cruise DY2009-12) were conducted during DY2011-03 (Dr. Chris Wilson, Chris.Wilson@noaa.gov). Activities included surveying 21 tightly spaced parallel line transects using the ME-70 multibeam echosounder to develop a trawlability index along with accompanying drop video camera deployments (n = 47) to ground-truth bottom classification. Operations were conducted during nighttime hours and lasted approximately 6 hours each depending on the number of camera deployments at each site.

When available in the catch, stomach samples were preserved in formalin for diet analysis from the following species: walleye pollock, Pacific herring, eulachon and capelin to provide trophic-level data for multispecies and food web models (Troy Buckley, Troy.Buckley@noaa.gov), and from Pacific cod, arrowtooth flounder, chum salmon, Chinook salmon, Pacific ocean perch, northern rockfish, and dusky rockfish to provide information on fish predation for five groundfish species (arrowtooth flounder, walleye pollock, sablefish, Pacific cod and Pacific ocean perch) young-of-the-year fishes (Sarah Hinckley, sarah.hinckley@noaa.gov). When present, age-0 specimens of pollock were frozen at -20°C for age and growth analysis (Annette Dougherty, annette.dougherty@noaa.gov). Results for all special projects are to be reported elsewhere.

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TABLES AND FIGURES

Table 1. -- Simrad ER60 38-kHz acoustic system description and settings used during the Summer 2011 acoustic trawl surveys of walleye pollock in the Gulf of Alaska, and results from standard sphere acoustic system calibrations conducted in association with the surveys.

		Survey system settings	14 June Three Saints Bay Alaska	7 Aug. Kalsin Bay Alaska	Final system values
Echosounder		Simrad ER60	--	--	--
Transducer		ES38B	--	--	--
Frequency (kHz)		38	--	--	--
Transducer depth (m)		9.15	--	--	--
Pulse length (ms)		0.512	--	--	--
Transmitted power (W)		2,000	--	--	--
Angle sensitivity:	Along	22.76	--	--	--
	Athwart	21.37	--	--	--
2-way beam angle (dB re 1 steradian)		-20.74	--	--	--
Gain (dB)		22.34	22.34	22.14	22.24
s_A correction (dB)		-0.69	-0.69	-0.64	-0.66
S_v gain (dB)		21.66	21.66	21.50	21.58
3 dB beamwidth:	Along	6.79	6.79	6.77	6.78
	Athwart	7.21	7.21	7.21	7.21
Angle offset:	Along	-0.07	-0.07	-0.07	-0.07
	Athwart	-0.05	-0.05	-0.05	-0.05
Measured standard sphere TS (dB re 1 m^2)		--	-42.16	-42.23	--
Sphere range from transducer (m)		--	21.43	15.91	--
Absorption coefficient (dB/m)		0.0096	0.0097	0.0093	--
Sound velocity (m/s)		1476.0	1476.0	1483.5	--
Water temp. at transducer (°C)		--	6.7	9.7	--

Note: Gain and beam pattern terms are defined in the Operator Manual for Simrad ER60 Scientific echo sounder 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 2011 walleye pollock acoustic trawl survey of the Gulf of Alaska and associated areas.

Haul	Walleye pollock				Capelin	Eulachon	Pacific herring	Pacific cod	Chum salmon	Chinook salmon	Other species#	Pacific ocean perch	Other Rockfish*
no.	Lengths	Weights	Maturity	Otoliths	Length/Weight	Length/Weight	Length/Weight	Length/Weight	Length/Weight	Length/Weight	Length/Weight	Length/Weight	Length/Weight
1	290	77	77	44	-	-	-	-	-	-	-	-	-
2	265	42	42	42	-	-	-	-	-	-	-	-	-
6	159	61	61	61	-	-	-	-	-	-	-	-	-
9	3	3	3	3	-	-	-	20/20	-	-	51	101/44	55/55
10	301	58	58	58	-	-	-	-	-	-	-	-	-
11	108	34	30	30	-	-	-	3/3	-	-	7/7	-	-
13	1	-	-	-	-	-	-	-	-	-	-	7	-
14	9	9	9	9	-	-	-	-	-	-	-	-	-
16	323	39	39	39	8/8	-	-	-	-	-	-	-	-
17	51	-	-	-	-	-	-	-	-	-	-	-	-
19	2	2	2	2	-	-	-	16/16	-	-	123	76/34	24/24
21	22	-	-	-	46	-	-	-	-	-	-	-	-
22	179	70	70	70	18	60/10	-	-	-	-	-	-	-
23	353	76	76	72	-	21/21	-	-	2/2	-	-	-	-
24	252	52	52	52	-	20/20	-	-	-	-	-	-	-
25	250	67	67	60	20/20	-	-	-	4/4	5/5	-	-	-
26	-	-	-	-	-	-	-	-	1/1	-	-	-	-
27	200	67	67	67	-	34/20	-	-	1/1	-	-	-	-
28	-	-	-	-	-	-	-	-	1/1	-	-	-	-
29	264	53	53	53	-	-	-	-	1/1	-	-	43/20	-
30	108	60	60	52	-	-	-	-	-	2/2	-	20/13	-
31	-	-	-	-	20	-	-	-	-	-	-	-	-
32	202	54	54	53	4/4	-	-	-	2/2	-	-	-	-
33	2	-	-	-	-	-	-	-	-	-	-	-	-
34	337	61	46	56	1/1	71/41	-	-	1/1	2/2	-	-	-
35	79	39	29	34	-	-	-	-	1/1	7/7	-	-	-
36	320	39	39	39	-	-	-	-	-	-	-	-	-
37	374	69	48	58	-	-	-	-	-	-	-	-	-
38	214	56	40	45	-	43/43	-	-	-	-	1/1	-	-
39	401	30	20	20	-	51/20	-	-	-	-	-	-	-
40	67	24	24	12	-	57/55	-	-	-	-	7/7	-	-
41	44	44	2	12	-	-	-	-	-	-	-	-	-
42	356	40	40	40	3/3	22/22	-	-	-	2/2	-	-	-
43	392	34	34	34	-	-	-	-	-	-	-	-	-
44	279	57	57	40	-	-	-	-	-	-	-	-	-
45	-	-	-	-	41/41	-	-	-	-	-	-	-	-
46	-	-	-	-	-	-	-	-	-	-	-	-	-
47	374	41	41	41	-	-	-	-	-	1/1	1/1	-	-
48	4	-	-	-	-	-	-	-	-	-	-	-	-

Table 2. -- Cont.

Haul	Walleye pollock				Capelin	Eulachon	Pacific herring	Pacific cod	Chum salmon	Chinook salmon	Other species#	Pacific ocean perch	Other Rockfish*
no.	Lengths	Weights	Maturity	Otoliths	Length/Weight	Length/Weight	Length/Weight	Length/Weight	Length/Weight	Length/Weight	Length/Weight	Length/Weight	Length/Weight
49	148	18	18	18	40/40	-	4/4	-	-	-	-	-	-
50	344	45	45	41	-	-	6/6	-	-	-	-	-	-
51	43	43	27	27	73/24	1/1	1/1	1/1	-	-	-	-	-
52	292	51	51	41	3	-	-	-	-	-	-	1/1	-
53	92	23	23	8	-	-	-	-	-	-	-	2/2	-
Total	7,504	1,538	1,404	1,333	277/141	380/253	11/11	40/40	14/14	19/19	190/16	250/144	79/79

Other species include arrowtooth flounder (hauls 11, 38, 40, and 47) and Atka mackerel (hauls 9 and 19).

* Other rockfish species include dusky rockfish (haul 9 and 19), black rockfish (haul 9), and northern rockfish (haul 19).

Table 3. -- Trawl stations and catch data summary from the summer 2011 Gulf of Alaska shelf walleye pollock acoustic trawl survey aboard the NOAA ship *Oscar Dyson*.

Haul	Gear[a]	Date	Time	Duration	Start position		Depth (m)		Temp. (°C)		Walleye pollock		Other
no.	type	(GMT)	(GMT)	(minutes)	Lat. (N)	Long. (W)	footrope	bottom	headrope	surface[b]	(kg)	number	(kg)
1	PNE	18-Jun	3:39	12	52 44.78	169 30.19	179	183	-	5.2	338.0	290	6.5
2	PNE	19-Jun	2:20	16	53 02.60	167 20.97	168	168	5.1	7.1	459.8	361	9.0
3.1*	MOCC	19-Jun	9:36	2	53 16.53	166 53.92	110	115	-	6.6	-	-	-
3.2*	MOCC	19-Jun	9:40	2	53 16.69	166 54.16	110	111	-	6.6	-	-	-
3.3*	MOCC	19-Jun	9:43	2	53 16.84	166 54.39	105	106	-	6.6	-	-	-
4	Methot	19-Jun	17:38	14	53 30.97	166 26.82	88	100	4.9	6.4	-	-	-
5.1	MOCC	20-Jun	6:56	6	53 36.46	165 19.10	232	452	5	6.9	4.0	3	9.4
5.2	MOCC	20-Jun	7:05	6	53 36.85	165 19.64	258	396	4.8	6.9	-	-	-
5.3	MOCC	20-Jun	7:13	6	53 37.18	165 20.11	280	342	4.7	7.0	1.4	1	6.9
6.1	MOCC	20-Jun	17:43	7	53 49.35	164 51.20	101	109	4.7	6.6	115.1	126	5.4
6.2	MOCC	20-Jun	18:01	5	53 50.34	164 51.93	76	103	5.6	6.6	8.9	9	-
6.3	MOCC	20-Jun	18:12	8	53 50.91	164 52.37	50	101	6.4	6.6	24.7	24	0.9
7.1	MOCC	21-Jun	3:00	11	54 13.63	164 28.13	75	99	6.2	6.7	-	-	-
8	Methot	21-Jun	4:35	10	54 13.89	164 29.15	52	104	5.7	6.7	-	-	-
9	PNE	21-Jun	17:03	12	53 52.34	163 40.87	78	78	4.8	6.9	3.1	3	1,258.4
10.1	MOCC	22-Jun	22:07	26	54 48.33	163 10.88	69	82	5.9	7.0	448.8	301	6.8
11	PNE	23-Jun	2:00	6	55 01.31	163 04.52	82	84	5.8	6.8	161.4	108	83.9
12	PNE	24-Jun	1:14	6	54 14.85	162 06.70	59	72	5	7.2	-	-	-
13.1	MOCC	24-Jun	4:38	12	54 04.63	162 01.60	228	406	5.3	7.5	0.7	1	5.9
13.2	MOCC	24-Jun	4:51	10	54 04.83	162 00.62	184	427	5.1	7.5	-	-	-
14.1	MOCC	24-Jun	7:06	22	54 04.87	162 01.36	228	298	5.3	7.2	-	-	0.4
14.2	MOCC	24-Jun	7:28	10	54 05.29	162 00.64	140	207	4.5	7.2	11.4	9	0.1
15	Methot	24-Jun	20:04	14	54 20.79	161 35.07	129	151	4.5	6.8	-	-	-
16.1	MOCC	25-Jun	8:44	37	55 17.77	161 37.74	92	103	4.5	8.3	138.6	283	-
16.2	MOCC	25-Jun	9:21	11	55 17.18	161 41.06	63	106	5.5	8.4	23.2	40	0.1
17.1	MOCC	26-Jun	7:51	9	54 31.55	160 27.79	66	148	5.7	8.5	22.2	19	3.7
17.2	MOCC	26-Jun	8:07	30	54 31.17	160 26.37	139	148	5.7	8.5	36.5	32	0.6
18	PNE	6-Jul	7:18	15	54 33.13	159 17.71	98	104	4.6	8.8	-	-	1.0
19	PNE	6-Jul	17:13	16	54 36.52	159 54.60	86	87	4.4	7.8	6.2	4	1,750.8
20	Methot	7-Jul	4:34	17	55 04.27	160 28.91	81	84	5.1	8.0	-	-	35.0
21.1	MOCC	8-Jul	0:17	15	55 26.90	160 24.69	83	145	5.2	9.0	-	-	-
21.2	MOCC	8-Jul	0:39	13	55 28.25	160 24.97	131	149	4.6	8.8	-	-	0.6
21.3	MOCC	8-Jul	1:00	7	55 29.40	160 25.35	63	103	6.2	8.6	-	-	0.9
22.1	MOCC	8-Jul	6:46	41	55 33.38	160 10.97	171	183	4.2	9.1	167.1	199	12.0
23	AWT	9-Jul	16:33	28	55 25.18	158 55.43	146	170	4.5	9.4	1,001.8	1,369	7.1
24	AWT	10-Jul	2:41	22	55 42.14	159 01.69	148	148	5.1	8.4	624.1	599	8.6
25	AWT	10-Jul	16:31	47	55 27.84	158 14.55	129	137	5	9.4	200.5	250	21.8

Table 3. -- Cont.

Haul	Gear[a]	Date	Time	Duration	Start position		Depth (m)		Temp. (°C)		Walleye pollock		Other
no.	type	(GMT)	(GMT)	(minutes)	Lat. (N)	Long. (W)	footrope	bottom	headrope	surface[b]	(kg)	number	(kg)
26	AWT	10-Jul	23:35	54	55 00.16	157 40.25	70	78	5.6	9.4	-	-	2.2
27	AWT	12-Jul	2:05	6	56 23.24	157 51.01	196	243	4.9	7.5	95.0	247	5.4
28	PNE	12-Jul	22:01	51	55 32.08	156 54.53	87	91	5.2	9.1	-	-	2.5
29	AWT	13-Jul	6:10	17	55 25.28	156 07.29	173	197	5.5	10.0	1,731.8	2,772	64.2
30	AWT	14-Jul	1:03	37	56 00.56	154 42.34	260	296	5.3	9.7	92.0	125	19.6
31	PNE	15-Jul	2:45	3	56 33.62	153 11.14	100	103	-	9.4	-	-	3.8
32	AWT	16-Jul	3:10	20	59 03.21	152 48.19	148	159	5.6	9.0	566.4	465	7.2
33	Methot	16-Jul	7:00	20	59 09.06	153 00.69	70	111	6.5	9.6	-	-	0.8
34	AWT	16-Jul	19:43	46	58 21.15	153 08.69	162	220	5	9.6	503.1	1,856	86.1
35	AWT	17-Jul	6:31	44	58 12.88	153 52.68	128	208	5.2	9.7	148.1	4,466	8.7
36	AWT	18-Jul	6:14	27	57 20.94	154 51.67	105	147	5.5	10.1	1,068.6	1,348	20.4
37	AWT	18-Jul	20:09	14	57 21.45	155 19.19	185	252	5	9.8	274.1	1,677	0.6
38	AWT	19-Jul	3:25	16	57 08.23	155 10.33	226	238	5.2	10.0	191.2	4,529	114.1
39	AWT	19-Jul	20:36	12	56 51.01	155 23.85	179	245	4.9	10.9	365.9	10,549	9
40	AWT	20-Jul	7:56	18	56 34.09	155 43.71	168	220	4.9	10.9	26.3	401	38.3
41	PNE	21-Jul	4:58	5	56 09.87	156 14.27	169	235	5.3	10.7	5.6	167	0.8
42	AWT	7-Aug	21:40	35	57 38.85	151 54.38	152	173	-	9.5	1,187.8	1,329	5.1
43	AWT	8-Aug	3:03	8	57 32.05	151 34.17	135	154	6.2	10.9	2,427.0	2,261	0
44	AWT	8-Aug	16:08	9	57 22.93	151 19.45	148	155	5.7	10.6	1,678.0	1,475	0
45	PNE	8-Aug	23:27	9	57 16.07	151 49.86	57	64	8.3	10.2	-	-	23.9
46	Methot	9-Aug	18:29	15	56 44.90	152 20.57	129	157	5.5	11.2	-	-	0.9
47	AWT	9-Aug	22:46	30	56 51.11	152 22.51	149	154	5.5	11.0	969.5	867	2.8
48	Methot	10-Aug	2:26	25	56 54.44	152 36.25	146	151	5.4	11.1	-	-	2.8
49	PNE	10-Aug	19:31	15	56 45.82	154 20.09	58	60	8.8	11.0	23.6	18	10.4
50	AWT	11-Aug	1:02	14	57 05.21	153 53.76	156	176	2.8	12.2	1,995.4	4,128	4.6
51	PNE	11-Aug	6:05	11	56 49.17	154 27.52	67	71	8.9	11.1	33.3	27	12.3
52	AWT	11-Aug	20:06	11	57 06.02	152 41.65	151	158	5.8	11.2	754.7	671	1.7
53	PNE	12-Aug	7:58	19	56 33.16	152 30.21	195	195	5.3	11.5	74.9	92	6.7

[a]AWT = Aleutian wing trawl, PNE = Poly nor'eastern bottom trawl, Methot = Methot trawl, MOCC = AWT with Multiple opening and closing codend.
[b]shipboard sensor at 1.4 m depth.
* Experimental gear trawl.

Table 4. -- Summary of catch by species in 10 Aleutian wing trawls and five poly-Nor'eastern trawls conducted in midwater during the 2011 walleye pollock acoustic trawl survey of the Gulf of Alaska shelf from the Islands of Four Mountains to the southeast of Kodiak Island.

		Weight		Numbers	
Common name	Scientific name	kg	Percent	Nos.	Percent
walleye pollock	*Gadus chalcogrammus*	3,251.0	94.8	4,741	36.9
Pacific ocean perch	*Sebastes alutus*	81.6	2.4	107	0.8
chum salmon	*Oncorhynchus keta*	31.9	0.9	12	0.1
capelin	*Mallotus villosus*	17.1	0.5	7,754	60.3
Pacific grenadier	*Coryphaenoides acrolepis*	14.4	0.4	4	<0.1
Chinook salmon	*Oncorhynchus tshawytscha*	13.4	0.4	7	0.1
Pacific halibut	*Hippoglossus stenolepis*	5.9	0.2	1	<0.1
jellyfish unident.	Scyphozoa (class)	4.9	0.1	39	0.3
sockeye salmon	*Oncorhynchus nerka*	3.7	0.1	2	<0.1
arrowtooth flounder	*Atheresthes stomias*	2.0	0.1	3	<0.1
squid unident.	Cephalopoda (class)	1.6	<0.1	122	0.9
eulachon	*Thaleichthys pacificus*	0.8	<0.1	21	0.2
flathead sole	*Hippoglossoides elassodon*	0.6	<0.1	1	<0.1
salps unident.	Thaliacea (class)	0.2	<0.1	5	<0.1
northern smoothtongue	*Leuroglossus schmidti*	0.1	<0.1	9	0.1
lanternfish unident.	Myctophidae (family)	<0.1	<0.1	10	0.1
Pacific cod	*Gadus macrocephalus*	<0.1	<0.1	5	<0.1
spiny lumpsuckers	*Eumicrotremus orbis*	<0.1	<0.1	1	<0.1
fish larvae unident.	Actinopterygii (class)	<0.1	<0.1	4	<0.1
walleye pollock age-0	*Gadus chalcogrammus*	<0.1	<0.1	4	<0.1
Total		3,429.3		12,852	

Table 5. -- Summary of catch by species in five poly-Nor'eastern bottom trawls conducted during the 2011 walleye pollock acoustic trawl survey of the Gulf of Alaska shelf from the Islands of Four Mountains to the southeast of Kodiak Island.

		Weight		Numbers	
Common name	Scientific name	kg	Percent	Nos.	Percent
Atka mackerel	*Pleurogrammus monopterygius*	1,682.4	43.9	1,857	43.5
Pacific ocean perch	*Sebastes alutus*	912.8	23.8	1,242	29.1
walleye pollock	*Gadus chalcogrammus*	807.0	21.1	658	15.4
Pacific cod	*Gadus macrocephalus*	232.4	6.1	93	2.2
light dusky rockfish	*Sebastes variabilis*	58.1	1.5	40	0.9
northern rockfish	*Sebastes polyspinis*	49.4	1.3	55	1.3
black rockfish	*Sebastes melanops*	33.6	0.9	23	0.5
yellow Irish lord	*Hemilepidotus jordani*	28.9	0.8	16	0.4
sponge unident.	Porifera (phylum)	13.1	0.3	110	2.6
tunicate unident.	Ascidiacea (class)	3.4	0.1	42	1.0
chum salmon	*Oncorhynchus keta*	2.8	0.1	1	<0.1
arrowtooth flounder	*Atheresthes stomias*	1.8	<0.1	4	0.1
yellowfin sole	*Limanda aspera*	1.4	<0.1	3	0.1
kelp greenling	*Hexagrammos decagrammus*	1.1	<0.1	2	<0.1
sea anemone unident.	Actiniaria (order)	0.6	<0.1	3	0.1
rex sole	*Glyptocephalus zachirus*	0.4	<0.1	2	<0.1
sea urchin unident.	Echinoidea (class)	0.4	<0.1	9	0.2
cushion sea star	*Pteraster temnochiton*	0.3	<0.1	1	<0.1
soft coral sp.	*Fanellia compressa*	0.3	<0.1	8	0.2
Kamchatka coral	*Paragorgia arborea*	0.3	<0.1	1	<0.1
jellyfish unident.	Scyphozoa (class)	0.2	<0.1	1	<0.1
triton gastropod unident.	*Fusitriton* sp.	0.2	<0.1	4	0.1
basketstar	*Gorgonocephalus eucnemis*	0.2	<0.1	1	<0.1
salps unident.	Thaliacea (class)	0.2	<0.1	10	0.2
walleye pollock age-0	*Gadus chalcogrammus*	<0.1	<0.1	68	1.6
brittlestarfish unident.	*Ophiura* sp.	<0.1	<0.1	5	0.1
fish larvae unident.	Actinopterygii (class)	<0.1	<0.1	7	0.2
Total		3,831.2		4,266	

Table 6. -- Numbers-at-length estimates (millions) from summer 2011 acoustic-trawl surveys of walleye pollock in the Gulf of Alaska.

Length	GOA shelf	Morzhovoi	Sanak	Pavlof	Shumagins	Mitrofania	Nakchamik	Shelikof	Chiniak	Barnabas	Alitak/Deadman Bay	Total
5	-	-	-	-	-	-	-	-	-	-	-	-
6	-	-	-	-	-	-	-	-	-	-	-	-
7	-	-	-	-	-	-	-	-	-	-	-	-
8	-	-	-	-	-	-	-	-	-	-	-	-
9	-	-	-	-	-	-	-	-	-	-	-	-
10	-	-	-	-	-	-	-	-	-	-	-	-
11	-	-	-	-	-	-	-	5.89	-	-	-	5.89
12	-	-	-	-	-	-	-	14.19	-	-	-	14.19
13	-	-	-	-	-	-	-	31.08	-	-	-	31.08
14	0.11	0.05	<0.1	-	-	-	-	103.51	-	-	-	103.66
15	-	0.02	-	-	-	-	-	475.48	-	-	-	475.50
16	-	0.02	-	-	-	-	-	517.20	-	-	-	517.23
17	-	-	-	-	-	-	-	274.44	-	-	-	274.44
18	-	-	-	-	-	-	-	66.56	-	-	-	66.56
19	-	-	-	0.02	-	-	-	10.63	-	0.05	-	10.70
20	-	-	-	-	-	-	-	5.89	0.03	-	-	5.93
21	-	-	-	-	-	-	-	-	0.07	-	-	0.07
22	-	-	-	-	-	-	-	0.25	0.03	-	-	0.29
23	-	-	-	-	-	-	-	0.42	-	-	-	0.42
24	-	-	-	-	-	-	-	1.80	-	-	-	1.80
25	-	-	-	-	-	-	-	2.57	-	-	-	2.57
26	-	-	-	-	-	-	0.06	4.28	-	-	-	4.34
27	-	-	-	0.02	-	-	0.04	3.91	-	-	-	3.97
28	-	-	-	0.04	-	-	0.15	3.38	-	-	0.06	3.63
29	-	0.05	-	0.04	-	-	0.19	3.67	-	-	0.15	4.10
30	-	-	-	0.09	-	-	0.06	1.35	-	-	0.37	1.87
31	0.20	0.02	<0.1	0.05	0.03	-	0.06	1.49	0.03	-	0.46	2.36
32	0.20	0.07	<0.1	0.07	-	0.02	0.30	1.73	0.03	-	0.62	3.04
33	0.08	-	<0.1	0.07	-		0.21	2.25	0.30	-	0.34	3.25
34	0.33	0.02	<0.1	0.04	-	0.02	0.41	3.04	0.67	-	0.17	4.69
35	0.91	-	<0.1	0.05	0.05	0.02	0.56	4.99	0.63	0.05	0.14	7.40
36	1.32	-	0.01	0.07	0.10	0.07	0.56	6.34	0.96	-	0.12	9.54
37	1.58	-	0.01	0.09	0.33	0.07	0.77	6.88	0.88	0.10	0.18	10.90
38	2.32	-	0.01	0.32	0.33	0.08	0.41	7.95	0.61	0.04	0.20	12.28
39	3.99	-	0.02	0.71	0.33	0.08	0.15	10.36	0.52	-	0.49	16.66
40	5.29	-	0.03	0.82	0.36	0.03	0.09	5.85	0.32		0.46	13.26
41	7.00	-	0.03	0.79	0.20	0.10	0.02	9.09	0.06	0.26	0.18	17.74
42	5.83	0.02	0.03	0.79	0.15	0.19	0.02	6.61	0.13	0.04	0.18	13.99
43	11.83	0.05	0.06	0.50	0.23	0.20	-	7.50	0.21	0.31	0.05	20.94
44	21.10	0.02	0.10	0.21	0.13	0.20	-	8.21	0.46	0.80	0.12	31.36
45	22.07	0.05	0.11	0.14	0.05	0.37	0.04	11.02	0.61	1.16	0.17	35.79
46	21.03	-	0.10	0.04	0.10	0.46	-	8.55	1.49	1.95	0.14	33.85
47	19.21	-	0.09	-	0.10	0.32	-	8.71	1.39	2.24	0.15	32.22
48	12.55	-	0.06		0.20	0.32	0.02	8.00	1.52	2.74	0.12	25.54
49	12.08	-	0.06	0.02	0.20	0.41	-	4.77	2.21	1.94	0.14	21.83

Table 6.--Continued.

Length	GOA shelf	Morzhovoi	Sanak	Pavlof	Shumagins	Mitrofania	Nakchamik	Shelikof	Chiniak	Barnabas	Alitak/Deadman Bay	Total
50	8.66	0.05	0.04	-	0.08	0.24	-	4.84	2.13	1.69	0.06	17.79
51	8.37	0.02	0.04	-	0.13	0.14	0.02	2.14	2.49	2.03	0.03	15.40
52	9.56	-	0.05	-	0.08	0.02	-	2.21	2.62	1.68	0.08	16.28
53	5.85	-	0.03	-	0.20	0.17	0.02	2.74	2.97	1.56	-	13.55
54	5.40	0.05	0.03	-	0.18	0.07	0.02	2.98	2.11	2.43	0.03	13.29
55	4.10	0.02	0.02	-	0.08	0.17	-	2.29	2.52	1.74	-	10.93
56	3.08	-	0.02	-	0.08	0.08	0.02	2.58	2.12	1.53	0.02	9.53
57	3.70	0.05	0.02	-	0.23	0.15	-	1.32	1.68	1.01	0.02	8.17
58	2.38	0.09	0.01	-	0.18	0.05	-	1.70	0.98	1.14	0.02	6.55
59	2.29	0.05	0.01	-	0.13	0.07	0.04	1.65	0.95	0.99	-	6.18
60	2.82	0.16	0.01	0.02	0.10	0.07	0.02	1.14	0.71	0.82	-	5.87
61	1.55	0.16	0.01	0.02	0.08	-	-	0.16	0.48	0.51	0.02	2.98
62	2.26	0.18	0.01	-	0.03	0.02	-	0.15	0.18	0.29	-	3.11
63	1.55	0.09	0.01	-	-	0.02	-	0.12	0.11	0.18	-	2.08
64	1.01	0.14	<0.1	0.02	0.03	0.05	-	-	0.13	0.14	-	1.51
65	1.59	0.23	0.01	0.02	0.03	-	-	0.06	0.06	-	-	1.99
66	0.40	0.18	<0.1	-	0.03	-	-	-	0.03	-	-	0.64
67	0.41	0.16	<0.1	-	0.03	-	-	-	0.08	0.05	-	0.72
68	-	0.16	-	-	-	-	-	-	-	-	-	0.16
69	-	0.11	-	-	-	-	-	-	0.03	-	-	0.15
70	0.11	0.05	<0.1	-	-	-	-	-	-	-	-	0.15
71	0.19	0.02	<0.1	-	-	-	-	-	-	-	-	0.22
72	-	0.07	<0.1	-	-	-	-	-	-	-	-	0.07
73	0.10	0.05	-	-	-	-	-	-	-	0.05	-	0.20
74	-	-	-	-	-	-	-	-	-	-	-	-
75	-	-	-	-	-	-	-	-	-	-	-	-
76	-	-	-	-	-	-	-	-	-	-	-	-
Total	214.38	2.48	1.06	5.05	4.58	4.28	4.29	1,675.93	35.56	29.52	5.30	1,982.41

Table 7. -- Biomass-at-length estimates (thousands of metric tons) from summer 2011 acoustic-trawl surveys of walleye pollock in the Gulf of Alaska.

Length	GOA shelf	Morzhovoi	Sanak	Pavlof	Shumagins	Mitrofania	Nakchamik	Shelikof	Chiniak	Barnabas	Alitak/Deadman Bay	Total
5	-	-	-	-	-	-	-	-	-	-	-	-
6	-	-	-	-	-	-	-	-	-	-	-	-
7	-	-	-	-	-	-	-	-	-	-	-	-
8	-	-	-	-	-	-	-	-	-	-	-	-
9	-	-	-	-	-	-	-	-	-	-	-	-
10	-	-	-	-	-	-	-	-	-	-	-	-
11	-	-	-	-	-	-	-	0.05	-	-	-	0.05
12	-	-	-	-	-	-	-	0.16	-	-	-	0.16
13	-	-	-	-	-	-	-	0.46	-	-	-	0.46
14	<0.1	<0.1	<0.1	-	-	-	-	2.05	-	-	-	2.05
15	-	<0.1	-	-	-	-	-	11.13	-	-	-	11.13
16	-	<0.1	-	-	-	-	-	14.53	-	-	-	14.53
17	-	-	-	-	-	-	-	9.44	-	-	-	9.44
18	-	-	-	-	-	-	-	2.79	-	-	-	2.79
19	-	-	-	>0.01	-	-	-	0.53	-	<0.1	-	0.53
20	-	-	-	-	-	-	-	0.34	<0.1	-	-	0.34
21	-	-	-	-	-	-	-	-	<0.1	-	-	0.00
22	-	-	-	-	-	-	-	0.02	<0.1	-	-	0.02
23	-	-	-	-	-	-	-	0.04	-	-	-	0.04
24	-	-	-	-	-	-	-	0.19	-	-	-	0.19
25	-	-	-	-	-	-	-	0.30	-	-	-	0.30
26	-	-	-	-	-	-	0.01	0.58	-	-	-	0.59
27	-	-	-	<0.1	-	-	0.01	0.57	-	-	-	0.58
28	-	-	-	0.01	-	-	0.03	0.53	-	-	0.01	0.57
29	-	0.01	-	0.01	-	-	0.04	0.70	-	-	0.03	0.79
30	-	-	-	0.02	-	-	0.02	0.29	-	-	0.09	0.42
31	0.05	0.01	<0.1	0.01	0.01	-	0.02	0.35	0.01	-	0.11	0.56
32	0.06	0.02	<0.1	0.02	-	<0.1	0.08	0.45	0.01	-	0.17	0.81
33	0.02	-	<0.1	0.02	-	-	0.06	0.65	0.09	-	0.10	0.95
34	0.11	0.01	<0.1	0.01	-	0.01	0.13	0.93	0.21	-	0.05	1.46
35	0.33	-	<0.1	0.02	0.02	0.01	0.20	1.74	0.23	0.02	0.05	2.61
36	0.51	-	<0.1	0.03	0.04	0.03	0.22	2.43	0.37	-	0.05	3.68
37	0.67	-	<0.1	0.04	0.14	0.03	0.33	2.85	0.38	0.04	0.08	4.55
38	1.07	-	0.01	0.15	0.15	0.04	0.19	3.72	0.28	0.02	0.09	5.73
39	2.00	-	0.01	0.36	0.17	0.04	0.08	5.24	0.26	-	0.25	8.39
40	2.92	-	0.01	0.45	0.20	0.02	0.05	3.19	0.18		0.25	7.27
41	4.13	-	0.02	0.46	0.12	0.06	0.01	5.39	0.04	0.15	0.11	10.50
42	3.65	0.01	0.02	0.49	0.10	0.12	0.01	4.16	0.08	0.02	0.12	8.79
43	8.02	0.03	0.04	0.34	0.16	0.14	-	5.17	0.14	0.21	0.03	14.28
44	15.65	0.02	0.08	0.16	0.09	0.15	-	6.20	0.34	0.59	0.09	23.37
45	17.26	0.04	0.09	0.11	0.04	0.29	0.03	8.41	0.48	0.91	0.13	27.78
46	17.60	-	0.09	0.03	0.09	0.38	-	7.12	1.25	1.63	0.12	28.31
47	17.08	-	0.08	-	0.09	0.29	-	8.06	1.24	1.99	0.14	28.97
48	11.82	-	0.06	-	0.19	0.30	0.02	7.58	1.43	2.58	0.12	24.10
49	11.89	-	0.06	0.02	0.20	0.40	-	4.77	2.18	1.91	0.14	21.56

Table 7.-- Continued.

Length	GOA shelf	Morzhovoi	Sanak	Pavlof	Shumagins	Mitrofania	Nakchamik	Shelikof	Chiniak	Barnabas	Alitak/Deadman Bay	Total
50	9.02	0.05	0.04	-	0.08	0.25	-	5.15	2.22	1.77	0.06	18.65
51	9.16	0.03	0.05	-	0.14	0.15	0.02	2.39	2.73	2.22	0.03	16.92
52	10.98	-	0.05	-	0.09	0.02	-	2.58	3.01	1.93	0.09	18.75
53	6.99	-	0.03	-	0.24	0.20	0.03	3.34	3.55	1.86	-	16.25
54	6.94	0.06	0.03	-	0.23	0.09	0.03	3.85	2.71	3.12	0.04	17.09
55	5.47	0.03	0.03	-	0.10	0.23	-	3.11	3.36	2.32	-	14.65
56	4.33	-	0.02	-	0.11	0.12	0.03	3.73	2.98	2.15	0.02	13.49
57	5.36	0.07	0.03	-	0.33	0.22	-	1.94	2.43	1.46	0.02	11.87
58	3.82	0.15	0.02	-	0.29	0.08	-	2.76	1.57	1.83	0.02	10.53
59	3.68	0.07	0.02	-	0.21	0.11	0.07	2.68	1.54	1.59	-	9.97
60	4.55	0.26	0.02	0.03	0.17	0.11	0.03	1.94	1.14	1.32	-	9.57
61	2.38	0.25	0.01	0.03	0.12	-	-	0.24	0.74	0.79	0.02	4.58
62	3.86	0.31	0.02	-	0.04	0.03	-	0.31	0.30	0.50	-	5.37
63	2.89	0.17	0.01	-	-	0.03	-	0.25	0.20	0.34	-	3.89
64	1.87	0.26	0.01	0.03	0.05	0.09	-	-	0.25	0.26	-	2.82
65	3.08	0.45	0.02	0.03	0.05	-	-	0.12	0.12	-	-	3.86
66	0.96	0.44	<0.1	-	0.06	-	-	-	0.07	-	-	1.53
67	1.02	0.41	0.01	-	0.06	-	-	-	0.19	0.13	-	1.82
68	-	0.42	-	-	-	-	-	-	-	-	-	0.42
69	-	0.32	-	-	-	-	-	-	0.09	-	-	0.41
70	0.31	0.13	<0.1	-	-	-	-	-	-	-	-	0.44
71	0.58	0.07	<0.1	-	-	-	-	-	-	-	-	0.65
72	-	0.22	<0.1	-	-	-	-	-	-	-	-	0.22
73	0.33	0.15	-	-	-	-	-	-	-	0.17	-	0.65
74	-	-	-	-	-	-	-	-	-	-	-	-
75	-	-	-	-	-	-	-	-	-	-	-	-
76	-	-	-	-	-	-	-	-	-	-	-	-
Total	202.42	4.44	1.00	2.88	4.17	4.03	1.74	157.54	38.40	33.83	2.64	452.95

Table 8. -- Numbers-at-age estimates (millions) from 2011 summer acoustic trawl surveys of walleye pollock in the Gulf of Alaska.

Age	GOA shelf	Morzhovoi	Sanak	Pavlof	Shumagins	Mitrofania	Nakchamik	Shelikof	Chiniak	Barnabas	Alitak/Deadman Bay	Total
1	0.1	0.1	<0.1	<0.1	0.0	0.0	0.0	1,504.9	<0.1	0.1	0.0	1,505.2
2	0.3	0.1	<0.1	0.3	<0.1	<0.1	0.7	21.8	0.2	<0.1	1.2	26.3
3	26.1	0.1	0.1	2.8	1.6	0.6	3.2	60.7	4.9	0.6	2.6	102.9
4	98.4	0.1	0.5	1.7	1.1	1.8	0.1	46.8	7.6	9.1	1.0	168.1
5	57.8	0.3	0.3	0.2	1.0	1.2	0.1	22.9	14.0	12.2	0.4	109.7
6	18.8	0.3	0.1	<0.1	0.4	0.4	<0.1	12.3	6.0	4.9	0.1	43.1
7	2.3	0.1	<0.1	<0.1	0.1	<0.1	<0.1	3.6	0.7	0.6	<0.1	7.5
8	1.7	0.1	<0.1	<0.1	<0.1	<0.1	<0.1	2.1	0.3	0.4	<0.1	4.7
9	1.3	0.2	<0.1	<0.1	<0.1	<0.1	<0.1	0.0	0.2	0.3	<0.1	2.2
10	1.9	0.2	<0.1	<0.1	0.1	<0.1	<0.1	0.6	0.4	0.4	<0.1	3.7
11	2.6	0.4	<0.1	<0.1	0.1	<0.1	<0.1	0.3	0.4	0.5	<0.1	4.4
12	1.6	0.3	<0.1	<0.1	<0.1	<0.1	<0.1	0.0	0.3	0.3	<0.1	2.6
13	1.1	0.1	<0.1	<0.1	<0.1	<0.1	<0.1	0.0	0.2	0.2	<0.1	1.6
14	0.1	<0.1	<0.1	<0.1	<0.1	0.0	0.0	0.0	<0.1	<0.1	<0.1	0.1
15	0.1	<0.1	<0.1	0.0	<0.1	<0.1	0.0	0.0	<0.1	<0.1	0.0	0.1
16	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1
17	0.1	<0.1	<0.1	<0.1	<0.1	0.0	0.0	0.0	<0.1	<0.1	<0.1	0.1
Total	214.4	2.5	1.1	5.1	4.6	4.3	4.2	1,675.9	35.6	29.5	5.3	1,982.4

Table 9. -- Biomass-at-age estimates (thousands of metric tons) from 2011 summer acoustic trawl surveys of walleye pollock in the Gulf of Alaska.

Age	GOA shelf	Morzhovoi	Sanak	Pavlof	Shumagins	Mitrofania	Nakchamik	Shelikof	Chiniak	Barnabas	Alitak/Deadman Bay	Total
1	<0.1	<0.1	<0.1	<0.1	0.0	0.0	0.0	41.5	<0.1	<0.1	0.0	41.5
2	0.1	<0.1	<0.1	0.1	<0.1	<0.1	0.2	3.4	<0.1	<0.1	0.3	4.9
3	14.7	<0.1	0.1	1.5	0.8	0.3	1.3	28.2	2.1	0.4	1.1	50.4
4	81.2	0.1	0.4	1.1	0.9	1.5	0.1	36.7	7.3	8.4	0.8	138.9
5	61.4	0.5	0.3	0.1	1.2	1.4	0.1	23.5	16.9	14.4	0.4	119.4
6	23.3	0.6	0.1	<0.1	0.6	0.5	0.1	15.3	7.7	6.3	0.1	54.2
7	3.5	0.2	<0.1	<0.1	0.1	0.1	<0.1	4.7	1.0	0.9	<0.1	10.5
8	2.4	0.2	<0.1	<0.1	0.1	<0.1	<0.1	2.9	0.5	0.5	<0.1	6.6
9	2.4	0.6	<0.1	<0.1	0.1	<0.1	<0.1	0.0	0.4	0.4	<0.1	4.0
10	3.4	0.3	<0.1	<0.1	0.1	<0.1	<0.1	0.9	0.7	0.7	<0.1	6.2
11	4.9	0.9	<0.1	<0.1	0.1	<0.1	<0.1	0.6	0.8	0.8	<0.1	8.2
12	3.0	0.6	<0.1	<0.1	0.1	<0.1	<0.1	0.0	0.5	0.6	<0.1	4.8
13	1.9	0.2	<0.1	<0.1	0.1	<0.1	<0.1	0.0	0.3	0.3	<0.1	2.8
14	0.1	<0.1	<0.1	<0.1	<0.1	0.0	0.0	0.0	<0.1	<0.1	<0.1	0.2
15	0.2	<0.1	<0.1	0.0	<0.1	<0.1	0.0	0.0	<0.1	<0.1	0.0	0.2
16	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1
17	0.1	<0.1	<0.1	<0.1	<0.1	0.0	0.0	0.0	<0.1	<0.1	<0.1	0.2
Total	202.4	4.4	1.0	2.9	4.2	4.0	1.7	157.5	38.4	33.8	2.6	453.0

Table 10. -- Pollock numbers (millions), biomass (thousands of metric tons), and relative estimation error by area[1] for the summer 2003, 2005, and 2011 Gulf of Alaska acoustic trawl surveys.

	2003			2005			2011		
Area	Numbers	Biomass	est. error	Numbers	Biomass	est. error	Numbers	Biomass	est. error
Shumagin[a] Shelf	not surveyed		0.21	68.7	61.2	0.11	72.1	67.9	0.09
Chirikof[b] Shelf	7.6	3.9		35.5	31.3		104.6	98.8	
Kodiak[c] Shelf	484.7	53.1		24.5	21.9		37.7	35.6	
Eastern[d] Shelf	not surveyed			not surveyed			not surveyed		
Sanak Trough	not surveyed			not surveyed			1.1	1.0	0.11
Morzhovoi Bay	not surveyed			not surveyed			2.5	4.4	0.07
Pavlof Bay	not surveyed			not surveyed			5.1	2.9	0.08
Shumagin Islands	15.8	7.4	0.16	not surveyed			4.6	4.2	0.09
Mitrofania Island	<0.1	<0.1	[e]	not surveyed			4.3	4.0	0.13
Nakchamik Island	13.0	4.1	0.13	not surveyed			4.3	1.7	0.06
Shelikof Strait	693.8	151.3	0.09	1,291.2	81.6	[e]	1,675.9	157.5	0.06
Alitak/Deadman Bay	14.6	9.2	0.15	not surveyed			5.3	2.6	[e]
Chiniak Trough	29.0	14.0	0.11	9.1	12.6	0.12	35.6	38.4	0.07
Barnabas Trough	65.4	30.4	0.11	12.9	15.1	0.14	29.5	33.8	0.10
Marmot/Izhut Bay	17.2	8.3	0.18	not surveyed			not surveyed		
Amatuli Trench	78.7	23.1	[e]	not surveyed			not surveyed		
Kenai Peninsula Bays	17.7	1.5	[e]	not surveyed			not surveyed		
Prince William Sound	29.9	14.7	0.14	not surveyed			not surveyed		
Total	1,467.4	320.9		1,442.0	223.9		1,982.6	453.0	

[1]Total surveyed area varies by year and therefore may be different between years
[a] Shumagin INPFC area 610 - 159°-170°W
[b] Chirikof INPFC area 620 - 154°-159°W
[c] Kodiak INPFC area 630 - 147°-154°W
[d] Eastern INPFC area 640 - 140°-147°W
[e] survey design not appropriate for variance estimation

Table 11. -- Summary of catch by species in one Aleutian wing trawl conducted midwater during the 2011 walleye pollock acoustic trawl survey in Morzhovoi Bay.

		Weight		Numbers	
Common name	Scientific name	kg	Percent	Nos.	Percent
walleye pollock	*Gadus chalcogrammus*	448.8	98.5	301	99.3
smooth lumpsucker	*Aptocyclus ventricosus*	4.0	0.9	1	0.3
Pacific cod	*Gadus macrocephalus*	2.8	0.6	1	0.3
Total		455.6		303	

Table 12. -- Summary of catch by species in one poly-Nor'eastern bottom trawl conducted during the 2011 walleye pollock acoustic trawl survey in Morzhovoi Bay.

		Weight		Numbers	
Common name	Scientific name	kg	Percent	Nos.	Percent
walleye pollock	*Gadus chalcogrammus*	161.4	65.8	108	39.3
flathead sole	*Hippoglossoides elassodon*	46.0	18.8	111	40.4
yellowfin sole	*Limanda aspera*	19.6	8.0	41	14.9
Aleutian skate	*Bathyraja aleutica*	6.5	2.7	1	0.4
arrowtooth flounder	*Atheresthes stomias*	5.3	2.2	7	2.5
Pacific cod	*Gadus macrocephalus*	2.4	1.0	3	1.1
Alaska plaice	*Pleuronectes quadrituberculatus*	2.0	0.8	1	0.4
starry flounder	*Platichthys stellatus*	1.2	0.5	1	0.4
cabezon	*Scorpaenichthys marmoratus*	0.5	0.2	1	0.4
spinyhead sculpin	*Dasycottus setiger*	0.3	0.1	1	0.4
Total		245.3		275	

Table 13. -- Summary of catch by species in one Aleutian wing trawl conducted during the 2011 walleye pollock acoustic trawl survey in Pavlov Bay.

		Weight		Numbers	
Common name	Scientific name	kg	Percent	Nos.	Percent
walleye pollock	*Gadus chalcogrammus*	161.8	100.0	323	96.7
capelin	*Mallotus villosus*	0.1	<0.1	8	2.4
shrimp unident.	Decapoda (order)	<0.1	<0.1	3	0.9
Total		161.8		334	

Table 14. -- Summary of catch by species in two Aleutian wing trawls conducted during the 2011 walleye pollock acoustic trawl survey in the Shumagin Islands area.

		Weight		Numbers	
Common name	Scientific name	kg	Percent	Nos.	Percent
walleye pollock	*Gadus chalcogrammus*	167.1	92.7	199	4.9
eulachon	*Thaleichthys pacificus*	9.5	5.3	387	9.5
arrowtooth flounder	*Atheresthes stomias*	2.0	1.1	1	0.0
capelin	*Mallotus villosus*	0.9	0.5	375	9.2
jellyfish unident.	Scyphozoa (class)	0.6	0.3	81	2.0
euphausiid unident.	Euphausiidae (family)	0.2	0.1	2,588	63.5
squid unident.	Cephalopoda (class)	0.1	0.1	43	1.1
walleye pollock age-0	*Gadus chalcogrammus*	0.1	<0.1	391	9.6
isopod unident.	Isopoda (order)	<0.1	<0.1	7	0.2
Pacific sand lance	*Ammodytes hexapterus*	<0.1	<0.1	3	0.1
Pacific cod	*Gadus macrocephalus*	<0.1	<0.1	1	<0.1
Total		180.5		4,076	

Table 15. -- Summary of catch by species in one Aleutian wing trawl conducted during the 2011 walleye pollock acoustic trawl survey near Mitrofania Island.

Common name	Scientific name	Weight kg	Weight Percent	Numbers Nos.	Numbers Percent
walleye pollock	*Gadus chalcogrammus*	624.1	98.6	599	88.6
chum salmon	*Oncorhynchus keta*	5.9	0.9	2	0.3
eulachon	*Thaleichthys pacificus*	2.6	0.4	70	10.4
jellyfish unident.	Scyphozoa (class)	0.1	<0.1	5	0.7
Total		632.8		676	

Table 16. -- Summary of catch by species in one Aleutian wing trawl conducted during the 2011 walleye pollock acoustic trawl survey near Nakchamik Island.

Common name	Scientific name	Weight kg	Weight Percent	Numbers Nos.	Numbers Percent
walleye pollock	*Gadus chalcogrammus*	95.0	94.6	247	70.2
chum salmon	*Oncorhynchus keta*	2.9	2.8	1	0.3
eulachon	*Thaleichthys pacificus*	2.3	2.3	86	24.4
jellyfish unident.	Scyphozoa (class)	0.3	0.3	15	4.3
capelin	*Mallotus villosus*	<0.1	<0.1	1	0.3
squid unident.	Cephalopoda (class)	<0.1	<0.1	2	0.6
Total		100.4		352	

Table 17. -- Summary of catch by species in eight Aleutian wing trawls and one poly-Nor'eastern trawl conducted in midwater during the 2011 walleye pollock acoustic trawl survey in Shelikof Strait.

Common name	Scientific name	Weight kg	Weight Percent	Numbers Nos.	Numbers Percent
walleye pollock	*Gadus chalcogrammus*	3,149.3	91.7	25,458	67.4
eulachon	*Thaleichthys pacificus*	234.9	6.8	11,916	31.6
Chinook salmon	*Oncorhynchus tshawytscha*	16.1	0.5	13	<0.1
chum salmon	*Oncorhynchus keta*	16.0	0.5	5	<0.1
arrowtooth flounder	*Atheresthes stomias*	7.1	0.2	10	<0.1
squid unident.	Cephalopoda (class)	6.9	0.2	197	0.5
northern sea nettle	*Chrysaora melanaster*	1.6	0.0	21	0.1
jellyfish unident.	Scyphozoa (class)	1.3	<0.1	19	0.1
flathead sole	*Hippoglossoides elassodon*	0.6	<0.1	1	<0.1
capelin	*Mallotus villosus*	0.2	<0.1	35	0.1
jellyfish unident.	*Cyanea* sp.	0.2	<0.1	1	<0.1
pandalid shrimp unident.	Pandalidae (family)	0.1	<0.1	64	0.2
sculpin unident.	Cottidae (family)	<0.1	<0.1	2	<0.1
isopod unident.	Isopoda (order)	<0.1	<0.1	2	<0.1
searcher	*Bathymaster signatus*	<0.1	<0.1	2	<0.1
Total		3,434.5		37,746	

Table 18. -- Summary of catch by species in two poly-Nor'eastern trawlsconducted during the 2011 walleye pollock echo integration-trawl survey in Alitak Bay.

		Weight		Numbers	
Common name	Scientific name	kg	Percent	Nos.	Percent
walleye pollock	*Gadus chalcogrammus*	56.9	71.4	45	1.7
capelin	*Mallotus villosus*	8.5	10.7	1,525	59.1
lion's mane	*Cyanea capillata*	4.6	5.7	23	0.9
jellyfish unident.	Scyphozoa (class)	3.3	4.2	22	0.9
Pacific cod	*Gadus macrocephalus*	2.4	3.0	1	<0.1
Pacific sandfish	*Trichodon trichodon*	1.5	1.9	34	1.3
Pacific herring	*Clupea pallasi*	0.9	1.1	5	0.2
walleye pollock age-0	*Gadus chalcogrammus*	0.7	0.9	509	19.7
weathervane scallop	*Patinopecten caurinus*	0.4	0.5	1	<0.1
Pacific tomcod	*Microgadus proximus*	0.3	0.4	4	0.2
pandalid shrimp unident.	Pandalidae (family)	0.1	0.1	39	1.5
shrimp unident.	Decapoda (order)	0.1	<0.1	373	14.4
eulachon	*Thaleichthys pacificus*	<0.1	<0.1	1	<0.1
Total		79.7		2,582	

Table 19. -- Summary of catch by species in one Aleutian wing trawl conducted during the 2011 walleye pollock echo integration-trawl survey of Alitak Bay.

Common name	Scientific name	kg	Percent	Nos.	Percent
walleye pollock	*Gadus chalcogrammus*	1,995.4	99.8	4,128	99.5
Pacific herring	*Clupea pallasi*	3.8	0.2	16	0.4
magistrate armhook squid	*Berryteuthis magister*	0.8	<0.1	5	0.1
Total		2,000.0		4,149	

Table 20. -- Summary of catch by species in three Aleutian wing trawls conducted during the 2011 walleye pollock echo integration-trawl survey of Chiniak Trough.

		Weight		Numbers	
Common name	Scientific name	kg	Percent	Nos.	Percent
walleye pollock	*Gadus chalcogrammus*	5,292.7	99.9	5,065	99.4
Chinook salmon	*Oncorhynchus tshawytscha*	4.6	0.1	2	<0.1
eulachon	*Thaleichthys pacificus*	0.6	<0.1	25	0.5
capelin	*Mallotus villosus*	<0.1	<0.1	3	0.1
Total		5,297.9		5,095	

Table 21. -- Summary of catch by species in two Aleutian wing trawls conducted during the 2011 walleye pollock echo integration-trawl survey of Barnabus Trough.

		Weight		Numbers	
Common name	Scientific name	kg	Percent	Nos.	Percent
walleye pollock	*Gadus chalcogrammus*	1,724.2	99.7	1,538	98.9
Chinook salmon	*Oncorhynchus tshawytscha*	1.7	0.1	1	0.1
lion's mane jellyfish	*Cyanea capillata*	1.5	0.1	11	0.7
arrowtooth flounder	*Atheresthes stomias*	1.1	0.1	1	0.1
Pacific ocean perch	*Sebastes alutus*	0.2	<0.1	1	0.1
capelin	*Mallotus villosus*	<0.1	<0.1	3	0.2
Total		1,728.7		1,555	

Table 22. -- Pollock biomass (metric tons) by management area for walleye pollock less than or equal to 23 cm FL (age-1) and walleye pollock greater than 23 cm FL (age-2+) for the 2011 summer Gulf of Alaska acoustic-trawl survey.

Management area	Geographic area	Total biomass	Age-1 biomass	Age-2+ biomass
610	Shelf	67,949.01	0.74	67,948.27
	Morzhovoi	4,440.73	2.12	4,438.62
	Sanak	997.35	0.01	997.34
	Pavlof	2,883.15	0.97	2,882.19
	Shumagins	4,173.21	-	4,173.21
	Mitrofania	2,420.83	-	2,420.83
Total		82,864.30	3.84	82,860.46
620	Shelf	98,764.70	1.08	98,763.62
	Mitrofania	1,611.83	-	1,611.83
	Nakchamik	1,736.44	-	1,736.44
	Shelikof	126,942.11	37,182.35	89,759.77
	Alitak	2,642.66	-	2,642.66
Total		231,697.75	37,183.43	194,514.32
630	Shelf	35,559.13	0.39	35,558.74
	Shelikof	30,599.32	4,360.67	26,238.66
	Barnabas	33,834.89	2.74	33,832.15
	Chiniak	38,398.13	9.82	38,388.32
Total		138,391.47	4,373.61	134,017.86
Survey Total		452,953.52	41,560.88	411,392.64

Table 23. -- Summary of catch by species in seven methot trawls conducted during the 2011 walleye pollock echo integration-trawl survey.

Common name	Scientific name	kg	Percent	Nos.	Percent
euphausiid unident.	Euphausiidae (family)	2.96	66.31	50,507	97.3
northern sea nettle	*Chrysaora melanaster*	0.66	14.88	2	0.0
Aurelia jelly unident.	*Aurelia sp.*	0.36	7.96	89	0.2
squid unident.	Cephalopoda (class)	0.22	5.00	90	0.2
jellyfish unident.	Scyphozoa (class)	0.10	2.13	45	0.1
fish larvae unident.	Actinopterygii (class)	<0.1	2.02	272	0.5
crab unident.	Decapoda (order)	<0.1	1.30	875	1.7
mollusk unident.	Mollusca (phylum)	<0.1	0.31	29	0.1
flatfish larvae	Pleuronectiformes (order)	<0.1	<0.1	7	<0.1
copepod unident.	Copepoda (class)	<0.1	<0.1	5	<0.1
walleye pollock age-0	*Gadus chalcogrammus*	<0.1	<0.1	2	<0.1
amphipod unident.	Amphipoda (order)	<0.1	<0.1	2	<0.1
Total		4.46		51,925	

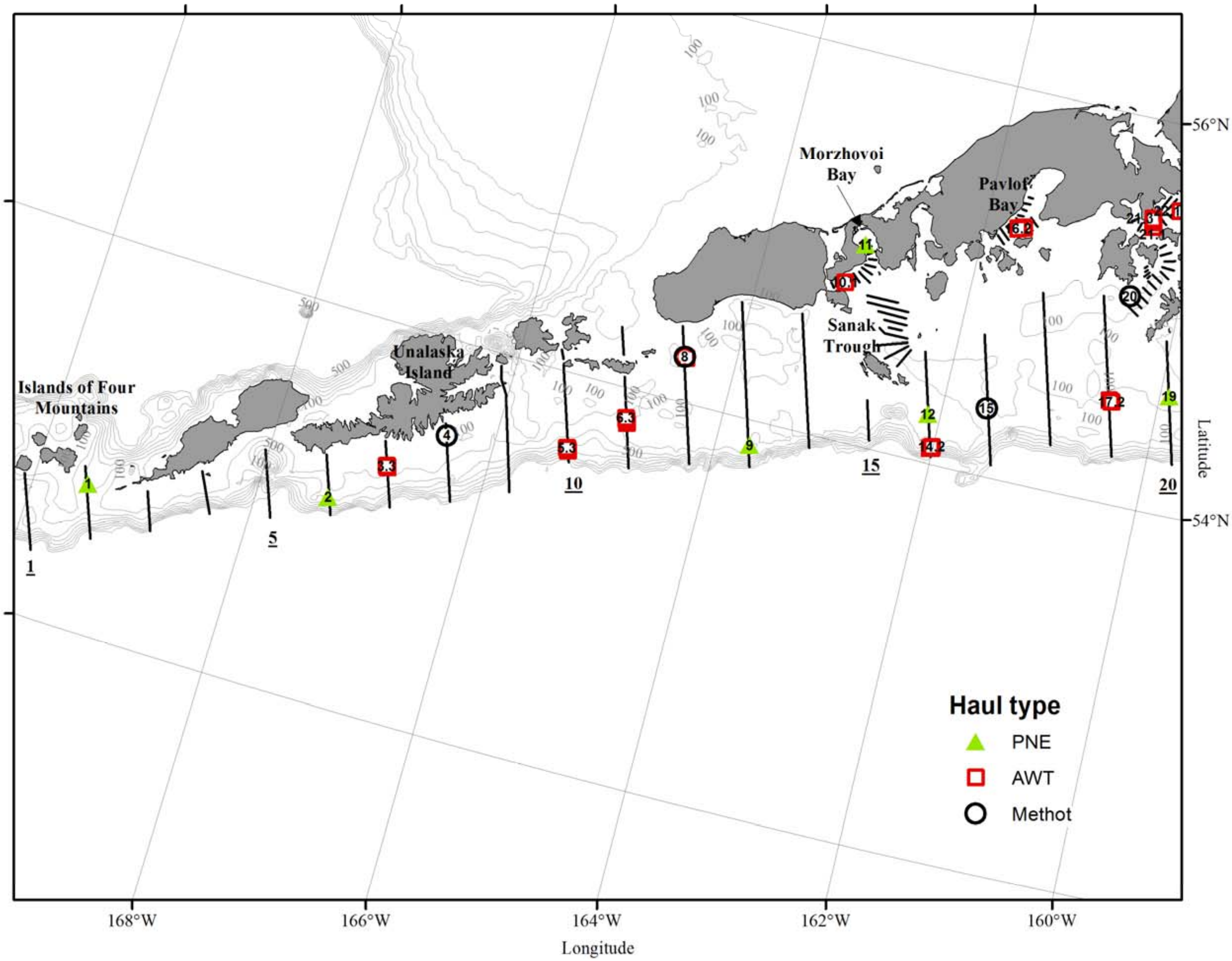

Figure 1. -- Transect lines and locations of Aleutian-wing trawl (AWT), poly-Nor'eastern trawl (PNE), and Methot hauls during the summer 2011 acoustic trawl survey of walleye pollock of the western Gulf of Alaska shelf from the Islands of Four Mountains to the Shumagin Islands and in Morzhovoi Bay, Pavlof Bay, and Sanak Trough. Transect numbers are underlined and haul numbers are on top of haul symbols.

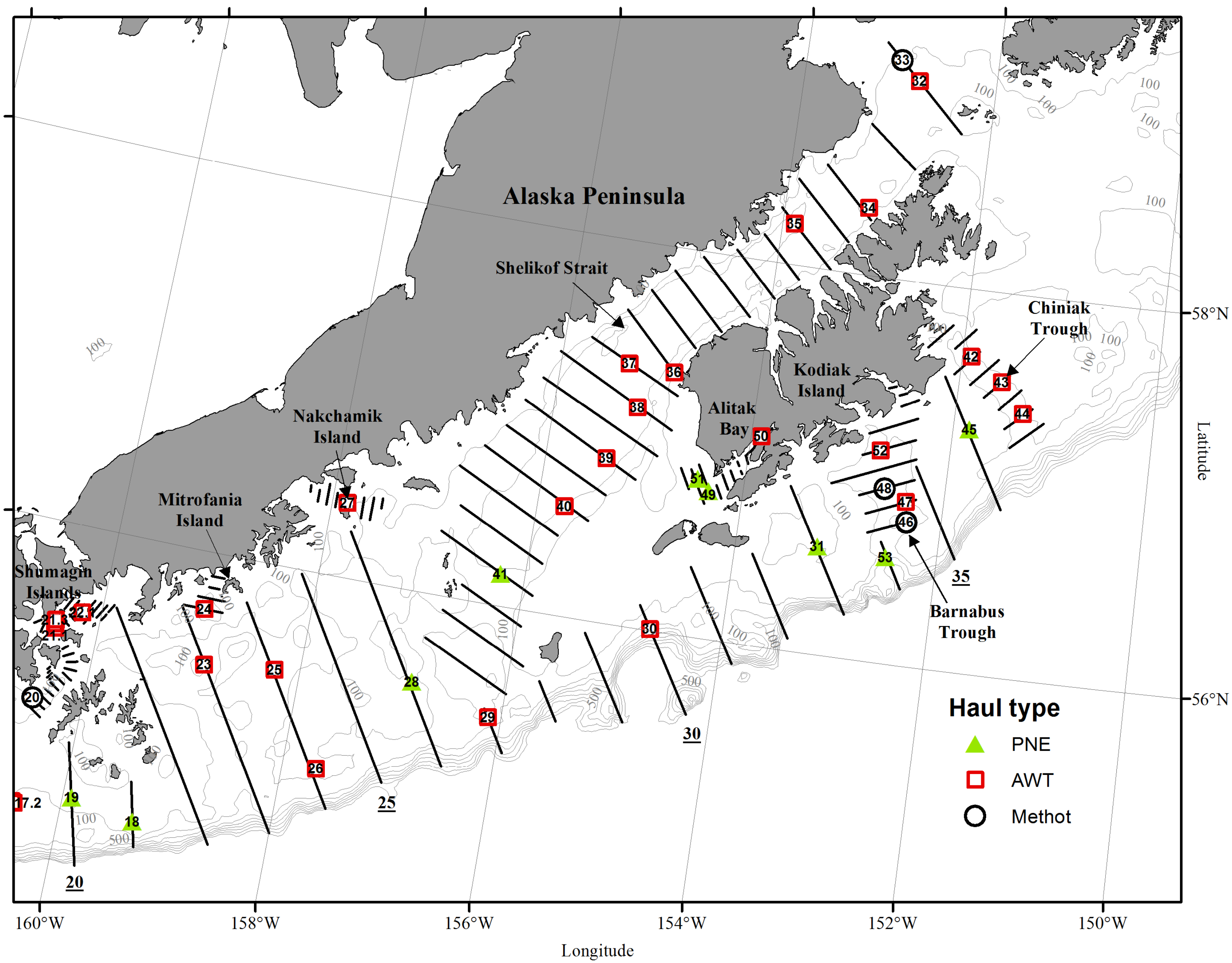

Figure 2. -- Transect lines and locations of Aleutian-wing trawl (AWT), poly-Nor'eastern trawl (PNE), and Methot hauls during the summer 2011 acoustic trawl survey of walleye pollock of the Gulf of Alaska shelf from the Shumagin Islands to eastern Kodiak Island and near Mitrofania Island, Nakchamik Island, Shelikof Strait, Alitak Bay, Barnabus trough, and Chiniak Trough. Transect numbers are underlined and haul numbers are on top of haul symbols.

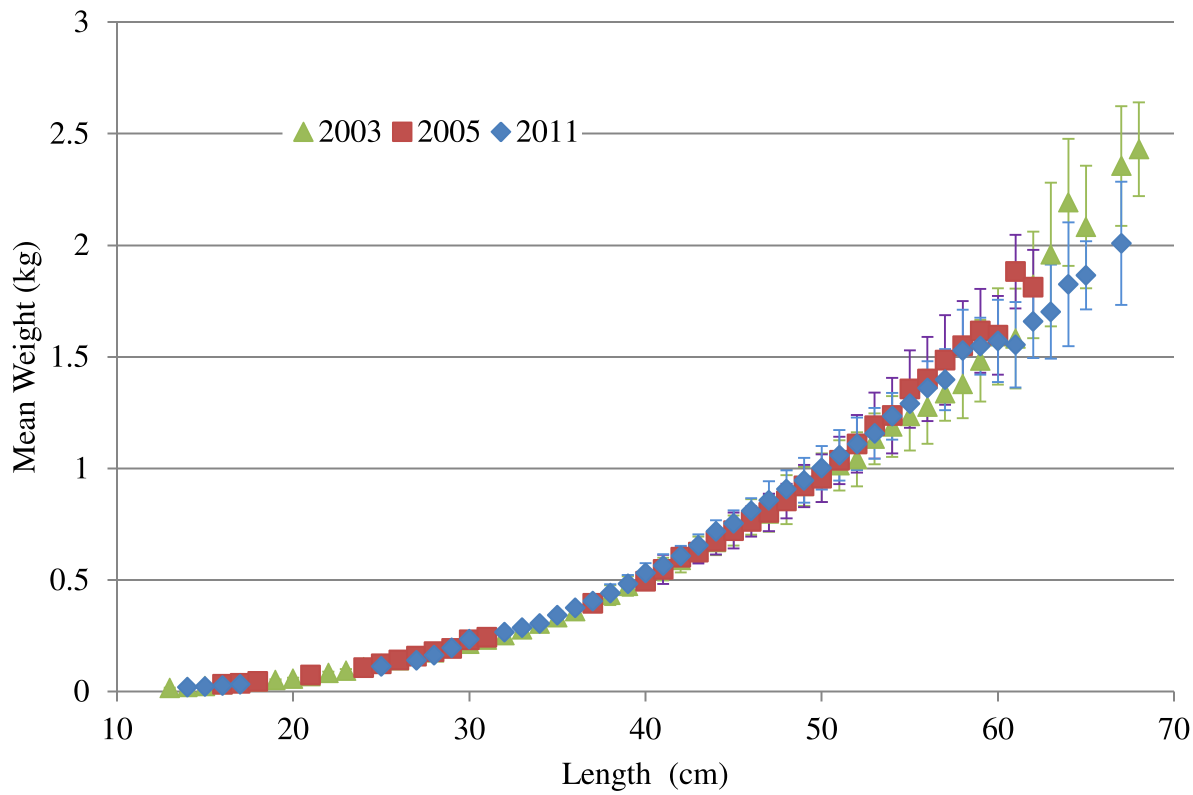

Figure 3. -- Mean weight (kg), and standard deviation, at length (cm) for all areas combined during GOA surveys conducted in 2003, 2005, and 2011. Only length classes containing at least six fish were plotted for each year.

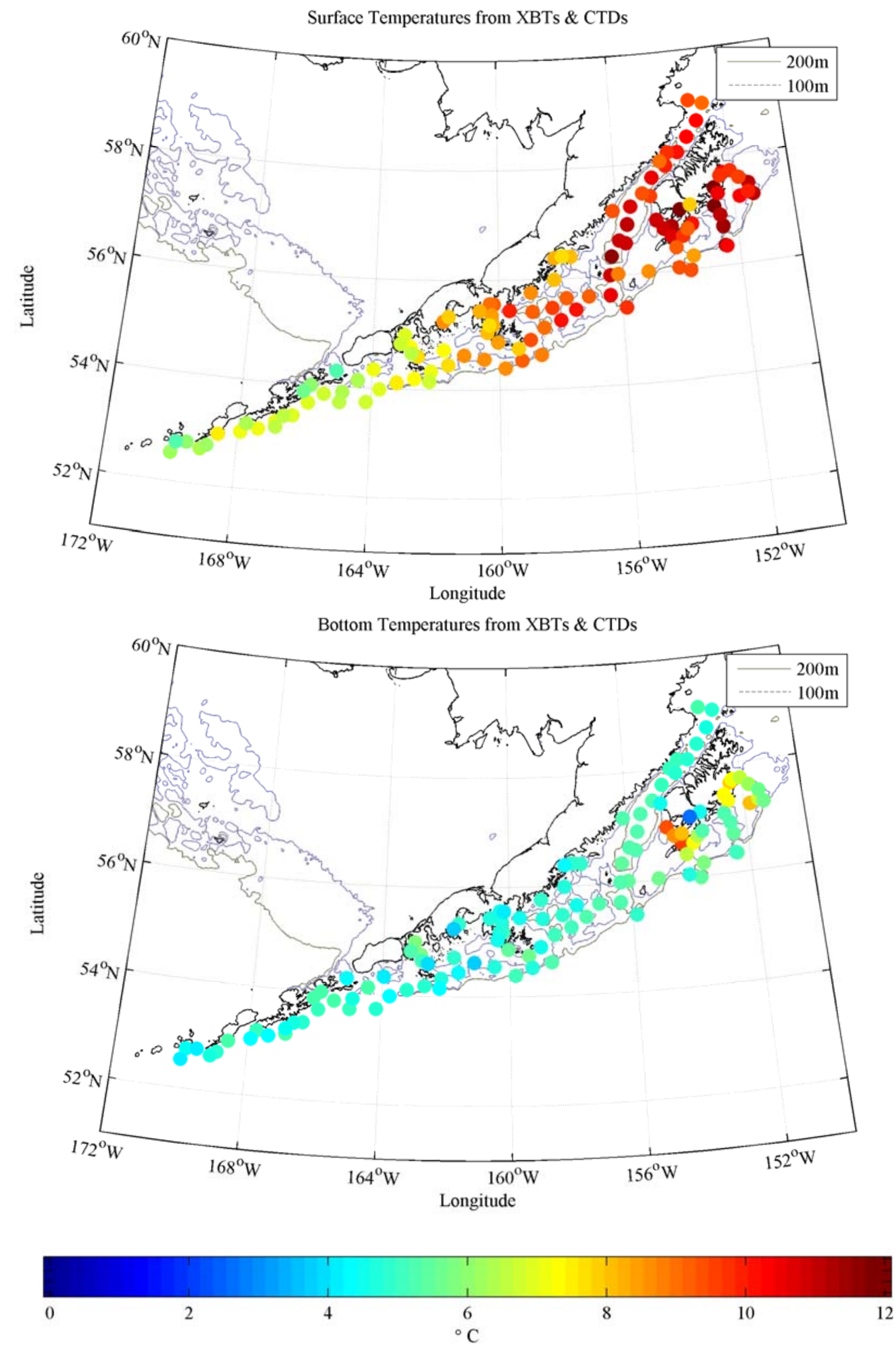

Figure 4. -- Sea surface (top) and bottom (bottom) temperatures from XBT and CTD deployments during DY1103 GOA survey.

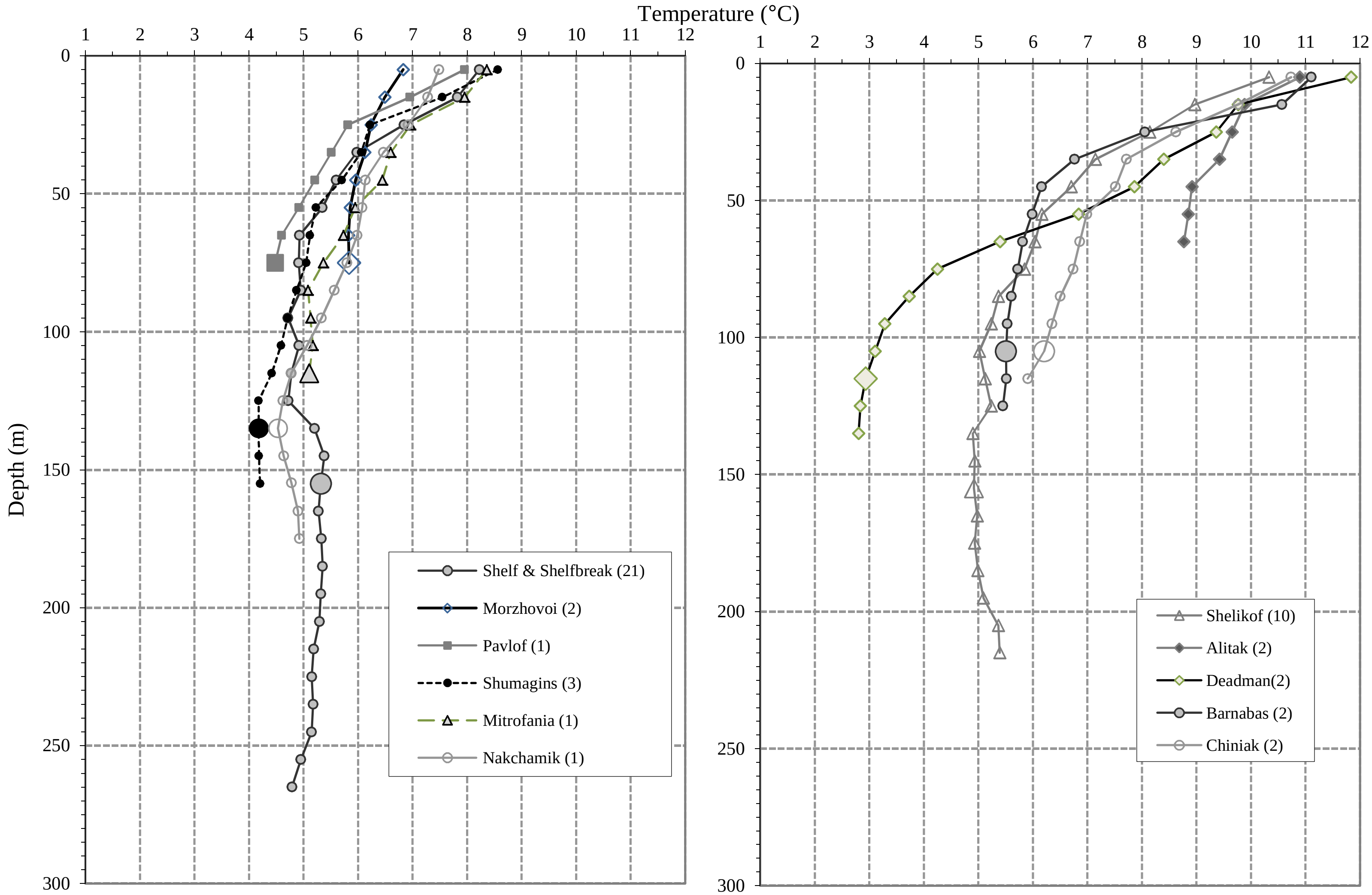

Figure 5. -- Average temperature (°C) at depth (m), and number of hauls sampled, by area surveyed during the summer 2011 acoustic trawl survey of the Gulf of Alaska. The largest symbol for each profile represents the mean depth of pollock biomass in that area.

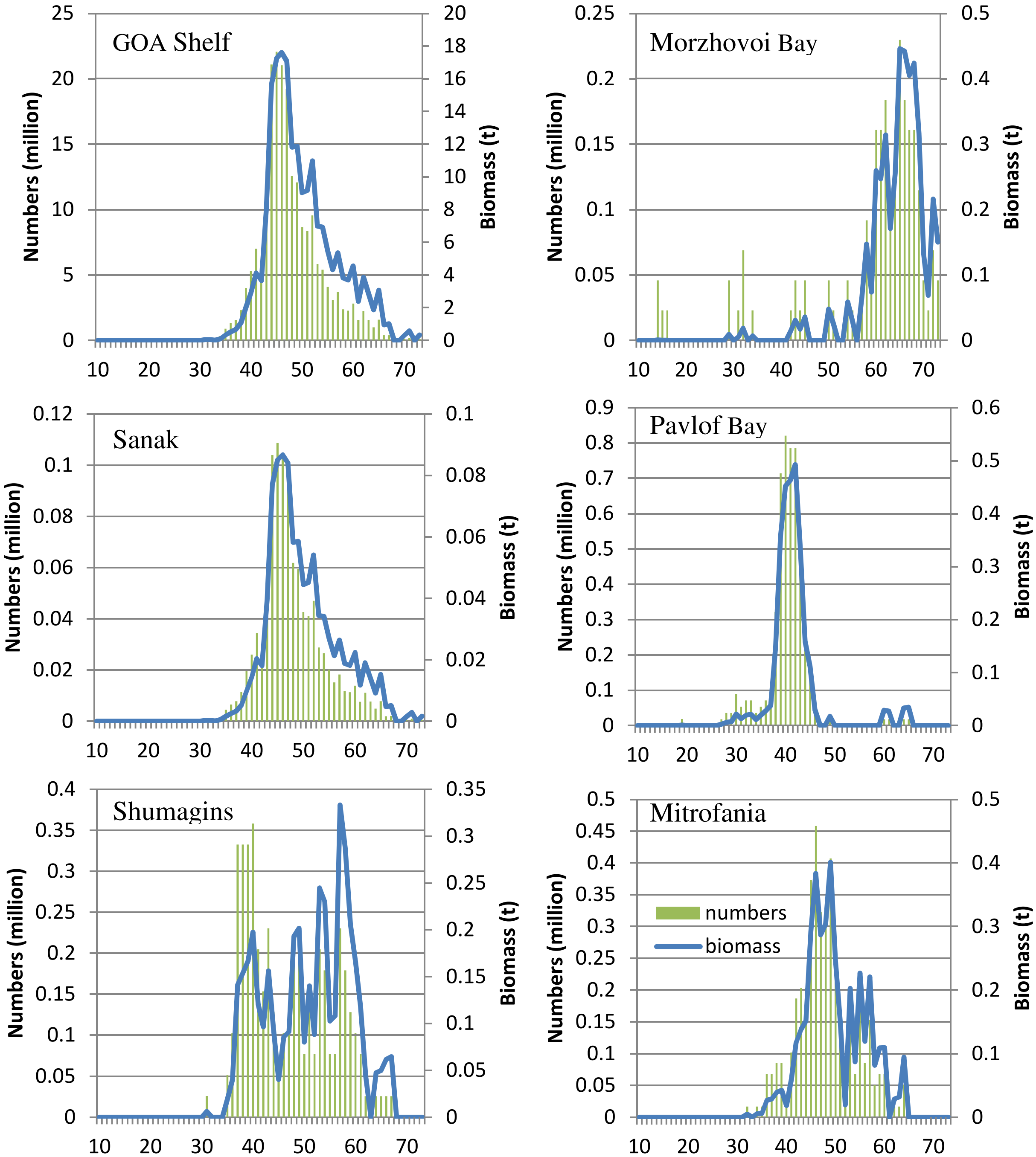

Figure 6. -- Walleye pollock numbers in millions and biomass in metric tons (t) at length for each of the major areas in the 2011 summer GOA acoustic trawl survey.

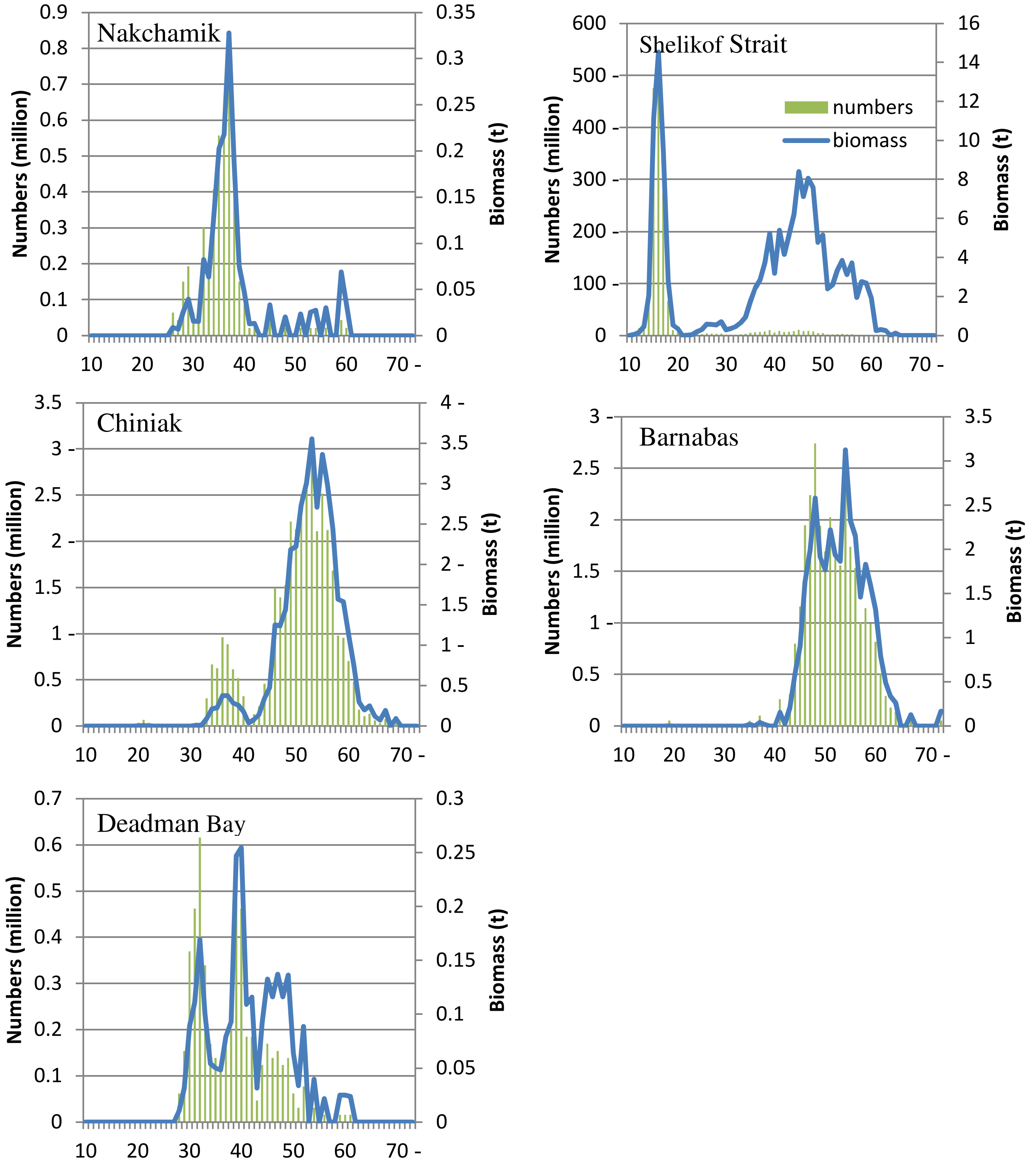

Figure 6. -- Continued.

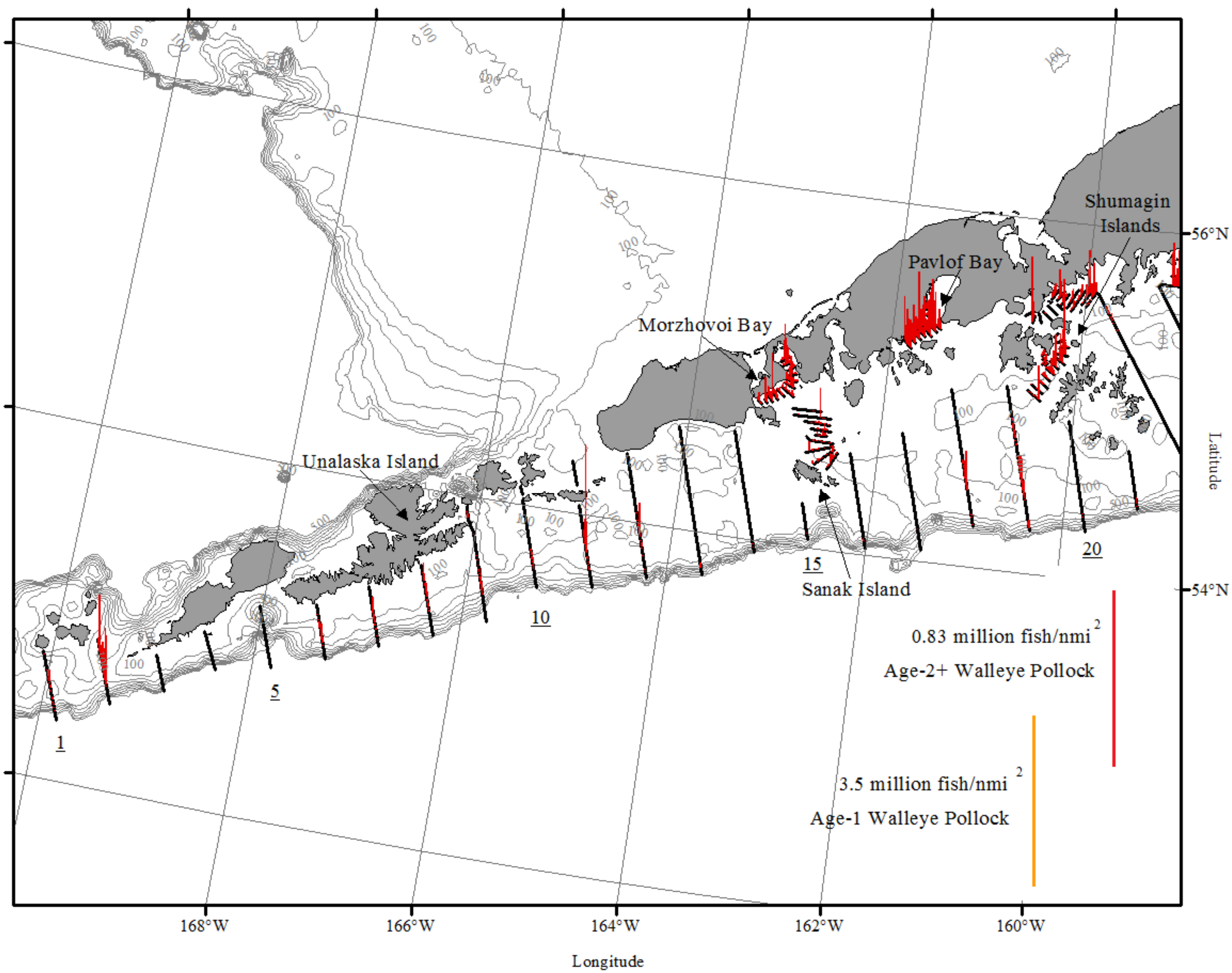

Figure 7. -- Density of age-1 walleye pollock (orange vertical lines) and age-2+ walleye pollock (red vertical lines) along tracklines surveyed during the western extent of the summer 2011 acoustic-trawl survey of the GOA with a) typical multifrequency response curve for walleye pollock and b) echogram of diffuse walleye pollock aggregation. Transect numbers are underlined.

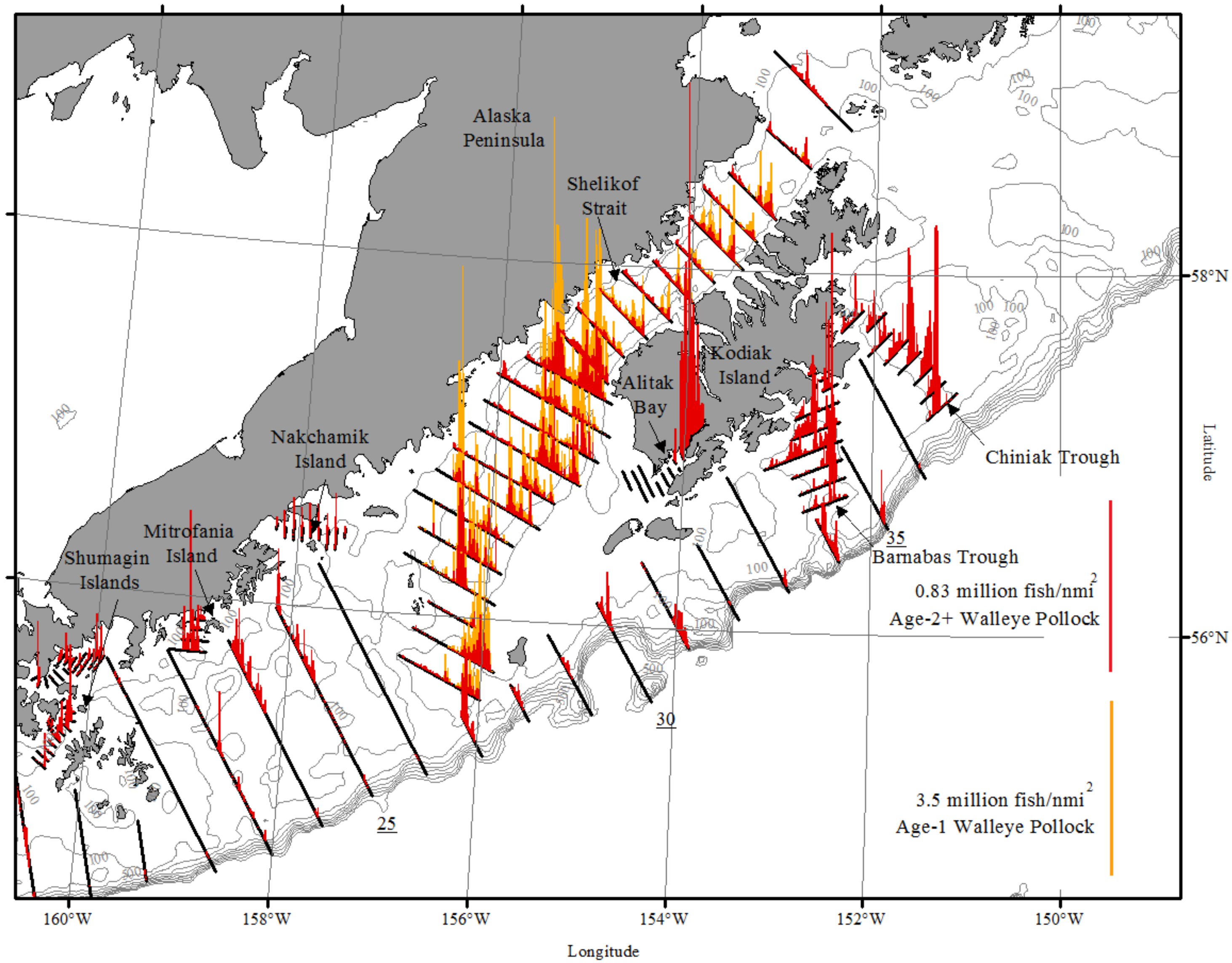

Figure 8. -- Density of age-1 walleye pollock (orange vertical lines) and age-2+ walleye pollock (red vertical lines) along tracklines surveyed during eastern extent of the summer 2011 acoustic-trawl survey of the GOA with a) echogram of midwater juvenile walleye pollock aggregation in Shelikof Strait. Note difference in vertical bar scale for age-1 and age-2+ pollock densities. Transect numbers are underlined.

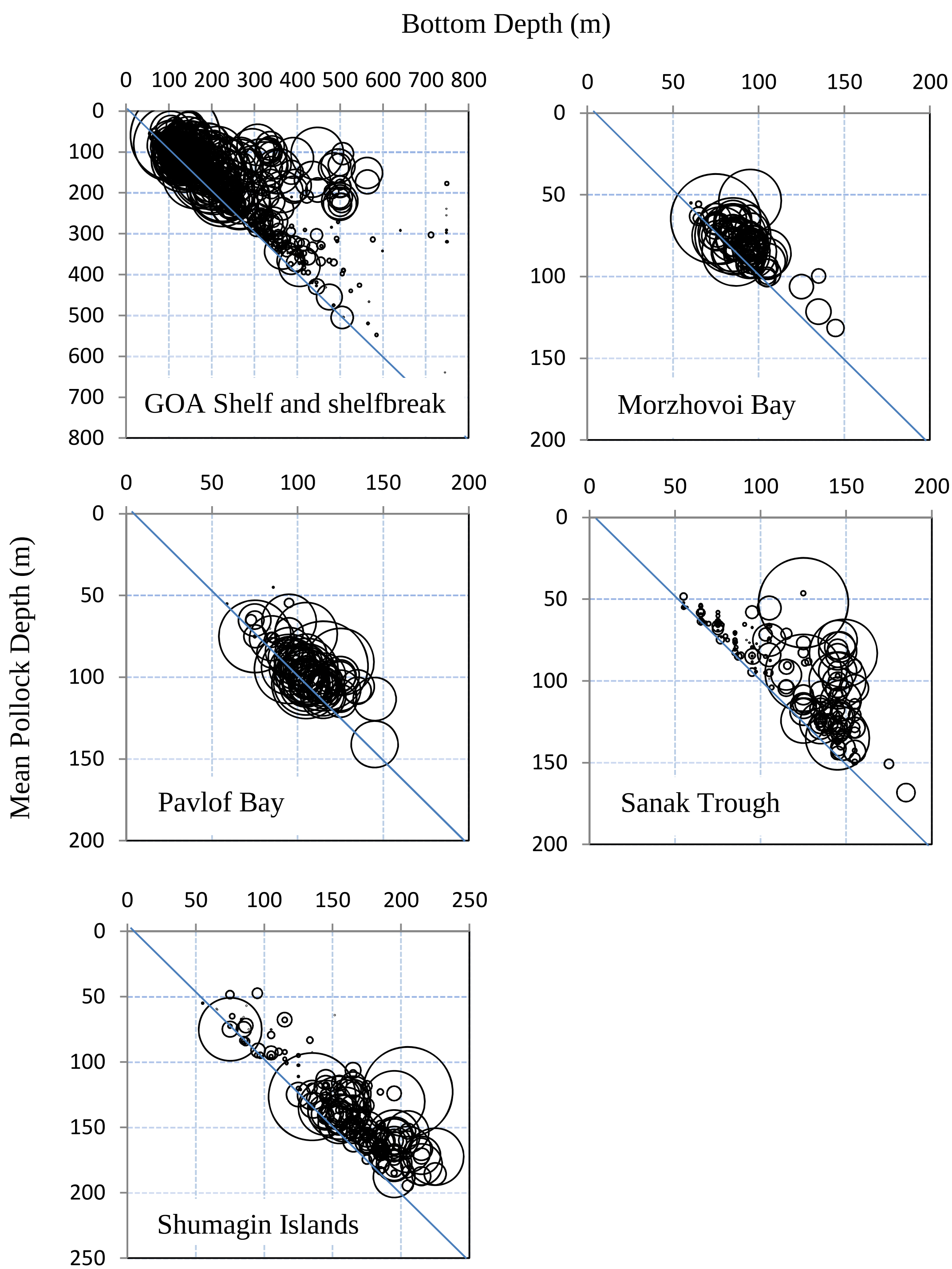

Figure 9. -- Mean pollock depth (weighted by biomass) versus bottom depth (m) for each 0.5 nmi of trackline from the summer 2011 acoustic trawl survey by area. Bubble size is scaled to the maximum biomass for each plot.

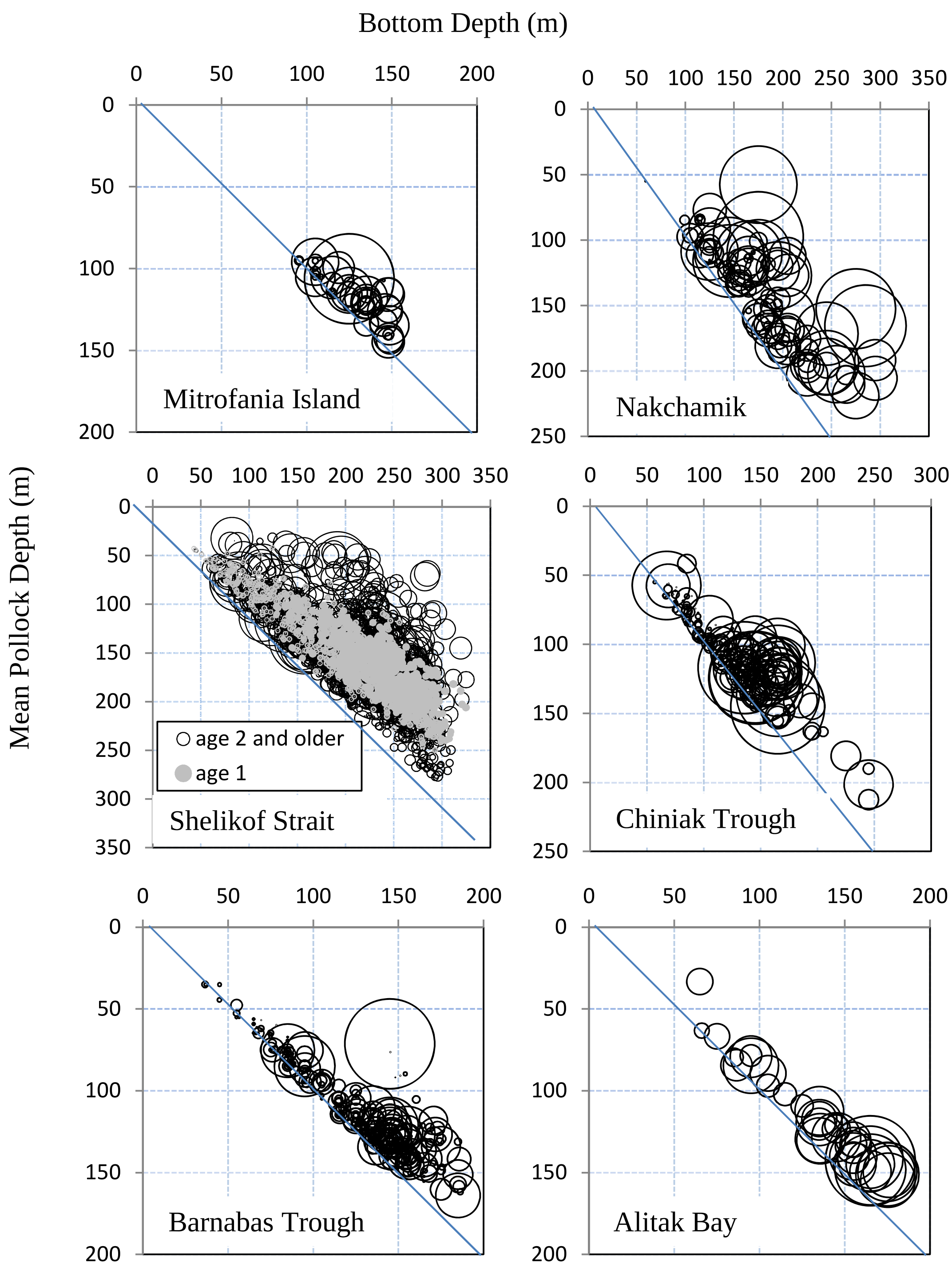

Figure 9. -- Cont.

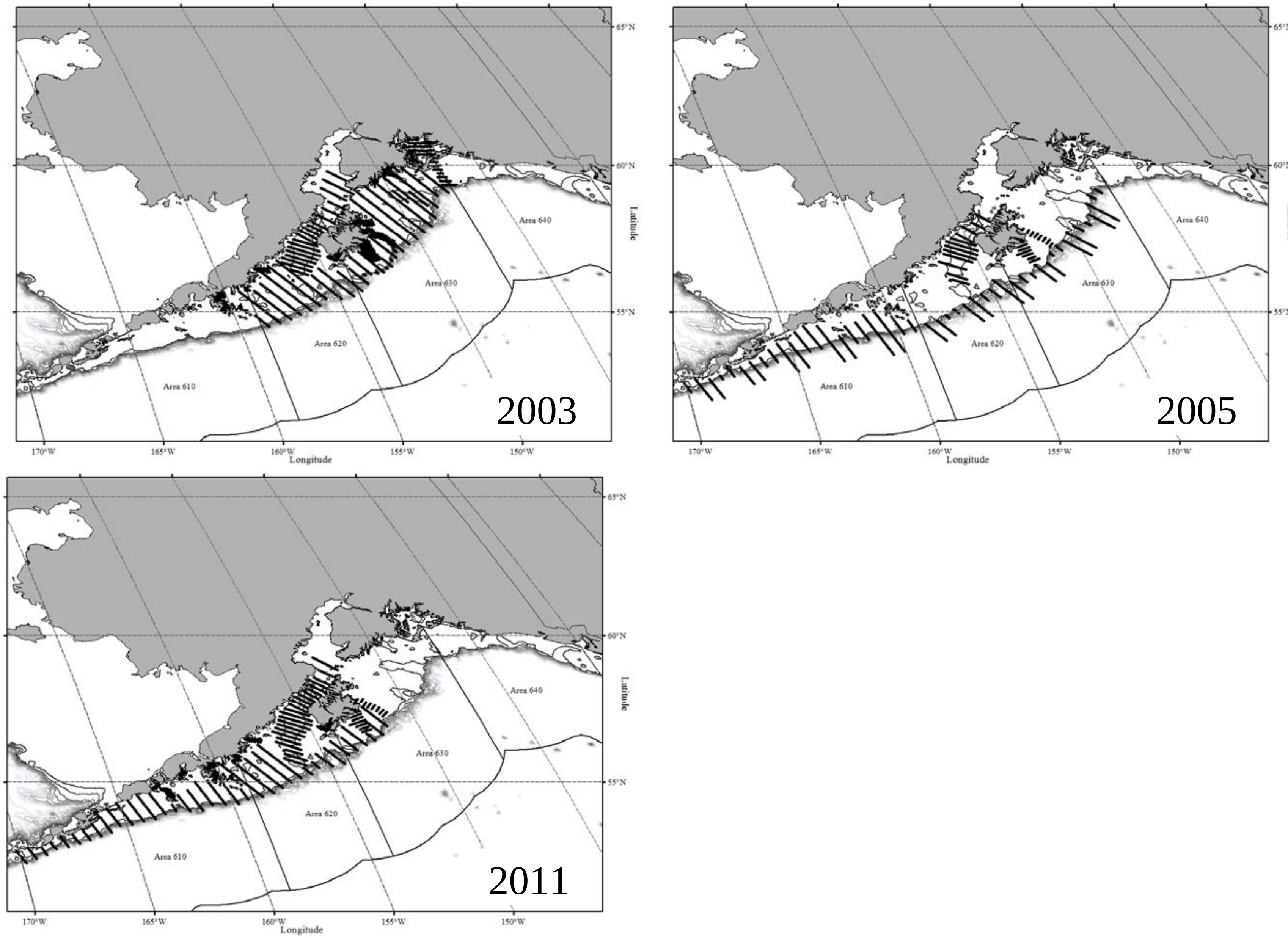

Figure 10.--Extent of the MACE summer GOA surveys conducted in 2003, 2005, and 2011.

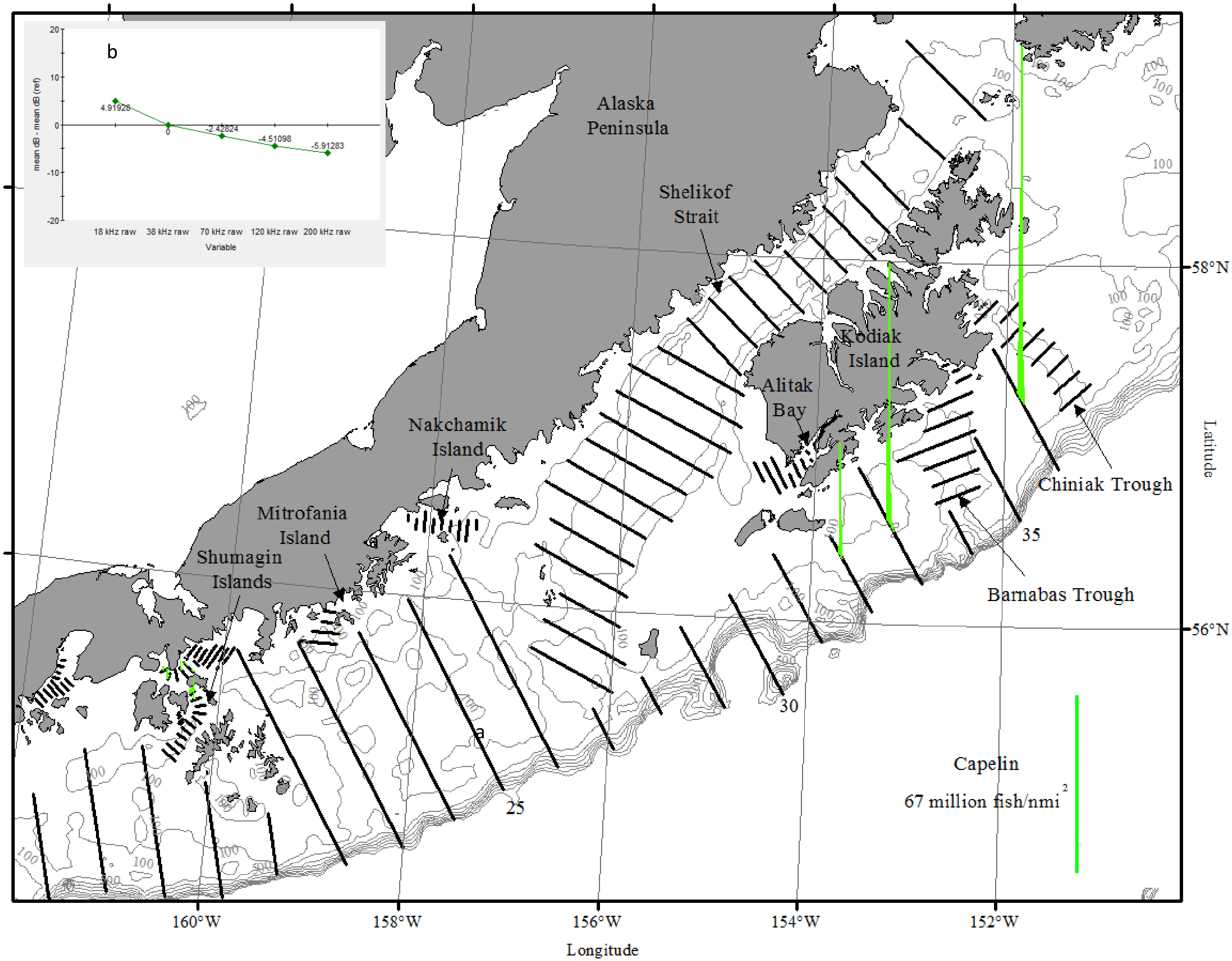

Figure 11. -- Density of capelin along tracklines surveyed during the eastern extent of the summer 2011 acoustic-trawl survey of the GOA with a) echogram of large capelin aggregation and b) multifrequency response.

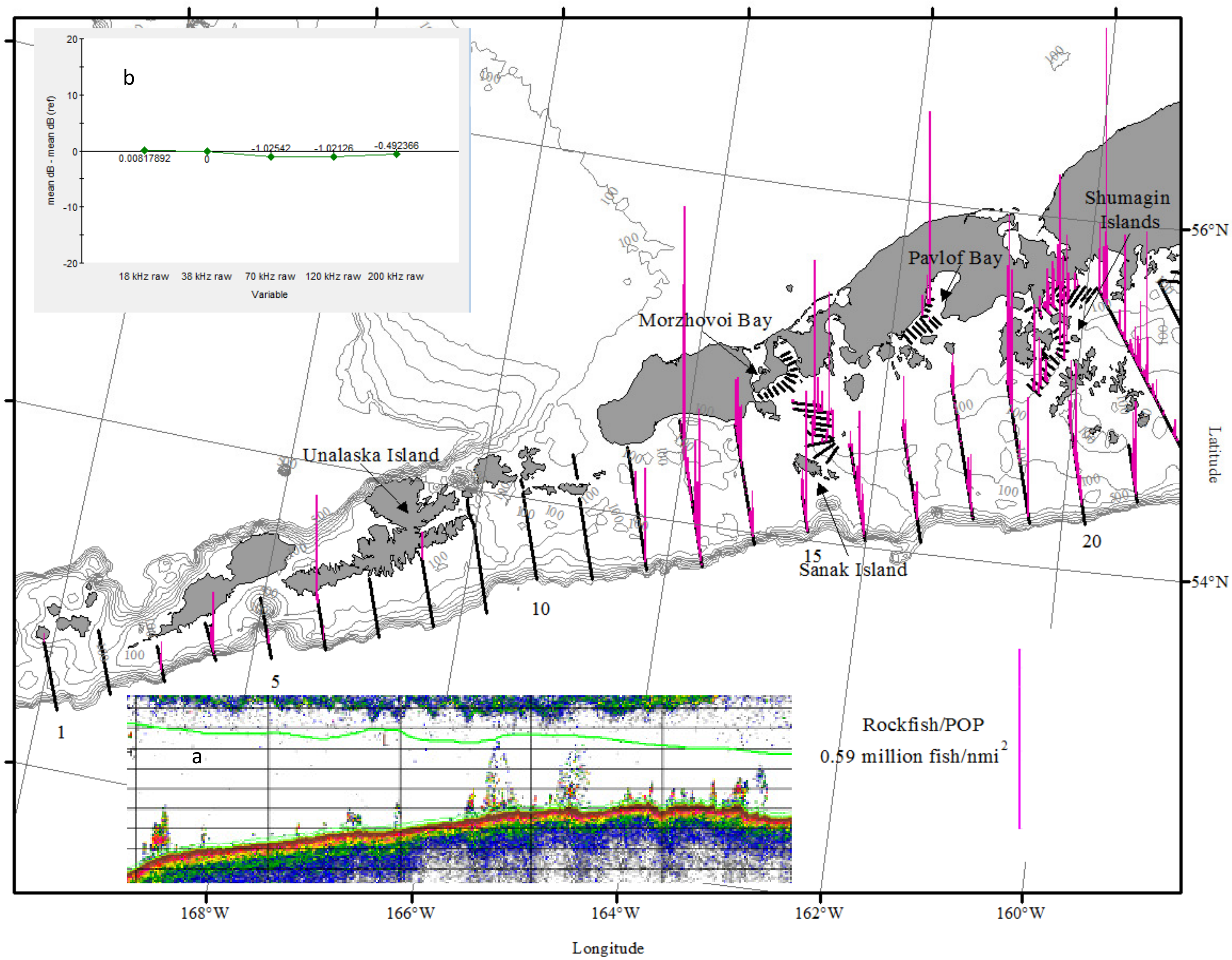

Figure 12. -- Density of Rockfish/POP along tracklines surveyed during the western extent of the summer 2011 acoustic-trawl survey of the GOA with a) representative echogram containing rockfish "haystacks" and b) typical multifrequency response for rockfish.

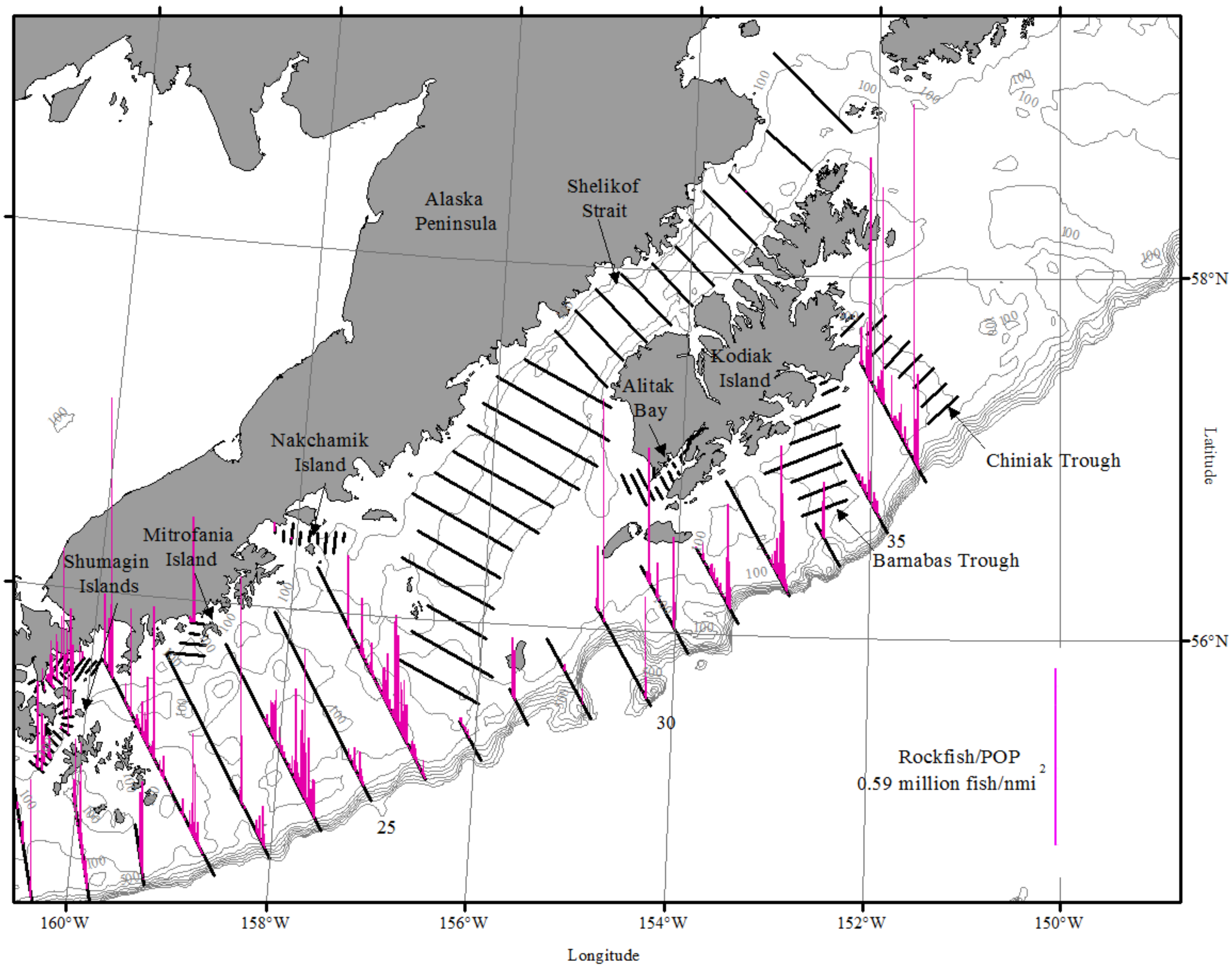

Figure 13. -- Density of Rockfish/POP along tracklines surveyed during the eastern extent of summer 2011 summer acoustic-trawl survey of the GOA.

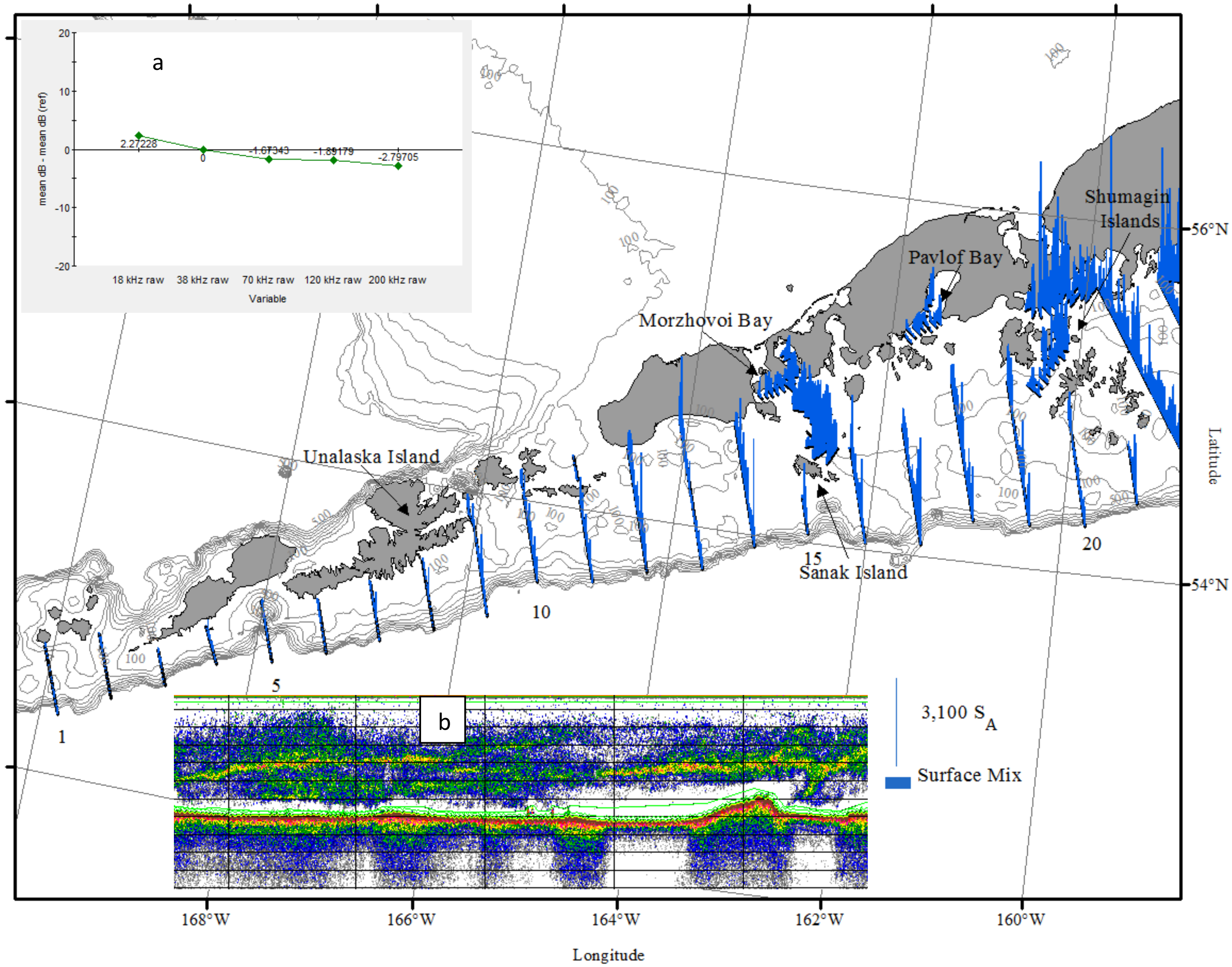

Figure 14. -- Surface mix backscatter (s_A at 38-kHz, m^2/nmi^2) in the western extent of the 2011 summer GOA AT survey of the GOA with a) echogram and b) multifrequency response.

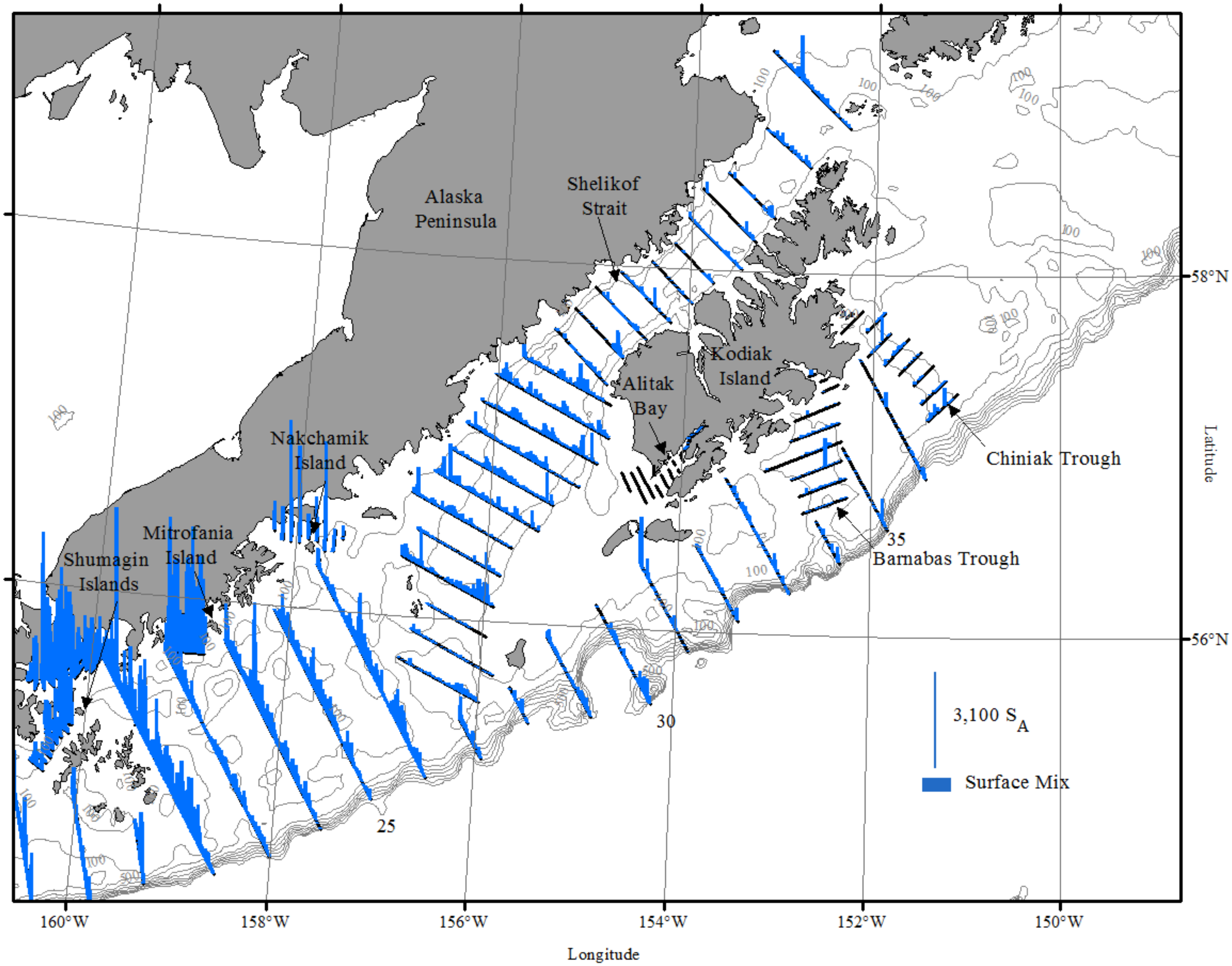

Figure 15. -- Surface mix backscatter (s_A at 38-kHz, m^2/nmi^2) in the eastern extent of the 2011 summer GOA AT survey of the GOA.

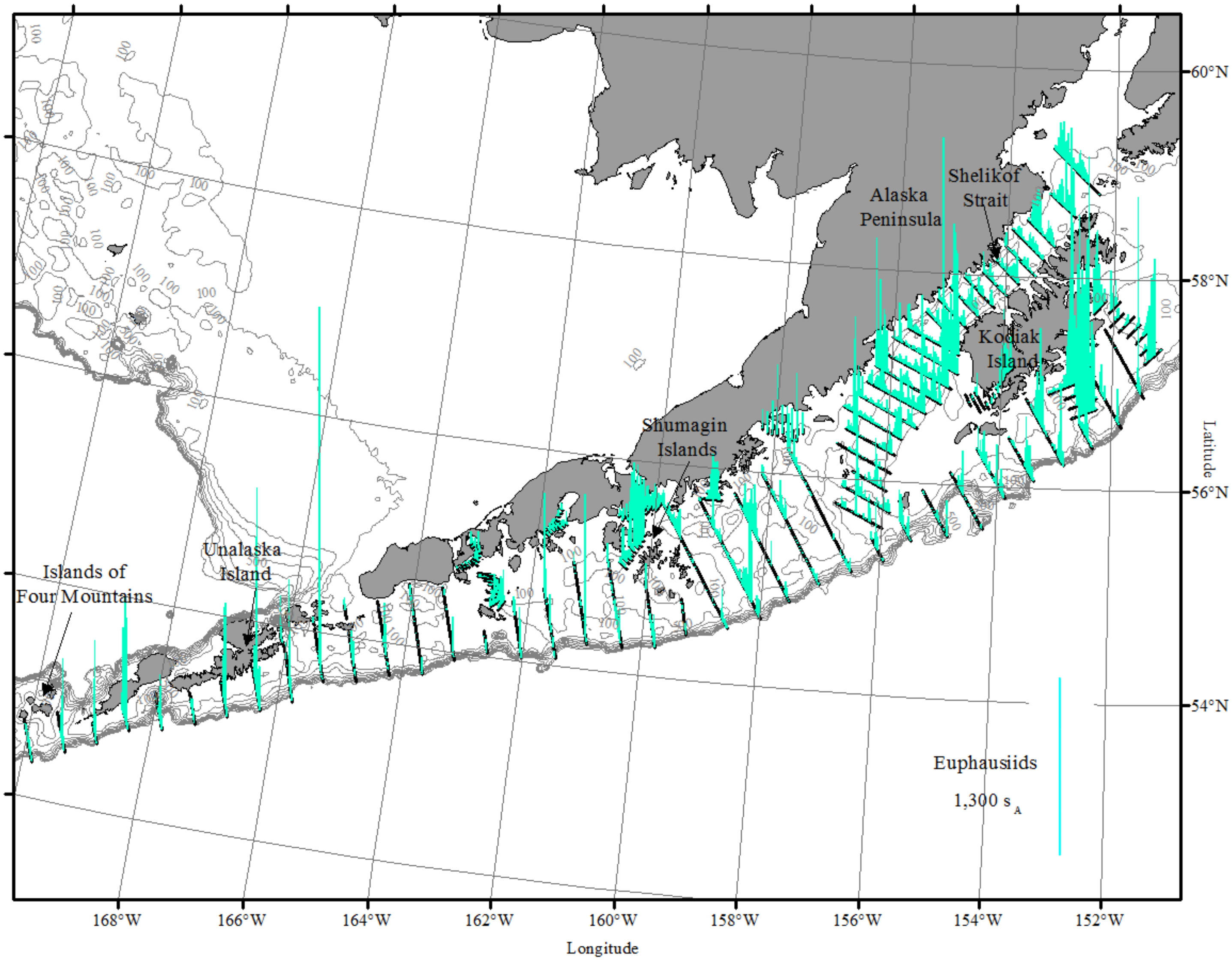

Figure 16. -- Spatial distribution of euphausiid backscatter (s_A at 120-kHz, m^2/nmi^2) along the Gulf of Alaska shelf and associated bays during the 2011 acoustic-trawl survey.

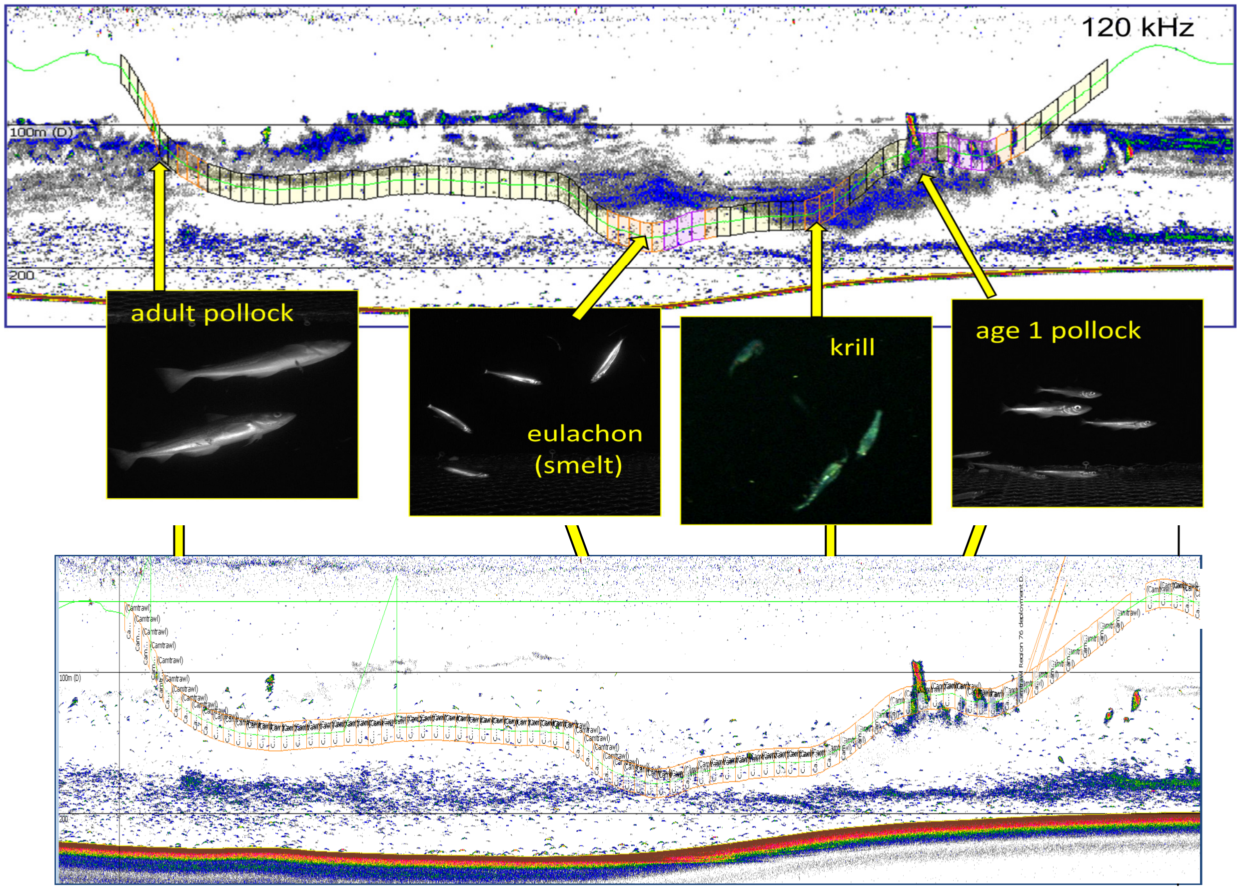

Figure 17. – 38-kHz and 120-kHz echograms during trawl operations overlaid with path of trawl through the water column and associated images captured using a Cam-Trawl camera inserted into Aleutian Wing Trawl just forward of the codend.

APPENDIX I. ITINERARY

Leg 1

14 June	Depart Kodiak, AK
14 June	Acoustic sphere calibration in Three Saints Bay, Kodiak Island
15 - 17 June	Transit to survey start area and test MOCC and cam-trawl deployments
17 - 22 June	Acoustic-trawl survey of the GOA shelf (Transects 1-15)
22 June	Acoustic-trawl survey of Morzhovoi Bay (Transects 101-112)
23 June	Acoustic-trawl survey of Sanak Trough (Transects 151-159)
23 - 24 June	Acoustic-trawl survey of the GOA shelf (Transects 16-17)
25 June	Acoustic-trawl survey of Pavlof Bay (Transects 201-211)
25 - 26 June	Acoustic-trawl survey of the GOA shelf (Transects 18-19)
27 -29 June	Transit to Kodiak. Leg ended early due to crewmember injury
29 June - 4 July	In port Kodiak (replace injured personnel)

Leg 2

5 July	Transit to survey resume point
6 - 7 July	Acoustic-trawl survey of the GOA shelf (Transects 19-21)
7 - 8 July	Acoustic-trawl survey of Shumagins Islands area (Transects 251-272, 281-284)
8 - 9 July	Acoustic-trawl survey of the GOA shelf (Transects 22-23)
9 - 10 July	Acoustic-trawl survey of Mitrofania area (Transects 301-304)
10 - 11 July	Acoustic-trawl survey of the GOA shelf (Transects 24-25)
11 - 12 July	Acoustic-trawl survey of Nakchamik area (Transects 351-359)
12 - 15 July	Acoustic-trawl survey of the GOA shelf (Transects 26-33)
15 July	Scientific personnel exchange in Kodiak
16 - 21 July	Acoustic-trawl survey of Shelikof Strait (Transects 401-423)
22 July	Transit to Kodiak, AK
22 July - 6 Aug.	In port Kodiak, AK (Rescue boat winch repair, net reel repair, crewmember injured during in port drills)

Leg 3

6 Aug.	Rescue boat and net reel tests
7 Aug.	Calibration in Kalsin Bay, Kodiak Island
7 - 8 Aug.	Acoustic-trawl survey of Chiniak Trough (Transects 451-458)
8 - 9 Aug.	Acoustic-trawl survey of the GOA shelf (Transects 34-36)
9 - 10 Aug.	Acoustic-trawl survey of Barnabas Trough (Transects 501-503)
10 - 11 Aug.	Acoustic-trawl survey of Alitak Bay (Transects 551-560)
11 - 12 Aug.	Resume Acoustic-trawl survey of Barnabas Trough (Transects 504-509)
12 Aug.	Transit to Kodiak, AK. End of survey

APPENDIX II. SCIENTIFIC PERSONNEL

Leg I (14 - 29 June)

Name	Position	Organization
Paul Walline	Chief Scientist	AFSC
Alex De Robertis	Fishery biologist	AFSC
Sarah Stienessen	Fishery Biologist	AFSC
Abigail McCarthy	Fishery Biologist	AFSC
Rick Towler	Computer Spec.	AFSC
William Floering	Fishery Biologist	AFSC
Jodi Pirtle	Postdoc. Research Associate	UNH
Jonathon Graas	graduate student intern	UBC
Jason Moeller	Teacher at Sea	NOAA
Tammy Orilio	Teacher at Sea	NOAA
Mike Jech	Fishery Biologist	NEFSC

Leg II (5 - 22 July)

Name	Position	Organization
Neal Williamson	Chief Scientist	AFSC
Paul Walline	Fishery Biologist	AFSC
Rick Towler (disembarked 15 July)	Computer Spec.	AFSC
Scott Furnish (embarked 15 July)	Computer Spec.	AFSC
Darin Jones	Fishery Biologist	AFSC
Denise McKelvey	Fishery Biologist	AFSC
Kresimir Williams (disembarked 15 July)	Fishery Biologist	AFSC
Tom Leeuw	undergraduate student intern	UMaine
Anne Mortimer	Teacher at Sea	NOAA
Kathleen Harrison	Teacher at Sea	NOAA

Leg III (6 - 12 Aug.)

Name	Position	Organization
Chris Wilson	Chief Scientist	AFSC
Patrick Ressler	Fishery Biologist	AFSC
Darin Jones	Fishery Biologist	AFSC
Abigail McCarthy	Fishery Biologist	AFSC
Scott Furnish	Computer Spec.	AFSC
Jodi Pirtle	Postdoc. Research Associate	UNH
Megan Stachura	graduate student intern	AFSC
Cathrine Fox	Teacher at Sea	NOAA
Staci DeSchryver	Teacher at Sea	NOAA

AFSC – Alaska Fisheries Science Center, Seattle, WA
NOAA – National Oceanic and Atmospheric Administration
NEFSC – Northeast Fisheries Science Center, Woods Hole, MA
UNH – University of New Hampshire - Center for Coastal & Ocean Mapping, Durham, NH
UBC – University of British Columbia, Vancouver, BC, Canada
UMaine – University of Maine, Orono, Maine